Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Reliability and Probabilistic Risk Assessment

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Friday, April 24, 2015

Work Order No.: NRC-1536 Pages 1-341

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

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

+ + + + +

RELIABILITY AND PROBABILISTIC RISK ASSESSMENT (PRA)

SUBCOMMITTEE

+ + + + +

FRIDAY

APRIL 24, 2015

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

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

COMMITTEE MEMBERS:

JOHN W. STETKAR, Chairman

RONALD G. BALLINGER, Member

DENNIS BLEY, Member

JOY REMPE, Member

STEPHEN P. SCHULTZ, Member

DESIGNATED FEDERAL OFFICIAL:

JOHN LAI

NRC STAFF:

JAMES CHANG, RES

LARRY CRISCIONE, RES

STEPHANIE MORROW, RES

SEAN PETERS, RES

MARY PRESLEY, EPRI

JING XING, RES

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

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

2 1:01 p.m.

3 CHAIRMAN STETKAR: The meeting will now come

4 to order. This is a meeting of the Reliability and PRA

5 Subcommittee. I'm John Stetkar, Chairman of the

6 Subcommittee meeting.

7 ACRS Members in attendance are Steve Schultz,

8 Dennis Bley will be joining us, on Ballinger, and Roy

9 Rempe. John Lai of the ACRS Staff is the Designated

10 Federal Official for this meeting.

11 The Subcommittee will hear the latest

12 developments of the HRA methodology and its applications

13 in response to the Commission's Staff Requirements

14 Memorandum M061020. We will hear presentations from the

15 NRC Staff and representatives of the Electric Power

16 Research Institute. And I believe that we also will have

17 an EPRI contractor available on the bridgeline.

18 There will be a phone bridgeline. To preclude

19 interruption of the meeting, the phone will be placed

20 in a listen-in mode during presentations and Committee

21 discussions. We received no written comments or requests

22 for time to make oral statements from members of the

23 public regarding today's meeting.

24 The entire meeting will be open to public

25 attendance. The Subcommittee will gather information,

analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the Full Committee. The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register.

A transcript of the meeting is being kept and will be made available, as stated in the Federal Register notice. Therefore, we request that participants in this meeting use the microphones located throughout the meeting room when addressing the Subcommittee. The participants should first identify themselves and speak with sufficient clarity and volume so that they may be readily heard. And, also, remind everyone to please turn off all of your little electronic devices.

We will now proceed with the meeting, and I'll ask Sean Peters, do you have anything to say?

MR. PETERS: Yes. This is Sean Peters, and I thank you for giving us an opportunity to have our first biannual meeting of the year on the IDHEAS Method Development status. What we're going to talk about today is the general status of internal at-power events methodology and the ACRS recommendations, and how we tackled those recommendations. We're going to talk about the IDHEAS Testing program, and also about the

development status of our General Methodology.

We look forward to getting the comments back from the Subcommittee, questions, ideas that may be generated as part of the discussion. And I think you guys are going to enjoy the presentation that's done by our three presenters.

MEMBER BLEY: I need to mention that I have done some work with the Staff on aspects of this work, so in those areas I'll not be able to participate in our deliberations.

CHAIRMAN STETKAR: Thank you. Jing, or Mary. Jing.

MS. XING: Okay, thanks for the introduction. I'm Jing Xing, and I'm a Senior Human Performance Engineer at the NRC Office of Research, and I'm the NRC's Technical Lead. And we don't need to go through this SRM again. I'm sure everyone already can recite it.

So, for today, as John introduced, so we will first --- I will first give you a quick overview of the project development status, and then I will talk about the update to IDHEAS for internal at-power event, mainly the work we did to address the ACRS comments and recommendations last year. And then I will turn the presentation to Mary Presley from EPRI, who will talk about their perspective. Then we come to the next part,

is the IDHEAS Testing Plan that Stephanie Morrow will present. And, finally, James Chang will present the IDHEAS General Methodology.

So, just a review of the strategic approach we had to work the HRA method. The first step would be to develop a cognitive basis for human error analysis based on our literature review. The result has been documented in NUREG-2114. And based on ---

CHAIRMAN STETKAR: By the way, Jing, just as long as you mentioned that, that hasn't been published yet, has it?

MS. XING: Stephanie could give you more accurate date.

CHAIRMAN STETKAR: Okay.

MS. MORROW: It is in the process, so it's going through publications right now.

CHAIRMAN STETKAR: It's been a year. No, it's been more than a year. I mean, we wrote our letter a year ago.

MS. XING: Basically, we've been waiting for Stephanie back to our Branch so we have someone in charge of the publication.

MR. PETERS: We're really looking into the resource issue. Either I get publications out or I continue the kind of fast pace of development. I really

1 am looking at basically one Staff member I can assign
2 to the task. Either Jing can work on publishing, or she
3 can work on the development. And since Stephanie came
4 to the Staff she was able to pick up the publication
5 process, so we are in process, and it should come out
6 in the next few months. I can never guarantee how quickly
7 things get through publications. I have my own beefs with
8 that, but we do have it in that process.
9 CHAIRMAN STETKAR: Thanks.
10 MR. PETERS: So, notated.
11 CHAIRMAN STETKAR: That was pretty good. I mean
12 we even said it, ACRS doesn't say things are very good
13 very often.
14 MEMBER SCHULTZ: That's when you want to
15 publish ---
16 (Simultaneous speaking)
17 MR. PETERS: Publish it before you change your
18 mind.
19 CHAIRMAN STETKAR: Okay. Next, it is
20 --- you're working on it.
21 MS. XING: Yes.
22 CHAIRMAN STETKAR: Okay.
23 MS. XING: And based on the cognitive basis
24 framework we developed IDHEAS General Methodology for
25 the diversity use of HRA applications, such as Leve-2/3

PRA, shutdown, external events, and the Ex-Control Room actions.

There's always a tradeoff on how general it is, and how specific is it to use. So, we also developed IDHEAS method for internal at-power events, specifically. And down the road we think we'll tailor the General Methodology to other HRA, other specific HRA applications in our Agency.

CHAIRMAN STETKAR: Jing, let me ask you about that, because my vision has always been that there is a General Methodology that is tailored to specific applications rather than a specific application that generates a General Methodology, which is then written in the context of other applications. And that's one of the problems I have reading the General Methodology Report right now, quite frankly, is that it is --- it borrows from the Fire Methodology, and it says well, here's a General Methodology but it's really Fire's, or maybe it's Seismic, or maybe it's --- to me, that's troubling.

MS. XING: I wouldn't say it's trouble. It's a compromise to how much effort we can put in the project. For the General Methodology, so overall framework come from the cognitive basis. But for specific part, like the part you mentioned, Human Event identification,

1 since the Fire HRA already did a good job there, we tried
2 to incorporate what's the good into this General
3 Methodology.
4 CHAIRMAN STETKAR: I'll wait until we get to
5 the General Methodology part of it until we discuss a
6 little bit more of this.
7 MS. XING: Okay. And I think your comments will
8 simply --- even this is the strategic approach, as you
9 said, a specific method that is tailored from the General
10 Methodology. However ---
11 CHAIRMAN STETKAR: This slide looks good, but
12 not what I hear you saying in words, and not what I read
13 on pieces of paper.
14 MS. XING: Yes. However, I was missing the
15 however part. So, historic reasons we developed the
16 IDHEAS method for internal at-power events first, and
17 then not completely parallel but sometime overlap time
18 frame we did develop the General Methodology. I'm sure
19 give you the impression the General Methodology is taken
20 from the specific one.
21 CHAIRMAN STETKAR: Okay. We'll discuss more of
22 that once you get to the general method.
23 MS. XING: Okay.
24 MEMBER REMPE: So, I have a general question,
25 too. And, again, maybe I came in midway through this,

1 and it's not my area of expertise. But if I look at the
2 SRM and from past meetings I've attended, I had the
3 general idea that this was something that was supposed
4 to be a General Methodology that was of interest not only
5 to NRC for use, but also for external stakeholders.
6 That's why the SRM says talk to ACRS and external
7 stakeholders. But then I read some of the information
8 for this meeting, and I look at your viewgraphs, it sounds
9 like that there's a divergence between what NRC is doing
10 for NRC users, and some EPRI input that's not going to
11 be able to be incorporated because of different reasons.
12 And what's your vision? Are you trying to do one
13 methodology that both EPRI and NRC will use, or are you
14 going to have just NRC using this, or what's the vision
15 here?
16 MS. XING: Okay. Oh, and I can show also the
17 ---
18 MR. PETERS: Yes, this is Sean Peters. The SRM
19 directs us to pick a method or set of methods for the
20 Agency to use. It does also tell us to work with internal
21 and external stakeholders to try to come to some type
22 of consensus. We're running into slight issues
23 associated with the different needs of the different
24 users. So, EPRI has particular needs for their industry,
25 and we have particular needs for the NRC, so I'm not sure

1 EPRI is really big into medical applications of byproduct
2 materials, but we do have that as a future need. So, there
3 are going to be some developmental areas that will be
4 different once ---
5 MEMBER REMPE: I can understand that, but if
6 there's --- if it's being used for the same application,
7 are you going to have two different results, like we have
8 MELCOR and MAAP. That's my background, and I think about
9 that. And are you going to have certain applications
10 where you're --- because you've worked together you'll
11 get the same result, hopefully?
12 MR. PETERS: Well, I mean, we do have different
13 applications now, so EPRI does have their HRA calculator,
14 and each licensee chooses the methodologies they use to
15 do their calculation. NRC uses SPAR-H exclusively when
16 we do our SDP and ASP analyses. So, there is a divergence
17 in how the industry will do their analysis of an event,
18 and then how we will. And sometimes they will actually
19 pull in our method to try to debate the facets of our
20 methodology. But our hopes are that we can get our team
21 more unified around a bigger direction. But even then,
22 industry is more in this what I would call this
23 perspective HRA world where they go out and they build
24 their models for their at-power operating plants. They
25 build it for the accidents that are of concern, and for

1 licensing applications. And 99 percent of the time, the
2 NRC only builds models for significance determination
3 process or ASP analysis, so there's kind of a bit of
4 deconstruction. So, because we are building these almost
5 for two different purposes, one to build a general plant
6 model, and the other is to subdivide events, there is
7 going to be some divergence then.
8 CHAIRMAN STETKAR: I'm sorry. A pump is a pump,
9 is a pump, a valve is a valve, is a valve, a diesel
10 generator is a diesel generator, is a diesel generator,
11 and the way that you should think about evaluating human
12 performance shouldn't depend on whether you're building
13 a model for the significance determination process or
14 the accident sequence precursor process, or a complete
15 Level 3 Full Scope PRA out in the industry with the same
16 people.
17 MR. PETERS: But what it will change is
18 physically the level of effort people are willing to put
19 into each of those applications.
20 CHAIRMAN STETKAR: That's their problem, how
21 they apply a methodology is their problem. There is a
22 methodology for doing fault tree and systems analysis.
23 Some people take shortcuts, some people add things, but
24 there is a General Methodology for doing that.
25 MR. PETERS: And I think ---

1 CHAIRMAN STETKAR: And my point is that the
2 whole point of this SRM, which I think Joy's problem is
3 that this --- the process and the conclusion of the Staff
4 was that we needed methodology to bring both human
5 reliability analysis up to the current state of knowledge
6 in terms of the Human Reliability Analysis community,
7 and to try to consolidate all of these bits and pieces
8 of I want to do it my way, you want to do it your way,
9 you want to do it your way that result in all of these
10 divergent numerical estimates that then people fight
11 over what should the number be. So, I am sympathetic.
12 And, in fact, if I do read that generic
13 methodology, there's a lot of discussion of well, this
14 is okay for the significance determination process.
15 Well, no, it ought to be okay for evaluating human
16 performance period, or we ought to give up and say we
17 can't do it, and everybody go use their own methodology.
18 It's not a generic methodology that is only okay for the
19 significance determination process, and it's not a
20 generic methodology that is only okay for a particular
21 utility's application for some focused tech spec
22 improvement.
23 That's a --- you know, stop pigeonholing
24 things. If you're going to pigeonhole things, give up
25 on the project, and the ACRS will --- this SRM was to

us, not to you. We'll write a letter saying sorry, we can't do it. You know, save some money.

MS. XING: Yes. Okay, thanks. At this point, I don't think EPRI and NRC has any fundamental differences in terms of the methodology itself. And the differences we have, it's in the --- I think you already mentioned. It's in the implementation part. If you want --- like if you want take a shortcut, skip some part. Just give an example, either you --- NRC Staff want to estimate the performance time in the central, in the meantime, and as a distribution range, and some EPRI user will say well, we typically just get a single number. So that's where the differences are, is reading the implementation, not on the fundamental measure. Mary, you're next.

MS. PRESLEY: That's pretty much true. You guys seem to use IDHEAS and generic method interchangeably. Just to be clear, we're not involved at this moment in the generic methodology. We are involved in IDHEAS. And most of the differences come to how things are worded, and the lens which you look at things, so I'll give you just a very quick for instance on the operational narrative.

Step 1 of the process was changed to be write your operational narrative in. We're like why would you

do that? You haven't defined your HFE yet. And the answer came back, was well, we talked to the ASP folks and the SDP folks, and the first thing they do is write out what happened. And so, oh, so the process steps are slightly different for different flavors. And because you're seeing an early draft, we haven't had a chance to hash that piece out and come to agreement. We're meeting actually face-to-face June 1st, that week to do that. So, it's really coming together to make sure we understand each other's perspective. It's not fundamental differences in anywhere except I think maybe timing a little bit of a technical disagreement, but ---

MEMBER BLEY: Mary's comment makes me need to say something. If that's what drove moving the narrative to the front, there is a difference between doing a retrospective analysis and doing a prospective analysis. And, in fact, in a retrospective analysis you start with what happened, lay it out, and then try to understand it better. In prospective, you start from the beginning and work your way into the scenarios. The descriptions ought to be very similar; although, in the prospective you have to look at other things that might be happening.

MS. PRESLEY: But ASP ---

MEMBER BLEY: I'm just sitting here because

1 that's the first time I've heard this comment. We have
2 a set of tasks you need to perform as you do either kind
3 of analysis. The ordering will be different; it's still
4 one methodology.
5 MS. PRESLEY: It is. How it's written is
6 slightly different. So, we have to --- it's just a matter
7 of ---
8 MEMBER BLEY: If you go back one slide, right
9 down here, where you were.
10 CHAIRMAN STETKAR: The nice picture.
11 MEMBER BLEY: That picture. Underneath the
12 methodology you can have an implementation scheme that
13 puts things in different orders, or maybe brings in some
14 additional conditioning factors that aren't there under
15 some conditions. But it's still the one methodology.
16 MS. PRESLEY: Yes.
17 MEMBER BLEY: That's why I'm a little ---
18 CHAIRMAN STETKAR: Think in the context, for
19 example, of REG Guide 1174. We're all familiar with Reg
20 Guide 1174 for risk-informed applications. That is a
21 General Methodology. Here's what you need to think about,
22 here's a framework, here's a context. Now, that's been
23 specialized in other Reg Guides. You know, if you want
24 to do a focused application for allowed outage times,
25 there is, indeed, a Reg Guide that specializes, you ought

to think about these particular things. If you want to do it for a different type of application, there's three or four of them floating around.

MEMBER SCHULTZ: And each of those may branch out ---

CHAIRMAN STETKAR: And each of the --- but it is not --- none of those are in inconsistent with the General Methodology. That central portion of this slide is that overarching methodology, and that's why I keep coming back to the General Methodology, rather than saying well, for this particular application, whether it's, as Dennis said, a retrospective look that the ASP people might want to look at, or the significance determination folks, the ROP folks, that's fine. That's a particular application of that methodology, or whether it's someone doing a PRA for only Level 1 PRA at-power internal events, you know, there might be different sort of shortcuts from the General Methodology that you might want to take. But that doesn't change the General Methodology, or the basic elements, the tasks that need to be done.

MS. XING: Okay. Thanks for all the comments. So, I'll move on, that you have chance to hear the General Methodology.

Okay. The project status of what's the data

1 between last May and now what we did, the first one is
2 a cognitive basis report. We already talked, is going
3 to be published soon. And IDHEAS method for internal
4 at-power events, so last year after our initial
5 development we received six ACRS recommendations. Of the
6 six recommendations, we preliminarily addressed four of
7 them, and the two other ones, the testing in progress.
8 Stephanie will talk about. And the expert elicitation
9 we haven't started yet. We are still trying to decide
10 how to get it done. And I will go over everybody's
11 recommendations.
12 For the General Methodology, I think we made
13 a lot of progress over the last year, good or bad. So,
14 we have --- finally we have the framework and the
15 process, but some bigger elements still need to be worked
16 out. But, nevertheless, it's in the status, we started
17 some preliminary work. We'll try to use it to see how
18 it works while we fix some of them.
19 And the path forward, down the road we will
20 make updates and the extension. For the IDHEAS for
21 internal at-power event, we will publish the method
22 report. That's what we see, and as we just discussed,
23 maybe different users to have different specific need.
24 So, at least the NRC part, the users want us to develop
25 a User's Manual for that. Right now the report is

1 --- including the appendix is 300 page long, so they want
2 to have a simple, easy to use manual. And after testing
3 we will implement the method in our Agency.
4 And for the General Methodology, of course we
5 will complete the development and pilot test it. And this
6 should be done by 2016, and then we will apply the
7 methodology to different applications. We already have
8 several applications in our Agency need this method.
9 Okay. So, if no further question, I will move
10 to ---
11 MEMBER BLEY: Jing, I do have a question. I have
12 a number of drafts of reports of all natures, including
13 this big thick one that was published in 2012, then there
14 was an update in 2013 of method for internal at-power.
15 MS. XING: Yes.
16 MEMBER BLEY: And now we have this new one that
17 starts with the narratives and the like. Is that
18 envisioned as something that gets incorporated into the
19 other one we saw, or is it something separate? Where are
20 you headed?
21 MS. XING: Which?
22 MEMBER BLEY: The --- I forget what it was
23 called, but it's ---
24 MS. XING: Short Report?
25 CHAIRMAN STETKAR: Yes, the short report ----

1 MEMBER BLEY: Short report, generic integrated
2 methodology ---
3 CHAIRMAN STETKAR: On Revision --- well, no,
4 there's two.
5 MEMBER BLEY: March 2015, you and James.
6 CHAIRMAN STETKAR: That's not the Short
7 Report.
8 MEMBER BLEY: Oh. There is a short ---
9 CHAIRMAN STETKAR: There is a short report on
10 the at-power, but that also talks ---
11 MS. XING: That's the General Methodology.
12 MEMBER BLEY: This is --- I'm sorry?
13 MS. XING: That's the General Methodology, so
14 you are looking at three report for each --- on the
15 product part. The one in your hand is the one about the
16 General Methodology.
17 MEMBER BLEY: Okay. And this big thick one?
18 CHAIRMAN STETKAR: The short report is the
19 --- is an update to sections of that big report. Right?
20 MS. XING: That big report, yes.
21 CHAIRMAN STETKAR: But most of that, not all
22 of it, but most of it is also reflected in the first couple
23 of sections of the General Methodology thing.
24 MEMBER BLEY: So you envision those as staying
25 separate documents.

1 MS. XING: Yes, they will be separate
2 documents, so each of these on your left side will be
3 one report.
4 MEMBER SCHULTZ: Each box, each category, one
5 report.
6 MS. XING: Yes.
7 MEMBER SCHULTZ: Eventually.
8 MS. XING: Yes. And, eventually, like for box
9 in the middle we will have a separate user's manual.
10 MEMBER BLEY: Okay.
11 MS. XING: Okay. No more questions allowed.
12 MEMBER BLEY: Yes, the last two. Will they be
13 consistent in some fashion?
14 MS. XING: Which last two?
15 MEMBER BLEY: The middle one and the bottom one.
16 MS. XING: They will be consistent --- first
17 of all, they are two separate products. And the ---
18 MEMBER BLEY: It doesn't smell like it when I
19 read it.
20 CHAIRMAN STETKAR: Go back to your Slide 4
21 again.
22 MS. XING: Okay.
23 CHAIRMAN STETKAR: They are not two separate
24 products. The middle box on Slide 6 is the lower lefthand
25 box on this slide. The bottom box on Slide 6 is the middle

box on this slide. They ought not to be separate in terms of inconsistencies.

MS. XING: They ---

CHAIRMAN STETKAR: Because the bottom thing on this slide is a subsidiary application specific document derived from the General Methodology, derived from it, not separate from it.

MEMBER BLEY: By the time they are published I would hope they look that way. That's all I'm saying.

CHAIRMAN STETKAR: They don't look that way now.

MEMBER BLEY: I know.

MS. XING: Well, at least by time they're published the --- in the first --- within the first five page more clearly explains the relation between these two reports. One is a general, the other is a subset, more specific.

MEMBER SCHULTZ: But on 6 --- go back to 6 for a moment. You don't have a bullet item for the General Methodology, the report, by the end of 2016. Or maybe we'll get into that in the next slide. No, that is the next slide. So, will there be a deliverable in 2016 related to the General Methodology?

MS. XING: That's my goal for now.

MEMBER SCHULTZ: Okay. But not so much that you

1 would put it on the slide.

2 MS. XING: That's why --- yes, look ---

3 MEMBER SCHULTZ: I understand.

4 MS. XING: Last May we think everything was

5 ready for NUREG-2114, now it's still in complication.

6 So, I can't really say when we can get that report

7 published, but ---

8 MEMBER SCHULTZ: In terms of an activity, is

9 a report for the General Methodology, and what Dennis

10 was saying and John commented, that they ought to be

11 connected appropriately, as you showed on the last slide.

12 MS. XING: Yes, I got that comment. Thank you.

13 MEMBER SCHULTZ: Thank you.

14 MS. XING: Okay. Now talk about the update to

15 IDHEAS. It's been a long time so I'll give a quick review

16 of the method. So, this the IDHEAS approach, forget about

17 the green box on the top. So, for the current draft of

18 the method, it started with identifying the Human Failure

19 Event. So, you have a scenario, you identify the HFEs,

20 and then break down the HFE, we perform --- develop a

21 crew response diagram of the HFE and analyze the critical

22 task in the HFE. For those of you have really good memory,

23 previously we always called the CRT, Crew Response Tree.

24 The word "tree" causing lots of confusion.

25 MEMBER BLEY: I'm sorry, say that again.

1 MS. XING: It's good that you already forgot.
2 We ---
3 MEMBER BLEY: No, I didn't hear.
4 MS. XING: We used to talk a lot about CRT.
5 MEMBER BLEY: Oh, okay. Yes.
6 MS. XING: Which means the Crew Response Tree
7 in the revision.
8 CHAIRMAN STETKAR: I'll note that in your
9 written reports you call it CRD, and you always call it
10 Crew Response Tree?
11 MS. XING: I think ---
12 CHAIRMAN STETKAR: Still --- yes, okay. But,
13 you know, if you're writing things ---
14 MS. XING: It sometimes misses that word.
15 CHAIRMAN STETKAR: Yes, that's right.
16 MS. XING: I tried a global replacement.
17 CHAIRMAN STETKAR: Yes, but it didn't work.
18 MS. XING: And then for --- then we look,
19 analyze each critical task. For each critical task, we
20 select the applicable critical failure mode.
21 MEMBER BLEY: Can I back you up to the top line?
22 Are we --- we're talking the general approach now.
23 MS. XING: We're talking the IDHEAS for
24 internal at-power event.
25 MEMBER BLEY: This is for internal at-power

events.

MS. XING: Yes, for the next 40 minutes.

MEMBER BLEY: Okay, then you're going to talk the other one?

MS. XING: Then we'll talk about testing, then we'll talk the other one.

MEMBER BLEY: Okay.

MS. XING: So, I will ---

MEMBER BLEY: Let me ask you a generic report question first, this report that we just got. In there it's generic for nuclear power plants, it says. It says, "Find the HFEs." And then it says, oh, but you don't have to do that because the PRA's internal events PRA has already defined them, and you don't have to think about them. Then you go on for about 10 pages of all kind of stuff that's pulled in from many places, some of it pretty good, telling you how to go back and think about some of these that maybe wasn't done thoroughly. So, it seems to have contradictions. It might be that you just gathered all this stuff and got it together and haven't cleaned it out yet, but it's really tough reading for things like that.

MS. XING: I understand. That's an indication that part is still under development, as I will talk --- at the end of the presentation, I point out the places

1 that need further development. HFE identification is a
2 part of it.
3 CHAIRMAN STETKAR: Okay. Let me --- so we try
4 to help you get to Slide 9. But help me just --- you
5 qualified that this is the IDHEAS for internal events
6 full power Level 1 PRA approach. What on this picture
7 would be different at the level of this picture for the
8 IDHEAS generic methodology?
9 MS. XING: Okay. So, top three boxes would be,
10 essentially, the same, except the generic methodology
11 will have more guidance, more detailed guidance, HFE
12 identification. And, also, more detailed guidance, test
13 analysis because the test is --- we need --- there are
14 some tests that's not proceduralized.
15 MEMBER BLEY: Then I would expect that the
16 specific one for internal events PRA, or for some other
17 HRA application would refer back to the generic to get
18 the details of how to do the HRE selection.
19 CHAIRMAN STETKAR: Especially if HFE is more
20 detailed guidance in the generic. Okay, rather than vice
21 versa.
22 MS. XING: Yes. And to finish the answer to your
23 question, the bottom --- the two boxes in the middle
24 basically is a quantification part would be different.
25 And not fundamentally different, but actually is a way

1 how --- you know, you can use --- if there's a set data,
2 the analogy will be, that's a set data. You can use a
3 different model with the data. And there you will see
4 the difference.
5 In general, I would say the two boxes in the
6 middle is the crew failure mode and the decision trees
7 in this method is a subset of the failure mode and the
8 performance factors in the generic methodology. Does
9 that answer your question?
10 CHAIRMAN STETKAR: I guess I'll have to
11 understand what that means, but go on.
12 MS. XING: Okay.
13 MEMBER BLEY: But at the level of this slide,
14 the words would probably be the same. I think that's what
15 John asked you.
16 MS. XING: Yes, you will see --- I make the
17 slide for General Methodology. I copied this one, made
18 a slight modification you will see in the next hour.
19 CHAIRMAN STETKAR: Yes, okay.
20 MS. XING: Okay. Only change is box 4 and 5.
21 So, you identify crew failure modes. For each crew
22 failure mode, the method come with a decision tree which
23 represents performance influencing factors that are
24 most relevant to this failure mode. And analysts were
25 analyzing this as performance influencing factors which

we call the branch point, and they decide a path in this tree. And the method also offers probability for each path, so analysts don't have to do their own estimation. At the end all the paths were added together, that will be the HEP for this whole event.

So, these are the six ACRS recommendations from last May. So, I'm not going to read each of these messages to take from this slide. After we got these, we talked, our Staff in our Agency. Actually, the recommendations are in very good, surprisingly good alignment to our Staff's need. Just to give you one example, Recommendation 5. "The probability that an action cannot be completed within the available time window should be included as a contribution to the overall HRA results." And what our users had been pushing the need, they want a continuous function to model the effect of time on the HEP, rather than just say available/not available. So, the two weren't continuous and this distribution means the same thing here. So, the work we did over this last year is actually one stone for two bird. Addressing ACRS recommendation, and also at same time addressing the NRC user's wishes.

So, I think do we want to go over every recommendation quickly, or just focus on some of them in detail, consider the time we have?

1 CHAIRMAN STETKAR: It's your show. Focus on the
2 ones that you think are most important.
3 MS. XING: Okay. Well, all they're important,
4 so I'll just try to speak really quick.
5 CHAIRMAN STETKAR: Okay.
6 MS. XING: Okay. The first one, "Document the
7 rationale for excluding specific cognitive mechanisms
8 and the PIFs in NUREG-2114." So, here's how it look like.
9 The left column is a cognitive basis framework in
10 NUREG-2114, so it started as five cognitive function.
11 For each cognitive function, we identified proximate
12 cause failure for this function. And then for each
13 proximate cause we identified a set of cognitive
14 mechanisms that can lead to the proximate cause. And,
15 also, looked together for each --- for these cognitive
16 mechanisms we also look at the performance influencing
17 factors that would influence this mechanism. That's the
18 structure of the cognitive framework.
19 On the right is a structure of IDHEAS. IDHEAS
20 model, the first model is a response base which are
21 corresponding to the cognitive functions. And for each
22 base we identify a set of cognitive failure mode. And
23 for each cognitive failure mode we have a set of --- which
24 I wrote here is the branch point, the PIF factors there.
25 So, ideally, if we model all the possible failures then

every cognitive mechanism and PIF on the left column, on the left side should be captured by the branch point in the right side in the IDHEAS method. And realize that some cognitive mechanisms may not be captured in the IDHEAS method. That's what ACRS want we provide a rationale why some of them were left out. So, we did a mapping between these two side, and a good news to you is most of the cognitive mechanism on the left were captured by the branch points on the right side. And, also, the PIFs. Well, the PIFs in the left I call the A/B safety. Well, in the IDHEAS decision tree, the branch point talk about the specific aspect of those. When you talk training, there could be many different aspect of training, like frequency of training, and whether you're trained enough on malfunctions. And when we come to the IDHEAS, we only capture the ones that are most relevant to the proceduralized event in the control room. So, we model the perceived urgency.

CHAIRMAN STETKAR: So, for example, in the generic methodology there might be a different mapping because you've tailored ---

MS. XING: Yes, in the generic method --- up to this, if you imagine that would be a layer down. Generic methodology map them, model them all. And IDHEAS for internal power event only models three of them that

1 are most relevant to the internal at-power setting.
2 CHAIRMAN STETKAR: Thanks.
3 MS. XING: Okay. Recommendation 2 is "Develop
4 operational narrative." So, the concept is because the
5 IDHEAS, the current draft we start with HFE
6 identification. We look at the issue from the PRA model,
7 and then go to the task that identifies the specific PIF.
8 I think our users and the ACRS both has a consideration,
9 well, when you break something very complicated into this
10 very detailed sense, you might miss some big fish up
11 front.
12 And I look at the ASP Report made by our NRC
13 analyst, they all start with a description, like a story,
14 give an overall description what's happening here, what
15 are the challenges of human performance, what was the
16 deviation to the baseline scenario. So, therefore, we
17 develop the guidance for what we call Step 1 of IDHEAS
18 process, which before you dive into the PRA model and
19 HFEs, just look at what are the basic foundations and
20 the challenges to the plant and the crew performance?
21 Well, different people can tell a story
22 differently, so here the guidance is try to capture,
23 delineate what are the essential elements should be
24 included, you should look at this narrative.
25 MEMBER BLEY: We're still in the IDHEAS for

internal events at-power?

MS. XING: Yes, we are always there for the next 30 minutes.

MEMBER BLEY: But that discussion you just had up there, I'm not sure that's in here at any level. Now, under the examples there are little short squibs that call themselves operational narratives, but I'm remembering back to, as all of this got started. Part of the input to it was the International Benchmark Study, and one of the conclusions, the earliest conclusions out of that was that various analysts either told a very thorough story, or not much of one. And that it was desirable for the new method to tell a more complete story. And the two examples that were most often cited, I think, by the reviewers of that project were the scenarios that were developed by the NRC ATHEANA team, and the ones that were developed by the French MEMOS team.

And there's kind of enough stuff in the new generic thing, although it's jumbled, to cover that kind of a narrative story. I don't think there's anything like that in the internal events at-power, or in the examples that are presented in there. Am I missing the boat?

MS. XING: In the --- at this point, we didn't update the big report. So, the big report, it's still the old example developed without this step.

1 MEMBER BLEY: I'm not missing the boat. The boat
2 isn't there yet.
3 MS. XING: Yes.
4 MEMBER BLEY: Okay.
5 MS. XING: So --- and I appreciate your point
6 of the international studies. In fact, all the developers
7 of guideline for this section, that was a big part of
8 the input. I just want to look how different people,
9 different team using a different method to develop their
10 operational story, try to make sure. That's why I say,
11 different people will tell the story differently.
12 MEMBER BLEY: Was is possible for you to see
13 what was submitted rather than what was in the reports
14 written by the ---
15 MS. XING: Yes, I ---
16 MEMBER BLEY: Yes, you did.
17 MS. XING: I actually have that.
18 MEMBER BLEY: Because the reports only have
19 really brief summaries of what was in those. Okay.
20 MS. XING: I saw like, for example, one method
21 on SPAR-H, we have very short story. And the other method,
22 like you just mentioned, have a very long story. But,
23 nevertheless, there is something in common, the
24 fundamental information most people try to capture.
25 That's the --- we summarize that in three sections, these

1 three section about plant context or plant condition,
2 crew context and human action context.
3 CHAIRMAN STETKAR: At that level, I'm going to
4 talk generically before you get into some of this. You
5 --- the guidance is written in terms of developing a
6 narrative or a baseline, so called baseline scenario.
7 I don't know what that means, so you define it for me.
8 That's a scenario when nothing has failed, and you talk
9 about well, okay, it's important to look at the
10 procedures of what the operators are expected to do in
11 that baseline scenario, and understand the staffing
12 according to NEI guidance and assumptions under FLEX
13 things, or perhaps with ATWS scenarios, or something or
14 other, and you talk about well, it's important to review
15 the procedures, and identify which procedures will be
16 used.
17 I don't understand how that relates to
18 developing a scenario narrative for the H.B. Robinson
19 fire event. I keep bringing you back to develop a scenario
20 narrative for the H.B. fire at Robinson has nothing to
21 do with procedures. It has nothing to do with what the
22 baseline expectation --- it has everything to do with
23 what's going on in the plant.
24 MEMBER BLEY: In the plant, it has something
25 to do with procedures.

CHAIRMAN STETKAR: Well, eventually, it has some ---

MEMBER BLEY: Because the people are ---

CHAIRMAN STETKAR: It eventually has something to do with procedures.

MEMBER BLEY: But it isn't dominated by ---

CHAIRMAN STETKAR: But it is not ---

MS. XING: Yes, it is not dominated ---

CHAIRMAN STETKAR: It is not --- the baseline scenario is the operator will pick up E0 and do the immediate actions. And, therefore, I don't need to think about it because I can assume that they will always do the immediate actions. I found those words in here. And, therefore, we should then focus on the first key critical action that they must perform. And they will perform this, and then they will do this, and then --- that is not a scenario narrative that is focused on what's happening in the plant. Because in the H.B. Robinson event they missed things because of what was happening in the plant. And I don't understand how this guidance leads me to that comprehensive description of what's happening.

Not what we expect people to do, not what we think we've trained people to do, but what is happening in the plant, and then lay onto that what people might

do.

MS. XING: I'll have James answer the question.

MR. CHANG: This is James Chang, Office of Research. Back to the earlier comment. We develop this method -- given that's --- using this method for the Robinson event, I would look at given the condition. All that will affect plant. And based on operator's procedure training, how would we would expect they respond to a situation. Yes, knowing that they might not --- they might deviate from their training, their procedure, and that in the guidance they're coming to the nexus. If this being done, do this, and then what's the next. That's the way that we think is a prospective analysis the Robinson event.

MS. XING: Thanks, James. And I take your comment, this part we have a couple. NRC Staff reviewed and we still haven't fully incorporated their comments.

CHAIRMAN STETKAR: Okay.

MS. XING: And, also, we will need to work with EPRI. They have a different perspective on this, so at this point I appreciate the comment, but I don't have that answer right now.

CHAIRMAN STETKAR: Just remember the comments from all of the international benchmark studies that that first operational narrative may be the key, may be the

1 most important thing in this whole methodology, because
2 some of the comments in that benchmark study, and Dennis
3 can help me, or not, depending on where his conflicts
4 are. Were that the operational narrative, the
5 completeness and the reality, realism in that
6 operational narrative were one of the key influences to
7 reducing variability regardless of what methodology you
8 use. And getting the analysts to think about what's
9 happening in the plant, the right context. So, of all
10 of these things they may be most important.
11 You know, we've tried to emphasize that in our
12 letters and orally in these meetings, so it's not
13 something you just sort of well, yes, we need to go around
14 and fix up a few words there. It's not just fixing up
15 a few words. And if there are fundamental differences
16 of opinion that you mentioned between EPRI and the Staff
17 about what should constitute a good operational
18 narrative, you should be spending a lot of time on that
19 now, not putting it off.
20 MS. XING: Okay, thank you. You want to go
21 through the detail of the narrative, or we ---
22 CHAIRMAN STETKAR: Yes, because we've
23 emphasized narratives a lot. You can hear that we think
24 narratives are important.
25 MS. XING: Okay. So, yes. I think just comment

--- as people comment is very frustrating --- first of all, it's difficult to tell a story that try to capture everything, the important stuff. And second of all, some users may answer I don't want to spend time on doing that. I just jump --- I just want to jump to the ---

CHAIRMAN STETKAR: Great. Then tell they shouldn't be using it. Find someone who actually wants to do what needs to be done.

MS. XING: So, we will put that in guidance. Okay. So ---

CHAIRMAN STETKAR: The guidance should be the guidance. If someone wants to take shortcuts, it's incumbent upon them to defend why that's reasonable.

MS. XING: Yes. So, what we have here is try to capture the elements that we think are important when you tell a story regardless which way you come from tells the story. You should have this information, like when you describe a plant you should look at the initial plant conditions, the operational sequence, what's the event sequence, like in a timeline fashion. And plant system equipment response, equipment may or may not respond the way you want them. And the key operator actions there, system success criteria and consequence of failure of those key operator actions.

MEMBER BLEY: There's something that bothered

me both in the internal event at-power methodology and in the generic methodology. And the best I can call it is a biased approach toward expected actions, you know, characterization of the expected success path, what are the expected human actions?

I would commend to you a book I had trouble with when I first read it, but he's on target on a lot of things, Sidney Dekker's Field Guide to Understanding Human Error. You've probably read that. But kind of the key thing there is we as analysts know how we want it to come out, so we like to think about here's what I want them to do. But really, the focus, if we want to model these people as people, ought to be given what the operator knows and can see, what are the possible paths forward from that point; rather than saying this is what they're doing to do, and maybe there's a chance they'll fail.

So, if we're getting this new methodology to try to take advantage of what we know about behaviors, it seems real important to give up that bias of what I expect them to do, or I know if they'd done this instead of this it would have gone to success.

Given what they know and can see about the plant, what are the things they might do, and their procedures, of course. It feels as I read both documents

as a real bias that we've built into the discussion.

MS. XING: I ---

MEMBER BLEY: And that will mean whoever is doing it is going to think that way.

MS. XING: I completely agree with you on that. In fact, I had several discussions with some question on this topic. He holds exactly same opinion as you, which to look at what --- not just what they are asked, but what they might do.

MEMBER BLEY: I think it's a view that's evolved over the last 20 years, is trying to ---

MS. XING: But that comes to --- related to one issue that we don't really tackle in our PRA model, is the error of commission.

CHAIRMAN STETKAR: No, that's --- it's too easy to say that word. It's too easy to say that word.

MEMBER BLEY: It's also an analyst dream.

CHAIRMAN STETKAR: It's --- and I'll pick up where Dennis, I'm not nearly as eloquent as Dennis is, nor as well read. And I don't have nearly as many books to move from my ---

MEMBER BLEY: I don't either.

CHAIRMAN STETKAR: One thing I --- in this vein in terms of plant context, one of the pieces of information that you identify on this screen, number 4

1 down there, key operator actions. Okay?

2 MEMBER BLEY: That's what triggered this.

3 CHAIRMAN STETKAR: And it triggered me exactly

4 the same way. If I build a particular PRA model, I, as

5 a PRA modeler, may focus solely on that particular

6 operator action. Okay? In the real plant, the operators

7 don't know anything about the PRA model. They only know

8 what's happening. And if, indeed, all of the fire alarms,

9 or half of the fire alarms went off, and they had a power

10 failure, and they don't know whether that power failure

11 was because they had a fire, or whether it was a

12 consequence that the fire alarms --- they just don't

13 know. All they know is that power failed to part of the

14 plant, a bunch of fire alarms went off. What is the key

15 operator action then? To the operators in that plant it

16 was go check those fire alarms.

17 Now, I'm not sure that's key operator --- but

18 that's what they did. And if I don't tell the narrative

19 that says the operators have the fire alarms going off,

20 and you'd expect them --- you would expect them to go

21 check those fire alarms. You would also expect them to

22 check component cooling water. You'd also expect them

23 to do a whole lot of other things. They have to develop

24 priorities, so focusing on key operator actions only in

25 the context of a PRA model will a priori bias the HRA

analyst, because it will tell the HRA analyst that for some reason all of this other stuff is not key. It's not important. And to real operators in the real plant, it's equal. It's all equally important.

MEMBER SCHULTZ: Yes. Isn't the narrative a tree? In other words, decision making that the operator should do, or is this all in one ---

CHAIRMAN STETKAR: No. It's actually a story of what --- part of it is to just do exactly what I was doing here, is to tell --- the plant tripped. You know, we know what the initiate --- we happen to know what the initiating event is because we have to have some sort of context. But under this initiating event, here is what we would expect to be happening. We lost instrument error. There's a whole bunch of stuff that failed open on the secondary side of the plant.

MEMBER SCHULTZ: The expected path.

CHAIRMAN STETKAR: Not even the expected pathway, just what's happening. And faced with these conditions, what --- I hate to use the term "expected," because that has a probability context with it. What are the operators confronted with? They're confronted with the fact that maybe they've got an overcooling event going off on the secondary side, which the PRA might not even care about. They're confronted with the fact that

1 they've lost component cooling water to the reactor
2 coolant pumps because some valve has failed in the closed
3 position. That, in principle, from the PRA they ought
4 to care about, but they might not even know about it
5 because of everything else that's going on. So, in my
6 sense, the operational narrative presents the picture
7 of the context that the operators are faced with.
8 Now, in the context of the PRA, we may want
9 them to do certain things for the PRA, but perhaps because
10 of everything else that's going on, they may not be
11 --- they may not get around to doing it in enough time,
12 or it might be overlooked because they're overwhelmed
13 with other things. But unless the narrative presents to
14 the analyst who is eventually given the task of assigning
15 some likelihood to whether the operators restore
16 component cooling water in this case ---
17 MS. XING: So ---
18 CHAIRMAN STETKAR: --- the poor analyst
19 already is now biased.
20 MS. XING: I got your --- I understand your
21 comment. So just say this part if you encompass a plant
22 context, if you imagine I'm the plant. I'm look at what
23 I want the operator to do for me to protect plant safety.
24 Then the next section is crew context. So, now like from
25 the operator's perspective --- crew's perspective, what

1 are the things I need to do.

2 The first item here is very much like what you

3 said. So activities other than just controlling the

4 plant, or the activities other than specified in the PRA

5 model require you to do. Say at this point we know the

6 crew not just to do the RCS, restore the CCW, but they

7 will also need to respond to the fire procedures. There

8 could be other things going on, as well. So, that's where

9 when you look at crew, the first thing you want to look

10 at, what's --- and there may be multiple units here, and

11 they are also --- shift supervisor will also have to

12 coordinate other unit. So, that's all the thing we try

13 to capture there.

14 So, the elements in this section is try to give

15 you a big picture what the crews need to do, and what's

16 available for them, like can they access to the site?

17 And if the information is integral, and do they have

18 procedures and guidance used. So, what are the

19 environmental factors that would impede their

20 performance. and importantly is availability of

21 decision makers. We cannot always assume the decision

22 maker is there. And staffing, not just the control room

23 staffing, but if you need field operator to do some

24 special --- fix some equipment, do they have the right

25 staff? Or if you need a contractor, do they have access

to the particular point.

Anyway, so in the guidance for each of these items, we have a list of things to suggest people to consider. So, this section try to give you a picture of those context around the crew.

CHAIRMAN STETKAR: I had --- as I read threw it, and I thought about it, I had several comments that I'll --- because they tend to be winding-type comments. What I'd suggest is that you have someone step back from those examples and think about those examples in the context of not a procedure-driven internal event PRA for Level 1, but in the context of what might the operators be challenged with? Because a lot of your examples are focused --- they say things, well, the operators have EOPs and we expect them to be trained on the EOPs, and the EOPs should lead them to the appropriate actions. Things like that.

That --- and if I'm reading that as guidance on what I should do to develop this narrative, I am now again biased toward that expected focus on what we're trying to analyze in the PRA, rather than setting the whole context for what the operators are challenged with. So, try to see if you can step back from it, and read it with that perspective, and try to avoid potentially focusing the guidance with examples, because people who

1 read the example say oh, okay, I have to think about this.
2 And, oh, I should ---
3 MS. XING: Yes, I appreciate the comments.
4 Also, just to let you know, after we got this draft
5 guidance developed, I tried to apply them to synchronize
6 them with a lot --- about 100 different reports of
7 Fukushima event. And I found that this framework actually
8 is very useful, just not performing HRA, just a document
9 of what happened. Like first I collect those like a whole
10 stack of Fukushima reports. Every report have some pages
11 more or less talk about human performance, a lot of pages
12 talk about plant conditions.
13 When trying to synchronize them, was very
14 difficult initially. Just try out the new guidance on
15 operational narrative, and it turned out to be very
16 helpful. And in that documentation I took a lot of
17 examples of what happened in Fukushima, like the one I
18 just mentioned. Contractor do not have authority to
19 access some important part for an action. So, that's just
20 the beginning of that work.
21 MEMBER SCHULTZ: And as you go forward in your
22 next --- to the action context, which is the next look,
23 you're seeing things here that are very important to the
24 overall narrative. And my --- it's multidimensional.
25 You might need to feed that back into the crew context,

1 and so forth, as you go forward; or not forward, but just
2 set it all together so you paint the whole picture ---
3 MS. XING: Yes.
4 MEMBER SCHULTZ: --- in a consistent fashion.
5 MS. XING: Thanks for that. Okay. Yes, and for
6 this action context, I say again many different parts,
7 and different Fukushima report, like scenarios
8 unfamiliar, and multitasking, concurrent demanding,
9 distraction, interruption. These words frequently
10 appeared in the various reports. And expected equipment
11 response, and time urgency. They didn't do that because
12 they feel they don't have --- they want to do something
13 else quickly. And the specific --- especially like in
14 Fukushima, the long lasting actions, some action last
15 days.
16 So, this section is trying to capture the
17 important overarching aspect to the action. And just to
18 say this part, we're still in the development stage. We
19 developed this very initial framework, and have our staff
20 build --- and I appreciate the comments we got from
21 today, and we'll continue to make it more functional.
22 Okay.
23 MS. PRESLEY: I don't know what the timing is,
24 but this section is supposed to end at 2?
25 MS. XING: This section should end at ---

1 CHAIRMAN STETKAR: It's okay. Mary, are you
2 --- don't worry about the ---
3 MS. PRESLEY: Okay.
4 CHAIRMAN STETKAR: I get to manage the time.
5 MS. XING: We can stay here off a clock.
6 MS. PRESLEY: Okay.
7 CHAIRMAN STETKAR: I don't know if any of you
8 have any time constraints, though. Do you need to leave
9 at ---
10 MS. PRESLEY: I have to leave by just before
11 5, so ---
12 CHAIRMAN STETKAR: Okay, that's ---
13 MS. PRESLEY: --- there's time. I just want to
14 make sure that it's not going to get cut off ---
15 CHAIRMAN STETKAR: No, no. Don't ---
16 MS. PRESLEY: --- for the testing and the
17 generic methodology stuff.
18 MS. XING: Okay. I hope I will get done in the
19 next 20 minutes.
20 CHAIRMAN STETKAR: We become more disciplined
21 as the day goes on.
22 MS. PRESLEY: Okay.
23 MS. XING: So, we'll come back to this part,
24 because Mary will talk about EPRI's perspective on
25 operational narrative.

CHAIRMAN STETKAR: Okay.

MS. XING: And so the --- so we move to the next recommendation, effect of time. So, here I plot these three diagrams show the different way for treating time. The one on the very left is what's the current IDHEAS draft, which the horizontal axis is the time, vertical axis is the error probability. So, the first way to treat it, now we assume if you have adequate time, the time does not affect your HEP. And if you have less than adequate time, whatever, there's a magic margin exist, if you have less time than that margin, the event is considered as physical which means HEP equals 1. And that's, I think, is the ACRS recommendation want us to address.

The one in the middle is like the SPAR-H model, the way it --- it's a little bit better staff function, like as you have more time and your HEP multiplier will be less. And our users really got troubled with this in their analysis, say hey, here I have --- how come 29 minutes versus 31 minutes will give me a ten time difference in the HEP estimation? So, they want us to really get --- give us a continuous function to treat ---

MEMBER BLEY: Can I ask what, to me, is the obvious question? Why don't we have a curve of how long

1 it takes, and a curve of how much time is available? And
2 then you just look at the overlap to see what the chance
3 of failure is. And I think you say something in one of
4 the documents that oh, HRA people don't know enough to
5 generate those times.
6 Well, my God, I thought we had hit the point
7 10 years ago or more than this shouldn't be one person
8 sitting in the corner. This ought to be a team involved
9 with --- have people know about the PRA, have people know
10 about the plant, who know about operations, so that, in
11 fact, you have that information available to do it right.
12 MS. XING: Mary, you want to answer that
13 question now, or later?
14 MS. PRESLEY: I have slides.
15 MS. XING: Okay, Mary will address that
16 question later on. But, anyway, here we assume people
17 are willing and able to estimate the time range. That's
18 what guidance here we have, the new guidance we're going
19 to have.
20 CHAIRMAN STETKAR: I'm sorry. Your guidance
21 says ---
22 MEMBER BLEY: Not here.
23 CHAIRMAN STETKAR: Here? Where? What guidance?
24 MS. XING: In that short report, but I'm going
25 to summarize ---

1 CHAIRMAN STETKAR: Well, the guide --- no, it
2 doesn't. I'm sorry.
3 MS. PRESLEY: There's another document. There
4 was a third ---
5 MEMBER BLEY: But it's got the same stuff in
6 it.
7 MS. PRESLEY: No, no, that's the generic
8 methodology. There was another one which ---
9 MS. XING: Summarize all these procedures.
10 MEMBER BLEY: At essentially the same times
11 then.
12 MS. XING: Oh, no.
13 MEMBER BLEY: No?
14 MEMBER REMPE: So, you're talking about we have
15 Reference 6, the summary of ---
16 CHAIRMAN STETKAR: Which document was that
17 one?
18 MS. XING: Actually, you're right, Dennis. In
19 both document the time part are the same.
20 CHAIRMAN STETKAR: Yes. I mean, I didn't do a
21 word-by-word comparison, but they sort of sounded like
22 the same to me.
23 MS. XING: Yes.
24 CHAIRMAN STETKAR: I will quote from --- I read
25 this, Section 2.4 ---

1 MEMBER BLEY: This turned out to be something
2 else.
3 CHAIRMAN STETKAR: 2.4.2 in the generic
4 methodology. "In practice, HRA analysts may not have
5 access to resources needed to estimate the time
6 distribution, e.g. analysts are given the mean value of
7 the time needed without additional time information.
8 IDHEAS provides a default standard distribution based
9 on analysis of the simulation data from Halden crew
10 performance experiments and the literature. For key
11 action, the standard distribution 95th percentile from
12 the mean is two times of the means. For t, cognitive,
13 the standard distribution 95th percentile from the mean
14 is two times of the mean. The broader distribution of
15 t-cog compared to that of t-action reflects the greater
16 individual differences of time needed for diagnosis and
17 decision making." That is a verbatim quote. It is absurd.
18 MS. XING: Okay.
19 CHAIRMAN STETKAR: Not only is it absurd, but
20 the words are not correct, because the two distributions
21 are exactly the same breadth. And you say one is broader
22 than the other, and they're arbitrary. And that is the
23 quote that Dennis found that says "human reliability
24 analysts don't have the access to resources to estimate
25 times." If they don't, fire them. Find somebody who does.

1 MEMBER SCHULTZ: Get a team. Get a team.
2 CHAIRMAN STETKAR: No, because if they have
3 that attitude that they don't have the resources ---
4 MEMBER SCHULTZ: If they have that attitude
5 then you're right.
6 CHAIRMAN STETKAR: Get rid of them and find
7 somebody who does.
8 MS. XING: I think there's --- we've hit the
9 general issue, how thorough you want to do a problem
10 versus how much resource you have. So, I ---
11 MEMBER SCHULTZ: We're talking about ---
12 MEMBER BLEY: In a lot of cases it's clear-cut.
13 There's more time than you'd ever need, or there's less
14 time than you can possibly do it in. For those middle
15 cases where it matters, it's important.
16 CHAIRMAN STETKAR: It's more important than
17 anything else, because it might be all --- you know, the
18 teeny tiny numbers that people tend to calculate from
19 the other methods might be wholly overwhelmed by the fact
20 that there's a 5 percent probability, 1 in 20 of the crews
21 might take longer than is available.
22 MS. XING: Yes.
23 CHAIRMAN STETKAR: That's a big number.
24 MS. XING: I quote from one of our HR analyst.
25 This is just one person's word. I got the --- we don't

1 have a lot of time. We don't have access to visit the
2 plants, so we have no way to ---
3 CHAIRMAN STETKAR: Reassign that person to
4 --- there's --- the Agency has a lot of different needs
5 for resources. Reassign that person to another job.
6 MS. XING: Okay.
7 CHAIRMAN STETKAR: That person ought not to be
8 here in HRA.
9 MS. XING: Have to take a note on that.
10 CHAIRMAN STETKAR: No, seriously. That's very
11 pejorative, but that type of attitude ought not to
12 persist in the 21st century evaluation of HRA because,
13 indeed, you ought --- as Dennis said, you ought to have
14 a team. That team should include people with operations
15 experience, plant knowledge, and people with HRA
16 experience.
17 If the HRA people don't feel that they
18 understand the plant well enough, or the scenario well
19 enough, fine. You know, thermal hydraulics people
20 understand uncertainties in their estimates, plant
21 operators can understand uncertainties in the amount of
22 time that's required to go through procedures, to go
23 through, you know, physical relocation, things like
24 that.
25 MS. XING: So, perhaps ---

1 CHAIRMAN STETKAR: You don't want to take the
2 time --- now, from a generic methodology, that's the
3 desire. If somebody wants to take a shortcut and say well,
4 you know, we didn't want to devote 15 minutes to do this
5 sort of team-based estimation. We want to use some sort
6 of ad hoc uncertainty, that's fine. They can document
7 the rationale for that, but the generic methodology out
8 not be developed to the laziest, least common
9 denominator.
10 MEMBER SCHULTZ: Yes. And the rationale for
11 that ---
12 CHAIRMAN STETKAR: And I'll just put it that
13 way.
14 MEMBER SCHULTZ: --- is that especially in
15 this area, this is where if you take a shortcut, you'll
16 get the wrong answer.
17 MS. XING: Okay.
18 MEMBER REMPE: And you'll have wasted the money
19 spent for the analysis. It would have been better to have
20 used the resources elsewhere.
21 MEMBER SCHULTZ: It's kind of a why do it?
22 MEMBER BLEY: You could just want some
23 instruments.
24 MEMBER REMPE: Yes, if you just want some
25 authorization ---

1 CHAIRMAN STETKAR: But for the --- and in this
2 case, the generic methodology is the same as in the short
3 report, which is, as I understand it, the plug-in for
4 the at-power study.
5 MS. XING: Okay. Yes, I really appreciate the
6 comments.
7 CHAIRMAN STETKAR: Don't fall victim to the
8 people who say we don't have enough time, we don't have
9 enough money. Not for the generic methodology.
10 Particular applications, you know, that's up to the
11 people who want to do those particular applications.
12 MEMBER SCHULTZ: Because once you have the
13 generic methodology, you will find opportunities, as
14 Dennis said, you'll find opportunities where you can
15 simplify and save time and resources. And then the other
16 areas where if you simplify you get the wrong answer.
17 MS. XING: Thanks for that.
18 CHAIRMAN STETKAR: You might even get the wrong
19 answer ---
20 MEMBER SCHULTZ: Anyway.
21 CHAIRMAN STETKAR: Well, no. Optimistically or
22 conservatively, if you just use some arbitrary, whether
23 it's a normal distribution, you know, with a certain
24 factor of 2, you know, or factor of 4, 90 percent
25 confidence interval, something like that. Who knows

1 whether that's reasonable or not?

2 MS. XING: Okay. So, what we did here with the

3 three bullet, we develop guidance estimating or

4 calibrating time needed which is the mean and the range

5 for human actions. And we also went to the literature

6 to study cognitive basis for the effects time available

7 of human error probability.

8 CHAIRMAN STETKAR: What literature have you

9 studied for that? You're talking about your so called

10 Option 2, which was ---

11 MS. XING: I will talk in the next slide.

12 CHAIRMAN STETKAR: You will? Okay, great.

13 MS. XING: Give you examples of the literature.

14 CHAIRMAN STETKAR: Okay.

15 MS. XING: And based on the literature, we

16 developed a math equation, or we can turn that into a

17 table calculating the contribution available.

18 MEMBER REMPE: But even --- I know you

19 reference a KAERI reference later in the viewgraphs, but

20 were all the 100 plus articles relevant that you review

21 here, that you mentioned? I mean, they were all

22 appropriate and plant-specific, or a --- not

23 plant-specific, but related to this type of --- were they

24 relevant?

25 MS. XING: I want to say of these 100 plus, I

didn't do an explicit number because there were a lot of articles. I wasn't sure are they really relevant or not I can use, so the number I put here, so like two stack of papers. This stack are the one I think the information are trustful. We can use it. But most of these literature studies are lab-controlled simulation, so it's not nuclear power plant simulation.

MEMBER REMPE: Not nuclear, so that's what I guess I should have said, are they relevant to nuclear? So, how many of them --- because the KAERI reference in the next slide or so, or somewhere where I was looking at it, I caught on that there was one that was a nuclear power plant ---

MS. XING: Yes, there were some of --- I would say ---

MEMBER REMPE: Out of the 100, how many were related to a nuclear power plant?

MS. XING: I can't give you precise number. I would say it is around ten that were.

MEMBER REMPE: Okay.

MS. XING: Okay, so based on the ---

CHAIRMAN STETKAR: You did the literature, so let's go on.

MS. XING: So, basically, this is just to summarize the key point from the literature. And not

surprising the first one was adequate time, more time available doesn't further reduce your error rate it remains the same. And it was very interesting, the second part, there were lots of lab studies, study what people actually do with their task and the time pressure. And I would say are about 20 of such studies, air traffic, pilots action. And, basically, they all agree humans tend to take a shortcut, or skip some steps of the combination process. For example, they only use a subset of information for decision making instead of consider all available relevant information. Or when they execute the actions, they don't do the verification or self-correction, which is a very important step to reduce errors. Like if we observe some air traffic controllers work, they told me they will probably make 30 percent of simple action errors in the first room. Then they quickly realize oh, I got it wrong, they correct it.

MEMBER BLEY: This is a subtle point, but it's important to remember. As an analyst, we sit there and we have somebody run a thermal hydraulic analysis, and we say oh, my gosh, they don't have much time to do this under this particular scenario. That may or may not apply to the people in the plant who don't have somebody running that analysis and a couple of days to think about it.

So, it's the sense that I'm under time pressure

that creates number 2, not the absolute time available. It's when I don't think I have enough time to get it done, and I might be right, and I might be wrong.

CHAIRMAN STETKAR: Or when ---

MEMBER BLEY: But there might not be much time, and I might not be aware of it.

CHAIRMAN STETKAR: That's right. Or when you think you've got tons of time, and you really don't.

MEMBER BLEY: And you really don't.

MS. XING: Yes. Actually, the example I put here ---

CHAIRMAN STETKAR: Let's ---

MS. XING: --- here from the other time is exactly like you said. They have enough time, but you tell them hey, you don't have enough time, and then they try to hurry up, skip some things.

MEMBER SCHULTZ: We have that in the next slide.

MS. XING: Yes, and they make a lot more errors. And the third part is important here, is a foundation how we model them. Experiments show the time available doesn't interact with other factors in term of their contribution to human error. So, time available appears to be independently contribute to the error probability rather than acting as a multiplier like some of our HRA method model. So, because of that we can model the time

1 effect in this very simple way on the top. So, overall
2 probability comes from two part. One part is contribution
3 of failure mode, TRFs, and the other part is time, so
4 we ---
5 CHAIRMAN STETKAR: Jing?
6 MS. XING: Yes?
7 CHAIRMAN STETKAR: Let me ask you before you
8 get into the math that we're going to be very critical
9 of, and summarily dismiss. Why is PT not simply what
10 Dennis said about a half hour ago? The intersection
11 between two probability distributions, there's a
12 probability distribution for the time available,
13 there's a probability distribution for the time
14 required. If they're well separated in space there's zero
15 intersection, so PT is zero.
16 If they are reversed, I am 100 percent
17 confident that there was no likelihood that they could
18 achieve success in the time available, so the action has
19 failed. And if they overlap, why isn't the probability
20 simply the overlap, period?
21 MS. XING: I ---
22 CHAIRMAN STETKAR: Who did that?
23 MS. XING: I didn't solve that, so I ---
24 CHAIRMAN STETKAR: You didn't think of that?
25 MS. XING: I didn't think of that.

CHAIRMAN STETKAR: Okay. Well, think of that, abandon this, because this is just an arbitrary mathematical framework with some assumptions that I couldn't even figure out. And I don't know where you found it, but it doesn't make any sense at all. And it's not physical. If you have those two distributions, you can ---

MEMBER BLEY: It's possibly been ---

CHAIRMAN STETKAR: --- convolute them.

MEMBER BLEY: --- fit to some information somewhere.

CHAIRMAN STETKAR: I don't understand what the low pressure, E to the minus 5, I really tried to think about this.

MS. XING: Okay.

CHAIRMAN STETKAR: And don't try to defend it, please.

MS. XING: I'm not trying to defend it. I want to say where this come from, that there's data, there's been experiment to support where this come from. And I do like to consider what Dennis said, if I want to spend more time to understand. You have two probability, you're talking ---

MEMBER BLEY: I guess the issue, though, is ----are those experiments --- how relevant are they to

the problem you're trying to solve each time you do another analysis? If they really match well, then maybe this is pretty good, but I don't know.

MS. XING: Yes. So, what you are suggesting is if you have two distribution of time, perform time and if the two overlap ---

MEMBER BLEY: Look at the probability that the time to recover is longer than the time available, which is the overlap of those two distributions.

MS. XING: Yes, there is over --- but how you ---

MEMBER BLEY: It's an easy calculation.

MS. XING: Yes, say in one case that you have this much overlap, but the other has a much larger, how do we tell the difference in the probability ---

CHAIRMAN STETKAR: You have a probability distribution for both of those.

MEMBER SCHULTZ: For each of them.

MS. PRESLEY: It's an involved area.

CHAIRMAN STETKAR: It's simply a convolution of the two probability distributions, and the joint probability that X is greater than Y, is the probability that X did not succeed. That if X is the time required to perform the action.

MS. XING: Okay.

CHAIRMAN STETKAR: I don't look at --- if I just look at a --- if I take a thermal hydraulic analysis, I did not say this on the record. If I take a thermal hydraulic analysis is absolutely certain, so therefore I am 100 percent confident of the time available than it's simply the amount of the probability distribution for the time required that exceeds that limit.

MEMBER BLEY: The area.

CHAIRMAN STETKAR: The areas.

MS. XING: If I ---

CHAIRMAN STETKAR: I mean, it's the area under the cume that exceeds that limit.

MS. XING: If I'm --- well, I don't --- I like the ---

MEMBER BLEY: You have an office full of people who can do this ---

CHAIRMAN STETKAR: Who know how to do this stuff. If you give them the distribution --- and you don't need to have a --- see the key is, you don't need to have a presumed analytical function for these things either. It could be something as simple as a 5-bin histograph. There's a 5 percent probability that it's, you know, 37 minutes, and 20 percent probability that it's 19 minutes, something like that.

MS. XING: And your ---

CHAIRMAN STETKAR: They don't have to be smooth form analytical functions. That's not the purpose of this ---

MS. XING: Yes, and your assumption is ---

CHAIRMAN STETKAR: --- is to be very precise.

MS. XING: If you have less time than you did, you go to probability of zero.

MEMBER BLEY: Yes.

CHAIRMAN STETKAR: I mean, that's ---

MEMBER SCHULTZ: I think, you know, what you're going to find when you do this is you will have derived an approach which develops curves that look like this. Here you've tried to do it in one step with some coefficients and shake factors, and that's not the way to do it. This is based upon the data and the practical application of that data ---

MS. XING: Okay.

MEMBER SCHULTZ: --- to develop this type of curve as the output.

MR. PETERS: But I think either way, what we're --- I guess also what I'm getting from the ACRS is that an improvement over the previous step function would look something along the lines of a curve of that fashion.

MEMBER SCHULTZ: Yes, but you shouldn't derive it this way.

MR. PETERS: Yes.

MEMBER SCHULTZ: This is not arbitrary, but it's ---

CHAIRMAN STETKAR: And, again, you're not getting ---

MEMBER BLEY: It fits one experiment.

MR. PETERS: The ACRS Subcommittee ---

CHAIRMAN STETKAR: Individual Subcommittee Members. I always have to say that. No, it's important for the record. This is not ---

MEMBER BLEY: The Committee could disagree with everything we've said. You know that.

MS. XING: And I think this ---

CHAIRMAN STETKAR: Yes, Sean, the step function is clearly, you know, the go/no-go with this 19.9 minutes versus 20.01 minutes, you know, is clearly wrong.

MS. PRESLEY: So, we're going to revisit this discussion when we get to my slides.

CHAIRMAN STETKAR: Yes, that's good.

MS. XING: Okay. The next one is relatively simple. So, uncertainties ---

MEMBER BLEY: There's almost a corollary to this, though, and it's related to things that are in the writeup. Some places you talk about uncertainty in time,

but not everywhere. But one place this can happen, you know, if you have a procedure and it's got a place where you branch off to another procedure for the expected case. Well, in the real world, you might have something that evolves a little more slowly, which means when you come to that step in the procedure, you keep going. Eventually, most of the procedures are written so eventually they'll correct that and say oh, you should have read. But that could be 10 seconds later, or it could be 25 minutes, which means you could have a real difference in the time it takes you to do something depending on how this action, particular action is progressing. Not every small LOCA progresses the same way, so that kind of timing changes your picture a lot. Changes the uncertainty and your times, the time required.

MS. PRESLEY: Think about that when you get to my slides.

MEMBER BLEY: I won't forget that.

MS. XING: Okay. So, we have some guidance to ---

MEMBER BLEY: Will I be happy?

MS. XING: --- try to capture ---

MS. PRESLEY: Maybe not.

MS. XING: --- these different factors that

will make time distribution. Okay, so can we move this issue to later, so we'll move to the next one, uncertainties in the human error probabilities. At the present, the human error --- in the current model the error probabilities at each piece for each decision tree path was estimated with a formal expert panel. The estimation come like --- come not just as a mean, but also the distribution as we showed in this example was tense.

MEMBER BLEY: You picked one with a lot of agreement. They weren't all like that.

MS. XING: And so, therefore, for every crew failure mode we identified, it comes with this distribution. And the quantification model is to find the probability for the HEP for the entire human failure event, it's a sum of this individual failure mode. So, we --- our guidance was we can use the distribution we obtained from the expert judgment as it harmed the uncertainty here. And that I just checked with NRC's guidance on uncertainty. What is that document number?

CHAIRMAN STETKAR: NUREG-1855.

MS. XING: And this complies with our Agency's suggestion. So, that was an easy one.

Okay. Now come to the expert elicitation. So just to review what we have done so far in our last expert

elicitation effort. We had a group like six domain experts, 5 HRA analysts, and a technical intergrator. And we conducted two workshops with all the panelists, and the technical integrator to integrate as a result.

So, in the first workshop the domain experts ranked the decision tree paths, and made some initial estimation of the HEPs for the decision path. And in the second workshop, the HRA analysts used the input from the first workshop and their own expertise, their own judgment to make an estimation of the HEP distributions.

MEMBER BLEY: I'm conflicted on this part, but a point of clarification for the Members. When Jing speaks of paths in this decision tree, those are really combinations of elements of context. So given the context looks like this, there was a quantification.

MS. XING: Thank you for clarifying that.

MEMBER BLEY: Yes, they aren't sequential paths, they're ---

MS. XING: Yes, it's the word "tree" causing the problem. There really ---

MEMBER BLEY: Well, and you look at it and there are paths, but really they are collections of context ---

MS. XING: They're just combinations ---

MEMBER BLEY: --- elements.

1 MS. XING: Yes.

2 CHAIRMAN STETKAR: Sort of like a truth table,

3 but not.

4 MEMBER BLEY: Well, laid out as a tree.

5 CHAIRMAN STETKAR: Yes, laid out as a tree.

6 MS. XING: And the technical integrator

7 integrated the input from five analysts into one single

8 distribution for the DT path. And the final outcome only

9 had HEP distributions for 63 out of the total 165

10 combinations, which means probably like a little bit over

11 a third of work is done. And among those, there are six

12 crew failure mode that we don't have estimation at all.

13 CHAIRMAN STETKAR: Jing, would you ---

14 MEMBER BLEY: Let me make a clarification ---

15 CHAIRMAN STETKAR: Okay. I was going to ask

16 --- okay.

17 MEMBER BLEY: --- that might help you. The

18 technical integrator didn't integrate all of them. They

19 tried to get the group to come to a consensus

20 distribution. There wasn't enough time to do that on all

21 of them, so given the way people carried out their

22 arguments, the technical integrator did more of them.

23 CHAIRMAN STETKAR: That's what I was going to

24 ask. My recollection was that the full process was only

25 applied to one, wasn't it?

1 MEMBER BLEY: You might be right. I can't
2 remember.
3 CHAIRMAN STETKAR: I thought ---
4 MEMBER BLEY: It was two years ago.
5 CHAIRMAN STETKAR: Yes, I thought that I recall
6 that, you know, if I want to think of a full expert
7 elicitation process, was only applied to one, that the
8 technical integrator, you got partway on the rest of the
9 63, but the technical integrator took what was available
10 and completed that without going back to the ---
11 MEMBER BLEY: Yes, on many on them people gave
12 the ---
13 CHAIRMAN STETKAR: --- team.
14 MEMBER BLEY: People gave their arguments and
15 those were recorded. So used those arguments, as well
16 as how they moved to consensus, and one is the basis for
17 ---
18 CHAIRMAN STETKAR: But you didn't actually
19 bring all of those others back to the consensus, you know,
20 complete the process.
21 MEMBER BLEY: That would be a good thing to do,
22 but they'd probably agree with most of them, if not
23 --- seen how they moved around.
24 MS. XING: Yes. What we did is in the second
25 workshop with data one, that item workshop, for every

1 combination the group data together. Then because of the
2 time, we only had two and a half day workshop.
3 MEMBER BLEY: It was one tree ---
4 MS. XING: Yes, one tree.
5 MEMBER BLEY: One tree but it had a number of
6 these combinations that we did push consensus on.
7 CHAIRMAN STETKAR: On one tree?
8 MEMBER BLEY: All of that paths through one
9 tree.
10 CHAIRMAN STETKAR: Oh, that's right. That's
11 more ---
12 MEMBER BLEY: Is that right?
13 MS. XING: Yes. And then ---
14 CHAIRMAN STETKAR: Okay, that's more --- I
15 thought that you had one path.
16 MEMBER BLEY: It's memory now.
17 CHAIRMAN STETKAR: But I haven't looked at it
18 for quite a while.
19 MS. XING: For one tree we as a workshop where
20 we ---
21 CHAIRMAN STETKAR: It was one tree.
22 MS. XING: But for the other set of trees, most
23 of them, we only selected paths at the workshop. However,
24 since because we demonstrated process in the workshop,
25 we asked the analyst to do their homework to complete

all the paths and return to us.

CHAIRMAN STETKAR: Yes. But, I mean, that's not actually a good implementation of the expert elicitation process.

MS. XING: Not the ideal, but we are really limited with how much contract dollar we have.

CHAIRMAN STETKAR: Okay. On the other hand, this theoretically --- this process theoretically is the fundamental basis for those HE --- those, I don't want to call them reference HEP numbers, if you will. So, in terms of quanti --- you know, the effects of quantification for this methodology, a current snapshot and the history of time, it seems that this again is an area where a reasonable amount of resources should be placed, because it's where the rubber eventually meets the road.

MEMBER BLEY: Another point of clarification. I don't disagree with you. Another point of clarification, though, is --- how to explain it? Here's a place where you could see that these things could be different for different applications, because these trees in principle looked at all of the performance influencing factors, but then the group narrowed it down to three to six that are important for this CFM for an operating nuclear plant. So, for a different thing, that

1 CFM would be the same kind of action, but it might have
2 different factors ---
3 CHAIRMAN STETKAR: Influences.
4 MEMBER BLEY: Yes, so you'd have to redo the
5 trees for those.
6 MS. XING: Yes, or like in the generic
7 methodology we propose a different approach. There you
8 have --- when you have 30 factors, you can't have a jumbo
9 tree. You have 900 combinations, so that's a different
10 story.
11 And, also, I'd like to point out here, in our
12 expert elicitation workshops, the first thing we tried
13 --- the experts tried to understand, what is this CFM
14 about? So, we tried to come up with different stories.
15 And all of the stories --- throughout the two workshops
16 we keep emphasizing --- I mean, when they come up
17 stories, they want to say tell us what is the context,
18 and we agree the context is internal at-power events.
19 And sometimes we come to a context like, for example,
20 for the CFM it's in the proper strategies. And expert
21 come up a lot of examples, but they were all denied by
22 our development team. Said no, no, no, that's out
23 --- that's not internal at-power --- so, therefore, by
24 saying that the numbers we obtained through this process
25 are applicable to the internal at-power event. We don't

know if the number would change when the big context change, so I'm not saying they will be different, but we don't know.

MEMBER BLEY: Right. There's one thing I don't think you said. In the first workshop, some --- a core group had come up with these trees. Then they talked over what the performance influencing factors meant, and what the CFM was. But then the participants, which included some operators and trainers, as well as HRA people, had the opportunity to challenge and say well, you didn't include this particular PIF, and you really should have. So, some of the time the trees got modified, or two states on this one isn't enough because of these problems. So, they ended up modifying some of the trees to some extent to account for the elicitation process.

MS. XING: Yes, and the modification still in the scope of the assumption for internal at-power events.

Well, not much to say. This just to give you overview of what kind of data we have available. So, the green, color green means all the paths estimated, all the combinations estimated. And the like a dash, that means partially estimated, means for data sets of CFM only several tree --- several combinations was estimated. The gray means we don't have estimation for that CFM at all.

1 So, as you can see at the first workshop five
2 of the state analysts domain expert pretty much did a
3 rough estimation for every situation. But their
4 estimation, they don't --- the first workshop they only
5 like draw the range or give a number. We didn't trend
6 them specifically to calibrate the distribution, so they
7 have some rough distributions there, but it's not
8 calibrated.
9 And the second workshop you will see there will
10 be less gray on the --- the second workshop we don't get
11 the full set of data. So, if we are going to repeat this
12 process again, we are very much limited by the contract
13 dollar for getting this expert, and also the staff time
14 to doing all this process. So, we think of ---
15 MEMBER BLEY: Before you go on, may I interject
16 one more comment? The point John raised about not having
17 carried the process all the way out, my memory, again,
18 is that for the ones that were integrated from the
19 individual inputs, we didn't come up with an estimate
20 if those were wildly different.
21 MS. XING: Right.
22 MEMBER BLEY: It was only if they were in
23 reasonable agreement to start with.
24 CHAIRMAN STETKAR: So, you didn't ---
25 MEMBER BLEY: Some of the cases we said we can't

1 give an estimate because either we only had two people
2 estimated and they were completely different from each
3 other, or something like that.
4 CHAIRMAN STETKAR: But you didn't --- if I
5 understand, you know, I know the stratify, you didn't
6 go back with the individual estimates and try to reach
7 a big group consensus. You didn't try to test that
8 process.
9 MEMBER BLEY: We just did it for the one tree.
10 CHAIRMAN STETKAR: You did it once.
11 MEMBER BLEY: We wanted to do it, I guess still
12 wanted to do it for all of them, go back to people and
13 say here's what we did with what you gave us. But, no.
14 But the reason I said earlier I think they'd agree is
15 they were pretty close in agreement, anyway. We didn't
16 stretch them very far.
17 CHAIRMAN STETKAR: A couple of years ago when
18 you did it.
19 MEMBER BLEY: Yes, three years ago. How long
20 was it?
21 CHAIRMAN STETKAR: Anyway, let's ---
22 MEMBER BLEY: Two years ago.
23 CHAIRMAN STETKAR: I want to see if we can get
24 to a break time here pretty quick so that we ---
25 MS. XING: Okay, we'll come to the last ---

1 CHAIRMAN STETKAR: --- can get through the
2 rest of the stuff.
3 MS. XING: --- slide. So, anyway, that part,
4 like for the --- to complete all the HEPs, we tried to
5 struggle between the available resource and a good enough
6 job. So, one possibility we thinking would be we can do
7 some experiment like using the data in the first --- from
8 the first workshop and make some estimate, interpolation
9 for those estimated combinations. See how different or
10 how close they are from what already integrated. If they
11 are dramatically different from the third column here,
12 the third part, the integrated there, then we probably
13 have to forget about that. If they are more or less
14 reasonable, we probably can use those numbers as an
15 initial data set, so only have one workshop for the expert
16 to challenge and verify those data. That is the reason
17 ---
18 CHAIRMAN STETKAR: I mean that's obviously
19 something that we need to ---
20 MS. XING: It's manageable.
21 CHAIRMAN STETKAR: --- decide internally. My
22 only observation is be careful on taking shortcuts
23 because eventually numbers will be printed in tables in
24 a NUREG, and they will then become entrenched in the
25 future history of the Agency and the industry as the

1 official NRC estimates for these human error
2 probabilities.
3 MEMBER BLEY: And it's part of the methodology.
4 CHAIRMAN STETKAR: That's right. It's in the
5 methodology. It isn't even somebody's application. In
6 some sense, a methodology that says how you ought to do
7 it, but we didn't do it, might be better than a
8 methodology that says how you ought to do it, and here
9 are some quick and dirty examples of the way we did it,
10 but you need to go think about it separately, because
11 in the latter case people won't think about it
12 separately. They'll just take those numbers and run with
13 them. And for years, people will be arguing about whether
14 they're good enough.
15 So, I guess, just keep that in mind, because
16 people will do that. And if you don't have enough time
17 to do something that seems --- I don't want to say
18 perfect, but good, it might be better to say here's the
19 way it ought to be done and, you know, have others try
20 to apply the process.
21 MEMBER SCHULTZ: Find the resources ---
22 CHAIRMAN STETKAR: Find the resources to do it.
23 MEMBER SCHULTZ: The resources have to be found
24 at some point by somebody.
25 MS. PRESLEY: EPRI does plan --- because we

1 went through this with CBDT. We said well, come up with
2 your own numbers, but we'll suggest some. And they got
3 locked into zone, and they caused issues, and so --- and
4 follow-on to the after we do our joint EPRI/NRC testing,
5 EPRI plans on --- and we've already gotten five or six
6 utility volunteers to quantify a handful of their
7 different types of HFEs to see if the outcomes are
8 reasonable from --- in terms of the risk insights match
9 the numbers so there are no problems with aggregating
10 too many CFMS, or do we need to go back and adjust --- like
11 put a floor or something. So, that's ---
12 CHAIRMAN STETKAR: But, again, you know, my
13 only observation, and because of time I won't --- is be
14 really careful, because this will be viewed as the
15 --- even as Mary said, that if the numbers are published
16 in a table and you say well, we really didn't spend enough
17 time, but we thought it was good enough for this
18 iteration, and we know later we need to clean up things,
19 there might not ever be a later.
20 MEMBER SCHULTZ: Yes. And I would encourage
21 that you keep communicating on this particularly. If
22 you've got resources available, and we have some
23 available, then some collaboration may be the best
24 solution. That's possible.
25 MS. XING: Yes, if we are going to do the

--- when we do the expert elicitation, that will be a collaboration like with data last time. It's right now, as I said, it's the resource limitation. We tried to come to the best resource allowable and good enough. Sean, you want to say something?

MR. PETERS: Oh, I was just going to make a joke. Did I just hear that ACRS would give up budget to putting forth estimations for these human error probabilities?

MS. PRESLEY: That's what I heard.

MEMBER BLEY: Sorry, I missed that.

MS. XING: Okay. So, I'm done with ---

CHAIRMAN STETKAR: If you'll come to --- if you personally will drive to Hot Springs, Arkansas and drive me up here, you know, the three days it takes to get up here every other week, I'll give up some of my resources. Seriously, let's see if we can get through this.

MS. XING: Yes, okay. So, Mary has a couple of slides that talk about their perspective on two of the recommendations. Do we want to continue or break?

CHAIRMAN STETKAR: I think we should break. I don't think we need to discuss --- you're going to discuss more about the estimate, so if Mary will give us 15 minutes before she gets ---

MS. PRESLEY: Sure.

CHAIRMAN STETKAR: Is that okay, or do you ---

1 MS. PRESLEY: Garreth emailed me, that's why
2 I was being rude and checking my phone ---
3 CHAIRMAN STETKAR: No, that's ---
4 MS. PRESLEY: Because he's on the bridgeline.
5 He has to sign off in, he said 15 minutes, and that was
6 about 5 minutes ago, so I don't know if he's still on
7 or not.
8 CHAIRMAN STETKAR: Oh, okay.
9 MS. PRESLEY: Garreth, are you still ---
10 MEMBER BLEY: Do you want to give him a ---
11 CHAIRMAN STETKAR: Let's then not take a break.
12 Let's see if you can get through your presentation, if
13 Garreth is still out there ---
14 MS. PRESLEY: Okay.
15 CHAIRMAN STETKAR: --- with the line open.
16 MS. PRESLEY: I apologize.
17 CHAIRMAN STETKAR: No, no, that's fine.
18 MS. PRESLEY: Maybe that will make this part
19 go faster.
20 CHAIRMAN STETKAR: I didn't realize that there
21 --- I checked with you. I didn't realize Garreth had a
22 time constraint.
23 MEMBER BLEY: Are we still in the first hour?
24 CHAIRMAN STETKAR: Yes.
25 MS. PRESLEY: Yes. Not time-wise.

1 CHAIRMAN STETKAR: We'll get faster.

2 MS. PRESLEY: Okay. So, we are very much --- I
3 want to preface this with very much want to keep a united
4 front with what the NRC is doing so we do end up with
5 one method that can be used consistently between the NRC
6 and industry. We think that's very important, and that's
7 why we're nitpicking to make sure that these things get
8 resolved.

9 There were a host of changes that were made
10 very quickly, because there are schedule constraints,
11 and budget constraints, and maybe didn't get the right
12 back and forth. And I just want to let you guys know that
13 we're still in the process for some of these things, so
14 you guys might be the tiebreaker. We'll see.

15 So, the first one is the operational narrative,
16 and I'll try to get through this quickly without going
17 through everything. The real issue is that the way it
18 was presented as Step 1 as a --- with all these tables.
19 It was presented as an up front, all inclusive
20 identification of every possible deviation scenario,
21 and thing that might happen, including PIF influences
22 and failure mechanisms. And it was very difficult to
23 accept as that.

24 When you look at it from a retrospective
25 component or, I guess, an analysis that has a

retrospective component and a prospective component like ASP or SDP, some of that makes sense to go through and be able to define, because you can define exactly what happened. And if you're doing it as a prospective analysis, and all-inclusive open-ended search is not useful for an analyst to do first thing off the bat.

And we believe that --- so, our areas of agreement. We do believe that operational narrative is a helpful tool to communicate the whole picture. So, you start off with the forest, you drill down to the trees, and you go back up to the forest to make sure the trees are still there. So, that is an area of agreement.

We believe that the documentation should include the definition of HFE, the identification, the mechanisms, and there should be a search for deviation scenarios, looking for challenging contexts where you're leading the operator or the crew to fail. And, particularly, where those deviation scenarios may have a non-negligible frequency, or significantly increase the HEP. So, this is our areas of agreement.

Fundamentally, we believe that you should be doing operational narrative for these reasons.

MEMBER BLEY: Can I --- just to make sure I understand. The content of a narrative once we've got something to analyze, now looking at prospective

analysis, that story should be --- let me just put it this way, should be more detailed than the little squibs we had in the examples in the original document.

MS. PRESLEY: Okay.

MEMBER BLEY: Is that right? Am I interpreting you right, because that's what it sounds like.

MS. PRESLEY: Can we cycle back for that question, because that's going to be my question back to you ---

MEMBER BLEY: Oh, sure. Yes.

MS. PRESLEY: --- after we go through the next slide. So, our concern with the way that the operational narrative stuff was written is that we believe the ideas were structured purposefully as a step by step guide to help you write the --- construct the operational narrative. So, the operational narrative, it's kind of a continuous action step through the process of HEP evaluation. So, first you have to identify, and then you identify that through your PRA, you define it through your PRA scenario. And then you write your success path, and that's your crew response diagram. And you look at ways that you can get off your success path, and what recoveries might be available to get you back on the success path. So, that's the first piece.

And then you go to the CFMs, and then the branch

1 points or the questions, the guiding questions that are
2 associated with each decision tree, and those
3 specifically direct you to go collect information on the
4 things that we think from cognitive literature will cause
5 you to deviate. So, we ask what else is going on during
6 the time that you're making that decision for that
7 particular action.
8 We ask where can the --- where is there a
9 mismatch between your expectation of a parameter and how
10 the parameter is actually progressing. So, when you
11 answer that question you have to know what the operator
12 bias is, if there's an operator bias, and you have to
13 understand how the plant is actually progressing.
14 MEMBER BLEY: Now, do you --- as you do this
15 --- I mean, if you're doing a retrospective analysis you
16 know what happened.
17 MS. PRESLEY: Yes.
18 MEMBER BLEY: So you know exactly the path ---
19 MS. PRESLEY: Yes.
20 MEMBER BLEY: --- and you can do all this very
21 easily. Doing a prospective and you start with the HFEs
22 and you say --- then you have your typical diagrams and
23 I could go this way and that way. Now, at that point,
24 the PRA model might not have developed something that's
25 complicating, let me just it that way. You gave some

1 examples of what would be complicating, but the real
2 world might. So, at that point you could have multiple
3 paths ---
4 MS. PRESLEY: Yes.
5 MEMBER BLEY: --- coming out. So, that's what
6 you're saying.
7 MS. PRESLEY: Yes, and that's the second bullet
8 point ---
9 MEMBER BLEY: That makes sense to me.
10 MS. PRESLEY: --- is that, you know, you start
11 with your kind of bounding average case, and this process
12 may lead you to find deviation scenarios that you really
13 need to split out as a separate case in your model.
14 MEMBER BLEY: Let me ask you a last question
15 for me right now on this area. Do you think at this time
16 anywhere in any of the guidance we have anything laid
17 out to walk somebody through this process? My opinion
18 is we don't. I think the new generic thing has a cart
19 load of stuff that might fit that, but it hasn't been
20 organized to items to get you through it. And Garreth
21 just ---
22 MS. PRESLEY: That's Garreth saying ---
23 CHAIRMAN STETKAR: This thing has a life of its
24 own, so ---
25 MEMBER BLEY: So, my question was, do you think

that guidance is already in place, or do we need to refine what's in all of these different places so that somebody could sit down and actually do this?

MS. PRESLEY: I think what's in Chapter 5 ---

MEMBER BLEY: Okay.

MS. PRESLEY: --- is a good --- well, what's in Chapter 4, which is the crew response diagram description, and what's in Chapter 5, which is how --- and specifically the questions that lead you to decide how to take a branch point, if they're not sufficient, they're certainly a huge improvement over what we currently have, and will be something that will direct people in the right place and reduce analyst to analyst variability.

MEMBER BLEY: Now, you had a --- I'm stealing it because I'm too cheap to print these over and over again. I'm staring at the December 2012 version ---

MS. PRESLEY: I think that's still Chapter 5.

MEMBER BLEY: There was another version I saw after that, but it didn't have any substantive changes in that part, I don't think. Okay. I'll look more closely at that.

CHAIRMAN STETKAR: My only concern is that if I hear you say the words, they sound good because it's always easy to say words at a broad context that sound

good. My experience has been, and my concern is that people will become pigeonholed on the actions that we in the PRA model want to focus on, and not the actions that the operators will take in the control room. And I bring you back to events that have actually happened where, indeed, the operators did not recognize that they've lost coolant to the seals because they were more concerned with stuff that was going on in the secondary side of the plant, that isn't even modeled in the PRA. And that a focus on only those particular crew failure modes or the influencing factors for those crew failure modes for that action to restore cooling to the reactor cooling pumps might not even acknowledge, because the PRA doesn't care about the secondary side of the plant.

MS. PRESLEY: I understand your concern.

CHAIRMAN STETKAR: And that's where we've seen people get in trouble in the real world, and unless the process, unless the methodology and the examples that are developed to support those words at the high level illustrate that type of thought process to tell people they really need to think about the entire context of what's happening in the plant, almost divorced from the action that we've put in the PRA model. Because the action in the PRA model is only one little part of what the operators are dealing with.

1 MS. PRESLEY: Yes and no.

2 CHAIRMAN STETKAR: Yes and yes.

3 MS. PRESLEY: I mean yes to the last thing you
4 said, no to the first thing you said.

5 CHAIRMAN STETKAR: What?

6 MS. PRESLEY: So, the --- you're right, the
7 crew --- so you look at the action and you're looking
8 at the failure mechanism. And there's all this other
9 stuff going on right here, but the trees now tell you,
10 okay, there's a time component. Right? You have to have
11 a timeline and understand holistically what's going on.
12 So, when you look at that crew failure mechanism for that
13 one critical action it's going to ask you are you --- you
14 know, if it's a workload memory type relevant crew
15 failure mode, it's going to ask you is the workload at
16 this point --- and it's going to have very specific
17 questions that goes to what kind of workload is
18 important. So, at that point it's going to tell you to
19 go look at what else is going on, what else are you
20 attending to?

21 CHAIRMAN STETKAR: It does, but a lot of the
22 words that I've read, and I'm going to play the devil's
23 advocate because I've seen too many people take the easy
24 way out, is a lot of the words say the EOPs will keep
25 you focused on what needs to be done, so you should not

--- yes, eventually they'll get to cleaning up the secondary side, but the EOPs give you guidance here. The training gives you guidance here. The EOPs provide a clear pathway. And that all tells me that to think in the context of the EOPs now, what is the workload? Oh, well, the workload is not very difficult because I'm already told to ignore all of that other stuff that's happening. It's already become subsidiary. The operators don't know that in the real world, and we have examples that show that they don't know that, because they do get distracted. They check the first couple of things from the EOPs and then the shift technical advisor has to leave the control room because the power failure made his indications go away and he's following a little checklist.

MS. PRESLEY: So ---

CHAIRMAN STETKAR: The shift supervisors look at the fire alarms.

MS. PRESLEY: Okay.

MEMBER BLEY: Well, go ahead, if you want ---

MS. PRESLEY: So, I just --- one thing. So, I understand what you're saying. I don't think an all-inclusive unstructured search at the beginning to write an operational narrative ---

MEMBER BLEY: We're not arguing that.

1 MS. PRESLEY: --- solves the ---
2 CHAIRMAN STETKAR: We're not arguing that.
3 MS. PRESLEY: Okay.
4 CHAIRMAN STETKAR: I am not arguing that. The
5 operational narratives, my personal opinion, ought to
6 be developed in the context of scenarios. You know, I'll
7 put it at that level. My concern is that focusing too
8 quickly on the particular scenario in the context of only
9 the action that's modeled in the PRA may bias that
10 process. So, I'm not arguing that there ought to be some
11 all-inclusive operator scenario narrative at the
12 beginning. I don't think that's ---
13 MS. PRESLEY: And the other piece I want to say
14 real --- I'm sorry, Dennis. Is that ---
15 MEMBER BLEY: I think I'll help you, but go
16 ahead.
17 MS. PRESLEY: Okay. So, you brought up the
18 international experimental study as an example of why
19 operational narratives are really important. I'm
20 actually going to --- I'm going to use the U.S.
21 experimental study as not a counter, but explanation of
22 why it's important to have a structured approach, because
23 the --- right, the ATHEANA team was one of the teams that
24 actually performed very poorly because they hadn't
25 captured the whole story. And there are other teams that

performed very poorly, and you could see independent of the tool that some were really good at understanding what was going on, and some were just not so good. And if you delve into the operator interviews and listen to the operator interviews, which I have, you can see how those operator interviews were conducted, and how that data was gathered. And that leads you down the path that you're going to take.

CHAIRMAN STETKAR: That's --- you're right. You are absolutely ---

MS. PRESLEY: So, to some extent that's something we can't normalize for. Which operator you talk to will give you one set of information, and how you conduct the interview will give you another set of information.

CHAIRMAN STETKAR: Absolutely. And I've done, you know --- again, I've done --- I used to use a different methodology, but it heavily relied on operator interviews. How you conduct the interviews, the questions that you ask the operator, and how you ask those questions are key.

MS. PRESLEY: And which operator you talk to.

CHAIRMAN STETKAR: But, I mean, there always will be some variability among the operators, but at least normalizing to how you ask the questions, rather

1 than saying would you do this, would you follow EOP-0
2 or would you follow EOP-1 under this condition? What
3 would you do? I'll sit here. You know, you think you guys
4 --- you operators think about it. What would you do?
5 Here's what's happening in the plant, and I'll write down
6 notes.
7 Now, you get very different answers in those
8 two questions. And if you --- put if you tell people to
9 write the narrative structured according to an expected
10 response that's focused on let's say restoring coolant
11 water, something like that, that should be guided by the
12 EOPs, you will certainly get a different set of answers
13 than if you just say what would you do in this situation?
14 MEMBER BLEY: Of course what would you do? And
15 I was going to --- you jogged me back to look again. In
16 Chapter 5, I think the questions and the things there
17 are right on target and very good. I mean --- and they
18 ask does the alarm, you know, occur coincident with other
19 alarms? All this kind of stuff. So, once you've laid out
20 a particular scenario qualitatively, and now you come
21 here, it's got the right questions to let you solve the
22 problem. Chapter 4, which guides you into finding those
23 things is the place I think the guidance is on the weak
24 side. A lot of the things you've talked about, you know,
25 are like bullet points here, and rather than telling

people how to work through --- how to talk to operators, all that kind of stuff, I think that's important guidance. And that's the part I didn't think was here.

MS. PRESLEY: So ---

MEMBER BLEY: So, to get the scenarios that you're going to analyze in Chapter 5, once you got them, I think Chapter 5 does a good job. Getting them, I don't think the story is there well enough to get somebody else to sit down and do it as well as you'd like them to do.

MS. PRESLEY: There's a question of whether ----from the EPRI perspective in terms of what we've done historically, we've separated the method guidance versus the qualitative analysis guidance, in terms of we think how you do an operator interview, and how to do a good operator interview is a fundamental skill that you need to learn, that's independent of whatever kind of method you use.

MEMBER BLEY: So are most of the steps in HRA.

MS. PRESLEY: Yes, that's true. And it has to be learned somewhere.

MEMBER BLEY: But where does somebody go to learn that?

MS. PRESLEY: That's a good question.

MEMBER BLEY: And where do you give them guidance on what's important for in there? I think the

1 new chapter, the one you guys don't like, especially
2 because it comes up front, and I don't like because it's
3 a jumble, I think has a lot of the words. And you've been
4 saying a lot of the words, but I don't think those words
5 are in the text yet.
6 MS. PRESLEY: So, I think what we need to do
7 is reshape what's in there, and ---
8 MEMBER BLEY: Chapter 4.
9 MS. PRESLEY: In Chapter 4 --- well, instead
10 of from an operational narrative perspective, talk about
11 a data collection narrative, of how do you collect the
12 data appropriately.
13 MEMBER BLEY: How do you turn that into ---
14 MS. PRESLEY: Into a narrative.
15 MEMBER BLEY: --- scenarios, and then the
16 narrative that explains that scenario, that you use in
17 the next section.
18 MS. PRESLEY: Yes.
19 MEMBER BLEY: You need it to do the next
20 section.
21 MS. PRESLEY: I agree with you that it needs
22 to fit in with the process steps. It can't be just ---
23 MEMBER BLEY: You can't teach everything, but
24 at least you can raise the important points and tell
25 people where they can get more help in that area or

1 something.

2 MS. PRESLEY: So ---

3 MEMBER BLEY: And we saw that in that

4 elicitation.

5 MS. PRESLEY: Yes.

6 MEMBER BLEY: My conflict --- we saw that in

7 the elicitation. People didn't understand that they were

8 going into essentially Chapter 5, already knowing the

9 conditions that existed, and the context that existed.

10 They had real trouble dealing with that, and they had

11 real trouble separating --- looking at that catalogue

12 of things and not thinking oh, this path is very unlikely.

13 No, we've already done that somewhere else. You can in

14 here with that path, so that shouldn't affect your

15 quantification of that path. So, it didn't come across.

16 Now, I don't know how much they studied what's in Chapter

17 4.

18 MS. PRESLEY: So, now that I've answered that,

19 or now that we've had this discussion, you asked a

20 question about what's in the appendix, in that little

21 scraggly writeup. So, we view the operational narrative

22 to be the little scraggly writeup, plus the timeline,

23 plus that big old table that had the comments.

24 MEMBER BLEY: What I'm saying is you don't

25 describe how you get to that timeline, I don't think.

And that's part of this --- that's part of the narrative, is how you get there.

MEMBER SCHULTZ: They're showing ---

MS. PRESLEY: And the CRT, sorry, and the CRT. So between the ---

MEMBER BLEY: But just showing the CRT, it's coming out of the sky.

MS. PRESLEY: Yes, so we wrote the --- we showed the CRT and then we wrote a narrative of how we got the CRT, and then what some of the relevant ongoings were.

MEMBER BLEY: But at the CRT level, that's still not the scenarios you're going to analyze. That includes all of them.

MS. PRESLEY: So, I guess I don't understand what's deficient from those appendices' examples that you would like to see? That would be very helpful to be a little bit more concrete on how we can provide more guidance, assuming there is ---

MEMBER BLEY: You can't use the example as the guidance.

MS. PRESLEY: No, I agree.

MEMBER BLEY: You've got to tell people how to get there. So, I'm not prepared to answer that at this --- because ---

MS. PRESLEY: Okay.

1 MEMBER BLEY: --- it's been a long time since
2 I studied those from that point of view.
3 MS. PRESLEY: I guess in the future if you have
4 thoughts on that, it would be helpful to figure out that,
5 because that was our best translation as we went through,
6 and we ---
7 MEMBER BLEY: Yes, but you already knew what
8 you wanted to do.
9 MS. PRESLEY: Yes, we already knew what we're
10 doing, so that was our best attempt at what we thought
11 the documentation needs to be at what level.
12 MEMBER BLEY: The point John always makes is
13 people will then replicate just what you do and not think
14 how to get to that spot. And that's the part we think
15 ---
16 CHAIRMAN STETKAR: That's --- and we've seen
17 it, and you've ---
18 MS. PRESLEY: Yes, and we've seen it, too. So
19 just --- we're in the process of developing a course on
20 the --- we have the Education of Risk Professionals
21 Program, and we're in the process of developing a course
22 potentially on how to do good HRA, the Art of HRA Method
23 Independent that will teach some of these things. What
24 do you look for in a similar observation? How do you do
25 a good operator interview? We're still trying to get

1 support behind doing the course, so it's not official
2 yet, but that's one of the things that we're seeing as
3 a need in industry, and we're trying to be responsive
4 to. So, I think that will go a long way to helping some
5 of those issues, and making people interpret what's
6 written correct, because you can only write so many
7 words.
8 CHAIRMAN STETKAR: You can only write so many
9 words, but judicious thought, you know, almost a detached
10 perspective, and you can't do that if you're writing the
11 words. You have to rely on other people. A detached
12 perspective of looking at the words and thinking about
13 how could one misinterpret this in combination with
14 examples that are shown, I think is really, really
15 important. Because, again, a lot of the words at eye level
16 say all the right things.
17 MS. PRESLEY: Right.
18 CHAIRMAN STETKAR: But when you look at
19 examples or excerpts, you know, whether it's a text
20 example or a picture example, you could easily be led
21 astray.
22 MEMBER SCHULTZ: About the how-to steps.
23 CHAIRMAN STETKAR: About how to do it, not what
24 ought to be done. I think a lot of the what ought to be
25 done is probably cast pretty well.

1 MS. PRESLEY: Well, a lot of the conversations
2 that we had in developing the examples are not
3 documented, because that's part of the process step, not
4 the documentation side. But, yes, that's a conundrum.
5 I'd like to move on to our ---
6 CHAIRMAN STETKAR: Yes, I was going to --- do
7 you want to take a break?
8 MS. PRESLEY: Probably take a break.
9 CHAIRMAN STETKAR: Do you want to take a break,
10 because it is a break time? I don't know if Garreth is
11 still there or not.
12 MS. PRESLEY: I'm going to assume he dropped
13 off.
14 MEMBER BLEY: Do you want to give him a chance
15 to say something?
16 CHAIRMAN STETKAR: If he's there ---
17 MS. PRESLEY: I want to check my email and see
18 if he's --- sorry, I had to go.
19 CHAIRMAN STETKAR: Okay, he's not there, so we
20 are --- it's just our happy family here. You're still
21 looking at it, so is there ---
22 MS. PRESLEY: No.
23 CHAIRMAN STETKAR: --- anything else?
24 MS. PRESLEY: That's it.
25 CHAIRMAN STETKAR: He's gone.

1 MS. PRESLEY: He's gone.

2 CHAIRMAN STETKAR: We'll re-close the

3 bridgeline. We'll take a break until 3:30.

4 (Whereupon, the above-entitled matter went

5 off the record at 3:12 p.m., and resumed at 3:32 p.m.)

6 CHAIRMAN STETKAR: We're trying desperately

7 to get back in session. Here we go.

8 Mary, you're still up.

9 MS. PRESLEY: Okay. So accounting for time is

10 still a point of disagreement. And so the ACRS concern,

11 you know what your concern was, that you should have some

12 way to estimate the time windows and get certainty in

13 those times and then your probability should reflect the

14 time constraint. So we both agree, yes, those are

15 reasonable things to do. But how do you do it? And we

16 really don't like the idea of providing options, because

17 the more options you -- so, I think it's currently written

18 as three options, but that's because we're still in the

19 process, but the --

20 CHAIRMAN STETKAR: I think you heard our

21 feedback earlier on it, so --

22 MS. PRESLEY: Yes, but we also -- I don't want

23 to say we don't like TRCs, but we don't like TRCs. We

24 have some --

25 CHAIRMAN STETKAR: I think we're in --

1 MS. PRESLEY: Yes.

2 CHAIRMAN STETKAR: I'm certainly in agreement

3 with you.

4 MS. PRESLEY: And for the same reason we don't

5 like TRCs, I think we're going to have issues with the

6 convolution approach. So the HCR/ORE method, which is

7 what's currently in the HRA calculator, is based on -- I'm

8 not sure of the Subcommittee's familiarity with it --

9 CHAIRMAN STETKAR: Yes.

10 MS. PRESLEY: -- but it's similar in a rough

11 way to what you were describing --

12 CHAIRMAN STETKAR: No.

13 MS. PRESLEY: -- except -- well, give me a

14 moment -- in that instead of constructing a distribution

15 for the time available and the time acquired, you -- that

16 the distribution for time available -- or the sigma,

17 basically, your standard deviation, comes from the data

18 from the experiments based on the crew response

19 structure. So, instead of going for every action and

20 trying to figure out the curve, you estimate your median

21 and then you apply a standard deviation based on some

22 sort of experimental data that's many, many --

23 MEMBER BLEY: Strictly for execution, not for

24 diagnosis. Diagnosis they handle with a made up T out

25 in front of the whole thing.

1 MS. PRESLEY: Yes. This is true.
2 CHAIRMAN STETKAR: Which is put in there so
3 that you don't get -- yes, and with a correction factor
4 so you never go below 10 to the minus 5.
5 MS. PRESLEY: Yes. So, for the
6 execution --
7 CHAIRMAN STETKAR: Based on median estimated
8 crew response times, which means 50 percent of the time
9 they took longer, but I don't know how much longer. Not
10 mean --
11 MS. PRESLEY: Yes. Yes.
12 CHAIRMAN STETKAR: -- median.
13 MS. PRESLEY: No, I agree. I agree. Well,
14 it's -- the standard deviation will tell you, because
15 it's -- anyways, so --
16 CHAIRMAN STETKAR: If you assume a certain
17 type of distribution --
18 MS. PRESLEY: Yes.
19 CHAIRMAN STETKAR: -- which they assume with
20 a certain correlation --
21 MS. PRESLEY: Yes.
22 CHAIRMAN STETKAR: -- which they assume --
23 MS. PRESLEY: Which they assume. So, okay.
24 So, it's sort of similar, but clearly not the same as
25 what you're describing. But the issues that we saw with

1 the HCR/ORE application I believe are still applicable
2 to the -- your suggestion of actually convolving curves.
3 And so, I'd like to talk through and get your ideas, but
4 this is -- the first piece is that -- well, okay. So
5 the first piece I guess is not really that relevant,
6 because if we're actually going to solicit information
7 on timing distributions, will we be able to distinguish
8 those that are well understood? We would imagine them
9 to have a tighter distribution.
10 CHAIRMAN STETKAR: Sure.
11 MS. PRESLEY: And those are not. So, maybe
12 we'll go past the first bullet.
13 CHAIRMAN STETKAR: Okay.
14 MS. PRESLEY: And the second bullet as well for
15 long time frame actions you get screwy results.
16 The last two bullets though are kind of
17 important. So, historically this type of analysis has
18 been a large source of analyst-to-analyst variability,
19 and there's reasons for that once you drill it down. So,
20 one reason is with the correlation at least small
21 differences in time estimation lead to very large
22 differences in HEPs. That might be true --
23 CHAIRMAN STETKAR: That is true in the context
24 of the HCR/ORE correlation. That is true, but that
25 wasn't what I don't think Dennis and I were talking about

--

MS. PRESLEY: Correct.

CHAIRMAN STETKAR: -- convolving to probability distributions --

MS. PRESLEY: Correct, but --

CHAIRMAN STETKAR: -- without a presumed correlation.

MS. PRESLEY: But if you have ranges -- so, let's talk a minute, let's back up a minute and talk about how you get distributions. So, if you're going to get a distribution, you either have to make it up through talking with operator interviews or you have to do some sort of simulation of walk-through. To get sufficient data points to get a distribution that's meaningful, that's going to be difficult if you're going to do this consistently for all actions. Now, if you're focusing your energy, if the method lets you just focus your energy on the ones that you really think are time-critical and just go do simulated data collection for that -- and that's kind of how we use our time -- that's how we kind of use our HCR/ORE results to help us figure out where we really need to go look at a couple crews run through this scenario. We just can't do the operator interview and maybe watch one simulator run.

So, putting together distribution is going to

1 have a lot of uncertainty associated with it by itself
2 unless you're running lots of crews through the same
3 scenario, or through a set of scenarios that represent
4 that bin of -- that the HFE represents.
5 So if you do it through talking through
6 operator interviews, what we found is that operators are
7 very bad at estimating timing. And the reason that
8 they're very bad at estimating timing, one of the reasons
9 why they're very bad at estimating time is they don't
10 think in time space. They think in parameter space by
11 and large. So they think about how parameters progress
12 and they prioritize actions based on what they're seeing
13 the plant do. And in talking through operator
14 interviews what I've seen is that -- and kind of if you
15 looked at the timing information that was collected
16 during the U.S. experimental study, it deviates from what
17 actually happened.
18 And one reason is because the progression is
19 slightly different than -- the progression of reality
20 is slightly different than what your thermal hydraulics
21 said. And so, maybe the parameters is progressing a
22 little bit more slowly, so the operator takes more time,
23 because they don't feel rushed. They know what to do
24 with that parameter -- is moving that way. So it's
25 -- we've seen discrepancies between what we see in

operator interviews and what we see in simulator data.

And then the other piece is the PRA scenarios are typically bounding, so there's conservatisms in time available. So the time available piece is the distribution --

CHAIRMAN STETKAR: I'm sorry. What does that mean?

MS. PRESLEY: So, I'll give you a very cognitive example from the experimental studies since most people here are familiar with that one.

CHAIRMAN STETKAR: Okay.

MS. PRESLEY: Okay. So, you have a scenario -- which one was it? I don't remember which scenario it was. But there was -- I think it was the -- well, it doesn't matter which scenario it was. So, if you assume automatic trip, then you have one progression. Your decay heat is doing one thing. If you have a manual trip, 30 seconds or a minute before the automatic trip, then your progression is doing something -- your decay heat and your pressure progression looks quite different. And that means on the back end you could gain quite a few minutes extra to do your action.

So small differences in the scenario definition can mean big differences in what your time available is. And we always take the bounding. And we

1 don't really have good mechanisms and a reason really
2 to start considering, well, what are all the things that
3 can give me a distribution of more -- and it's always
4 a distribution going this way. Very rarely is there
5 distribution going that way because we start with the
6 bounding.
7 So, these are some of the barriers to why we
8 think this path is not particularly helpful. And then
9 the last one is there's a week empirical basis. I guess
10 for a TRC our HCR/ORE had a week empirical basis. There
11 was lots of uncertainty with the data that was collected.
12 There's data there, but it's older and there's a lot of
13 uncertainty associated with it.
14 If we create distributions, it's going to have
15 the same level of -- it's going to be -- they're going
16 to be highly uncertain because our data collection
17 methods, unless you run 20 crews through a -- I mean,
18 if you're talking about what John had mentioned earlier
19 of one crew out of 20 fails, that tells you something
20 because of time, but you have to run maybe 20 crews. Most
21 plants don't have 20 crews.
22 CHAIRMAN STETKAR: And I'm struck listening to
23 you in the difference in what I call precision versus
24 accuracy. I hear you saying a lot of things about why
25 it's difficult to develop a precise uncertainty

1 distribution regarding time. I don't think you need a
2 precise uncertainty distribution. I think you need a
3 reasonably accurate uncertainty distribution.
4 My experience it's pretty easy to get
5 reasonably accurate uncertainty distributions. They
6 may not fit a smooth form analytic function. They might
7 be as course as a 5-bin histogram. Maybe a 5-bin
8 histogram is all that you need to give you confidence
9 that indeed there's no overlap, in which case end of
10 problem. Maybe a 5-bin histogram is enough to give you
11 confidence that there is an inverse relationship, or
12 however you want to characterize it, and there's no way
13 that they can possibly perform this action in the amount
14 of time that's available, or maybe a 5-bin histogram will
15 be good enough to say, well, maybe there's about a 10,
16 15, 20 percent chance that they aren't going to make it.
17 I don't know. Maybe 10, 15, 20 percent. Not
18 7 significant figures times 10 to the minus 4 and not
19 a particular analytical form that you can fit to some
20 sort of correlation, but somewhere in the 10, 15, 20
21 percent, which might be a lot more important than the
22 amount of effort that you place in doing a very detailed
23 analysis and the rest of ideas to come up with 3
24 significant figures times 10 to the minus 3. And that's
25 all I'm saying though.

1 MEMBER BLEY: We're using expert elicitation
2 elsewhere --
3 MS. PRESLEY: Yes.
4 MEMBER BLEY: -- and the way you want to do it.
5 Now, I understand what you're saying about --
6 MS. PRESLEY: So this is --
7 MEMBER BLEY: -- operators --
8 (Simultaneous speaking)
9 MS. PRESLEY: -- TRCs. Okay?
10 MEMBER BLEY: -- but --
11 MS. PRESLEY: Where precision is important.
12 CHAIRMAN STETKAR: Most of your people are
13 doing --
14 MS. PRESLEY: So, but you're right.
15 CHAIRMAN STETKAR: We're saying go away from
16 the TRC.
17 MS. PRESLEY: Yes. No, I understand.
18 MEMBER BLEY: Most of your people are doing
19 this in the power plants. They're training people.
20 Some of them have run thousands of drills, and usually
21 what happens when you start talking to them, they say
22 our guys would never do that. And then you mention that,
23 gee, I remember somebody who did this, and all of a sudden
24 it's, well, yes, Johnny Jones did this other oddball
25 thing and then somebody -- and all of a sudden they spin

1 up memories of the number of times things went not the
2 way they were expecting.
3 MS. PRESLEY: Right.
4 MEMBER BLEY: And they're able to in
5 reasonably short order; I kind of agree with John, come
6 up with -- hey, you might miss once in a while, but you
7 did pretty well.
8 CHAIRMAN STETKAR: But if you ask people not
9 --
10 MEMBER BLEY: And especially you're not taking
11 a chance on missing something that's a 10 to the minus
12 2.
13 CHAIRMAN STETKAR: This is part of the -- we
14 talked earlier about the importance of operator
15 interviews and how you talk to people.
16 MS. PRESLEY: Yes.
17 CHAIRMAN STETKAR: Rather than saying how much
18 do you think it would take you to do this action, where
19 you will get a lot of variability and typically
20 optimistic estimates, if I ask you, well, what do you
21 think the longest amount of time that it might take under
22 these plant conditions to do this action. You can try
23 things. Is it six hours? Oh, no. Is it four hours?
24 You finally get down to, ah, yes, I remember somebody
25 fell down once and it might be as long as 23 minutes.

1 What's the shortest amount? What's the quickest?
2 Well, heck, we can never do it in less than 12 minutes.
3 Well, there's a range. I don't know whether that 23
4 minutes, or whatever I said, is the 97.8th percentile,
5 but it's a reasonable upper bound.
6 MS. PRESLEY: Well, that's considered a
7 uniform distribution and make assumptions about
8 distribution --
9 CHAIRMAN STETKAR: No. No, I'm not saying
10 making assumptions. Fair it in. As you get information
11 about the ends, then people will start to think about,
12 well, how is it kind of shaped in between that? Is it
13 humped up closer to the bottom or is it humped up closer
14 to the top?
15 MEMBER BLEY: Kind of the first step is where's
16 the most likely? What's the thing you see most of?
17 Where's the median? People actually do make better
18 estimates of medians than almost anything else, or most
19 likely the thing that happens most often. So if you got
20 that point and the two end points of the triangle, it's
21 the beginning of fairing in something.
22 Now in many cases --
23 MEMBER SCHULTZ: From that point you could ask
24 what the shape is and get pretty good responses.
25 MS. PRESLEY: Well, so I agree. And people did

1 ask those things when I listened to operator interviews
2 and still got -- well, I'm not going to argue the point.
3 I think it's worth looking to do a couple of --
4 CHAIRMAN STETKAR: I think, Mary, there's a
5 lot of things that we do in risk assessment that's kind
6 of a progressive refinement process.
7 MS. PRESLEY: Yes.
8 CHAIRMAN STETKAR: I think that if you try to
9 develop the most precise answer to every possible
10 question the first time through, very often you spend
11 a lot of time doing things that you later would learn
12 that you really didn't need to spend that time on, and
13 perhaps not enough time in some other areas.
14 I think that in many, many cases a fairly -- I
15 don't want to say "simple," but a structured analysis
16 along these lines would give you confidence that indeed
17 the distributions aren't nearly close to overlapping.
18 I think that in some cases, especially for what you call
19 time critical actions --
20 MS. PRESLEY: Yes.
21 CHAIRMAN STETKAR: -- you might indeed find
22 out that there could be a measurable overlap. Now, is
23 that overlap important to the overall PRA results? In
24 other words, you might say, well, I think that's way too
25 conservative because the process that we used was very,

very approximate and we know that people were not very forthcoming or something. But if it doesn't make any difference to the overall results and you think it's conservative, fine, especially of that probability of not being able to achieve the desired response within the available time is indeed much larger than the probability that you would expend a lot of resources on to look at performance influencing factors and developing crew response diagrams and all of that stuff --

MS. PRESLEY: Yes.

CHAIRMAN STETKAR: -- which is also very resource-intensive --

MS. PRESLEY: Yes.

CHAIRMAN STETKAR: -- and may give you the illusion of precision because if you've done all of these little bits and pieces, when it might not be all that accurate. So, that's sort of my spin on -- if indeed it's an important action and you're suspect over this convolution of probability distributions and that drives the results, well then, yes, go back and refine it, but for those particular scenarios now where that shows up as being important.

MS. PRESLEY: And we've tried to do that through -- I completely agree with you on the principle,

1 but at some point you have to put an -- and we try to
2 capture that discussion in our feasibility, is that if
3 you're close --
4 CHAIRMAN STETKAR: It's all --
5 MS. PRESLEY: -- then you need to really go and
6 collect that simulator data.
7 CHAIRMAN STETKAR: But see, I look at the time
8 lines for the feasibility analysis in the sense it's all
9 one part of the pie. You don't do the feasibility
10 assessment and then go back and do this uncertainty
11 analysis on the time. You do it all at once.
12 MS. PRESLEY: Great.
13 MEMBER SCHULTZ: Using the --
14 (Simultaneous speaking)
15 MS. PRESLEY: But the question --
16 CHAIRMAN STETKAR: Using the same --
17 (Simultaneous speaking)
18 MS. PRESLEY: But the question is when they're
19 close, what do you do about it?
20 CHAIRMAN STETKAR: You grit your teeth and if
21 there's no overlap, there's no overlap.
22 MS. PRESLEY: Well, but if there might be some
23 overlap --
24 CHAIRMAN STETKAR: You grit your teeth, live
25 with that. One minus that is what you come up with your

1 cognitive and implementation stuff.

2 MS. PRESLEY: Okay. So a couple more bullet

3 points and then tell me if you still feel that way,

4 because in my -- I think that might be a reasonable way

5 to do it. I'm concerned it will still be a very large

6 source of analyst-to-analyst variability. Now, you

7 have a little overlap, especially with the push to be

8 conservative in every place possible.

9 So, and then the other piece; and I want to

10 go through these couple of bullets and then I'd like to

11 hear what you think, if you still think this is the right

12 thing to do.

13 So, the first question is is it appropriate

14 to add an HEP that you got through this convolution method

15 from the TRC? So, I guess the question is do you even

16 add the HEP that you got through this convolving

17 distributions, and then do you add that to what you go

18 through --

19 CHAIRMAN STETKAR: I guess why not?

20 MS. PRESLEY: -- the IDHEAS process?

21 CHAIRMAN STETKAR: I mean, I was very careful.

22 You didn't hear me. I said one minus.

23 MS. PRESLEY: Yes.

24 CHAIRMAN STETKAR: The convolution says

25 that's the likelihood that they didn't accomplish it in

the amount of time that's available given the fact that they had full opportunity to accomplish it, knew everything that they were supposed to do. Now, let's say that's point 2.

MS. PRESLEY: Yes.

CHAIRMAN STETKAR: For the remaining 80 percent of the time there is still some likelihood that they would fail open and not even try to do it, which my interpretation of everything else in the IDHEAS methodology is trying to quantify that likelihood.

MS. PRESLEY: Yes.

CHAIRMAN STETKAR: So in that sense they should be at 80 percent times 1.23 E to the minus 3 plus 0.2.

MS. PRESLEY: Okay. So --

CHAIRMAN STETKAR: So we're not just adding 0.5 plus 0.6.

MEMBER BLEY: No, it's --

MS. PRESLEY: Yes.

MEMBER BLEY: -- A plus B minus --

(Simultaneous speaking)

MS. PRESLEY: Yes. Yes. So, okay. So if you do that, this is where --

CHAIRMAN STETKAR: So it won't come higher than one.

1 MS. PRESLEY: Right. So this is my next
2 question: Time variability comes from a variety of
3 factors. Well, there --
4 MEMBER BLEY: So does the other failures, but
5 go ahead.
6 MS. PRESLEY: Yes. Well, so that's my point,
7 is that you have all these things that you're trying to
8 -- so whether or not you've appropriately prioritized,
9 and I'll give you a very good example, right? So, the
10 U.S. experimental study where they had to trip the RCPs
11 and start the PDP pump. They were very well trained -- in
12 like nine minutes or something. They were very well
13 trained to tripped the RCPs. The training did not
14 include starting the PDP. And it was in like step 6 of
15 E0. So all the crews were successful in tripping the
16 RCP and they had all gotten to about step 6 and none of
17 them started the PDP because they knew to prioritize.
18 Stopping the RCP and starting the PDP were in the same
19 step, but they knew to prioritize through training. And
20 that narrowed the time variability for that failure.
21 So when you go through those trees, I guess
22 if you're doing A minus B, maybe this is not a relevant
23 point because you're not double counting.
24 CHAIRMAN STETKAR: But you're adding
25 probability.

1 MS. PRESLEY: Yes.
2 CHAIRMAN STETKAR: So you need to be careful
3 about doing that.
4 MEMBER BLEY: The other thing to be careful
5 about in the empirical studies is you only had three
6 crews.
7 MS. PRESLEY: Oh, that's true.
8 MEMBER BLEY: And on that same one; you know
9 this, but --
10 MS. PRESLEY: Yes.
11 MEMBER BLEY: -- just before they ran it on the
12 crews they ran it on a test crew, same way they ran it
13 on everybody else, and they zipped right through it.
14 MS. PRESLEY: Yes.
15 MEMBER BLEY: So three is not many.
16 MS. PRESLEY: It's not many.
17 MEMBER BLEY: Three is not a big data base.
18 But three of them failed, yes.
19 MS. PRESLEY: I guess, okay, well, this is
20 something we should could consider, I think.
21 (Simultaneous speaking)
22 MEMBER BLEY: -- think about it.
23 MS. PRESLEY: I do think we need to make sure
24 that we focus the discussion to the ones that might be
25 time critical instead of spending a lot of time coming

1 up with distribution.

2 CHAIRMAN STETKAR: Oh, yes.

3 MEMBER SCHULTZ: That will happen with what's

4 --

5 CHAIRMAN STETKAR: But that would happen

6 naturally.

7 MS. PRESLEY: Yes.

8 CHAIRMAN STETKAR: And that's another reason

9 why when you develop those feasibility assessments,

10 which is part of what we're talking about, is you ask

11 people -- again, on the record, for the time available

12 people tend to take that as gospel because it's the result

13 of some thermal hydraulics analyses that people have

14 confidence in. There's uncertainty in that.

15 MS. PRESLEY: Lots of uncertainty in that.

16 CHAIRMAN STETKAR: Not as much as the time

17 required, but --

18 MEMBER BLEY: Well, the scenario --

19 CHAIRMAN STETKAR: -- some -- okay. I'll give

20 you that.

21 MS. PRESLEY: Yes.

22 MEMBER BLEY: Yes.

23 CHAIRMAN STETKAR: But not spending an

24 inordinate amount of time on either of those, but enough

25 that you understand the basic spread of the

uncertainties, like I said, whatever the example -- 13 minutes to 23 minutes. And it doesn't make any difference if the uncertainty out here is 75 minutes to an hour-and-a-half.

MS. PRESLEY: Yes. No.

CHAIRMAN STETKAR: Doesn't make any difference. Fine. Good confidence. Is it feasible? Absolutely. Is there any chance that there would be a time-related PT in this construct? No, good confidence is done. Check. We did it.

MS. PRESLEY: I think we need to make sure that the testing bears out the fact that the HEPs that are produced are reasonable and that the types of distributions that people are getting -- that our guidance is good enough that people can actually get distributions that make sense.

CHAIRMAN STETKAR: Well, I think that's --

(Simultaneous speaking)

MS. PRESLEY: I think if we do that -- yes.

CHAIRMAN STETKAR: But again, don't focus too much on the difficulty in getting precision, but focus more what you're talking about is general accuracy.

MS. PRESLEY: Well, when you're talking about a method that you're trying to get on the same page with the NRC because how I do it and how the analyst there

1 does it is slightly different. I mean, you have
2 drastically different HEPs. It's kind of important to
3 at least have some ground rules.
4 CHAIRMAN STETKAR: But at least at the -- I'll
5 come back again to the methodology. If you set out the
6 way the methodology ought to be done, how I apply that
7 methodology and how you apply that methodology -- we
8 apply it differently, come up with different results.
9 At least we now have a point where we can -- why are your
10 results different than mine? It isn't because of
11 vagueness in the methodology or it isn't because I
12 selected option 1 from the methodology and you selected
13 option 2.
14 MEMBER SCHULTZ: You derived different data.
15 That's why it's different.
16 CHAIRMAN STETKAR: Yes, that's right.
17 MS. PRESLEY: Okay.
18 MEMBER SCHULTZ: It's not in the selection of
19 some constants.
20 CHAIRMAN STETKAR: Yes, or some empirical fit
21 to someone's presumed correlation.
22 MEMBER SCHULTZ: Yes.
23 MS. PRESLEY: Thank you.
24 CHAIRMAN STETKAR: And thanks. I hope you
25 didn't -- did you come here specifically for this, or

1 was this --

2 MS. PRESLEY: Oh, the ATHEANA workshop.

3 CHAIRMAN STETKAR: Okay.

4 (Laughter)

5 MS. PRESLEY: Okay. Just to argue with you,

6 John.

7 MS. MORROW: Now, we're on to part 2 of the

8 agenda for the day.

9 CHAIRMAN STETKAR: Good.

10 (Laughter)

11 CHAIRMAN STETKAR: Trust me, it will go

12 quicker.

13 MS. MORROW: So what I'm going to talk about

14 today is the plan for the formal pilot testing of the

15 IDHEAS method. And because of the conversation that

16 we've been having earlier, what I'm talking about is our

17 plans for testing the IDHEAS method for at-power internal

18 events, because that's the method that we have that is

19 near completion.

20 MEMBER BLEY: If you're not going to talk about

21 this later, talk about it now, but if you're going to

22 talk about it later, fine. We're testing a method that's

23 not complete, so are we just testing the complete parts

24 of the method?

25 MS. MORROW: I will talk about that a bit

later.

MEMBER BLEY: Okay. I'll wait to hear.

MS. MORROW: And that's probably something that will be some discussion.

MEMBER BLEY: Okay.

MS. MORROW: Okay. So quickly just what I'm going to over is the objectives of the testing, the testing criteria that we'll be using, our scenarios, a timeline for the testing. And, Dennis, the question you asked, we'll talk about in terms of assumptions and constraints for the testing. And then just go over who our project team is for your benefit.

MEMBER BLEY: Is this already in progress?

MS. MORROW: So right now we're are in what I would consider the development phase. We're still developing the training materials and the testing materials. It's actually a good time for me to present this information to you because it's a good opportunity to have feedback, and we're not so far along in the process that we can't make changes.

Our primary objectives are to evaluate whether IDHEAS can provide acceptable and reasonable HRA results and also to identify the strengths and weaknesses of the IDHEAS method. When I talk about what "acceptable and reasonable" means, what we're really looking at are our

1 testing criteria.

2 As you see on the slide, these are kind of some

3 short descriptions of our testing criteria. And I'd

4 like to briefly go through each of those criteria that

5 we'll be using.

6 The first, criterion validity, is sort of the

7 end-all-be-all in terms of is the IDHEAS method something

8 that can provide reasonable predictions about human

9 reliability? We'd say is it a valid HRA method? In this

10 case I'm using the term "validity." Really what we'll

11 be doing is trying to develop evidence of validity

12 because we don't have a gold standard. We don't have

13 something to say, okay, let's compare the IDHEAS method

14 against what we know the human error probability should

15 be. We don't have that. So what we'll be doing is

16 looking at the data we do have available such as that

17 from the U.S. and international empirical studies, the

18 benchmarking studies.

19 MEMBER BLEY: You're going to find

20 participants who don't know anything about this?

21 MS. MORROW: Yes. Yes, that was --

22 MEMBER BLEY: Can you do that?

23 (Laughter)

24 MS. MORROW: That's something we have talked

25 about quite a bit, and I do think we do have some people

identified that still have HRA experience or operations experience that we'll be able to use that are familiar with --

(Simultaneous speaking)

MR. PETERS: We've been able to identify people in the NRC itself, in the regions, and even some industry partners who have no knowledge. I've even advised them not to read the reports.

MS. MORROW: Yes.

CHAIRMAN STETKAR: Despite the fact that you think it's the most wonderful thing in the world, a lot of other people have never heard of it.

MEMBER BLEY: I'm sure they won't look.

MS. MORROW: And luckily it hasn't been officially published, although there are drafts out there. So if you ask why that hasn't been published yet --

MEMBER BLEY: Well, at least some of that's been published.

MS. MORROW: Well, the international --

MR. PETERS: The entirety of the international reports are all published. The U.S. --

(Simultaneous speaking)

MEMBER BLEY: The U.S. has -- nothing's been published?

1 MR. PETERS: There's just the draft form
2 available, publicly draft form. But we have the final
3 coming out this year. The final report is coming out
4 this year.
5 MEMBER BLEY: Plus there are open-session
6 meetings that are available.
7 MR. PETERS: Oh, yes. If you Google it, you
8 can find all sorts of stuff on there.
9 MS. MORROW: But we have been considering
10 that.
11 So the things we'll be looking at for criterion
12 validity are whether the failure mechanisms that are
13 identified using IDHEAS correspond to the failures that
14 we'd see in either real or simulated events. Also,
15 whether they're identified using other HRA methods. So,
16 as you might be able to tell, what we'll be looking at
17 is using scenarios that have been well-analyzed so that
18 we have some data or have at least some concurrence among
19 different HRA methods. We know what we should be
20 getting.
21 We'll also be looking at whether the human
22 error probabilities that are produced using IDHEAS can
23 differentiate among different scenarios with varying
24 levels of complexity. That's some things that we'll be
25 looking at in terms of criterion validity.

1 MEMBER BLEY: You're going to be look at both
2 the qualitative and the quantitative aspect?
3 MS. MORROW: Yes. Yes, both.
4 The second criterion is inter-analyst
5 reliability. This one is very important for IDHEAS
6 testing because one of the primary drivers for developing
7 IDHEAS was to reduce the variability between analysts.
8 So again, qualitative and quantitatively we'll be
9 looking at that in terms of are the analysts producing
10 the same qualitative results? Do we see the same sort
11 of things in their operational narrative and their
12 feasibility analysis? And then also on the quantitative
13 side the decision tree paths that they use and also their
14 justification for the decision tree paths. So it's more
15 than did they produce the same human error probability,
16 but why did they take the path they took?
17 MEMBER BLEY: Will there be a way to look at
18 these results and not just say either it's good or it's
19 lousy or say from the results we've seen some aspects
20 of the documentation needs to be improved to improve the
21 results?
22 MS. MORROW: That would be the intent is that
23 it's not going to be just a pass/fail sort of thing, but
24 that we'd be identifying, okay, this is a weakness and
25 here's something that could be improved to address that

weakness.

MEMBER BLEY: Or maybe even identify a weakness in the methodology rather than --

MS. MORROW: Yes. Right.

Next is traceability. So this is really about whether the documentation, the output that we see from the IDHEAS method can provide that clear linkage between the qualitative analysis to the quantitative inputs and finally to the human error probabilities. This is of course so that we can go back and if analysts do get different results, then a third party could look at this and understand why their results differed. So traceability is very important.

Fourth is usability. And here what we'll be addressing is what's the quality of the HRA analyst's experience with using IDHEAS? This is a new method, so we're going to be training them. And hopefully at the end of the training they're able to use the method. Did they find it easy to use? Did they experience any difficulties? They will have used other methods before. How does it compare to the other methods they've used? And then also will they be willing to use IDHEAS in place of kind of their method of choice?

MEMBER REMPE: Stephanie, in the report we were given to read before this meeting, when I saw those

1 lists of criteria I was thinking about the last one that
2 you mentioned about using IDHEAS in place of the current
3 method of choice.
4 MS. MORROW: Right.
5 MEMBER REMPE: And can you a bit further and
6 also ask them what's needed to make them want to change
7 to IDHEAS?
8 MS. MORROW: Most definitely.
9 MEMBER REMPE: And would that be possible? I
10 think that might help in making the methodology more
11 robust.
12 MS. MORROW: Yes. I will take that as a point
13 of feedback to add that and make sure that we ask that
14 in the usability.
15 MEMBER REMPE: Okay. Thanks.
16 MS. MORROW: And then finally utility. And
17 here we added this criterion to look at whether IDHEAS
18 can provide useful information for decision making.
19 Kind of focusing on the idea that it is more than just
20 the number, it's more than just the human error
21 probability. So does the information that we get out
22 of IDHEAS inform how we could reduce the potential for
23 human error? Are there other things we could do to give
24 more opportunities for recovery? Also, how can we use
25 the information that we get from IDHEAS for like HRA data

1 collection, information exchange, that sort of thing?
2 What we have included in the testing plan right
3 now are three scenarios with five human failure events.
4 These scenarios would probably be very familiar to all
5 of you. You're probably more familiar with them than
6 I am.
7 The first two scenarios are taken from the U.S.
8 Empirical Study, and they are your more traditional sort
9 of prospective analysis, or things you'd see in a PRA.
10 The third scenario is the 2010 Robinson fire event.
11 We've actually taken information from the accident
12 sequence for cursor analysis. And so, I'll just kind
13 of go through these really quickly. MEMBER
14 REMPE: Could I express or show my ignorance by asking
15 if does the plant configuration come in to how they
16 evaluate these failures? When I was reading the
17 documentation, except for the Browns Ferry one, it wasn't
18 obvious that a particular plant control room was going
19 to be provided to the folks that are doing this testing.
20 And is that not important? Again, I don't do HRA, so
21 --
22 MEMBER BLEY: Yes.
23 MEMBER REMPE: -- I'm showing my ignorance
24 here.
25 MEMBER REMPE: Will you give them the plant

1 layout and say, okay, this is five feet from here or
2 something like that, or what is shown? I just was
3 wondering.
4 MS. MORROW: Yes, we will. And these two
5 scenarios are taken from the U.S. benchmarking.
6 MEMBER REMPE: Oh, so it's in the --
7 MS. MORROW: So, kind of what they'll be
8 provided with is a full information packet which will
9 include diagrams of plant layout, procedures. So they
10 are specific procedures. I am forgetting the plant
11 configuration. Actually, I might -- Larry?
12 MR. CRISCIONE: Yes.
13 MS. MORROW: Could you speak to the plant
14 configuration for these first two scenarios from the U.S.
15 benchmarking?
16 MR. CRISCIONE: Yes, what's most important is
17 the procedures.
18 CHAIRMAN STETKAR: Larry, you're on the
19 record, so --
20 MR. CRISCIONE: Oh, I'm sorry. This is Larry
21 Criscione, Office of Research.
22 Yes, so when you asked the question like does
23 the plant matter? It certainly does, because that's the
24 procedures you're going to be using. The plant layout,
25 I think it helps to tour the plant and see the control

room. And if you can't do that, to maybe see pictures and displays. But it matters to a lot lesser extent than the procedures. The dominating thing is that we will be tying it to -- I mean, we don't have the mention the plant in the study, but we will be tying to a specific plant using their procedures. And they're evaluating it to that plant and that plant alone. They're not trying to predict how this human failure event would play out.

MEMBER REMPE: Well, this is fine. This is what I read. I didn't catch on that that was being done.

MR. CRISCIONE: Yes.

MEMBER BLEY: I just want to correct what I said. You asked is the plant configuration important, and I said yes, it is. Then you said something like does -- you mean if it's two feet or three feet to the switch? No, that doesn't.

MEMBER REMPE: Well, just looking we'll see -- and again, procedures and some sort of diagrams --

(Simultaneous speaking)

MEMBER BLEY: And the way the plant's piped together and all of that.

MEMBER REMPE: I just couldn't get it from what I was reading. And perhaps if I did I would have

1 understood that they were getting that.

2 CHAIRMAN STETKAR: As Larry said, course

3 information about the layout of the control room is

4 important because, for example, some set of distracting

5 alarms are happening over there on a back panel or around

6 the corner. That's really important. Whether or not

7 two control switches are 18 inches apart or whether your

8 gauges are vertical or -- that doesn't make any

9 difference.

10 MEMBER REMPE: Yes, well, I just wondered if

11 they were going to get enough information that you're

12 not going to have variability because someone's assuming

13 plant X versus someone else is assuming plant Y.

14 MR. CRISCIONE: Yes, for the U.S. benchmarking

15 they traveled down to the plant. We probably won't have

16 the money to do that, but we'll certainly be able to give

17 them the layouts of what the control boards look like

18 and --

19 MEMBER REMPE: That's fine. Thanks.

20 MS. MORROW: So, the first scenario is total

21 loss of feedwater followed by a steam generator tube

22 rupture. The second is just a standard steam generator

23 tube rupture scenario. And then the third again is

24 adapted from the 2010 Robinson event, loss of reactor

25 coolant pump seal injection and cooling.

1 MEMBER BLEY: I can see how you use what
2 happened there to see what they do qualitatively. I'm
3 not sure how you'll be able to judge about their
4 quantification for this one. I mean, it happened once
5 exactly the way it happened, but that's not much of a
6 basis to --
7 MS. MORROW: What we do have is the accident
8 sequence precursor analysis, the ASP analysis. So we
9 also have in terms of -- not just the things that did
10 happen, but when we look at the prospective aspects of
11 it, we have the SPAR-H model from that to look at. Again,
12 there isn't a gold standard.
13 (Simultaneous speaking)
14 MEMBER BLEY: -- all of the confusing things
15 that were going on in that control room at the same time
16 and the --
17 MS. MORROW: Yes.
18 MEMBER BLEY: -- status of -- I think you're
19 going to have trouble evaluating the quantitative part,
20 but we'll see.
21 MS. MORROW: Okay. Our timeline for this:
22 Again, right now, as I mentioned, we're in the
23 development phase, so we're still developing the
24 training materials and testing materials. We'll be
25 spending a lot of time piloting that information because

1 we want to make sure that we're providing enough
2 information so that they can perform the HRA analysis.
3 We also want to make sure that we're providing enough
4 training and that the training is sufficient so that they
5 can use the IDHEAS method as it was intended, as it was
6 developed.
7 For the HRA analyst teams we'll be finalizing
8 those anticipated around July. And we're going to be
9 having five teams total. Three teams will be from NRC
10 staff; two teams will be from industry staff. Basically
11 what we could do. And we're also trying to make sure
12 that the teams that we choose have not been involved in
13 the benchmarking studies before.
14 CHAIRMAN STETKAR: You're still identifying
15 that.
16 MS. MORROW: Yes.
17 CHAIRMAN STETKAR: But I hope at least some of
18 the folks are from the regions.
19 MS. MORROW: Yes.
20 CHAIRMAN STETKAR: Okay. Good.
21 MS. MORROW: Yes, they definitely will be.
22 CHAIRMAN STETKAR: Good. Excellent.
23 MS. MORROW: And we're going to make sure that
24 --
25 CHAIRMAN STETKAR: They tend to be more

1 practitioners than perhaps folks at headquarters.
2 MS. MORROW: Right. We're going to make sure,
3 like if we're able to get two or three people from the
4 regions, that the regional people will be on different
5 teams --
6 CHAIRMAN STETKAR: Yes. Good.
7 MS. MORROW: -- so that we are able to mix up
8 the expertise and the exposure to different things.
9 CHAIRMAN STETKAR: Good. Good.
10 MS. MORROW: Yes. We'll also have an
11 evaluation team. I'm presenting at the end of this
12 presentation or project team right now. The evaluation
13 team will be -- there will be a lot of overlap there,
14 but that team will be specifically to evaluate the
15 results from the testing.
16 Then September of 2015 is when we're planning
17 to conduct the Testing and Training Workshop. This will
18 be a three-day workshop. The first two days will be just
19 devoted to the training on IDHEAS. On the third day
20 we'll be giving them the information packet of the
21 testing protocol, that sort of thing. And at the end
22 of this workshop, that's basically the official start
23 of the testing. They will go forth then with all of the
24 information they need to complete the analysis. They'll
25 work in teams of two to do that.

1 MEMBER BLEY: Well, will those have teams have
2 people with any operational experience on them?
3 MS. MORROW: I don't know the answer to that
4 yes because the teams have not been chosen.
5 CHAIRMAN STETKAR: You may want to think
6 carefully though -- what I'm thinking, two is nice to
7 bounced things off, but if neither of them have any
8 operational experience, the question about the content
9 of the narratives, the scenario narratives becomes
10 questionable.
11 MS. MORROW: Okay.
12 MEMBER BLEY: I don't know if you can do it,
13 but maybe you can at least provide them with access to
14 some folks with operational experience. We do have
15 scattered ones around the Agency and the regions.
16 MS. MORROW: One thing we are going to be doing
17 for the testing is part of that workshop is going to be
18 a question and answer with a member of our project team
19 with operations experience, so they'll kind of serve as
20 the operations subject matter expert in lieu of them
21 going to a plant and doing interviews with operators.
22 We've chosen to do it in this way to control the
23 information so that we don't run into a situation like
24 we saw with the U.S. benchmarking where as part of the
25 information collection phase they got different

information from different operators. That's not a function of the method. That's the function of kind of the information they received.

MEMBER BLEY: They'll only get answers though if they ask the questions?

MS. MORROW: They'll only get answers if they ask the questions, but if they do ask the questions, we were planning to send the answers to every team.

MEMBER BLEY: Well, you'd want to think about that.

CHAIRMAN STETKAR: I was going to say, that sounds --

MEMBER BLEY: Part of doing the method is coming up with the right questions to ask.

CHAIRMAN STETKAR: And if you're actually testing variability, how well does the method drive people to reduce variability, you're now constraining an important piece of information that may indeed be a source of variability you're not testing.

MS. MORROW: I think it's a source of variability in terms different HRA analysts, but is it a source of variability for the IDHEAS method in particular?

MEMBER BLEY: Yes, because apply the method. And if they don't ask the right questions, they don't

1 get the right answers. They don't get any answers.
2 MS. MORROW: Yes.
3 MEMBER BLEY: So a major part of using the
4 methodology is knowing what to ask for.
5 MS. MORROW: I think we'll have to revisit
6 that.
7 MEMBER BLEY: I mean, that really does clean
8 out a big chunk of the variability, I think. And it's
9 part of the method.
10 CHAIRMAN STETKAR: Yes.
11 MEMBER BLEY: People do the method, I
12 mean --
13 MEMBER SCHULTZ: The inter-analyst
14 reliability will need that opportunity.
15 MS. MORROW: And I see Mary Presley wanting to
16 comment here.
17 MS. PRESLEY: We struggled a lot more
18 designing the testing on how much information to provide,
19 and also the timing area, too, because those are normally
20 things that you would go and have the chance to interview
21 operators and have the chance to look at all the plant
22 information and be familiar with that plant, because it's
23 normally the plant that you're familiar with. But we
24 had to decide what parts of the method you can test, and
25 we thought it was more important to get information on

1 how people build CRTs and how people go through the trees.
2 Given we know that they have the right information, do
3 those questions lead them to extrapolate insights from
4 that information?
5 CHAIRMAN STETKAR: But I think one thing that
6 I heard -- I think the thing that bothered me was if
7 somebody asks a question, we're going to distribute that
8 answer to all of the teams. I don't see a problem having
9 an information source such that if I ask the information
10 source about some factual information, that information
11 source gives it to me, but doesn't give it to him if he
12 didn't ask --
13 MEMBER SCHULTZ: And if I ask it, I get the same
14 information.
15 MEMBER BLEY: If you ask the same question.
16 CHAIRMAN STETKAR: You ask the same question
17 and you get the same -- you ask a slightly different
18 question, I give you -- the information source gives you
19 --
20 MEMBER SCHULTZ: According to the question.
21 CHAIRMAN STETKAR: According to the question.
22 MS. MORROW: So I can definitely bring that
23 feedback back to our project team to address.
24 CHAIRMAN STETKAR: But if I ask a question a
25 certain way, giving Steve the information that I received

1 automatically will reduce variability.

2 MEMBER BLEY: Now, to Mary's point, it might

3 be that somebody asks a question that you -- and this

4 is just off the top of my head; I haven't thought about

5 it, you say, oh my God, that should have been part of

6 the package and we forgot to include it --

7 MEMBER SCHULTZ: That's different.

8 MEMBER BLEY: -- that might be different, I

9 don't know.

10 MEMBER SCHULTZ: Yes.

11 MS. MORROW: Okay.

12 MEMBER BLEY: Oh, we gave you an incomplete

13 package. They would even know to ask for that.

14 CHAIRMAN STETKAR: Well, when you say "pilot

15 testing materials," would that pilot try to sort out that

16 sort of information or not?

17 MS. MORROW: It would, but there is still the

18 potential when we piloted it, we never thought of that

19 either.

20 CHAIRMAN STETKAR: Somebody didn't ask the

21 question.

22 MS. MORROW: Yes.

23 MEMBER SCHULTZ: Yes.

24 MS. MORROW: Okay. But so, kind of the main

25 point was our plan is to have a single source of

information so that we're reducing the variability that they'd get from doing different operator interviews.

MEMBER BLEY: An example John gave earlier was right on point. If Steve asks will the operators trip this pump at a certain time, the answer is probably yes. But if John asks what might the operators do faced with this situation and lays it out, it might not be that same answer. It might be something quite different. I don't know if we can replicate that or not, but that's a big source of mistakes, I guess you could say on doing this kind of analysis.

MS. MORROW: How the question is asked.

CHAIRMAN STETKAR: How the question is asked.

MS. MORROW: Okay.

CHAIRMAN STETKAR: But there, too, I mean, the methodology ought to point you toward asking the question the right way.

MEMBER SCHULTZ: Right.

MS. MORROW: Yes.

CHAIRMAN STETKAR: You can't make it foolproof, but I mean it ought to -- it's not there.

MS. MORROW: Yes, and I think we're trying to parse out what is something that you learn as a skill of being an HRA analyst versus something that's very method-specific.

CHAIRMAN STETKAR: Yes, again, but just in terms of kind of off-the-cuff feedback at least it's -- if one of the things that indeed you are trying to test is how well does the methodology --

MEMBER BLEY: Prompt the analyst.

CHAIRMAN STETKAR: Yes, reduce the variability analyst-to-analyst. You don't necessarily want to insert biases that artificially reduce that by just distributing -- making sure that everybody gets the same information. Same technical information, yes, but not that as soon as I ask the question everybody gets that -- John asked this question and here was the answer to that question.

MS. MORROW: Okay.

CHAIRMAN STETKAR: I think that will defeat some of your purpose.

MS. MORROW: Appreciate that.

Okay. So the part that I think would probably garner the most discussion is the assumptions on constraints. The second bullet is what we were just talking about, controlling the information gathering.

So, the first bullet: Testing will be limited to in-control room activities while at power. What this is testing is the IDHEAS at power. And I know when we were talking to users, they were wanting to see scenarios

of flooding, fire, seismic, that sort of thing. And right now all we're testing is this part of the IDHEAS --

(Simultaneous speaking)

CHAIRMAN STETKAR: Those users want to see all of that, have them fork over the bucks. I offered up a car ride from Arkansas.

(Laughter)

MS. MORROW: Okay.

MEMBER BLEY: But in the scenarios you defined for them, you won't be giving them things that would require actions out in the plant.

MS. MORROW: Right. No. So, like for the Robinson fire event we were choosing human failure events that were in control room events. Right.

The third bullet, I kind of talked about this a little bit, but that there is not a gold standard for HRA method testing. So when we talk about validating the IDHEAS methodology, it's really about just building a case of evidence that -- an evidence for validity.

And then the fourth bullet is, Dennis, a question that you asked to begin with, and we're kind of operating under a constraint in terms of if we're moving forward with testing, at some point we'd have to have a completed method to test. And looking at this

1 is sort of a summative evaluation, how those ideas work.
2 So testing may not include changes made after a certain
3 cut-off date. And we've been running into this and kind
4 of going back and forth a bit because we have been trying
5 to make changes to IDHEAS while also trying to get the
6 testing plan in place.
7 MEMBER BLEY: So in particular if the
8 elicitation on the decision trees isn't complete, you'll
9 just stick numbers in the methodology or something like
10 that that they can use?
11 CHAIRMAN STETKAR: No, it won't be complete
12 because we're talking about June of this year.
13 MEMBER BLEY: Thank you.
14 (Laughter)
15 MS. XING: Actually we thought about that part
16 and the --
17 CHAIRMAN STETKAR: You can't assume they won't
18 go after one that's got a blank in it. They might.
19 MS. XING: Yes, at our current plant we are not
20 going to give those numbers to the analyst during their
21 initial testing.
22 CHAIRMAN STETKAR: Any of them?
23 MS. XING: Yes. So, this is try to avoid there
24 being biased by the numbers. So they were finished with
25 their analysis by the time they selected -- they're done

1 with the decision tree, selected the decision tree paths.
2 Then they will submit their initial results.
3 MEMBER BLEY: Okay. So it won't have numbers
4 in it?
5 MS. XING: Yes, to our evaluation team. Yes,
6 and the evaluation team will get the numbers. Some
7 they'll give them -- hey, this is your total HEP. They
8 will say, oh, this is too high. They want to revisit
9 their --
10 CHAIRMAN STETKAR: Yes.
11 MS. XING: -- analysis, but they don't know
12 which one made too high. So that may try to bias their
13 analysis. So from that perspective it's okay. Even we
14 don't have the numbers by the time of testing.
15 MEMBER BLEY: Okay. They won't get any.
16 CHAIRMAN STETKAR: But I mean that test -- that
17 does indeed test a huge part of that methodology.
18 MEMBER BLEY: Yes, it does. But it tests the
19 part I was worried about.
20 CHAIRMAN STETKAR: The big conceptual part of
21 it. That's right.
22 MS. XING: Yes, well, at the end we'll look at
23 those things.
24 MEMBER BLEY: Okay.
25 MS. MORROW: Any other questions about the

1 changes?

2 (No audible response)

3 MS. MORROW: Okay.

4 MS. XING: Other than the HEP, the other part

5 that changed is the operation narrative and the time

6 issue. Mary and I just talked. We plan to get to -- come

7 to a list of some level of the consensus part of it in

8 the beginning of June.

9 CHAIRMAN STETKAR: That would be great.

10 MS. XING: We're going to have a meeting, a

11 one-week meeting in June. Try to put everything on the

12 table.

13 CHAIRMAN STETKAR: My sense is that's probably

14 something we can get some reasonable agreement on between

15 now and the June/July time frame.

16 MEMBER BLEY: It's not a lot of time, but it's

17 possible, yes.

18 CHAIRMAN STETKAR: It's not a lot, but it's

19 possible.

20 MEMBER BALLINGER: Have you decided on what

21 constitutes success?

22 MS. MORROW: That's a good question. I don't

23 know that we'll have like a pass/fail.

24 MEMBER BALLINGER: I don't mean pass/fail. I

25 mean, are you going to --

1 MEMBER BLEY: What are the --
2 (Simultaneous speaking)
3 MEMBER BALLINGER: Will you smile at the end
4 or frown at the end?
5 MEMBER BLEY: What are the things we want the
6 method to do?
7 MEMBER BALLINGER: Yes.
8 MEMBER BLEY: That catalogue of things.
9 MEMBER BALLINGER: What are your figures of
10 merit that are going to say, okay, this achieved our goal;
11 this did not? Because I don't know how you can take the
12 next step without having being surprised or in way or
13 another by the results.
14 MS. MORROW: Yes.
15 MEMBER SCHULTZ: And you should at least do
16 that somewhere in between the test runs and the pilots
17 and then have all this done. Before you go into
18 evaluation, you need to have that available.
19 MS. MORROW: And actually, if I go back to
20 -- oh, I don't have it on -- in the time line in the project
21 plan that you had as background material. Kind of
22 finishing the evaluation plan was its own entry in the
23 timeline because it was --
24 MEMBER SCHULTZ: Yes, but that just means
25 surviving to the end. Right? You finish it.

1 MS. MORROW: No.

2 MR. PETERS: Finishing developing the plan for

3 how to test --

4 (Simultaneous speaking)

5 MS. MORROW: The plan for how to evaluate it,

6 yes. So, we've gotten to the point where we have the

7 testing criteria and we've narrowed down these are the

8 kinds of questions we want to ask, but we have not reached

9 the point where the next step is to say, okay, well, what

10 is an acceptable answer to this question? And I think

11 that's the smile or frown.

12 MEMBER BALLINGER: I guess it's -- I don't

13 know. See, I'm an experimentalist. And so before I do

14 an experiment, I ask the question what's the answer going

15 to be?

16 MS. MORROW: Right. And so finalizing --

17 MEMBER BALLINGER: So that when I get through

18 I'm either surprised or not, but I've had to predict what

19 the answer's going to be to start with.

20 MS. MORROW: That's part of finalizing the

21 evaluation plan, which comes before we start testing.

22 So, yes.

23 MR. PETERS: It's a great question. I mean,

24 now that we're in this open forum, do any of the members

25 the ACRS have any recommendations for what would be good

1 enough? We kind of scratch our brains, but we're not
2 aware of any real long history of testing HRA methods
3 prior to implementation so --
4 CHAIRMAN STETKAR: You look at the benchmark
5 studies and there it was -- the conclusions; and Dennis
6 could speak to this better than I can, were not that
7 something was too bad. It was observations that indeed
8 there was a lot of variability. And we identified
9 problem areas. That's not an acceptance criteria. And
10 it's results of running those experiments and what you
11 learn from them. One comparison is in terms of
12 variability at least is there some evidence that you get
13 less variability than those? But to say, well, the HEPs
14 among all five groups have to be within 37 percent to
15 be considered -- you know, the mean to be considered
16 acceptable, I don't think that that's the type of --
17 MEMBER BALLINGER: Yes, I guess but I -- one
18 outcome I -- with all five groups you expect -- you've
19 done all this work to -- it was standardized, right?
20 Well, what happens if you get very different results
21 between each of the groups? Is that something that you
22 don't expect, that you do expect? What are the possible
23 sources of -- that could drive that variability?
24 MS. XING: In the test manual we prepared
25 there's one section asks the analyst to document the

uncertainty of the variability. For example, when they choose the decision tree and the decision tree paths. They chose one -- like one branch point is the work load high or low? It's not always a binary also. And the answer to this question may be very different HEP, but at least you document your reason. We have questions in our document. I like -- because my answer to the three questions, two of three is right, so I choose this high. And the other person may have the same -- base on the same facts chose no, but at least you know where this come from. That's one thing we hope we can get from the testing.

CHAIRMAN STETKAR: But I think part of this, from my perspective, is evaluating the results of this process, to me personally; this is me personally, is less important than actually getting this methodology into the hands of people who can test and use it to see where are the rough parts of the methodology, if there are any, and things like that. Because nobody's really used this.

MEMBER BALLINGER: Right, but one of the; I don't know what slide it was, previous slides said, well, what do I have to do -- the usability thing. Right?

CHAIRMAN STETKAR: Right.

MEMBER BALLINGER: So your goal is to get that

1 into the hands -- well, what do you need to achieve by
2 doing this to ensure that that happens?
3 CHAIRMAN STETKAR: What you're going to find
4 is that people who are used to going to table No. 37,
5 looking up a number and putting it in a box and that number
6 came out the same as this, they're going to say, well,
7 this is not nearly as usable as looking up the number.
8
9 MEMBER SCHULTZ: That's what I used to use. My
10 method's better. But you have the criteria.
11 CHAIRMAN STETKAR: Right.
12 MS. MORROW: Right.
13 MEMBER SCHULTZ: You have, next slide, at the
14 end, the project team.
15 MS. MORROW: Yes.
16 MEMBER SCHULTZ: And the project team can
17 develop the measures associated with the criteria
18 elements 1 through 10, 1 through 5 maybe. What would
19 be the derivation of the measures that one would choose
20 for each of these select two or three different elements
21 and then define what is the suitable definition for
22 getting a one, a two, a three, a four, a five?
23 MS. MORROW: Yes.
24 MEMBER SCHULTZ: So matrix of that will
25 provide good information about the success of the

1 methodology.

2 MS. MORROW: Yes, I agree.

3 MEMBER SCHULTZ: For this purpose, like John

4 said. This is only the first set of it.

5 MS. MORROW: Right.

6 MEMBER SCHULTZ: The next test is

7 implementation.

8 MS. MORROW: Yes. And actually something I

9 should mention is we've been getting a lot of

10 international groups and others asking, oh, can we take

11 part in the testing? Can we help, too? And what we

12 decided at this point is right now we're just focusing

13 on the formal testing so that we can work out those

14 initial kinks.

15 MEMBER SCHULTZ: This is the alpha test, or

16 whatever you want to call it.

17 MS. MORROW: Yes, exactly. And so, the next

18 would be kind of the early adopters --

19 (Simultaneous speaking)

20 CHAIRMAN STETKAR: The beta test --

21 MS. MORROW: -- of the method.

22 CHAIRMAN STETKAR: -- might be --

23 MS. MORROW: Right. So the next phase after

24 this would be when we roll it out to a larger population

25 of the people who are really interested in testing it.

1 And they're kind of the early adopters of the method and
2 they'd tell us what else needs to be worked out.
3 MS. XING: And this is related to earlier
4 question, like whether we think we can make this test
5 a success or failure? So to manage, one potential
6 difficulty part in the test is we need to have the testers
7 really understand what we mean by this or that in the
8 method. I don't say we do -- and we saw this in the expert
9 elicitation workshop. People read the same document,
10 come up very different interpretation. So our case, our
11 former task team we controlled this by -- we work a lot
12 on the training material, do the self-pilot here.
13 However, later on when we roll out to the large
14 international volunteers, they're not having chance to
15 ask here for the training --
16 MEMBER SCHULTZ: Well, maybe they should.
17 MS. XING: -- for question.
18 (Laughter)
19 MS. XING: And that will give us a test whether
20 the guidance is reading the way people can comprehend
21 it correctly as we intended.
22 MS. MORROW: Yes, that's a very good point.
23 People who don't come and talk to Jing and Mary and
24 everything about the IDHEAS method, if they just have
25 the materials in front of them, would they be able to

1 use it?

2 Okay. This last slide -- and Michael was to

3 make up some time for today, so short presentation. But

4 this last slide is just the project team, and I'd just

5 like to acknowledge the other members of the project

6 team.

7 Larry Criscione, also Office of Research. He

8 is kind of our primary person on the team providing

9 operations experience. Harry Liao from Sandia is

10 leading the development of our testing materials and our

11 information packets for the scenarios. Mary Presley,

12 of course our primary EPRI point of contact. She's also

13 with Gareth Parry leading day two of the testifying

14 workshop where they will go through IDHEAS examples and

15 work through just a simple example using IDHEAS and then

16 a complex example. Of course Jing as our IDHEAS advisor

17 for method questions. Jing will also be leading day one

18 of the training to go over the IDHEAS fundamentals. And

19 then we'll also have another member of our project team

20 who hasn't signed on yet to be sort of the lead evaluator.

21 And they'll kind of lead working out the rest of the

22 evaluation plan, what are our criteria going to be, the

23 rubrics for actually when we look at if we're going to

24 score the testing criteria or something like that, what

25 that would look like.

1 And that's all I have for the testing plan right
2 now.
3 CHAIRMAN STETKAR: Any more comments for
4 Stephanie?
5 (No audible response)
6 CHAIRMAN STETKAR: If not, Jing, thank you by
7 the way.
8 MS. XING: Okay. A question I have for -- what
9 time we have for today so we --
10 CHAIRMAN STETKAR: We're kind of open-ended on
11 the end. We tend to ask you in terms of if you have any
12 compelling reasons that you need to leave by a certain
13 time. We don't.
14 MS. XING: I can be here until 12:00, yes.
15 CHAIRMAN STETKAR: Oh, good.
16 MEMBER REMPE: He doesn't serve dinner, just
17 so you know.
18 (Laughter)
19 CHAIRMAN STETKAR: No, seriously. I mean,
20 I'd like to finish between 5:30 and 6:00. I don't know
21 if our reporter -- I thought I'd be sensitive. Yes?
22 COURT REPORTER: I can be here --
23 (Simultaneous speaking)
24 CHAIRMAN STETKAR: You're okay? Good.
25 So let's shoot for no later than 6:00. Earlier

1 than that is better.

2 MEMBER BLEY: And we may have already talked

3 about some of this.

4 CHAIRMAN STETKAR: Yes. Use that to sort of

5 organize your time and we'll try to be more disciplined.

6 MS. XING: Okay. So with I term a valuable

7 window, we think we wish to cover two parts. One is the

8 generic methodology we developed so far. And the other

9 part is the insight from SACADA data and how that can

10 inform the method. So regardless of how much time

11 available we have, I wish to cover both of them.

12 Okay. Because we like this slide, I put it

13 here again. So you know we are on the middle part.

14 Okay. We think we already talk this part, the scope

15 of the general methodology, the difference between this

16 and the other. So just give you overview. The method

17 is based on the cognitive basis framework, so it model

18 the five cognitive functions support human action:

19 detection, understanding, decision making and planning,

20 action execution and teamwork.

21 And second part, the method model is the full

22 cycle for cognitive process for complex human actions.

23 I will explain little bit what we mean by "full cycle."

24 And the third part is the method considers

25 extensive contextual factors, or traditional we call

them PIFs, without making application-specific assumptions. That's as we talked early, for example, in the other HRA method or the method for internal at-power event. We made some assumption there. It's for internal at-power event, therefore, you have a structure the crew that has been well trained for the procedures to use. You do action based on your procedure. And so we made a number assumption there. Here we tried to make -- not make application-specific assumptions. And also the method put a big emphasize on teamwork part and organizational factors.

So any question?

(No audible response)

MS. XING: No? Okay. I will just use one slide to explain what we mean the full -- it model the full cycle of the cognitive process.

Okay. Here you have three columns. The column on the left is what we talk about full cycle of cognitive process. This is for detection. From the very beginning when you look to do a detection test you start with your decision criteria, what you want to do.

For example, if a procedure will tell you so check it's pressurized pressure is above 2250. So your criteria is 2250. You say something you compare with that. In another sentence it may tell you -- ask you

1 to check the pressurized pressure, what's the word,
2 stably increasing. So that's a more difficult part
3 here. What do you mean by stably increase? If there's
4 a small vibrations that are allowable, so you have to
5 set up the criteria for your detection. Then you select
6 and identify the source of information. Now you go
7 perceive and register, recognize information.
8 And that's not the end. You go back to -- in
9 the real safety-critical job you always verify your
10 information and you may modify. Well, at first time you
11 may say it's increasing. You wait for couple second,
12 a minute. Say it's not steady increasing. And finally,
13 you will communicate the information as request. So
14 this what we mean by the full cycle.
15 And in the middle column is the cognitive
16 mechanism of the process. We document it in NUREG-2114.
17 When we developed that cognitive basis, we were already
18 came and agenda. This cognitive basis was going to
19 develop that for the IDHEAS method. At that time we have
20 to use this term for the new method. And the new method
21 is for internal at-power event only. Therefore, we
22 limited our literature review to something similar to
23 that part. So we used the failure -- we use the proximate
24 causes to represent the accompanied process. As you see
25 our literature review, they did not cover the why, the

criteria part. And it's also did not really the -- for verifying modifying detections.

And then the IDHEAS method for internal at-power event, we develop a crew failure mode based on the proximate causes. So those failure mode, they do not sufficiently cover the verification, the modification detection. So that's we say in the generic methodology which find the model, the full cycle of the process in the left column.

And also in the contextual factor domain, as we try not make assumptions. So we look at the contextual factor in the -- related to plant, related to crew, to task. And those traditional PIF like HSI, tools, procedures and training. And the methodology model these factors through -- first later down we call the PIF characterizations, which are the detailed traits or aspect of the factor. Here, I will just give you an example. Like for HSI is traditionally -- a traditional PIF factor. We have to model the detail aspect of HSI such as alarm saliency, distribution of relevant information, display format and many others. That's what we talked earlier. The generic methodology may model certain factors and the method for internal at-power only. We're only select like three of five, six most relevant ones.

1 Okay. This come to the question Dr. Bley asked
2 early. So the process of the general methodology. So
3 very similar to the one you saw before. And the circle
4 part is where the two have difference. And again, it's
5 not fundamental difference. So you do the same thing:
6 develop the operational narrative, identify HFE,
7 analyze the time factor and identify critical task.
8 Now when come to the failure mode, the IDHEAS
9 we had a very specific failure mode. Like under
10 detection we had five failure modes and the decision
11 making had two failure mode. Here in this general
12 methodology we first tried that way, like tried to
13 identify the failure model the same way.
14 Yes?
15 MEMBER BLEY: Why would you identify the
16 process that we used for the operating reactors to
17 develop their list as a general process to develop your
18 list for whatever application you're doing rather than
19 saying we got to think about it altogether differently?
20 We've got a giant list from the human factors document.
21 And now we're talking about a process to get that down
22 to the ones that are important for the current situation?
23 Thinking of your earlier diagram, the next little box
24 there, why would we just follow the same process we
25 followed here with the different criteria for what's

1 going on? And that way the current methodology would
2 fit very nicely with the generic methodology.
3 MS. XING: That was an early version and get
4 back to you a year ago. We tried that and we find like
5 a failure at a basic step.
6 CHAIRMAN STETKAR: Jing, why are you trying to
7 get to an answer for specific examples rather than
8 developing a generic methodology? Everything that I
9 read focuses on we need to do this specifically for this
10 type of scenario so we can get this answer. That's not
11 a methodology. That's an application of a methodology.
12 If the generic methodology is different, conceptually
13 different, parroting Dennis, from the incarnation of
14 that generic methodology for internal events level 1
15 at-power, then the generic methodology is not the generic
16 methodology because you cannot derive that particular
17 application from the generic methodology.
18 MS. XING: I'm sorry. I didn't get that part.
19 CHAIRMAN STETKAR: You're right. You don't.
20 That's the whole point. The generic methodology should
21 tell you what needs to be done with some general guidance
22 about how it should be done in a general way, and then
23 a specific application of that. Unfortunately we have
24 one right now. If we didn't, it would make a lot more
25 sense. A specific application would say, well, for

1 these particular purposes according to the methodology
2 I can think about it this way and narrow it down the set
3 of influencing factors that I need because that's what
4 the generic methodology tells me I can do. And here's
5 an example if you want to focus it.
6 But what I see you doing; maybe I'm reading
7 it wrong, is crafting something that you're calling a
8 generic methodology that too quickly gets into here are
9 some examples of numbers for a particular situation, or,
10 well, here's a way that I have to simplify it generically
11 because if I tried to do it generically I can't do it
12 generically. But that's not the point of the generic
13 methodology. Is it?
14 MS. XING: Yes, I think the two aspects for
15 that. One is in the writing, the right hand as I put
16 in the first page. It's a work in progress.
17 So --
18 CHAIRMAN STETKAR: But the work in progress
19 already has you pigeonholed into a certain way of
20 thinking about things. You've got numbers and tables
21 and appendices that said, well, you can assume this
22 number and assume this numerical relationship, and
23 that's probably good enough for this.
24 MS. XING: Yes.
25 CHAIRMAN STETKAR: That's not consistent with

1 what's done in the focused application of that generic
2 methodology for the internal --
3 (Simultaneous speaking)
4 MS. XING: Because those number as we
5 indicated is just so far, only based on the literature.
6 We hadn't really -- eventually those numbers will be
7 replaced by expert judgment. So we only put those number
8 there as an initial --
9 CHAIRMAN STETKAR: And what did I say a couple
10 of hours ago? Once you put numbers in a table in an
11 appendix of a published report, they will become what
12 people will use. And why do we need those numbers in
13 this generic methodology?
14 MEMBER BLEY: Because they're derived for
15 at-power application in that application. So in each
16 application you develop those pieces you need. You
17 don't need to solve that in the beginning. And you sure
18 don't need to be saying, oh, let's take this really
19 gigantic shortcut. That's even for me a layer down.
20 You've got then the specific applications and there might
21 be sometimes you're using it where you take --
22 MS. XING: Okay.
23 MEMBER BLEY: -- reason and you say I'm
24 deviating, taking a shortcut for the following reasons.
25 I sure wouldn't imbed that stuff in our overarching

1 methodology.

2 MEMBER SCHULTZ: If you go back on

3 slide --

4 MEMBER BLEY: That's all anybody will

5 do --

6 (Simultaneous speaking)

7 MEMBER SCHULTZ: -- or these three slides, the

8 last column is crew failure modes for internal at-power

9 events. I don't see anything in that last column that

10 is not general concept. It really doesn't have anything

11 to do with internal at-power event information.

12 CHAIRMAN STETKAR: Well, I think Jing is

13 arguing though if you thought more holistically that that

14 column could get larger.

15 MS. XING: Yes. We're not saying --

16 CHAIRMAN STETKAR: She's worried that the

17 column could get larger. See, I'm not worried that the

18 column could get larger because I don't think that any

19 particular application, if you wrote guidance, would

20 lead you to --

21 MEMBER SCHULTZ: But maybe --

22 CHAIRMAN STETKAR: -- do everything.

23 MEMBER SCHULTZ: -- the alarm -- I don't know.

24 I don't see -- I look at all of the features and I don't

25 see it there, except that there are procedures and

alarms. Other than that -- and data. But otherwise, it's really generic.

CHAIRMAN STETKAR: It is, but if you look at the underlying cognitive basis document, you could be led to several other failure modes --

MEMBER SCHULTZ: Listings.

CHAIRMAN STETKAR: -- that are influencing --

(Simultaneous speaking)

MEMBER BLEY: Yes, that were removed here.

CHAIRMAN STETKAR: -- that they've already screened out from this.

MEMBER SCHULTZ: Okay. So that there has --

CHAIRMAN STETKAR: It's a good comprehensive set --

MEMBER SCHULTZ: All right.

CHAIRMAN STETKAR: -- for the stuff that you're used to looking at --

MEMBER SCHULTZ: I see what you're --

CHAIRMAN STETKAR: -- for power reactors, but not necessarily if you wanted to apply -- you mentioned medical applications or something like that.

MEMBER SCHULTZ: Okay. So, then that's fine. It's set up this way, but it's for an overview and general

application. Okay. I understand. I hadn't thought of it outside the realm of power reactors in that way.

MS. XING: In the early --

CHAIRMAN STETKAR: Or for even power reactors, but for things that aren't procedure-driven.

MEMBER SCHULTZ: Right.

CHAIRMAN STETKAR: Plus they're thinking about interactions of emergency response organizations for --

MEMBER SCHULTZ: Outside. Outside of that, I mean.

CHAIRMAN STETKAR: -- integration with emergency -- yes.

MEMBER SCHULTZ: Yes, or external events or -- yes.

CHAIRMAN STETKAR: Emergency planning-type stuff, external events and --

(Simultaneous speaking)

MEMBER SCHULTZ: Sure. Okay.

MS. XING: In the early prototype we actually tried the same -- try to identify the failure mode at this level, like in the right column.

MEMBER SCHULTZ: We can go on.

MS. XING: Yes, okay. Just for --

MEMBER SCHULTZ: You've answered my question.

1 MS. XING: -- information. We actually came
2 up -- I don't remember exact numbers, like 45 or 46, those
3 failure mode. We saw, okay, this seems too complicated
4 to handle, so let's try another way to simply -- from
5 simple way. Instead of identify all these possible
6 failure mode, let's model them at a relative high level.
7 So which just look at the -- overall we say it's a failure
8 of detection, a failure of understanding, failure of
9 decision making, just a failure of these functions.
10 And we -- one strategy, we thought we could
11 give people two choice: either model from this high level
12 or if you really want to model from detail level, we can
13 provide those 46 negative model. But for today let's
14 look at if -- just the model from high level can do the
15 job.
16 Okay. So here we call cognitive failure mode.
17 We have these four cognitive failure mode. For each
18 failure mode it has a two part for the quantification.
19 That is the base HEP we call. That's and is assumption
20 most of the -- even you have traditional PIFs already
21 good condition, people still don't have a failure rate.
22 You don't do a 100 percent job. And the other part was
23 a PIF.
24 So, we can take a look what the failure mode
25 covers. So, because we only have these four high level

1 failure mode, so it's a task can involve any of this,
2 like requires checking, verify information, response to
3 alarms, monitoring parameter. All this fell into the
4 category. Failure of detection. And just from this
5 table you can see another way you identify the failure
6 mode. Every time on the left column you can see failure
7 of verifying information, failure for response to alarm,
8 failure for monitor parameters. You can even to a
9 further detailed level, not the monitor parameter
10 correctly or monitor the parameter infrequently.
11 Really, you can break down many detail failure mode.
12 So I'd like to talk to the quantification part.
13 The quantification early we talk is a time factor there.
14 So for the contribution from this failure mode it has
15 two part. One is the baseline HEP and the other is a
16 factors of the PIF influence. So I'll talk the base
17 actually first, then talk about the influence from other
18 factors.
19 The baseline HEP actually derive from the
20 signal detection theory, which really the error
21 probability is determined -- supposedly have a good
22 interface, good on those PIFs good. You still get error
23 because it's determined by the signal sensitivity and
24 the specificity of the decision criteria.
25 In some application we said, okay, in the

control room we always have good signal and the operator already well trained to the procedure. Therefore, they have the decision criteria very specific. No uncertainties there. So that case you can get a -- you will say, okay, my base actually is here. Is good now. But we are still monitoring the situation, think about in a scenario like in an accident event. You don't have all the information. All the indicators are not reliable. So that's what we use this table to -- we use these factors. We put a list of the factors that influence in your baseline HEP.

Okay. Any question about baseline HEP?

CHAIRMAN STETKAR: Yes, they don't make any sense. Let's just --

(Simultaneous speaking)

MEMBER BLEY: This doesn't sing to me.

CHAIRMAN STETKAR: First of all it doesn't hang together for me. There's too many tables of numbers and assumed correlations, which is what we're trying to get away from because we already have several methodologies that have tables of numbers and assumed correlations. And creating another one that just has a different one is just another one that has a different -- but more importantly is we've now, I think, deviated pretty substantially from the subset of the generic

1 methodology that's going to be tested and applied at our
2 internal events, that at least there seems to be some
3 agreement among folks that research and folks in the
4 industry that seems like a reasonable approach.
5 There's bugs to be worked out on it, certainly,
6 but -- and now why are we suddenly changing that basic
7 methodology, basic methodology in the sense of how you
8 think about structuring the problem. And once you've
9 structured the problem, how you go about systematically
10 examining factors that will affect the overall HEP, not
11 with an assumed correlation or a shape or some number
12 that you pick out of a table.
13 MEMBER BLEY: Right. And I just don't quite
14 get why we jumped to signal detection theory and this
15 stuff based on somebody's experiment. Are we suggesting
16 we don't do the kind of stuff we're doing in the --
17 CHAIRMAN STETKAR: The expert --
18 MEMBER BLEY: -- internal events?
19 MS. XING: No, we are going to do expert
20 elicitation, as I think when we talk of working report,
21 and we put in both numbers just as an initial
22 demonstration.
23 CHAIRMAN STETKAR: But see, Jing --
24 MS. XING: We will have --
25 CHAIRMAN STETKAR: -- why did you spend

-- somebody spent real time writing words and thinking about all of these curves and trying to develop some sort of approach. Somebody spent real time to do that. Dollars. Resources. We always talk about resource limitations. Why were the resources spent developing this even if it's --

(Simultaneous speaking)

MEMBER BLEY: No, I look at this and say, wow, this is mathematics and --

CHAIRMAN STETKAR: And, gee, no, maybe all we --

MEMBER BLEY: That's what I say.

CHAIRMAN STETKAR: -- need to do is refine the way that we estimate K now because we've already established that we have a K multiplier here. Why did somebody spend the effort to do this if indeed the intent was to follow the methodology that has been promoted for the internal events?

MEMBER BLEY: Is there some belief that this is more accurate to use?

MS. XING: Yes, it's cover the situation like from right now we always have the assumption, okay, like in the current methodology, like some -- if we think you don't -- you either have good indicators or not. If your indicators are not good enough, your HEP will be one.

1 That's our -- that's the feasibility assessment. In the
2 broad scope of in the event case we have certain amount
3 for -- and it you can have at the time even two out of
4 the four indicators fail. You don't get -- you're not
5 going to the HEP equal to one. People are still
6 struggling and that try their best to get work done.
7 CHAIRMAN STETKAR: Sure.
8 MS. XING: And that's the -- there's a
9 probability there. And so I think this the same I think
10 in the one recommendation from the IAEA's Fukushima
11 report is HRA should account for the human relief part.
12 So that curve I can simply make it then like the
13 traditional would do. If we don't get a fail, we simply
14 assign HEP equal to one. We don't want to do that.
15 That's the model that factor. So I --
16 MEMBER BLEY: But you're not doing that.
17 MS. XING: -- completely disagree with you.
18 That's a wasting of resource.
19 MEMBER BLEY: But you're not doing that over
20 in the at-power.
21 MS. XING: Yes, because at power we have a very
22 sharp cut function in the feasibility. We ask the
23 question whether are all the indicators available? If
24 not, HEP goes to one.
25 CHAIRMAN STETKAR: Okay. And what's wrong

with that?

MS. XING: I just explained what's wrong. Because that's not the real case people doing the job.

CHAIRMAN STETKAR: We're doing this though for risk assessment.

MS. XING: Yes.

CHAIRMAN STETKAR: And if I were doing a risk assessment and I screened out that HEP because there's no indicators available, and if a particular scenario showed up as the most important contributor to core damage out of billions and billions of cut sets, I would certainly go back and reexamine all of my assumptions for that scenario, but I wouldn't try to make that scenario perfect on day one, because I would then spend hundreds and hundreds of billions and billions of dollars doing a lot of work that I don't need to do.

MEMBER BLEY: To use that, you really got to make a strong link between the source of the data that's based on and the particular thing you're analyzing and --

MS. XING: Okay.

MEMBER BLEY: -- that you've done that. And I don't know that you can do that in general.

MS. XING: Take another case. If we take that, you said what's wrong with that by assign if an indicator

1 -- if 2 out of 10 indicator --

2 CHAIRMAN STETKAR: I didn't say 2 out of 10.
3 You said no indicators available. See, you have to be
4 really careful about the words. The screening criterion
5 says no indications available.

6 MS. XING: The screen criteria not say no
7 indicator available. If it said that, we really need
8 to modify it. The screening criteria basically, if you
9 read the interpretation, it means if critical indicator
10 not available, HEP will be one. And by that criteria
11 we would simply assign HEP one to pretty much all the
12 actions in Fukushima. But the real thing is we saw
13 people successed in many of the actions.

14 MR. CHANG: A question to the Committee, that
15 I understand that we are presenting a methodology level,
16 like what need to be down and then how to do it says
17 unable. Is that appropriate to include example that how
18 to do this is as one example that in how to do it in this
19 document?

20 MEMBER BLEY: If it's well written, and right
21 now I don't think it passes that test. At least it didn't
22 for me. Examples just seem to be tossed in here and there
23 are different things. And this one's real hard to track.

24 CHAIRMAN STETKAR: I'll keep coming back.
25 The danger of putting in examples, especially if they're

1 presented in the context of a general methodology, is
2 that people will just take those and run with them.
3 Regardless of what your intent is right now, things like
4 these appendices and these curves start to develop a life
5 of their own. And the authors -- you're already
6 defending these in front of at least my challenge. On
7 the one hand you're saying, well, of course we're going
8 to do expert elicitation, but if I start challenging you
9 on these curves, you're already defensive about that.
10 So you're already saying, no, no, there's a real basis
11 for this and I really kind of like this. That's what
12 I'm concerned about.
13 MS. XING: Okay. That's I think there's a
14 misunderstanding here. These numbers I put here, I'm
15 not defending these number. I say they are examples,
16 just demonstrate the -- how they may look like.
17 CHAIRMAN STETKAR: But see, this basic
18 construct is somewhat different, is -- I'm not saying
19 somewhat different, is different than the construct in
20 the at-power analysis.
21 MS. XING: Yes.
22 CHAIRMAN STETKAR: And that's what I'm arguing
23 is the basic construct in the generic analysis. Who took
24 the generic analysis and from the generic methodology
25 divined the approach that's used in the full-power study?

1 Because it's supposed to be derived from this event. How
2 was that particular approach derived from this generic
3 methodology? Not -- qualitatively up at the top it hangs
4 together, but as you get down into the two places --
5 MS. XING: Yes.
6 CHAIRMAN STETKAR: -- where you've circled, it
7 doesn't sound like it's derived from it. It deviates
8 substantially.
9 MS. XING: I take that as a input. And we
10 haven't documented this, but we did have as an end of
11 the product. That's already our consideration. We
12 show to go from this to that one. One way I can primarily
13 illustrate is here. See, every item on the left column
14 is corresponding to or to specific failure mode there.
15 So people can -- when you don't have enough information,
16 you can quantify at this high level, or you can go to
17 this detailed level, quantify them. And in the method
18 --
19 CHAIRMAN STETKAR: Okay. It may be a matter
20 of style. This is my personal style --
21 MS. XING: Okay.
22 CHAIRMAN STETKAR: -- when people can ---
23 (Simultaneous speaking)
24 MS. XING: And I have to say I wrote the report
25 in a very rough state. But from here -- okay. Maybe this

diagram can give you some idea of how that going to work. But this -- I just -- see, on the left column, each of this D1 represent -- that's for division. The first step in division. Okay? Then the corresponding failure mode is not properly managing it, or not selected in that way. That's the one that's not modeled in the basics. So you have -- you could really quantify this whole paper -- it's a failure for -- failure for the decision making, or it's each of this individual part corresponding that failure mechanism -- I'm sorry, failure mode in the at-power method. So therefore, the PIFs should have corresponded to the branching point in the specific, in the at-power method. Except here we have more PIFs than what we had in the method. So it's really not too different approach.

CHAIRMAN STETKAR: I'll have to think about it.

MR. PETERS: Is the fundamental disagreement or issue associated with the fact that we have values that are expert elicitation-generated in the ideas method at power and here in the general methodology they're taking an approach of using some type of mathematical formula for analyzing individual effects of PIFs? Is that what we're talking about?

CHAIRMAN STETKAR: That's a big part of it, but

1 it's not necessarily all of it.

2 MR. PETERS: Okay.

3 CHAIRMAN STETKAR: If I think about the

4 at-power method, the at-power methodology develops crew

5 -- it goes through a process to identify crew failure

6 modes.

7 MS. XING: Yes.

8 CHAIRMAN STETKAR: And then it develops the

9 expert elicitation process to evaluate performance

10 influencing factors, a truth table; I won't call it a

11 tree, that said well these factors affect this crew

12 failure mode and, as a basis from this expert elicitation

13 for people who've thought about the context, develops

14 a admittedly expert elicitation, a number with an

15 uncertainty distribution. Okay. You can argue about

16 how precise is that number and how we -- but that's the

17 process that's approached. And people seem to agree

18 that the given state of the practice, that's a reasonable

19 process.

20 Now, all I'm saying is if that's a reasonable

21 process for that particular application, why is that also

22 not a reasonable process for any possible application?

23 Not with a set of particular crew failure modes or a

24 percent of specific influencing factors, because those

25 might be different depending on whether or not I'm

1 looking at some medical application or if I'm looking
2 at even a different type of set of scenarios in a nuclear
3 power plant, but why does that basic process not apply?
4 And I don't see link here. I just don't.
5 MS. XING: Okay. Let me --
6 CHAIRMAN STETKAR: Maybe I'm missing it
7 somehow.
8 MS. XING: Yes, I apologize report wasn't well
9 written and I'll see if I can give you a quick explain
10 of the link. The link is there's -- basically we're
11 looking two different ways of treating the effect of PIF.
12 One, the way we use this in the at-power one we could
13 call it holistic. We identify these three PIF that are
14 important for this failure mode. Instead of think -- try
15 to quantify the each PIF's individual contribution, we
16 pick this as a whole story. Okay. If A and B happen,
17 says what's the likely failure mode?
18 CHAIRMAN STETKAR: But you did that in the
19 context of that particular application, right?
20 MS. XING: Yes.
21 CHAIRMAN STETKAR: I mean, in principle --
22 MS. XING: In that particular case.
23 CHAIRMAN STETKAR: -- you started off with the
24 whole set and you went through a process that says, okay,
25 these are not so important; these are important. We're

1 going to focus on this. Fine. Okay. I get it.
2 MS. XING: Yes, and the reason we cannot follow
3 precisely that approach, because there we did a lot -- as
4 we say which -- out of a long list of factors here, 30
5 or 40, we only -- we were only afford choose the 3 or
6 4, the top factors that we think is the most important.
7 CHAIRMAN STETKAR: Okay.
8 MS. XING: Now, if we wanted this generic
9 methodology be applicable to many situations, we have
10 to including a lot of factors. So we have this long list.
11 For this long list we cannot use that holistic approach
12 because the combination is that it multiplies.
13 CHAIRMAN STETKAR: Okay. But my point is that
14 I'm not sure that any particular type of application
15 would ever need all of those, but like the full power
16 there is a process that you could say you can go through
17 and selectively determine the set that you would need.
18 MS. XING: And then --
19 CHAIRMAN STETKAR: But the generic
20 methodology, in my opinion anyway, should lead you to
21 do that, not do it for you. In other words, you don't
22 have to solve the answer to every possible problem in
23 the generic methodology.
24 MS. XING: Yes.
25 CHAIRMAN STETKAR: You have to provide a

1 thought process --

2 MS. XING: Yes.

3 CHAIRMAN STETKAR: -- that can then be

4 specialized to different applications. Maybe. I don't

5 know. I haven't thought about the process.

6 MS. XING: I think in that sense we already did

7 more than what we would need for that.

8 CHAIRMAN STETKAR: I think you're trying

9 -- we might be saying --

10 MS. XING: Yes, we -- early we had --

11 CHAIRMAN STETKAR: From my perspective I think

12 you're trying to go too far to have a generic methodology

13 that tries to provide the answer for any possible

14 problem. And you're saying, well, we can't do that.

15 It's too complicated. But I -- you can't do that. It's

16 too complicated. But the generic methodology should,

17 in my opinion again, provide a framework, which you do

18 have at the top, and a process by which you can say you

19 can see how the at-power -- you want to call it

20 condensation, but it's not -- and then if I thought about

21 that same process for a different type of application,

22 if I followed that process, I'd come up with a different

23 set.

24 MS. XING: Yes.

25 CHAIRMAN STETKAR: Instead of 3 or 5 or

1 something like that, I might come up with 16, because
2 it's a really complex type of thing, but not 45, or
3 whatever you had. Right?
4 MS. XING: Yes. Okay. And so, let's see.
5 Assume --
6 CHAIRMAN STETKAR: But then the
7 quantification also would be follow the notion of an
8 expert elicitation process. It might be more complex.
9 Might even be simpler.
10 MS. XING: Your last sentence answered your
11 question. The thing is when we develop this general
12 methodology, we had the agenda our mind we need this
13 method. Initially we want to use this method in our
14 level 3 project. We have flags. We have contend to
15 mention all this and since the Agency cannot every time
16 affording a formal expert elicitation.
17 CHAIRMAN STETKAR: But back to
18 four-and-a-half hours ago, that is the decision that's
19 made by the particular user of a methodology in terms
20 of where they want to simplify it. NUREG-1174 does not
21 tell you what you should think about in terms of doing
22 an analysis for risk-informed allowed outage times. It
23 doesn't tell you that. It doesn't even try to. It gives
24 you basic principles. And the people doing those
25 analyses, even following the Reg Guide for that

1 particular type of application in many cases will make
2 further simplifications, which they must then justify
3 to a reviewer somewhere, and they might be fully
4 justified for the particular application. But the
5 generic methodology; my analogy, 1174, doesn't try to
6 do that. It just tells you what should be done and the
7 basic principles.
8 MR. CHANG: I think --
9 CHAIRMAN STETKAR: So that, for example, some
10 analyst sitting out in a region needing to estimate a
11 human error probability to develop risk significance for
12 a retrospective event that happened, yes, he's not going
13 to have the time to do an expert elicitation. So he might
14 need a help, a crutch.
15 MR. CHANG: Yes, I think Jing presenting here
16 that probably combination of the two products. One in
17 the methodology level for further guidance what need to
18 be consider, how to do that, come to that part. It
19 doesn't come to the end of HEP is what -- that's generic
20 methodology level. I think we have almost --
21 MS. XING: We have --
22 (Simultaneous speaking)
23 MR. CHANG: -- almost there. And then that's
24 -- but we -- when we have this task, it in our minds that
25 we need a method -- also needs a method that general

1 enough can be apply for level 2, can be available for
2 the medical application. That's method level, not
3 methodology level. So that's what's asking about
4 example. That's coming to this generic methodology.
5 Maybe it's an example of getting HEP. That's what we
6 have in mind in our end product.
7 MS. XING: Yes, for example, currently we have
8 the applications, actually control room actions and
9 flags and others. Our users, our custom basis, they are
10 prepared or they're not ready, not going to do the full
11 expert elicitation like what we did earlier. They want
12 a method off the shelf. Okay. Here's a general
13 methodology. I will just grab it use. And there will
14 be another --
15 (Simultaneous speaking)
16 CHAIRMAN STETKAR: There's a difference
17 though between a general methodology and a cookbook.
18 What you're saying is somebody wants a cookbook and a
19 look-up table. That's not a methodology.
20 MS. XING: Then we can rename it.
21 CHAIRMAN STETKAR: No, no, no. But that's not
22 -- I'm sorry. The SRM --
23 MS. XING: Yes, we can separate the two parts
24 actually.
25 CHAIRMAN STETKAR: -- was written to the ACRS.

1 MS. XING: Yes.
2 CHAIRMAN STETKAR: And that's not the
3 methodology that the ACRS wants. The ACRS is looking
4 for a methodology, not a look-up table cookbook.
5 MS. XING: Yes. The way I think -- the message
6 I take from this comment; I think James was right, we
7 combined these two thing, a cookbook and a general
8 methodology.
9 CHAIRMAN STETKAR: And again, I use analogies
10 an awful lot, but if I think of rulemaking, if you think
11 of the methodology as a rule, if you think of the Reg
12 Guides as further information, well, the Reg Guide level
13 is where some of the -- hate to call it cookbooky stuff
14 might apply, or the elaboration of the methodology for
15 particular applications, like the at-power stuff, were
16 you indeed do have examples; hopefully eventually we'll
17 have examples of the expert elicitation with numbers and
18 tables, to see how it works, which then will be enshrined
19 -- use the term also -- for those types of applications.
20 MS. XING: Yes.
21 CHAIRMAN STETKAR: Right?
22 MEMBER BLEY: That's a vision.
23 CHAIRMAN STETKAR: Just stating a fact.
24 Okay.
25 MEMBER BLEY: That's a vision.

(Laughter)

MS. XING: I take your input and I think if I separate it into part, it will make this much clearer how we do. But on the other hand, I think, at least for now, I will talk to my manager. I think we're getting two different direction from ACRS. As you say, you think of this general methodology almost like a Reg Guide. From our users, they want a cookbook. This book has a bunch of menus.

CHAIRMAN STETKAR: I again; and just as an ACRS member, and this is a Subcommittee meeting, I look at the general methodology at the level of conceptually like a Reg Guide 1174. That's a general methodology.

MS. XING: Yes.

CHAIRMAN STETKAR: Where the subsidiary Reg Guides that have been developed for different risk-informed applications look at that general methodology and say, okay, we'll specialize it this way. Or I look at the general methodology here at the level of a rule where the specific application; let's say the at-power, is like a Reg Guide.

MS. XING: Yes.

CHAIRMAN STETKAR: Okay. So that sort of hierarchy.

MS. XING: Yes, and the plan we had I think

1 we're not -- that's down the road. We plan to do after
2 we get this general methodology done -- we're going to
3 tailor this different part for specific one.
4 CHAIRMAN STETKAR: And that would be great on
5 -- kind of dragging on too long, but my only comment would
6 be, at least the way it's presented now, the snapshot
7 that we have in time today of the general methodology
8 document is I think you're trying to get to too much
9 detail of the how-to and the results and the calculations
10 to try to make that methodology apply to any particular
11 application. And I think you're trying to go too far
12 in that.
13 I think that a lot of the stuff that's in there
14 is more appropriate for these more focused applications,
15 if you will. For the methodology it should say, yes,
16 I can see how this application is derived from that
17 methodology and I can see how this one is derived from
18 the methodology. And they both hang together in the
19 sense that they have those common elements, although
20 obviously different combinations of perhaps crew
21 failure modes or specific influencing factors would be
22 different. And the results of expert elicitations, if
23 you did expert elicitations for all of them, it would
24 be different -- could be different.
25 MR. PETERS: And I think that's driving down

1 us a path of expert elicitation as the method for doing
2 all your reliability through the future. And I think
3 an approach that our team has been taking is they're
4 looking at the fundamental underlying science. So
5 NUREG-2114 is this overall basis looking at the various
6 mechanisms that apply, not just a human in a nuclear power
7 plant operation, but a human as a human. I don't care
8 if I put them in a nuclear power plant or I put them in
9 a submarine or I put them somewhere else, if there's an
10 action, there's a typical reaction response time. And
11 our team is trying to make that scientific linkage
12 between 2114 and the outcome of what these results of
13 their actions will be.
14 And so, the approach they're taking is to try
15 to scientifically, at least semi-scientifically make
16 these kind of appropriate weightings to an alternate
17 method of how you do human reliability analysis?
18 Obviously the ATHEANA method and other methods have used
19 expert elicitation as their way, but we have a whole
20 litany of methods that have this kind of quantification
21 model where they have these influencing factors and they
22 do multiplication, which of course when we look at the
23 science under those, we find a lot of -- we have a lot
24 of issues ourselves with that. So we're trying to
25 provide from that quantification aspect what we consider

a more reasonable or more scientifically sound basis.

And what James is doing on the back end with the SACADA data, they're trying to work getting actual data to fit and compare these, what we say improving the science, or even improving the expert elicitation, whichever method you use for quantification. They're trying to fit that and hope that we can get a more firm basis, a more scientific basis.

So, what I feel is an expert elicitation is if I go out and do an expert elicitation for any particular action, why did I even make a 2114? Why did I even break it down to perform its influencing factors? Why did I just get a scenario, plop the team of guys in there and then just come up with --

(Simultaneous speaking)

MEMBER BLEY: But that has a real easy answer. They got to know that stuff to do a knowledgeable elicitation. If you just want them go in there and throw darts at the board, they don't need it. But they need that to understand how to do it.

I kind of understand a lot of what you're saying, but a lot of this science comes from very specific places and very specific experiments. And likewise SACADA is going to be from the plant, from simulators. And whenever we go to using some of the scientific

numbers, we got to be very careful that we think about all those things in that basis document and how the scientific data fit within that framework. Does it only answer a little piece of the problem, or is it the whole answer? Is the whole answer for every possible situation, or just for some? And that's really crucial.

So you don't get better answers by being scientific. Because that's the only data I have, I'm going to use it everywhere. You have to use it judiciously and lay out the framework for why it's relevant to the case at hand. And that's a big job.

MR. PETERS: Oh, it is.

MEMBER BLEY: That's a big job. If we really had good numbers for everything we're trying to quantify, that would be grand.

MR. PETERS: Yes, I mean --

MEMBER BLEY: But, and when we don't, we have to do something else. We can use data from experiments if we properly condition it. It's also an expert elicitation thing, how to apply that to a specific case. So unless you match perfectly, you got to do something beyond pulling these numbers from the studies.

MR. PETERS: I would debate perfection, I mean, because our job here, we're trying --

MEMBER BLEY: Yes, but that's what all this is

1 about is not perfect, but it's why do we believe it's
2 reasonable? Now, for this particular thing, which comes
3 from -- which I never heard of before, but I'm sure Jing
4 has -- psychophysics, we got to know why it's appropriate
5 to use that.
6 MR. PETERS: Sure.
7 MEMBER BLEY: Right now the document doesn't
8 get us there.
9 MR. PETERS: And what I'm looking at is -- I'll
10 take a step back as a non-psychologist or cognitive
11 scientist-- is that I look at the current state. My job
12 in our agency is to improve the current state of practice.
13 And if I know from all the experimentation that what we
14 have now -- say the stress factors in SPAR-H are
15 completely -- they completely don't match how people
16 respond to stress, but that's the current state of
17 practice. And we model every plant with SPAR-H and we
18 come forth and we come and debate these human error
19 probabilities. Why is that a better approach? I mean,
20 because if I don't make this work, people are still going
21 to be working on SPAR-H and using these values.
22 So I see our job as thinking what do we
23 currently? Try to make it more realistic. Try to make
24 it better. I can't achieve perfection, but I can start
25 approaching towards it. And so, when I see what they're

doing --

MEMBER BLEY: But to approach it it has to be put into a context that makes sense.

MR. PETERS: Oh, yes.

MEMBER BLEY: For whatever particular thing we're looking at.

MR. PETERS: I agree.

MEMBER BLEY: I think that's what we're saying.

Now, from all of John's stuff I would distill two things from it: One is we've got the basis document. The methodology is a bridge on how to use that stuff in the basis document to come up with a way to try to do HRA in general. Under that you specialize it to different cases. You may have a document that has examples or alternative things. That would be okay, too. But whenever we're done, there has to be a clear path from the generic methodology to each of these applications, including what we're doing for plants at power. So you have to be able to look at that general methodology and say I see how this gets me to this place. Even though we did it backwards, that's what we need to end up with.

MS. XING: Yes, in fact --

MR. PETERS: I like that recommendation.

1 MS. XING: Yes.

2 MR. PETERS: We'll take it back as a team. But

3 I like that concept for how we would lay it out.

4 MEMBER SCHULTZ: We were with you up to slide 11.

5 (Laughter)

6 MEMBER SCHULTZ: And then there was --

7 MS. XING: That's okay. I wasn't

8 planning --

9 CHAIRMAN STETKAR: No, that's right.

10 MS. XING: -- to go every slide anyway.

11 MEMBER SCHULTZ: And then we ran into a

12 roadblock associated with the quantification model and

13 it seems as if we jumped from the general descriptive

14 evaluation, which was, as you showed in the box before

15 with a circle around it -- that's what we were discussing.

16 And then suddenly we moved into a quantification of the

17 particular model. That's the at-power evaluation. And

18 the method used to quantify was something that kind of

19 sprang out of the box as well. So at least do some

20 additional thinking about that.

21 And just to have a methodology and say, well,

22 yes, but we're not going to really do that, we're going

23 to do expert elicitation, as John said, that may never

24 happen. That may never happen in practical application.

25 People will look at these numbers and say, oh, that's

1 how I'm going to do it. I don't want to do the expert
2 elicitation. But we don't know whether -- we have a
3 description of where these numbers came from, but --
4 MR. PETERS: Yes, and it's not feasible, it's
5 not practical to do, like you said, the full-scale expert
6 elicitation. We'll have to devise quantification
7 schemes based --
8 (Simultaneous speaking)
9 MEMBER SCHULTZ: I don't have to do that,
10 because if I have this information, I can just use this.
11 MR. PETERS: Well --
12 MEMBER SCHULTZ: So that's my problem with it.
13 MR. PETERS: I agree. I mean, if you have
14 values --
15 MEMBER SCHULTZ: And I don't know where these
16 came from, but I might use them.
17 MR. PETERS: What you're describing --
18 MEMBER SCHULTZ: And that's my concern.
19 MR. PETERS: -- is how we use all these
20 methods now. You're exactly right.
21 MEMBER SCHULTZ: Yes.
22 CHAIRMAN STETKAR: Well, yes, you don't know
23 where they came from, but they are presented as
24 fundamental science from cognitive --
25 MEMBER SCHULTZ: So I can pick from --

1 CHAIRMAN STETKAR: -- whatever, the words that
2 are used in there -- cognitive science. And, oh my God,
3 really smart people did this, so, sure, I'll just use
4 --
5 (Simultaneous speaking)
6 MR. PETERS: And likewise, I would challenge
7 expert elicitation, too. I mean, the experts are
8 limited by their own understanding of scenarios and --
9 MS. XING: Okay.
10 CHAIRMAN STETKAR: Absolutely.
11 MR. PETERS: There's no perfect way to do this.
12 CHAIRMAN STETKAR: I mean, I'm not defending
13 expert elicitation as a surrogate for compiling infinite
14 amounts of data, but we're not going to be able to do
15 that, either.
16 MR. PETERS: Exactly. So we're trying to find
17 ways to improve both.
18 CHAIRMAN STETKAR: But we do actually have
19 experience that in many cases expert elicitation can
20 provide more accurate, not as mathematically precise as
21 engineers like from particular models and assumptions
22 and -- but more accurate results than you get from
23 believing in a particular model or correlation. There's
24 evidence that supports that. Engineers don't like to
25 do that, but indeed expert elicitation oftentimes, if

1 it's structured properly, isn't too bad.
2 MS. XING: I don't think we are talking two
3 different approach. It's just that you are talking
4 whether you do expert elicitation in a holistic way like
5 what we did in the at-power method. Think of this
6 several factor, but those are -- think of as a story
7 what's going to -- what's the likely cause of failure
8 versus here we're going to do expert elicitation on each
9 individual factors of -- assume all the other factors
10 are good. How much this factor would bring up, bring
11 your action team up.
12 CHAIRMAN STETKAR: But --
13 MS. XING: So that's really no difference.
14 And the way we justify to do this is because we review.
15 And if you want to see, there's a detail in our -- from
16 previous expert elicitation. What we have here is the
17 numbers, data is what we did for the other expert
18 elicitation, too. SHAC process request you collect and
19 analyze, collect all the available data. This is a part
20 of the available data. And for the expert elicitation
21 we conducted -- we collected data like this, gave it to
22 the expert in the workshop to inform them this is the
23 part of the data from cognitive studies.
24 MEMBER BLEY: Not exactly. It's been --
25 (Simultaneous speaking)

1 MS. XING: They may not operate. It's part of
2 the data.
3 So I think in the 300-page report, actually
4 in the appendix, we have this kind of data there. We
5 have data. We started -- they provided analyst's data
6 from the literature. Whether -- from what extent the
7 expert used that data, we don't really know. But that's
8 what we provided.
9 So we are using the same as we proposed. These
10 numbers will be acquired through expert elicitation.
11 This is just some initial information we have put here
12 to illustrate how they look like in a particular setting.
13 And the only difference you are looking at is the two
14 process. It's whether you consider fact of several
15 factor together, or you consider the each individual
16 factor.
17 CHAIRMAN STETKAR: Well, we're running short
18 on time, and James needs a little bit of time to talk
19 about SACADA, but I didn't go through the expert
20 elicitation process. From what I've heard though is
21 that in many cases considering those factors in total
22 provides better -- I hate to turn to insight, but I'll
23 use it -- insight to the people doing that elicitation
24 than if they simply put blinders on and consider them
25 each individually. Assume all others are perfect.

1 That's often difficult for me because I know not all
2 others are perfect and I know that somehow these things
3 work with one another, and yet -- and if I have that
4 framework for the expert elicitation, I can look at those
5 combinations and say, oh, yes, this one is somewhat
6 different because I get to think about all of those in
7 combination, not in isolation assuming that I hold all
8 others perfect.
9 MS. XING: If you talk with our expert -- and
10 not everyone talks -- some of the expert in our workshop
11 actually talk their thinking process how they get the
12 numbers. Well, I consider the contribution of
13 individual factor then think about use that as a basis
14 and think about when they combine that there's a -- in
15 fact, our first workshop we actually did that, look at
16 the -- ask the expert and talk about the contribution
17 of the individual factor. I mean, they may once they
18 gave the number look like a holistic thing. Well, I'm
19 thinking of all this factor together. But in their
20 thinking process they still evaluate as a contribution
21 each individual factor. It's only how this individual
22 factor combine together. That part is ambiguous
23 problem. Different people have different way of combine
24 them. And what we did in this study we really went
25 through a lot of study and we are convinced that the

1 easiest way is just made a combination of these factors.
2 CHAIRMAN STETKAR: Are you convinced that that
3 assumed model is consistent with the way people actually
4 combined the factors in the expert elicitations?
5 MS. XING: Yes, I want to check that. Actually
6 when we talk about -- early we talk about we want to try
7 to interpolate. We want to say if -- what kind of rules?
8 We said we're going to do interpolation. The expert,
9 also they did interpolation. I think Dennis was in the
10 process. You find all the factors are better. And some
11 were in the middle. Some were in the bottom. Then,
12 well, in the middle is probably this much. So we want
13 to look -- exam the data, see if we can find something
14 there, or ask individual people what do you think when
15 these thing come together? At least we find a lot of
16 experiment data show when the two factors come together,
17 it's simply added together, not in multiplication.
18 And if we are eventually going to go this path,
19 in the -- we have people, expert evaluated this
20 individual factor, which you can think is like one pass
21 in the division tree, in the combination with all the
22 other factor that only this factor is high. So, like
23 you are getting those anchor point in the case you cannot
24 evaluate all the 900 paths.
25 CHAIRMAN STETKAR: Yes, my problem is I'm not

so concerned about the good, good, good and the bad, bad, bad anchor points. I'm concerned about the real complex stuff in the middle.

MS. XING: Yes, that's we want to --

CHAIRMAN STETKAR: I don't know how that works because I wasn't part of the expert elicitations that have been performed, but my experience from other things where people develop little models that you either add or multiply, or whatever you want to do with factors, is that you come -- just that, that divorce people from thinking about some of the complex stuff.

MEMBER BLEY: I might be able to shed a little light. I think different people did it differently. We talked about these issues. Some I know thought of the integrated set and used that. And I'm pretty sure that at least one consider them essentially independent.

CHAIRMAN STETKAR: Yes.

MEMBER BLEY: But it was something talked about and discussed.

CHAIRMAN STETKAR: That's also though in my mind part of the expert elicitation process in terms of that feedback that wasn't -- when you look at those differences --

MEMBER BLEY: People wrote down the basis for each one. And those are piled up in stacks of paper

1 somewhere.

2 CHAIRMAN STETKAR: Well, Jing said she's going

3 to go back and look.

4 I hate to cut this off, but James does want

5 to talk about SACADA and --

6 MS. XING: Yes.

7 CHAIRMAN STETKAR: -- we would like to

8 -- you've heard our feedback and it's enough to -- so

9 unless there's other comments that whoever's left here

10 wants to make, or, Jing, if you want to say anything,

11 I think we should just let James talk about SACADA.

12 MEMBER BLEY: Can I throw in one last one?

13 This might help when you're doing it. Draw a little

14 diagram of the methodology and make sure that it flows

15 from beginning to end, that it points -- so that you can

16 go to these applications and that the structure of the

17 report is real clear against that picture of how it's

18 all laid out.

19 MS. XING: Good suggestion.

20 MEMBER BLEY: That usually helps me when I do

21 that, so it's worth a try.

22 MS. XING: Yes. And I think the input I got

23 if I separated this generic methodology versus --

24 (Simultaneous speaking)

25 CHAIRMAN STETKAR: I think that's really

1 important.

2 MS. XING: I think that --

3 (Simultaneous speaking)

4 CHAIRMAN STETKAR: I understand the problem

5 you're struggling with trying to solve everybody's

6 problems for them and --

7 MS. XING: Yes.

8 CHAIRMAN STETKAR: -- getting feedback from

9 your potential users, at least inside the NRC. I

10 understand that, but I think that if you take this sort

11 of tiered approach, if you will, where the general

12 methodology is not unduly affected by your concerns about

13 one particular user or how easy or difficult you want

14 to make it for that user --

15 MS. XING: Yes, I --

16 CHAIRMAN STETKAR: -- you might get to an end

17 point quicker, at least on the overall methodology. How

18 many other different types of application reports with

19 perhaps different appropriate ways of simplifying the

20 process for those applications. Once you get the

21 general methodology laid out --

22 MS. XING: Yes.

23 CHAIRMAN STETKAR: -- and the results of

24 testing, at least one specific application of that

25 methodology for the at-power, to make sure that it indeed

1 sort of works that way.

2 MS. XING: Yes, that --

3 MEMBER SCHULTZ: And you got that in the

4 quantification. I mean, even with the level of detail

5 you have, it's still only partially developed. So there

6 needs to be a program associated with how that piece of

7 it's going to be brought forward and how it does compare

8 with other options that might be used.

9 MS. XING: Okay. Thanks.

10 MR. CHANG: My name is Jim Chang. I work for

11 the Office of Research. My last time here did briefing

12 to brief the Committee on the SACADA database. It was

13 about two years ago. That was the time that we establish

14 a bilateral agreement with U.S. bench and then starting

15 correcting data.

16 The international visitor here that these two

17 days that we have the SACADA meeting that the purpose

18 of that we thought we have some data in the database.

19 It's a good time that we analyze data and then come to

20 give a review, see that whether the way though we analyze

21 the data is approach feasible to inform the HRA and then

22 how to inform the HRA in what aspect. And then also

23 looking at the broader issue that's include and what

24 things we need to consider including what occurrence is

25 sufficient, what else need to improve and then the way

that the data entry, that quality, that aspect. So these two days give us a review of the data we have.

It's already know that this SACADA data program is designed is to try to piggyback to the existing simulator data collection program, like operator relicensing program all these Halden simulator activity. They have conducting the simulator experiments and then the collection. And we try to determine this methodology piggyback through the process, see -- looking for the long-term ratio that the person collecting the information that could be put in training or the researcher doing experiment.

When they collecting their data for their purpose and then can also get data in here. So that's a consideration that the -- the main purpose here is try to get large number of data to provide indication of certain performance. This picture, I'll start on the low, low part of these pictures. Talk about is what we -- the data here. In the simulator simulation from the initial condition. Okay? From initial condition as well that the training that were inject the -- will cause malfunction of either the -- saying that pipe break or the component fail open, like this. And then, so that's given that the malfunction that we'll say, okay, well, how crew responds to this malfunction?

And what they have the training objectives, so these -- given this malfunction, like here is example that's a loss of a ECW 1A malfunction. So it was training objective. The trainer will want to see that the responding to this malfunction. Like, for example here crew need to recognize loss of WE flow to A train lost.

So, this issue of the -- that's because test objective elements, is that our data unit, data record on data points. And in the information here shown on the table here that it's an indicator, what's the perspective? What's the principal responder to that particular element? Like here, that any crew could respond to detection. And then also the color code is how important is this test? That's currently that -- well, the plant we work with, they use a four-color code. Red means a critical task and orange, that's something in -- describe in the procedure has -- it failed. That has a significant impact on plant safety, but not come to the critical task level. And yellow is typical the procedure step. And then the white is less important.

So, the way SACADA -- so each element is a data point. And in the way that SACADA collected the information for each data element including two portion. One is the prospective portion and then the other is the

1 resource portion. The prospective portion here is in
2 the picture on the left, on your left -- on your right
3 that is the context. The context means that as the
4 situation -- and we represent the context by so-called
5 performance. And this context was entered by the
6 trainer.
7 Based on the trainer's understand of the crew,
8 the scenario and the -- so he will come here, say, okay,
9 when the crew come into this situation that what expect
10 the situation. What's the work load level? Okay?
11 That's we have two -- either two disparate states, three
12 disparate traits that -- for each performance factor.
13 So that's -- trainer will propose perspectives
14 respective to -- said, okay, given this situation that
15 what's the context for this each individual elements?
16 So base on the -- because each individual
17 elements has this different -- they perform a different
18 person and for different specific task, so context would
19 be different. And then the second portion of the data
20 points is the resource aspect. For this specific crew
21 in this scenario, to the end of scenario that's how good
22 they performed these elements. That's including
23 information -- the performance displacement. It could
24 be SAT data. That's a very good -- that could be very
25 -- a model for all other crew. Well, SAT, that means

1 satisfactory. Or SAT data, that means that they met the
2 performance requirement, but there's room to improve
3 their performance or simply UNSAT.
4 So we did need the trainer to -- and the crew
5 to the end to rate their performance. And for this data
6 that's come -- it's graded as SAT data or UNSAT. We ask
7 more question, more information. Say what type of
8 performance deficiency identified it? And what's the
9 process of that? And given this, the relationship,
10 that's the principal responder has -- his performance
11 deficiency on the -- but from the crew contacts what are
12 the human error has been -- is recovered, how is
13 recovered, they recover it, and by whom? And then that's
14 how -- look at the crew as a whole. How this thing
15 affected the scenario for question? Okay. And then
16 that's -- to the end that's addressing the training
17 needs, is there any remediation need to be -- what -- or
18 what remediation need to be performed to address this
19 performance deficiency?
20 So, from the HRA perspective here that we are
21 interested in the prospectives, the information, the
22 contact information and also the -- given the context,
23 how -- what's the error that's made. Okay?
24 And now I move to this portion here. For this
25 workshop that we discuss for data entry, use SACADA

1 taxonomy. The first is operator training. This is
2 simply that the plan we work with, they enter the data
3 into the database here. This plan that in the -- we start
4 -- we work with them. And then in May 2012 they did a
5 pilot study. Pilot study the data that we have some
6 modification to the methodology. Come to the stable
7 -- we have stabled methodology was in 2013. So the
8 number of scenario here represent that from 2013 to I
9 think few weeks ago, the number of scenario we collect
10 from that -- these plans. And we also let's look back
11 into the HRA benchmark base on the NUREG reports, direct
12 NUREG reports. And though these are information into
13 the SACADA data.
14 From -- I think Jing noted last year that Halden
15 started use our SACADA, so the trainer, once that they
16 perform experiments, they load data into SACADA. Here
17 on these three sets of data that are in the workshop we
18 also has carried. They use the SACADA taxonomy to
19 analyze their three scenario night crews performance and
20 then we discuss the inside of the finding in this
21 workshop.
22 This table that's show you that -- I want to
23 show you that the three data that's the NRC -- we have
24 access to. The number of data points here, that's what
25 we see operator training is we got 6,771 data points.

1 That's each -- I mean, each data point including the front
2 end context and the performance results. U.S.
3 benchmark, there were 176. And the Halden experiment
4 we got 95 data points. Total we got a little bit more
5 than 7,000 data points.
6 Given these in that we -- it specify UNSAT,
7 that's a training that's 67 data point as -- of UNSAT.
8 And U.S. HRA benchmark, 12 and Halden experiment, 10.
9 Here we see that the UNSAT ratio that's for operator
10 training is about one percent, so simple by divide -- the
11 number is divided by the total number. And then that
12 we see that the experiments, U.S. benchmark and the
13 Halden experiment is about 10 percent.
14 CHAIRMAN STETKAR: But, James, comparing
15 these numbers, help me, because you said that the
16 trainers when they develop a scenario assess the
17 different PIFs. You said two or three -- like work load
18 is high, or work load is low, or work load is average,
19 or something like that.
20 MR. CHANG: Yes.
21 CHAIRMAN STETKAR: These are simply raw
22 numbers. They're not normalized by different levels of
23 challenge to those PIFs, are they? For example, this
24 says, well, one percent UNSATs for operator training.
25 Well, if all of the PIFs for the operator training were

assessed good, good, good, good, good, I wouldn't expect a very high. And yet, if the benchmark and the Halden experiments are tailored to particularly challenging conditions, you would expect those higher numbers, right?

MR. CHANG: Yes, the meaning of presenting these number just --

(Simultaneous speaking)

CHAIRMAN STETKAR: Is --

MR. CHANG: Yes, it's because the Halden, this experiment tend to go into more -- much complicated --

(Simultaneous speaking)

CHAIRMAN STETKAR: Sure.

MR. CHANG: So that's what we see that the --

CHAIRMAN STETKAR: Okay.

MR. CHANG: We are not going to use this for HRA.

CHAIRMAN STETKAR: I just wanted to make sure I didn't misunderstand these numbers --

MR. CHANG: Yes.

CHAIRMAN STETKAR: -- because I thought I understood what you were doing in the process.

MR. CHANG: Yes.

CHAIRMAN STETKAR: Okay.

1 MR. CHANG: Yes. So this is kind of just
2 provided a n very high-level overview.
3 CHAIRMAN STETKAR: But I mean, you do have the
4 data at that level, so you can look at a particular
5 trajectory of performance influencing factors --
6 MR. CHANG: Yes.
7 CHAIRMAN STETKAR: -- whether you call it
8 high, high, high, low, low, low, medium.
9 MR. CHANG: Yes.
10 CHAIRMAN STETKAR: And then extract from that
11 this type of information, right, in principle? I mean,
12 if you had an infinite number of experiments.
13 MS. XING: You can also --
14 (Simultaneous speaking)
15 MR. CHANG: Exactly. Yes.
16 CHAIRMAN STETKAR: That's the good of it.
17 MR. CHANG: And then so, each -- you look at
18 each data point that -- from the perspective that's
19 aspect. We have a different influencing factor. This
20 is one type of cognitive activity. So here that's in
21 the SACADA database we have five options. That's
22 detection, monitor and detection, or diagnosis,
23 understanding activity, response planning or make
24 decision activity, manipulation. And then the other one
25 was external communication.

1 This was -- it's negotiation with the plants.
2 The plant we work with come out with it, well, that did
3 the way that they can accept, they can use the data. And
4 look at this data point here. This data points is
5 already some of these three data I mention earlier.
6 That, well, it's pretty much evenly distribution of the
7 data points in each category. And UNSAT, it's also
8 relative. It's a big -- look at UNSAT rate. This just
9 provide that level of the delayed data we have.
10 So for these thing, that for monitoring and
11 detection that we have a sets of the performance
12 influencing factors and then to characterize the
13 context. This performance influencing factor that we
14 divided to two group. That's one is that we cause
15 overarching effects like work load, that affect all the
16 cognitive factors. And then there's also specific data.
17 And therefore alarms was -- it would say -- it would ask
18 the performance influencing factor. It would say what's
19 the situation of our alarm? So we state it's dark.
20 That means single, two alarm in the really dark
21 alarm. Or busy. Okay. There's some alarm coming in,
22 but it's not come to the third level that's overwhelmed
23 that's like a Christmas lights coming in. So, that's
24 for each cognitive function that SACADA has these
25 specific -- PIF specific to these medical need function

1 and then also that -- the overarching factors. And so,
2 we have all these characterize in that -- for all these
3 700 also data points.
4 And the way that we -- when we determine this
5 taxonomy, that the way the system that we have, we know
6 that we may -- well, likely that I'm able to get a large
7 number of data in a short time to for -- to get all the
8 data we need. And then we need to be better. How can
9 we evaluate it, how we can use the limited amount of data
10 to inform better HRA? And one thing we come up was a
11 similarity-based data analysis. So the bottom side here
12 that -- now I have HRA task I need -- I want to analyze.
13 Based on the event sequence, based on the task discretion
14 that's was HRA and on this predictive perspective there
15 to -- what's the context in performing these tasks? And
16 then so we can take this context into SACADA database
17 to identify the exact combination of context here, say,
18 okay, this pool of element have the same context.
19 And then given this pool of elements, how many
20 success? How many failure that this -- and then given
21 these -- and failure is a very -- what type of failure
22 and what's the cause of that? That will give us the
23 information, this the connection, this information.
24 That's what we plan for. And through these exercise
25 -- so we just exercise that. We going to find an exact

contact. Well, let's -- depends on the way that the PIF confirmation. Some of them we may able to find sufficient, that's 100, but they have -- and some of them we can just be. These are two, three crew, the fitting crews that only perform these same elements.

And, well, just doing the things that here that we tried to use the, say, cognitive activity is decision making. Okay. This is example. So these are the factors for the response planning, or decision type of activity. And then it's -- so here, that's based on it will ask better what's the response planning basis. It's a skilled-based, a procedure-based, knowledge-based. And then that's a -- what's the crews to perform these type of procedure?

These three are the response planning specific performance influencing factors. And below that's like a work load, time criticality, communication required, miscellaneous data performance influencing factor. These are the overarching factors we ask in the context. We got 1,990 data points. And then it was narrow down. Say, okay, it's a procedure-based reduced to the 1,282. And gradually that come to the end that exact mention this specification, we got 201 data point.

For this exercise that's -- well, we go -- going to here. What are these elements? What are these

elements? These are the discretion and they come in from -- come from the nice and narrow 16 elements. And the numbers here is showing how many crew went through this element, and then how many UNSATs came by there. So, just a curiosity they're changing -- simply they're doing the same thing, but changing let's say the final procedure to knowledge base, and we got the 115 data points. And for these 115 data points we found one element was specified as UNSAT.

So, this is the way that we started. Now, this, but these tasks, they are characterized in this context. And we saw that, well, let perform similar change and so that we can -- some of these data point they give instead of 130 out of 14, that's now I can say that I'm more felt comfortable in -- based on my data 130 out of 115. That's the way that we tried to -- that to inform these HEP.

MEMBER BLEY: James?

MR. CHANG: Yes?

MEMBER BLEY: Have you done enough of this that you're nearing the point of preparing a report of some kind?

MR. CHANG: Not yet. Not yet. We haven't do it -- done extensive. But because these -- a lot of these doing this was manually. And so it's a manual exercise

that we know that, okay, what -- how we are going to analyze the data. And then now we are in the process of ask them to tell their program to insert data in the format that to help us easier --

(Simultaneous speaking)

MEMBER BLEY: Are you free to use this in any want for this as long as you don't identify the source?

MR. CHANG: Okay. Say --

MEMBER BLEY: The agreement you have with the utility that's collecting all this information, we can use it any of these ways to support HRA as long as we don't identify the source?

MR. CHANG: Yes.

MEMBER BLEY: Okay.

MR. CHANG: Yes.

CHAIRMAN STETKAR: James, one quick -- I do -- we want to finish because it's getting late, but go back to the -- that's good. No, the one that's got the red and the black. You mentioned earlier when the simulator and stuff, your set-up scenarios, you said you had them rate PIFs. You said two or three. Are these actually the ratings that the simulator --

MR. CHANG: Yes.

CHAIRMAN STETKAR: Okay.

MR. CHANG: Yes.

1 CHAIRMAN STETKAR: I just wanted to make sure
2 that it wasn't something you'd sort of --
3 MR. CHANG: Right.
4 CHAIRMAN STETKAR: -- expanded the scope of
5 things to get a better delineation. Oh, I get it. Good.
6 MEMBER BLEY: I think James told us the last
7 time the way they input all this and the questions that
8 are asked to get there are something that involved a lot
9 of cooperation and iterations between what we see --
10 CHAIRMAN STETKAR: He did --
11 MEMBER BLEY: -- in Idaho and --
12 CHAIRMAN STETKAR: -- but in his quick
13 introduction he said for the PIFs we just -- he said two
14 or three. And this looks like three or four and not
15 necessarily just bad or good. It's quite a bit more
16 thought. And I just wanted to make sure that indeed it
17 was consistent.
18 MR. CHANG: Yes.
19 CHAIRMAN STETKAR: Good.
20 MEMBER SCHULTZ: James, before you go on, I'd
21 also be careful when on slide 30 that you showed us where
22 you were taking the same data that you had related to
23 the UNSAT rate on the previous slide. the next one
24 forward. I'm not sure it's what we have in our package.
25 MR. CHANG: I think here.

1 MEMBER SCHULTZ: Thirty? It was that one.
2 MR. CHANG: Thirty. Yes.
3 MEMBER SCHULTZ: Okay. So you took the data
4 on what was our previous slide and that was UNSAT rates
5 for different types of scenario.
6 MR. CHANG: Yes.
7 MEMBER SCHULTZ: Put it on the slide. You
8 categorize it along with the different categories on the
9 left-hand side.
10 MR. CHANG: Yes.
11 MEMBER SCHULTZ: And then you bundle it with
12 UNSAT data. But characterizing that as an UNSAT rate
13 I don't think is correct. You're really seeing what
14 UNSATs were in particular categories. Which of the
15 UNSATs that had a certain --
16 MR. CHANG: Yes.
17 MEMBER SCHULTZ: -- UNSAT rate were in that
18 category there.
19 MR. CHANG: Yes.
20 MEMBER SCHULTZ: The UNSAT rate is a little
21 misleading.
22 MR. CHANG: Oh, okay.
23 MEMBER SCHULTZ: But just be careful when you
24 look at it and then you describe what you're trying to
25 -- how you're trying to present this data. It's not --

1 CHAIRMAN STETKAR: To me it says about 25
2 percent come from diagnosis and about 25 percent from
3 manipulation, 25 percent from communication, about 122
4 percent each of monitoring and --
5 MEMBER SCHULTZ: Yes, exactly. That caution,
6 using that column to evaluate where they're coming from
7 is appropriate.
8 CHAIRMAN STETKAR: Yes, it's just the
9 distribution.
10 MEMBER SCHULTZ: Somebody could look that and
11 say, well, the UNSAT rate and the monitoring and
12 detecting is that, but that's not exactly right --
13 MR. CHANG: No, not --
14 MEMBER SCHULTZ: -- because the data you
15 gathered from had different UNSAT rates for
16 different --
17 MR. CHANG: Yes.
18 MEMBER SCHULTZ: -- there were different
19 performance influence factors --
20 MR. CHANG: Oh, certainly. Certainly. Yes.
21 MEMBER SCHULTZ: -- yes --
22 MR. CHANG: Yes.
23 MEMBER SCHULTZ: -- for each of those data
24 sets.
25 MR. CHANG: Yes. So, given the limited data

1 point we have one thing that's -- we can go look into
2 that exact combination of certain PIF to get it, but they
3 are data points we have.
4 The other thing that we are looking was, okay,
5 how about I simply look at these negative -- number of
6 negative factors. So for example, that's if this were
7 loss context specific, but now I say, okay, now this is
8 the factor that I'm -- for detecting alarm. And then
9 that's just looking at -- each factor has either binary
10 or three states. And then I just take this, what we saw
11 the most challenging portion. For example, that the
12 detecting mode is awareness and inspection, which is the
13 most negative one. And then the alarm tile status is
14 overloaded, etcetera.
15 So, going to the data here that's looking at
16 the alarm, these are alarm detection. And then that's,
17 well, given these elements, how many of these are
18 red-highlighted and appear for this data point? Okay.
19 So, I got this. So, the negative number means that it
20 seems everything is good. Not on everything. No, these
21 negative -- any of these are PIF.
22 Okay. So, this could be situation here. For
23 example, this alarm tile status could be dark, busy,
24 overloaded. If this tile status will check busy or dark,
25 this will -- in that category were no negative factor.

1 Only the overloaded was checked is a consider as one.
2 So I basically was add in that how many of these are red
3 factors checked for this application.
4 Okay? How many data points are in detecting
5 alarm is -- that's data points was there in the data.
6 And then how many UNSAT points was there? So here that
7 we got 420 that's detecting alarm activity. That's
8 there's no extreme negative factor, but there's two
9 UNSATs. And then there's a one negative factor
10 regardless which one was checked. But there's one,
11 combination's one. I have one UNSAT and I have 112 data
12 points. And then two, three that I come to the three
13 negative points, but there's no UNSATs. So, I got this
14 data point, this curve.
15 The bar chart represented that the number of
16 data that's in my database. And the x-y is the how many
17 negative factors. And this x-y, simply that's just base
18 on that simple math. What's the UNSAT rates of
19 probability there? So there is for the alarm
20 detection,. This curve, that could be a lot easy things.
21 Maybe data quality. Maybe that we don't have enough data
22 that's work -- that's still have to spend more effort
23 to investigate. But for the diagnosis. We got this kind
24 of plots. And for response planning got these plots.
25 Manipulation action we got these type plots.

1 So, that is still -- we still didn't -- haven't
2 got the -- we expect a curve like this. That's no more
3 negative factor represent a more challenging situation,
4 so that come to a certain point that I shall see that
5 the error rate. That's the curve that we were expecting
6 to see, but so far based on the data points we have we
7 still haven't seen
8 that --
9 (Simultaneous speaking)
10 MEMBER SCHULTZ: I would have thought you'd
11 expect a curve like this. No?
12 MR. CHANG: Well, yes, but if that has five,
13 six, that's --
14 (Simultaneous speaking)
15 CHAIRMAN STETKAR: You'd expect that to knee
16 over at some point. He just hasn't extended it out.
17 MEMBER SCHULTZ: I see.
18 MEMBER BLEY: There's not enough points.
19 CHAIRMAN STETKAR: There's not enough points.
20 MR. CHANG: Yes, and --
21 MEMBER SCHULTZ: Oh, I see. Yes.
22 MR. CHANG: And the way that we do this is not
23 -- I think the -- the way that the data can help in idea
24 method or methodology in the future, not only these are
25 quantitative aspect. We could provide these reference

1 points that way out in the future that's, well, that could
2 be an input for the IDHEAS take into the different
3 location. But the other things that we -- importance
4 was the data here provided relation between context,
5 error mode, causes, error causes. So, we have --
6 (Simultaneous speaking)
7 CHAIRMAN STETKAR: That's the first one.
8 That's --
9 (Simultaneous speaking)
10 MR. CHANG: -- quantitative aspects. That's
11 would be very useful for IDHEAS that are foundation that
12 come how this thing has a data basis.
13 CHAIRMAN STETKAR: But see, eventually as you
14 compile more data this also supports a lot more of that
15 notion of not expert elicitation, but it can support the
16 expert elicitation. But if you don't want to go there,
17 at least the experts can say, well, I have this context
18 that's a -- I'll just use high, high, low, low, low,
19 medium. And at least the evidence that we have would
20 indicate that the human error probability should be in
21 the ballpark of 10 to the minus 2-ish, or 0.5.
22 MEMBER SCHULTZ: Yes. Yes.
23 CHAIRMAN STETKAR: For that combination.
24 MEMBER SCHULTZ: That can support what you
25 showing.

1 MS. XING: Right.

2 CHAIRMAN STETKAR: But it does show the
3 integration of that, not the individual -- assessing them
4 individually assuming all the others are constant or
5 perfect.

6 MR. CHANG: Yes, I think I done with my
7 presentation.

8 MS. XING: Yes, just want to add another part
9 for this database can really -- can support our
10 development is there's lots of small operational story
11 developed from this, and which those are the kind of story
12 we were looking for when doing our expert elicitation.
13 For example, we had a failure mode like critical data,
14 not check at the proper frequency. Our expert
15 elicitation we had a hard time to think what is this
16 situation? And the database has -- almost is a perfect
17 story for that case. So, and a lot of the such story
18 we can -- if we can compile them as our future user manual,
19 which would really HRA analysts going forward.

20 CHAIRMAN STETKAR: Thank you.

21 MEMBER BLEY: We've still got a quorum.

22 (Laughter)

23 CHAIRMAN STETKAR: I'm sensitive. One extra
24 body. Because I have to do this -- go see if Theron is
25 still here -- let me see if there's anyone in the room

that would like to make any comments, please come up and do so. Identify yourselves. I have to open up the bridge line to see if there's anyone out there.

MEMBER BLEY: There ought to be somebody for this.

CHAIRMAN STETKAR: There was. Gareth was here.

MEMBER SCHULTZ: Maybe Gareth is back on the line.

CHAIRMAN STETKAR: He left three-and-a-half hours ago as best as I could tell.

MEMBER SCHULTZ: He might be back on.

CHAIRMAN STETKAR: Yes, he might be. Open? Is it open?

MEMBER BLEY: I hear nothing.

CHAIRMAN STETKAR: I don't hear any pops, but let's do this. If there's anyone on the bridge line, please do me a favor and just say hello so that we know it's open.

MR. BROWN: Excuse me, Mr. Stetkar. There's no one on the line.

CHAIRMAN STETKAR: There's no one on the line? Okay. Thanks a lot, Theron. He does know if there's nobody on there, so that's good.

With that, as we usually do in a Subcommittee

meetings, I'll go around the table and see if there are any final comments. Steve?

MEMBER SCHULTZ: I'd just like to express my appreciation for the presentations that have been made. And more than, all the work that is behind the presentations. There's been a lot of progress and information flow since the last meeting that we had. So I'm very appreciative of that.

I think the process that you're going through again continues to be a very aggressive approach to getting the work done, and you're moving forward on many different fronts to accomplish that with regard to not only the technical methodologies -- and I think you've got a general good organization associated with that. And you're doing technical work in the documentation, and then we have the testing process associated with the overall methodology. So you're moving forward well on all the different fronts you've described today.

There are some comments that we've made associated with piecing that puzzle together appropriately so that will make the largest impact with the application of the methodology in the future. And it would be good for you to sit back and think about the comments that we've made today in order to get some of those things tweaked on the right track and right

1 direction, because it's really critical that as you get
2 closer to the final product that it is presented
3 appropriately with the pieces in the right place.
4 And we did set out some challenging work for
5 you with the comments we made in the past, some
6 challenging work to set it up in just the right way to
7 optimize that. You've made some good progress, but more
8 to be made. But thank you very much.
9 MS. XING: Thank you.
10 CHAIRMAN STETKAR: Dennis?
11 MEMBER BLEY: I appreciated the presentations
12 from everyone today, and they helped me better understand
13 some of the things I saw. I'm pleased that EPRI and the
14 staff still seem to be reasonably close together as we
15 go forward. No additional comments. Thanks.
16 CHAIRMAN STETKAR: Thank you. And I don't
17 have anything to add other than again thanks. I know
18 I've been pretty critical in this meeting, but you know
19 my personality by now.
20 I'll echo what Steve said. I think you've come
21 a long way. I think that you have some things to think
22 about, especially on that generic methodology. I really
23 look forward to this testing effort. And I think we need
24 to keep in close touch with you as that develops over
25 the next six months or so and make sure that we schedule

1 our next Subcommittee meeting at an appropriate time.
2 I don't know when relative to the testing or when relative
3 to -- for the revision of the generic methodology
4 document. That's something that I think you'll need to
5 work out internally a little bit.
6 But I think we're at a pace now I think where
7 I don't want to wait too awfully long before -- we've
8 been doing this on about a semi-annual basis and I don't
9 want to wait too long before we have our next update,
10 but I want to make sure that we have something that's
11 reasonably well developed by then. Not final
12 necessarily. Okay?
13 Any other final comments? Sean, anything?
14 MR. PETERS: Nothing. Just thank you for the
15 opportunity to come here and present, and we'll get back
16 through John and see what times we can get a more
17 reasonable I guess time to come back to --
18 (Simultaneous speaking)
19 CHAIRMAN STETKAR: Yes, I mean, you have to
20 look at schedules for products --
21 MR. PETERS: Exactly.
22 CHAIRMAN STETKAR: -- and things like that.
23 Good. And as a final comment -- Jing, did you have --
24 MS. XING: Go ahead.
25 CHAIRMAN STETKAR: No, I have one final thing

1 that I have to say.

2 MS. XING: I just want to say I want to thank

3 all the comments, the input. That's the purpose we come

4 to this meeting. And in particular one thing: I

5 appreciate your observation of this mixture of the

6 general methodology and cookbook. I think by separating

7 the two will make my job much, much easier for the next

8 stage. And it will make you all --

9 (Simultaneous speaking)

10 CHAIRMAN STETKAR: No, I think it will.

11 MS. XING: So, thanks.

12 CHAIRMAN STETKAR: And as a final comment

13 before I bang this, I want to thank our reporter for his

14 stamina on the public record so it's in the transcript.

15 And we are adjourned.

16 (Whereupon, the above-entitled matter went

17 off the record at 6:29 p.m.)

18

19

20

21

22

23

HRA method development – IDHEAS for internal at-power events

Jing Xing
Sr. Human Performance Engineer
RES/DRA/HFRB

ACRS Subcommittee briefing on HRA, 4/24/2015

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

SRM-M061020

SRM-M061020 directed the ACRS to

> "work with the staff and external stakeholders to evaluate the different human reliability models in an effort to propose a single model for the agency to use or guidance on which model(s) should be used in specific circumstances"

Outline

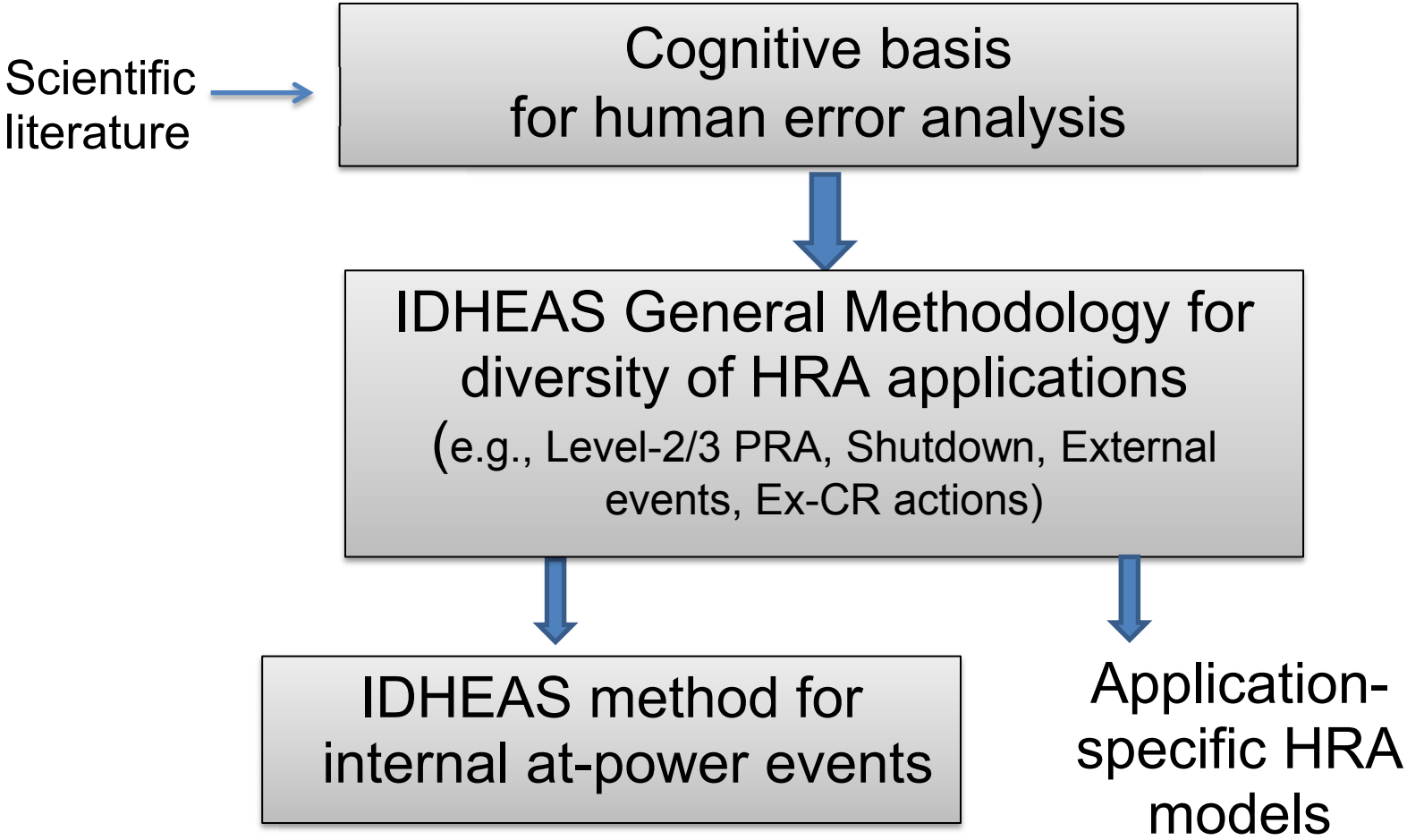
I. Overview of the HRA method development

II. Updates to IDHEAS (An Integrated Human Event Analysis System) for internal, at-power events

III. IDHEAS testing plan

IV. IDHEAS General Methodology
(previously referred to as HRA Generic Methodology)

Strategic approach



Project status

Product	May 2014	April 2015
Cognitive basis for human error analysis	• External reviewed • ACRS reviewed • Ready for publication	• Under publication
IDHEAS method for internal, at-power events	• Initially developed and piloted • 6 ACRS recommendations	• Addressed 4 recommendations • Testing in progress • Expert elicitation TBD
IDHEAS General Methodology for HRA applications	• Under development	• Draft method developed • Being piloted

Project path forward

Product	Path forward	Tentative time
Cognitive basis for human error analysis	• Extension and updates	2017 -
IDHEAS method for internal, at-power events	• Publish the method report • Develop NRC's User's manual • Implement the method at NRC	2015 -16
IDHEAS General Methodology for HRA applications	• Complete the methodology • Pilot / test • Apply the methodology to NRC HRA applications	2015 - 16

Outline

I. Overview of the HRA method development

II. Updates to IDHEAS for internal, at-power events

III. IDHEAS testing plan

IV. HRA General Methodology

IDHEAS approach

Analyze scenario context and develop operational narrative

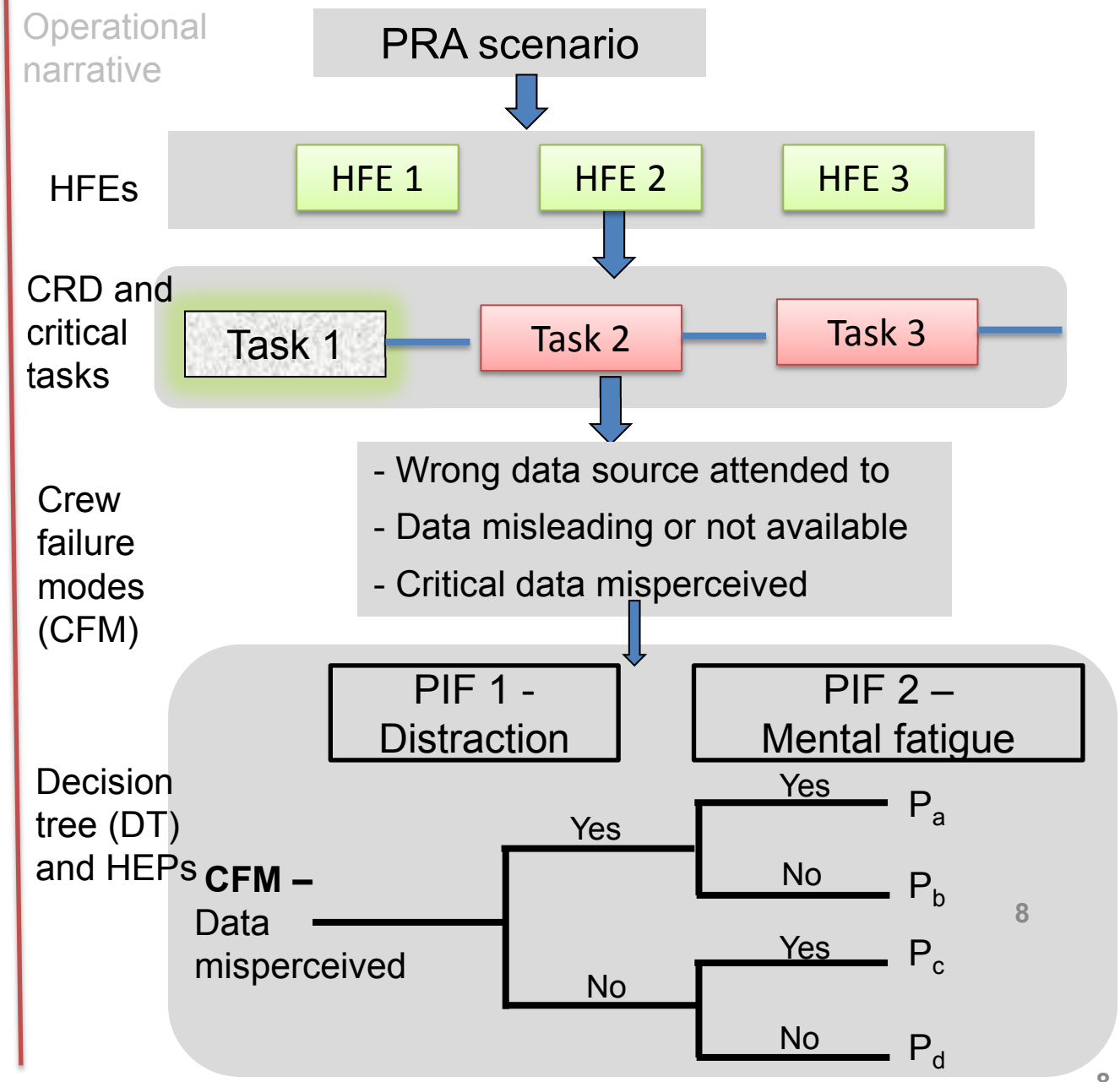
Identify, define, and assess HFEs

Develop CRD of the HFE and analyze the critical tasks

Select applicable CFMs for a task

Calculate HEP:
- Analyze PIFs in the DT to determine the DT path
- Combine the HEPs of all the selected DT paths in the HFE

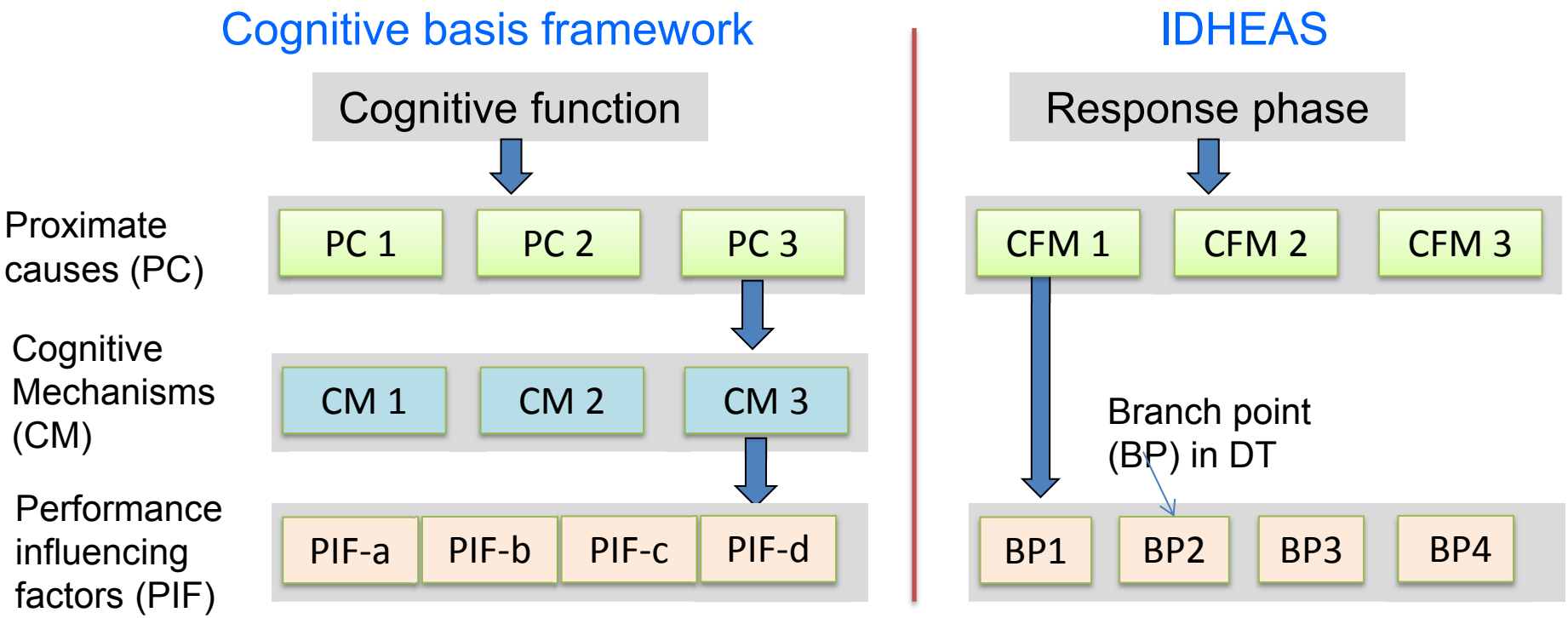
Perform integrative analysis



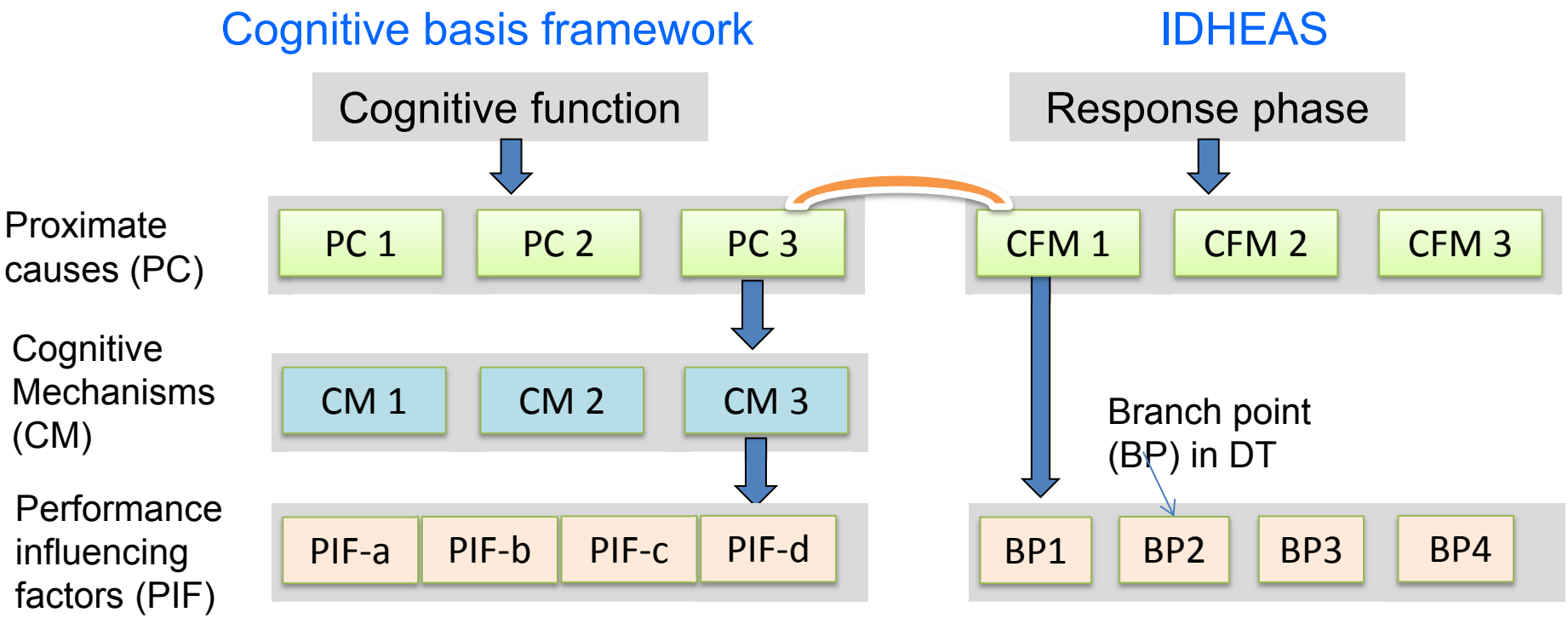
ACRS recommendations on IDHEAS

ACRS recommendation	NRC users' wishes
1. Document the rationale for excluding specific cognitive mechanisms and performance influencing factors delineated in NUREG-2114	Provide cognitive basis or rationale for the PIFs in HRA methods
2. Guidance for developing operational narratives that adequately describe the entire context of the evolving event scenario	Guidance for documenting the context and deviations from the base scenario
3. A formal and complete expert elicitation process to develop HEPs for all the decision-tree paths	Formal expert judgment should be used
4. Uncertainties in HEPs should be derived directly from the expert elicitations.	Comply to NRC's guidance on Treatment of Uncertainty
5. The probability that an action cannot be completed within the available time window should be included as a contribution to the overall HRA results	Use a continuous function to model the effect of time on the HEP
6. Perform Formal pilot testing of the IDHEAS methodology	Test the method before using it.

Recommendation 1: Mapping between cognitive mechanisms and PIFs in the decision-trees



Recommendation 1: Mapping between cognitive mechanisms and PIFs in the decision-trees



Outcome: Mapping between every CFM /PIF and BPs

- BPs are the detail characterization of PIFs, e.g. PIF – Training vs. BP – Perceived urgency of an alarm; A BP could be the characterization of several PIFs.
- Every branch point is justified – mapped to one or several cognitive mechanisms;
- Most mechanisms and PIFs are represented by one or several BPs; the ones not represented are justified with the assumptions for internal at-power events (e.g., HSI is not in the BPs for “Incorrectly execute simple actions”;
- BPs represent the PIF characterization most relevant to internal at-power events.

Recommendation 2: Develop operational narrative

Recommendation:

"The qualitative assessment guidance should emphasize the need to develop operational narratives which adequately describe the entire context of the evolving event scenario, how that scenario affects all information and stimuli in the operators' environment, and factors that may influence personnel response in that context, considering the effects on all plant systems and functions"

Outcome – Guidance for Step 1 of IDHEAS process: Develop operational narrative

The operational narrative includes context and deviations from the base scenario that challenge the plant and crew performance; A narrative should include three sections:

- Plant condition,
- Crew context, and
- Human action context

The description of the elements for each section should emphasize the delta between the status /assumptions in the baseline scenario and the deviation from the baseline status.

Operational narrative – Plant condition

Objective: Describe the plant condition, behavior and evolution (e.g., timeline), and expected operational crew involvement.

Elements	Example
Initial plant condition and initiating events	Cable fire, Circuit breaker failed to open, Loss of power in components
Operational sequence	Event timeline (e.g., 18:52 reactor trip, 19:00 Safety injection actuation occurred due to an uncontrolled RCS cooldown … 19:24 RCP 'B' high bearing temp alarm)
Plant system and equipment response	Air-operated valve closed during power transfer; Secondary plant heater drain valves failed open; Charging suction did not transfer to RWST
Key operator actions	Operators restore CCW to the RCPs
System success Criteria	operators would have to reopen FCV-626 from the control room prior to voiding within the RCPs occurs. Typically, the time available is approximately 13 minutes.
Consequence of failure	RCP seal will experience voiding conditions in approximately 13 minutes.

Operational narrative –Crew context

Objective: Describes the factors related to operators' performing key actions with the focus of challenges to the success of the actions.

Elements	Example
Activities other than controlling the plant	Crew responded to fire with Fire Response procedures
Work sites and accessibility to the sites	Accessible even with the fire
Availability of information	All indicators were intact
Procedures and guidance documents	The annunciator procedures were available to direct operators to reopen FCV-626. EOP procedure was deficient in regards to verifying RCP seal injection.
Environmental factors	Nominal
Availability of decision-makers	Available but distracted by fire
Staffing	The crew composition was less than optimal; Several members of the crew were newly qualified or were standing unfamiliar or new positions.
Training	The plant's training simulator did not demonstrate the correct expected plant response for a loss of Instrument

Operational narrative – Action context

Objective: Describes the factors that may influence personnel responses in the entire scenario evolution.

Elements	Description
Unfamiliar scenario	Scenario is partially unfamiliar because of unexpected system responses and multiple failures.
Multitasking	Crew focused on response to fire and AC power recovery
Distraction / interruption	BOP and RO distracted by fire response; Supervisors distracted by Emergency Action Level reviews; Interrupted by frequent crew updates
Complex dynamics	Unexpected equipment response
Time urgency	Urgent human action, ~13mins to restore CCW to RCPs
Long-lasting actions (long working hours)	Nominal (18:52 – 20:44)
Additional information	

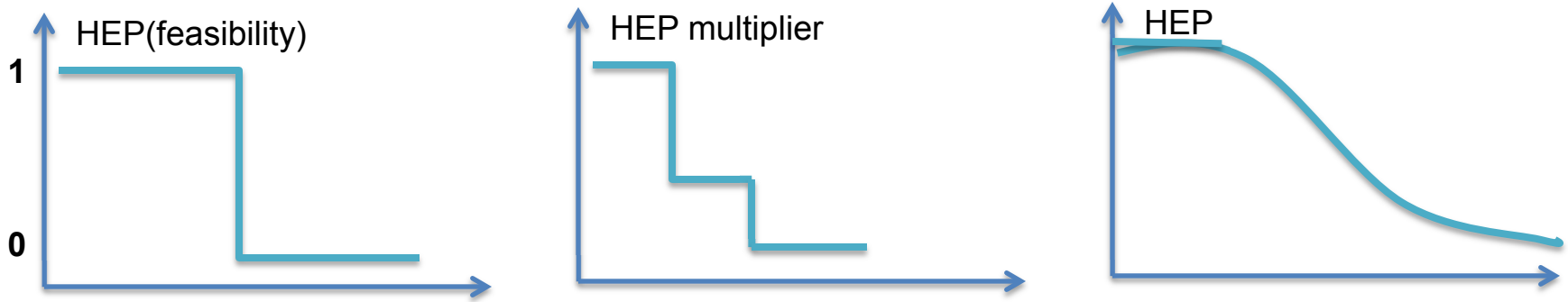
Summary of activities addressing Recommendation 2

- Guidance developed through reviewing existing HRA methods / guidance and HRA applications performed by NRC staff and discussing with NRC's HRA staff
- Reviewed and revised by three NRC HRA staff
- Incorporated the output of narrative analysis into other steps of IDHEAS process
- Applied the guidance to an analysis and documentation of human performance in Fukushima accident

Recommendation 5: The effect of time (available vs. needed) on the overall human error probability

Recommendation:

"The guidance for estimation of the available time window and the time required to perform each action should include explicit evaluation of the uncertainties in those times. The probability that an action cannot be completed within the available time window should be included as a contribution to the overall HRA results."



Outcome:

- Guidance on estimating and calibrating time needed (mean and range) for human actions
- Cognitive basis for the effect of time available on human error probability
- A math equation or look-up table for calculating the contribution of time available to the overall HEP

Cognitive basis of the effect of time available on human error probability

Summary of reviewing 100+ articles about the effect of time available:

1) With adequate time, more time available doesn't further reduce error rates;

2) Under time pressure, human tends to take short-cuts or skip some steps of the cognitive process, i.e., trading-off between speed and accuracy – for examples, selecting only a subset of information for decision-making, executing actions without verification / self-correction.

3) Experiments showed that time available doesn't interact with other factors in contributing to human errors, thus time available appears to independently contribute to human error probability rather than acting as a multiplier.

Cognitive basis of the effect of time available on human error probability – Examples in the literature

Excerpts from the literature – effect of time on decision-making:

"(1) Participants who were advised that time was sufficient to complete the task outperformed those who were advised that time was insufficient to complete the task. (2) Participants who were given ample time to complete the task did not outperform those who were given less time to complete the task. (3) Sufficiency and time had an impact on explicit knowledge of which decks were good or bad. (4) Sufficiency and time did not have an effect on the selection of cards from risky or safe decks."

"Time pressure: (i) reduces the overall quality of decision-making. (ii) reduces risk-taking. (iii) leads to more polarised judgements. (iv) increases the importance of the more important aspects of information and decreases the attractiveness of all alternatives. (v) reduces confidence in the decision."

Modeling the contribution of time available to the overall human error probability

The overall HEP of a given HFE is **P = Pt + Pc**

Pt – Error probability introduced by the time factor in the HFE

Pc – Error probability from the crew failure modes

Time factor or time pressure Rt = (Tavailable – Tneeded) / Tneeded

Rt=-1 No time to perform the task

-1<Rt<0 Less time than needed, high time pressure

0<Rt < 1 Just about adequate time, low time pressure

Rt > 2 More than adequate time, no time pressure

Pt can be calculated using the logistic function

Pt = 1/[1+ k . Exp(a. Rt)]

Modeling the contribution of time available to the overall human error probability (cont.)

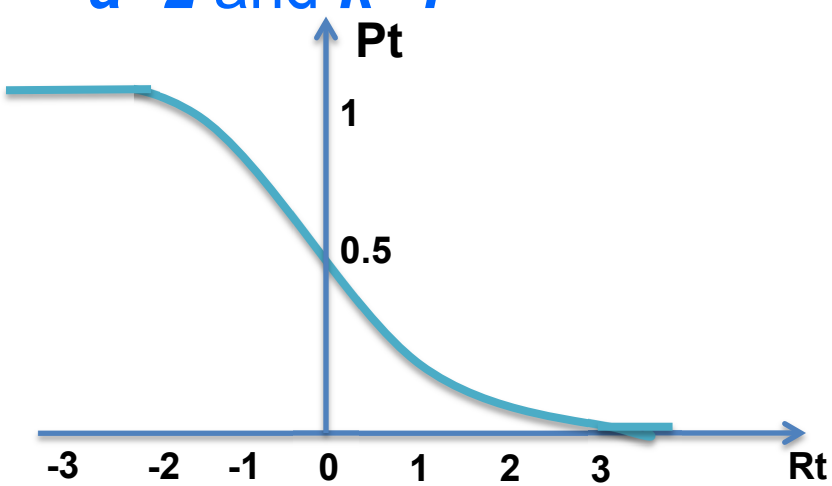
The parameters in the equation, ***a*** and ***k***, can be estimated through expert judgment or data fitting.

Example: Judgment from an expert

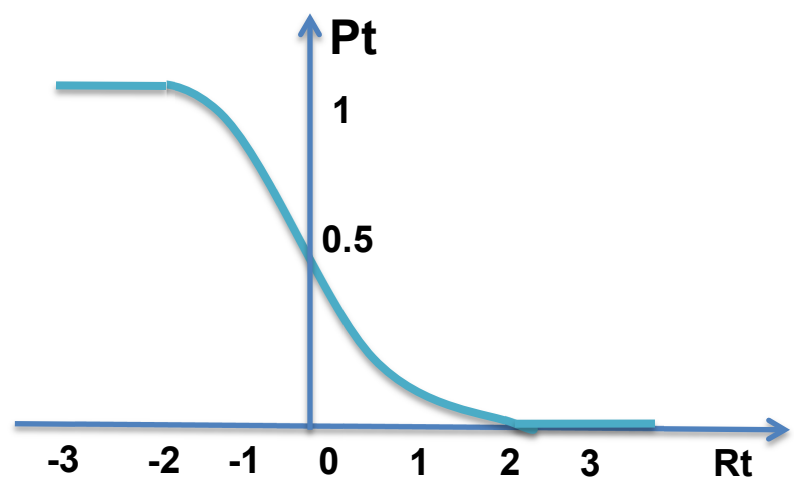
	Rt	Pt
Little time	-1	→1
High pressure	-1 < Rt < 0	0.7 ~ 1
Exact time	0	0.7
Low pressure	0<Rt < 1	E-4 ~ 0.7
No constraint	Rt > 2	0

Two examples of ***a*** and ***k***

a=2 and ***k=1***



a=4 and ***k=1***



Guidance for estimating and calibrating time needed

Estimating the mean T_{needed}

Estimating T_{needed} should consider three key aspects: *time contributors,* modification *factors*, and *bias factors* (i.e., the information that may be missed due to the biases):

1) Acquire the Initial estimation of T_{needed} from PRA models or plant information.
2) Verify T_{needed} by checking if the contributing factors are considered;
3) Adjust the time by estimating and accounting for the effects of the modification factors
4) Adjust the time by considering the bias factors

Calibrating T_{needed}

Analysts may estimate the range of T_{needed} (e.g., 10th, 50th, 90th percentile) or they can use a default distribution function for T_{needed}; the default function can be obtained through data fitting.

Develop a default distribution function for T_{needed}

Example: Operator action time from simulation data:

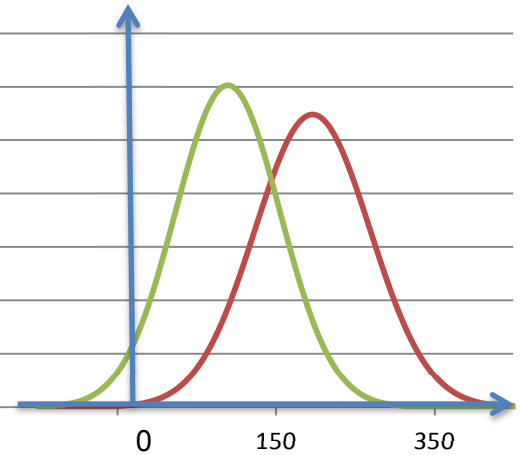
(From "A METHOD FOR OPERATOR ACTION TIME OF AN EMERGENCY PROCEDURAL TASK" by Wondea Jung and Jinkyun Park, Korea Atomic Energy Research Institute)

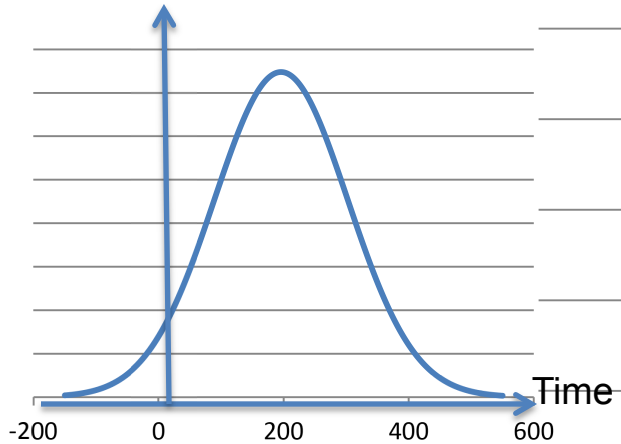
Procedure	Step #	Task description	Number of data	OATc (sec)	
				Average	Std. Dev.
SPTA	1-8	Standard post trip action (SPTA)	55	196.2	72.8
DA	1-16	Event diagnosis	15	195.9	106.7
E-3 (SGTR)	1-3	Reconfirm the entry conditions of E-3	3	1.2	4.6
	4-5	Deliver a sufficient SI flow	7	44.1	19.7
	6-7	Check criteria for RCP stoppage	9	89.0	66.2
	8-10	Initial cooling down the hot-leg temperature of RCS	4	169.0	66.7
	11-14	Identify and isolate a faulty SG	3	507.0	239.4

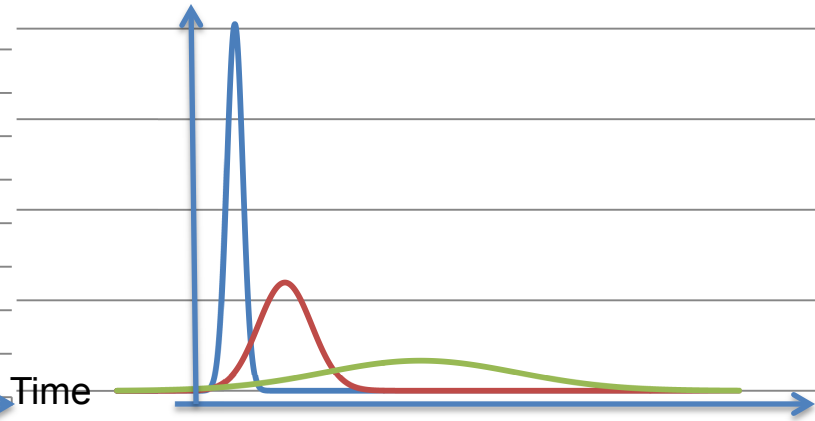
Develop a default distribution function for T_{needed}

Example: Distribution functions for T_{needed} fitted from the simulation data of operator ctiontime :

(From "A METHOD FOR OPERATOR ACTION TIME OF AN EMERGENCY PROCEDURAL TASK" by Wondea Jung and Jinkyun Park, Korea Atomic Energy Res







Detection

- Standard post trip action
- Reconfirm the entry conditions of E-3
- Check criteria for RCP stoppage

Understanding

- Event diagnosis

Action execution

- Deliver a sufficient SI flow
- Initial cooling down the hot-leg temperature of RCS
- Identify and isolate a faulty SG

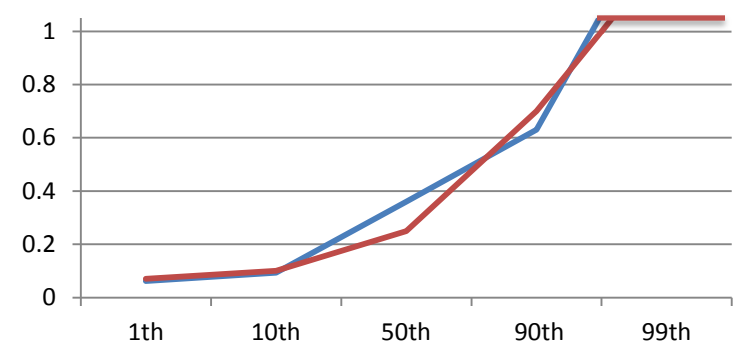
Recommendation 4: Uncertainties in the human error probabilities

Recommendation 4: "Uncertainties in the human error probabilities should be derived directly from the expert elicitations."

Outcome: Guidance developed for computing parameter uncertainty - The Uncertainty of the summed HEP from all the applicable CFMs is computed from the HEP distribution (lognormal) of the CFMs obtained from expert judgment.

Example:

CFM / DT path	1th	10th	50th	90th	99th	
CFM 1	0.001	0.01	0.04	0.1	0.5	
CFM 2	0.05	0.08	0.3	0.5	0.9	
CFM 3	0.001	0.003	0.02	0.03	3.3E-02	
Sum	0.052	0.093	0.36	0.63	1	



Recommendation 3: Estimate HEPs for all the decision-tree paths through expert elicitation

Recommendation 3: "A formal and complete expert elicitation process should be conducted to develop human error probabilities and associated uncertainty distributions for each combination of contextual factors in the final version of every decision tree."

Summary of the past expert elicitation:

- 6 domain experts, 5 HRA analysts, and 1 technical integrator
- Two workshops and the integration
  - Workshop #1: domain experts ranked DT paths and made initial estimation of HEPs for all the DT paths
  - Workshop #2: HRA analysts used the inputs from Workshop #1 to make estimation of the HEP distributions
  - The technical integrators integrates the inputs from the 5 HRA analysts into one single HEP distribution for every DT paths; The final outcome only had HEP distributions for 63 out of the total 165 DT paths.

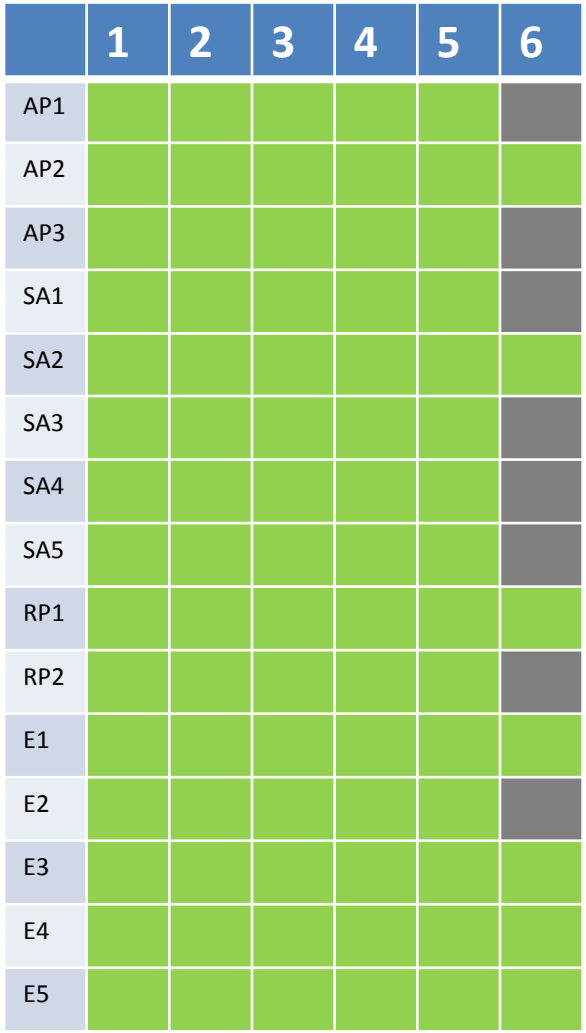
1 CFM had completed estimation for all the paths
8 CFMs had estimation of a portion of the DT paths
6 CFMs had no estimation at all

- *Critical data not checked with appropriate frequency*
- *Fail to initiate execution*
- *Misread or skip step in procedure*
- *Premature termination of data collection*
- *Choose inappropriate strategies*
- *Critical data miscommunicated*

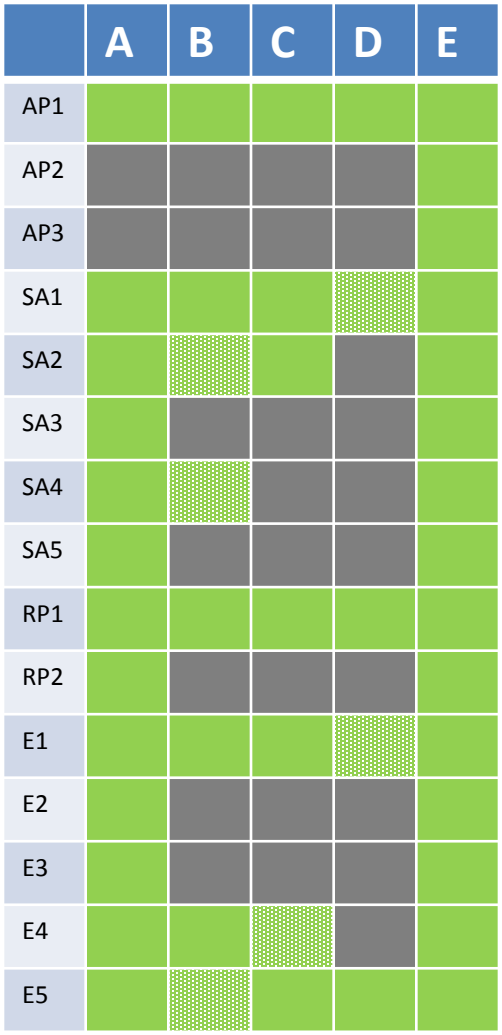
Results of the past expert elicitation

All paths estimated | Partly estimated | No estimation

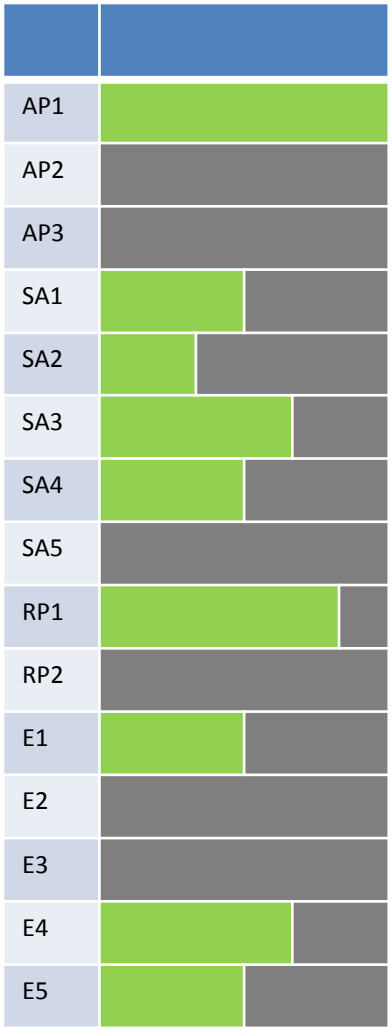
Workshop #1



Workshop #2



Integrated



Plan for the next expert elicitation

Resources limited.

Before elicitation:

- Work with domain experts to refine the no-estimation CFMs and develop examples for the CFMs
- Interpolate the HEPs for un-estimated DT paths

Elicitation:

- SSHAC- like process
- 3-5 experts (including technical integrators)
- One workshop
    - Experts review, challenge, and modify the HEPs
    - Experts estimate the HEPs of the no-estimation DT paths
- Technical integrators integrate the inputs of the experts into a single HEP distribution for every DT path

Recommendation 6: Testing IDHEAS

Recommendation 6:

"Formal pilot testing of the IDHEAS methodology should be performed.

The testing should be conducted by multiple teams of analysts who have a range of practical experience with evaluating human performance in PRA applications.

Teams should include members with expertise in nuclear power plant engineering, operations, and the plant-specific PRA, as well as human performance and HRA.

Each team should evaluate the same set of PRA event scenarios that cover a range of human actions and anticipated crew failure modes."

Discussion

- EPRI and NRC have different HRA customer basis

ACRS recommendation	NRC users' wishes
1. Document the rationale for excluding specific cognitive mechanisms and performance influencing factors delineated in NUREG-2114	Provide cognitive basis or rationale for the PIFs in HRA methods
2. Guidance for developing operational narratives that adequately describe the entire context of the evolving event scenario	Guidance for documenting the context and deviations from the base scenario
3. A formal and complete expert elicitation process to develop HEPs for all the decision-tree paths	Formal expert judgment should be used
4. Uncertainties in HEPs should be derived directly from the expert elicitations.	Comply to NRC's guidance on Treatment of Uncertainty
5. The probability that an action cannot be completed within the available time window should be included as a contribution to the overall HRA results	Use a continuous function to model the effect of time on the HEP
6. Perform Formal pilot testing of the IDHEAS methodology	Test the method before using it.

ELECTRIC POWER RESEARCH INSTITUTE

EPRI Perspective

ACRS Reliability PRA Subcommittee Meeting

April 24, 2015

Mary Presley
Senior Technical Leader, EPRI

Operational Narrative & the Process for Application of IDHEAS

- Draft IDHEAS document – four steps
  - Identification and definition of HFEs (including feasibility assessment)
  - Procedural task analysis
  - Implementation of quantification model
  - Integration

- Revised draft document
  - Added a new step 1 - scenario analysis and operation narrative
  - Issue: When presented as the first step, it appears to require the up-front all-inclusive identification of deviation scenarios, PIF influences, and failure mechanisms.

Areas of agreement

- Documentation of HRA should include:
  - Definition of HFE consistent with PRA scenario
  - An identification of the failure mechanisms (failure modes and PIFs) consistent with PRA scenario boundary conditions
- Analysis should search for “deviation” scenarios within the PRA scenario definition for which the PIFs could be challenging and modify PRA model (e.g., include new accident scenarios) if
  - Deviation scenario frequency not negligible
  - HEP significantly increased
- Operational narrative is a helpful tool to communicate the “whole picture” and integrate the collected information

Concerns with Step 1

- Construction of an operational narrative is a continuous action step, guided by the process originally defined in IDHEAS
  - An operational narrative describes, at a functional level, the interaction between the crew and the plant as a basis for constructing the CRD and associated timeline
  - The characterization of the potential failure mechanisms is performed as part of the analysis of the CRD
  - The CRD/CFM/DT approach provides a structure to derive the information NRC describes in the new Step 1
- The HEPs are averages over the spectrum of scenarios embedded in the PRA scenario
  - The analysis may result in the identification of deviation scenarios that should be explicitly modeled
- Concerns should be reconcilable and may have arisen from inadequate understanding of respective user needs (e.g., NRC has additional use cases beyond PRA)

Accounting for Time - Major Technical Area of Disagreement

- ACRS concern:
  - The guidance for estimation of the available time window and the time required to perform each action should include explicit evaluation of the uncertainties in those times.
  - The probability that an action cannot be completed within the available time window should be included as a contribution to the overall HRA results.

- EPRI & NRC agree with both points, but disagree on how the probability should be included

Issues with TRCs

- Use of generic TRCs does not distinguish between responses that are well understood and those that are less well understood
- Using normalized time can lead to unrealistic results for long duration/long time frame actions
- Historically a large source of analyst-to-analyst variability
  - Small difference in time estimation (t_available and required) leads to large variability in HEP
  - PRA scenarios typically bounding, so conservatisms in time available
- Weak empirical basis

Conclusion on Timing

- Is it appropriate to add the HEP from the TRC to that from IDHEAS?
  - One is based on recognizing mechanisms for failure, the other a phenomenological model with no clear mechanism

- Time variability influenced by many things (e.g., appropriate prioritization, complexity, workload, procedures and training)
  - Most important PIFs are captured in IDHEAS branches and are mechanism-specific
  - Short time frame scenarios will have little to no recovery available

- Recommendations:
  1. For small time margin, a structured approach to direct estimation or use of simulator data to prove feasibility may be better than a TRC
  2. Include mapping of how time influences PIF selection (or have time-specific questions included in the PIF selection)
  3. Time is a source of uncertainty that should be captured in the distribution

- **IF** a TRC is used, then it should have <u>a strong empirical basis</u> and <u>address issues with existing use of TRCs</u>.

Together…Shaping the Future of Electricity

ELECTRIC POWER RESEARCH INSTITUTE

Where do We Stop?

- A PRA Model is a Discrete Representation of the spectrum of accident scenarios
- Practicality makes it necessary to adopt a “reasonable” level of discretization
- Some level of grouping/bounding of scenarios and therefore level of definition of HFEs is essential
- Focus on the more significant variations
  - Frequency
  - HEP

IDHEAS Method Testing

ACRS Reliability and PRA Subcommittee Meeting – April 24, 2015

Stephanie Morrow, Ph.D.
Human Factors Engineer
Human Factors and Reliability Branch
Division of Risk Analysis
Office of Nuclear Regulatory Research

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Outline

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Objectives
- Testing Criteria
- Testing Scenarios
- Timeline
- Assumptions and Constraints
- Project Team

Objectives

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- Evaluate whether IDHEAS can provide acceptable and reasonable HRA results before its deployment.
- Identify strengths and weaknesses of the IDHEAS method to inform future developmental activities.

Testing Criteria

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

1. **Criterion Validity:** whether IDHEAS can provide reasonable predictions about human reliability.
2. **Inter-analyst Reliability:** whether different HRA analyst teams produce the same or similar results when using IDHEAS.
3. **Traceability:** whether IDHEAS documentation provides a clear link between the qualitative analysis, quantitative inputs, and HEPs.
4. **Usability:** the quality of the analysts' experience with using the IDHEAS method for HRA.
5. **Utility:** whether IDHEAS provides useful information for decisionmaking.

Testing Scenario 1

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **Total LOFW followed by SGTR** (adapted from US Empirical Study)
  - HFE 1.1: Failure to establish bleed and feed within 45 minutes of the reactor trip after the crew initiates a manual reactor trip.
  - HFE 1.2: Failure of crew to isolate the ruptured steam generator and control pressure below the SG PORV setpoint to avoid SG PORV opening.

Testing Scenario 2

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **Standard SGTR** (adapted from US Study)
  - HFE 2.1: Failure of crew to isolate the ruptured steam generator and control pressure below the SG PORV setpoint before SG PORV opening.

Testing Scenario 3

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- **Loss of RCP Seal Injection and Cooling** (adapted from ASP of 2010 Robinson Event)
  - HFE 3.1: Operators fail to restore CCW to the RCPs by reopening FCV-626.
  - HFE 3.2: Operators fail to trip the RCPs during a loss of all seal cooling and injection.
  - HFE 3.3: Operators fail to depressurize the RCS during a small LOCA.

Timeline

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Task	Projected Date	Status
Develop Training & Testing Materials	May 2015	In progress. Training was piloted at NRC in January 2015. Currently under revision. US Benchmark information package being modified for Scenarios 1 & 2. Gathering information for Scenario 3.
Pilot the Testing Materials	June - July 2015	Testing to ensure the scenarios will provide a complete test of IDHEAS, and confirm that all required information is available to complete the HRA.
Identify HRA Analyst Teams	July 2015	Initial contacts have been established. Will be finalized once dates for testing are firm.
Establish Evaluation Team	July 2015	Initial contacts have been established. Will be finalized once dates for testing are firm.
Dry Run of Training & Testing Workshop	August 2015	Dry run with project team to ensure all training and testing materials are complete.
Conduct Training & Testing Workshop with HRA Analysts	September 2015	
HRA Analysts Perform Testing	Sept - October 2015	
Evaluation Team Performs Initial Analysis of Results	November 2015	
Conduct Evaluation Workshop	December 2015	
Analyze and Document Results	Dec 2015 – Mar 2016	

Assumptions and Constraints

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

- The testing will be limited to in-control room activities while at power.
- Information gathering will be controlled for the purposes of testing.
- A “gold standard” for HRA method testing does not exist.
- Testing may not include changes made to IDHEAS after a certain cut-off date.

Project Team

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Name	Affiliation	Role	Responsibilities
Stephanie Morrow	NRC	NRC Project Manager	• Technical Monitor – provide technical direction • Control project scope and schedule • Provide input based on research method experience
Larry Criscione	NRC	NRC Project Manager	• Contracting Officer Representative (COR) for Sandia Contract • Provide input based on HRA and operations experience
Harry Liao	Sandia (NRC sub-contractor)	Project Team Member	• Lead for developing testing materials • Provide input based on PRA/HRA experience
Mary Presley	EPRI	EPRI Project Manager	• Primary point of contact for EPRI • Provide input based on HRA experience • Provide training on IDHEAS examples to HRA Analyst Teams
Gareth Parry	ERIN Engineering (EPRI sub-contractor)	Project Team Member	• Lead for developing training examples • Provide input based on HRA and IDHEAS development experience
Jing Xing	NRC	IDHEAS Advisor	• Resource for IDHEAS method questions • Provide IDHEAS training to HRA Analyst Teams • Develop IDHEAS user manual for use in testing
TBD	Sub-contract TBD	Reviewer/Evaluator	• Lead for evaluation • Provide input based on HRA expertise

HRA Method Development – IDHEAS General Methodology

Jing Xing, Y. James Chang
RES/DRA/HFRB

ACRS Subcommittee briefing on HRA, 4/24/2015

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Outline

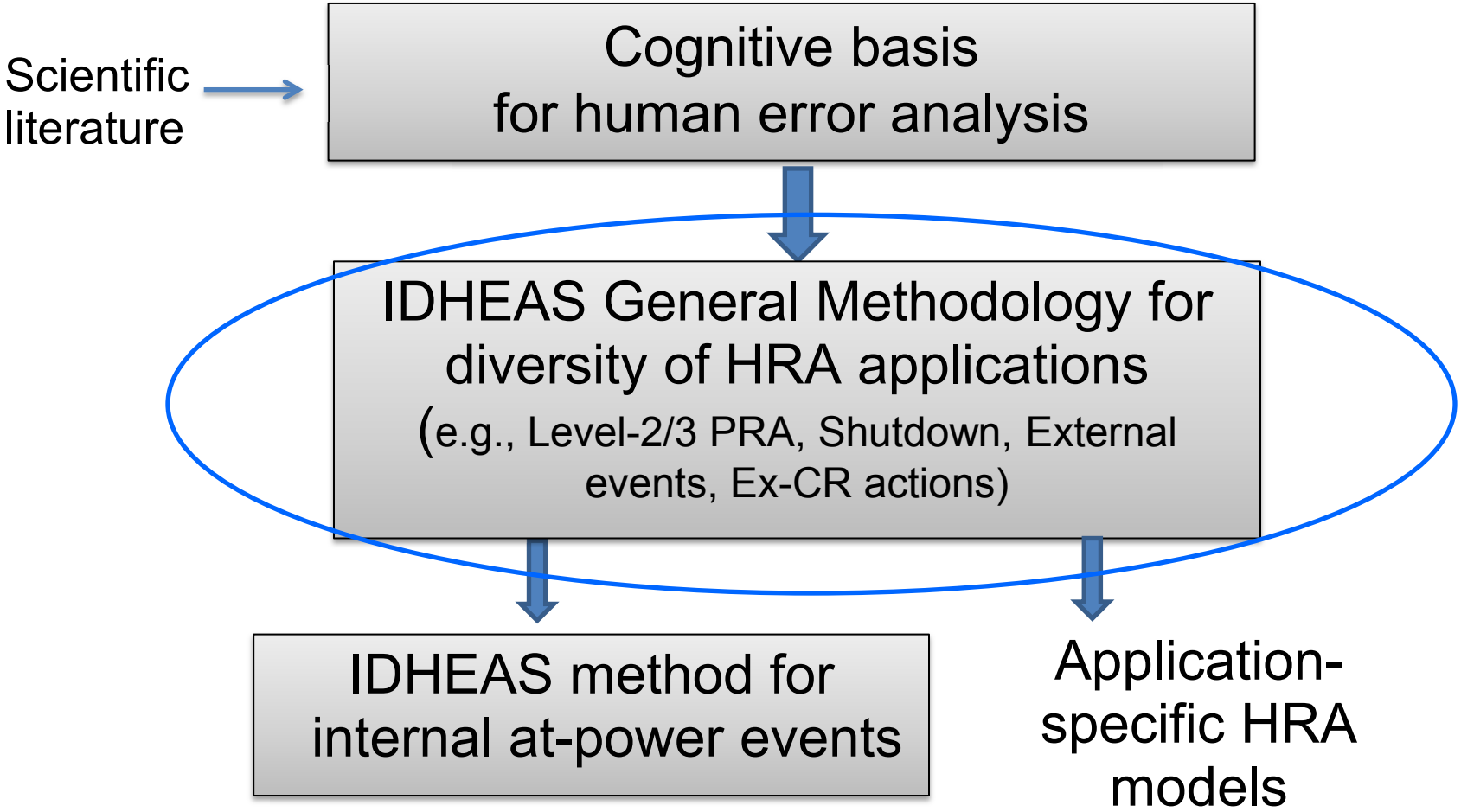
I. Overview of the HRA method development

II. Updates to IDHEAS
(An Integrated Human Event Analysis System for internal, at-power events)

III. IDHEAS testing plan

IV. HRA General Methodology

Strategic approach



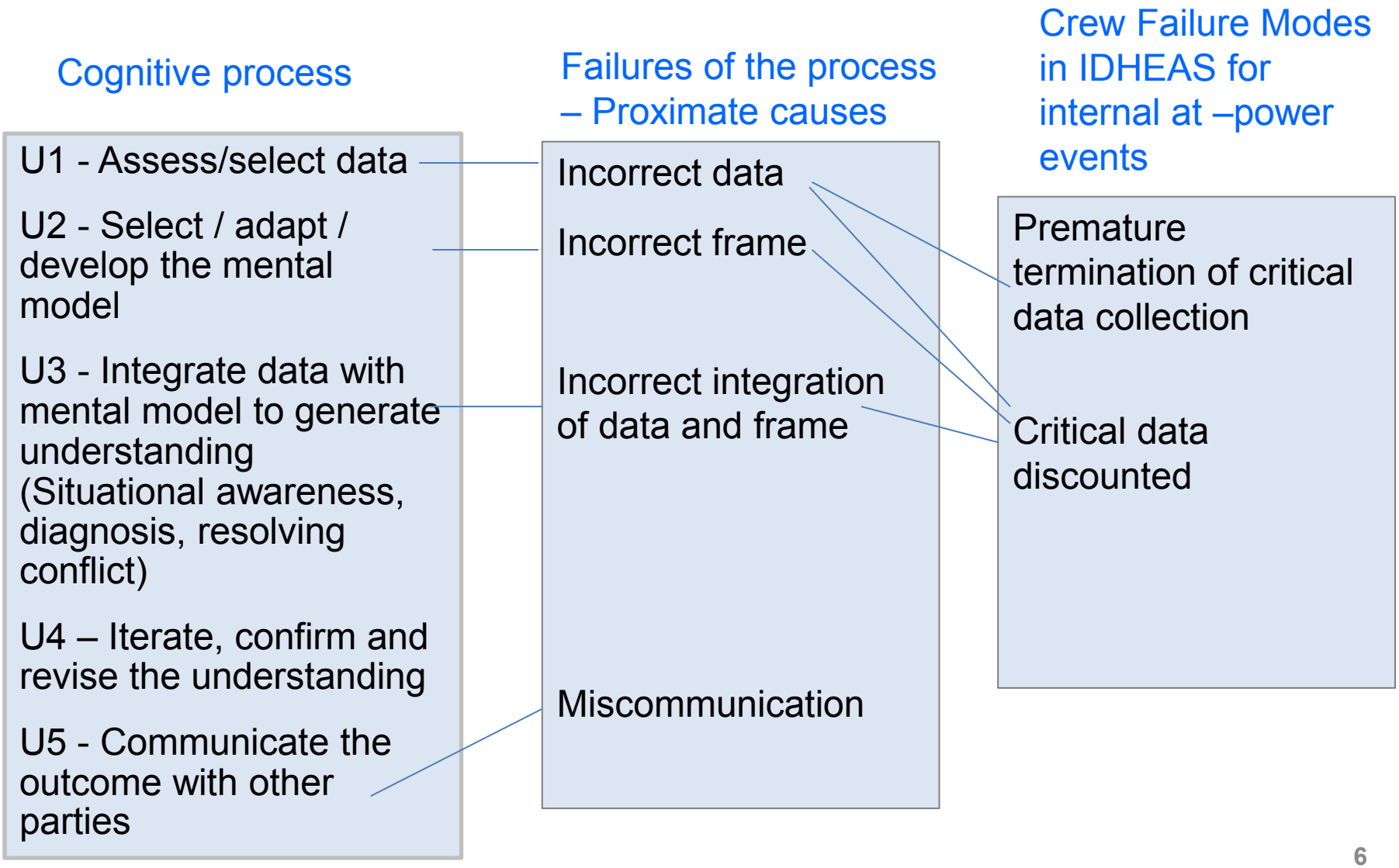
Scope of the General Methodology

- Based on the Cognitive Basis Framework – Model the five cognitive functions underlying human actions: *Detection, Understanding, Decision-making and planning, Action execution, and Teamwork*.
- Model the full cycle of cognitive processes for complex human actions
- Consider extensive contextual factors or PIFs without making application-specific assumptions
- Emphasize teamwork (communication, coordination, cooperation) and organizational factors

Cognitive processes for complex human actions - *Detection*

Cognitive process	Failures of the process – Proximate causes in NUREG-2114	Crew Failure Modes in IDHEAS for internal at –power events
D1- Establish decision-criteria for information to be acquired		
D2 – Select / identify / attend to sources of information	Cue not attended to	Key alarm not attended to Incorrect data source attended
D3 - Perceive, register, and recognize information	Cue not perceived Cue misperceived	Critical data misperceived
D4- Verify / modify detection	Miscommunication	Critical data not communicated
D5- Communicate the information		

Cognitive processes for complex human actions -*Understanding*



Cognitive processes for complex human actions – *Decision-making*

Cognitive process

DM1 – Manage the goals

DM2 – Select or develop a decision model to meet the decision goals and criteria

DM3 – Acquire / select information for decision

DM4 - Make decision (strategies, choices, plans)

DM5 - Simulate / evaluate the decision / plan

DM6 - Communicate and authorize the decision

Failures of the process – Proximate causes

Incorrect goals or priorities set

Incorrect internal pattern matching

Incorrect mental simulation or evaluation of options

Crew Failure Modes in IDHEAS for internal at –power events

Choose inappropriate strategies

Misinterpret procedures

Cognitive processes for complex human actions – *Action execution*

Cognitive process	Failures of the process – Proximate causes	Crew Failure Modes in IDHEAS for internal at –power events
E1–Assess action plan and criteria E2 - Develop / modify action scripts E3– Synchronize, supervise, and coordinate action implementation E4 - Initiate and implement action scripts E5 - Assess and adjust actions	Executed undesired action Failed to take required action (did not attempt action). Executed desired action incorrectly	Delay implementation Critical parameter for execution not checked with appropriate frequency Fail to initiate execution Fail to execute simple actions Fail to execute complex actions

Contextual Factors in the Methodology

- Plant – Information, event evolution, system responses
- Crew – staffing, work environment, infrastructure of communication, coordination, and cooperation, organizational factors
- Task – Workload, task complexity, available time
- Traditional PIF – Human-system interface (HSI), tools, procedures, training

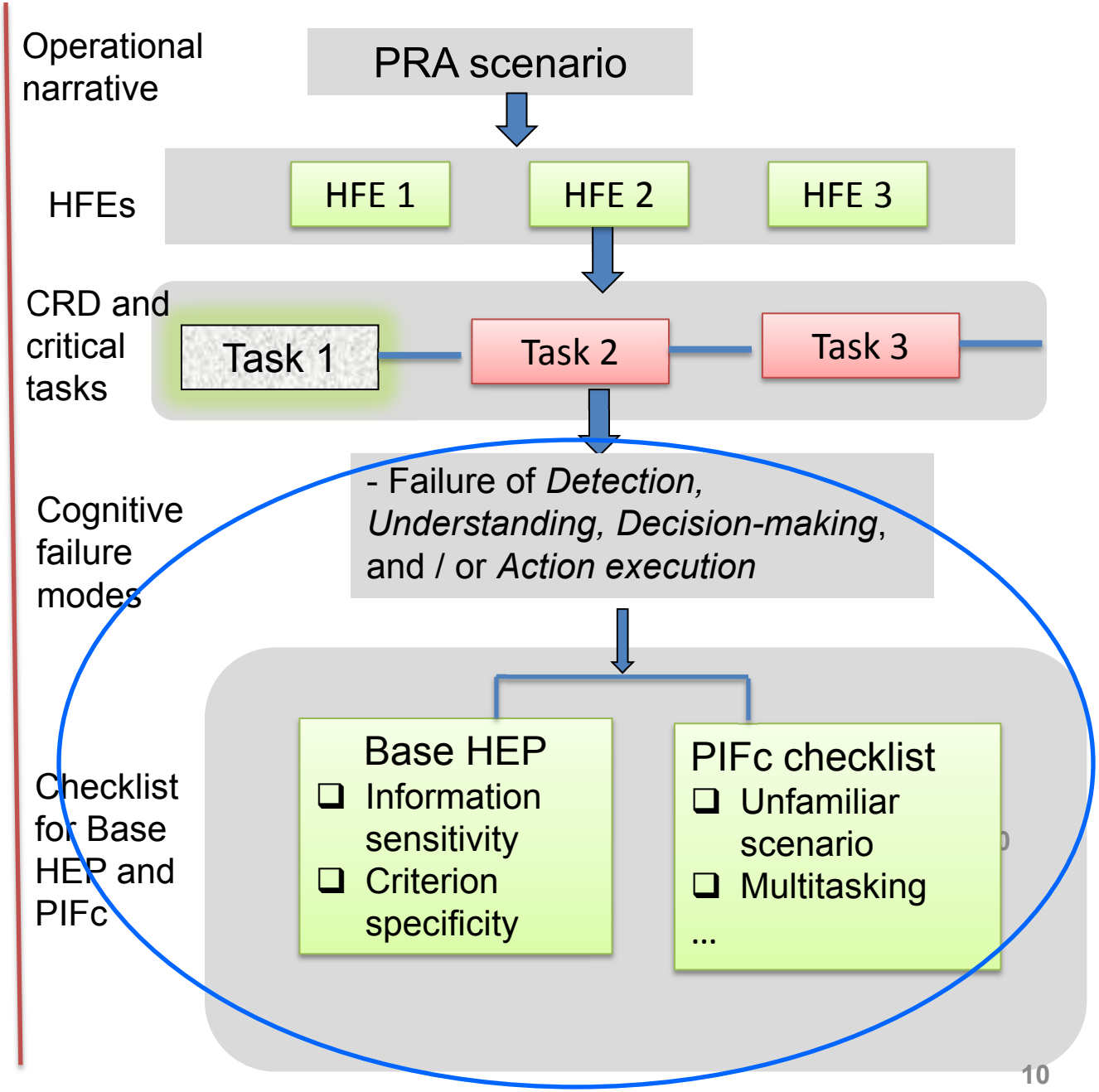
The General Methodology models these factors through PIF characterizations (PIFc) - the detailed traits or aspects of a factor, e.g.,

HSI – Alarm saliency, distribution of relevant information, display format

Training – Perceived urgency, frequency of training, training on I&C failure modes

Process of IDHEAS General Methodology

- Analyze scenario context and develop operational narrative
- Identify, define, assess HFEs, and analyze time effect
- Develop CRD of the HFE, analyze the critical tasks, and identify failure modes
- Calculate base HEP for the cognitive failure modes
- Determine applicable PIF characterizations (PIFc)
- Perform integrative analysis (dependency, uncertainty, and recovery)



Identify Cognitive Failure Mode

Assessment of CFM	Cognitive failure mode
The task requires checking / verifying information, responding to alarms/alerts, monitoring parameters or status, searching information, or comparing parameters	Failure of Detection
The task requires maintaining situational awareness, diagnosing problems, resolving conflicts, assessing status, or making predictions	Failure of Understanding / Situation assessment
The task requires making go / no-go decisions, choosing or developing strategies, adapting / developing plans, or making judgment	Failure of Decision-making / Panning
The task requires executing planned physical actions, executing skill-of-craft actions, or taking command and control.	Failure of Action execution

Cognitive basis for quantification

Cognitive function → Processes → mechanisms →PIF

Cognitive process for *Understanding*

U1 - Assess data
U2 – Select the mental model
U3 - Integrate the mental model with data
U4 – Iterate, confirm and revise the understanding
U5 - Communicate the outcomes

Proximate causes

- *Incorrect data*
- *Incorrect mental model*
- *Incorrect integration*

Cognitive mechanisms for U1 - Assess data

- Information is not complete, correct, or otherwise sufficient to generate understanding of the situation
- Attention to wrong or inappropriate information
- Improper data or aspects of the data selected for comparison with or identification of a frame
- Incorrect or inappropriate or inadequate frame used to search for, identify, or attend to information
- Data not properly recognized, classified, or distinguished.

Quantification model

P = Pt + ∑Pc

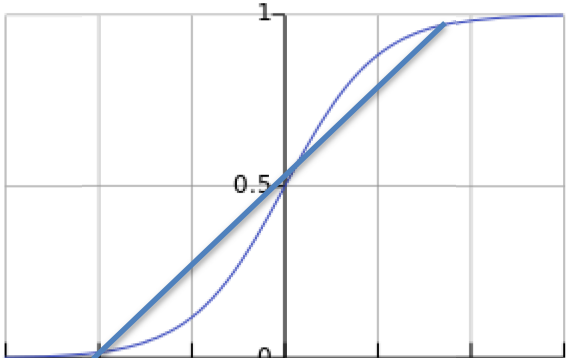
Pt – Error probability introduced by the time factor in the HFE

Pc – Probability of a cognitive failure mode

Pc = P0 **x W**

P0 is The base probability of a cognitive failure mode; it is determined by the basic principle of Signal Detection Theory, i.e., the error probability is determined by information sensitivity and decision-criteria specificity.

W – The effect of all the PIFs on the failure of the cognitive function;



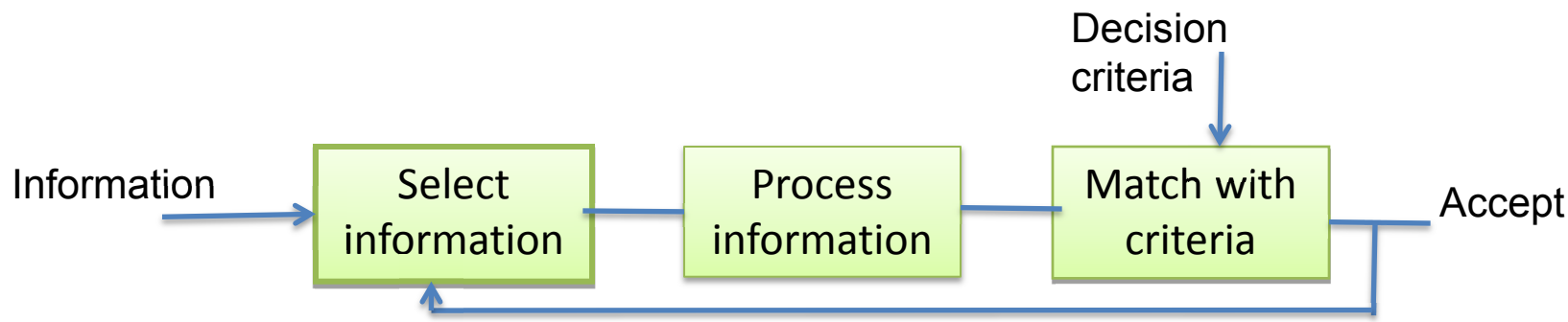
W= (∑ Wi) * Recover factor

Wi is the weight of an individual PIFc

(Alternatively,

W= logistic function of (∑ Wi * Recover factor)

Signal Detection Theory

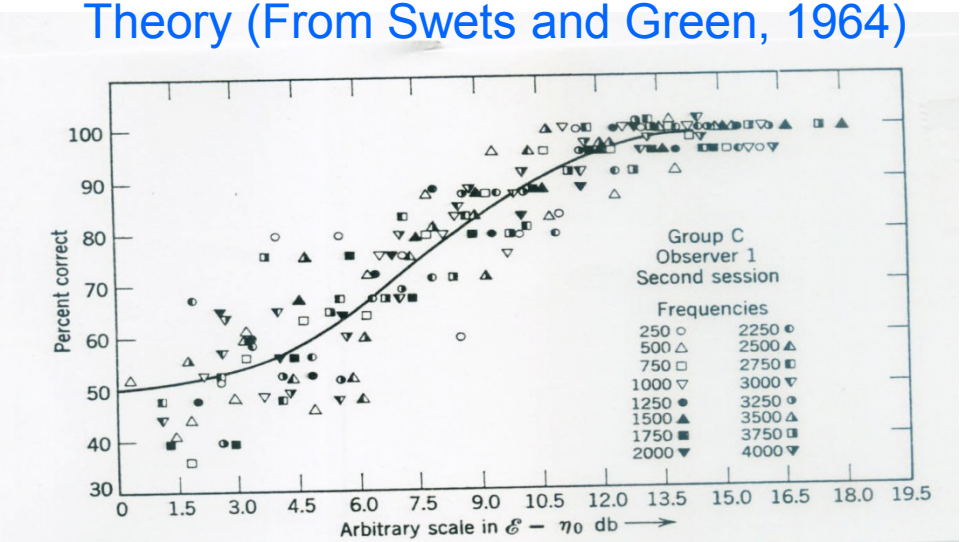


Error probability is determined by signal sensitivity (i.e., signal-noise ratio) and specificity of decision criteria:

P= 1/[1 + a* exp(-k * Rs)], where Rs is the product of signal sensitivity and criterion specificity.

Research has applied the theory to model data in detection, understanding, Decision-making and action execution.

Experimental data for Signal Detection Theory (From Swets and Green, 1964)



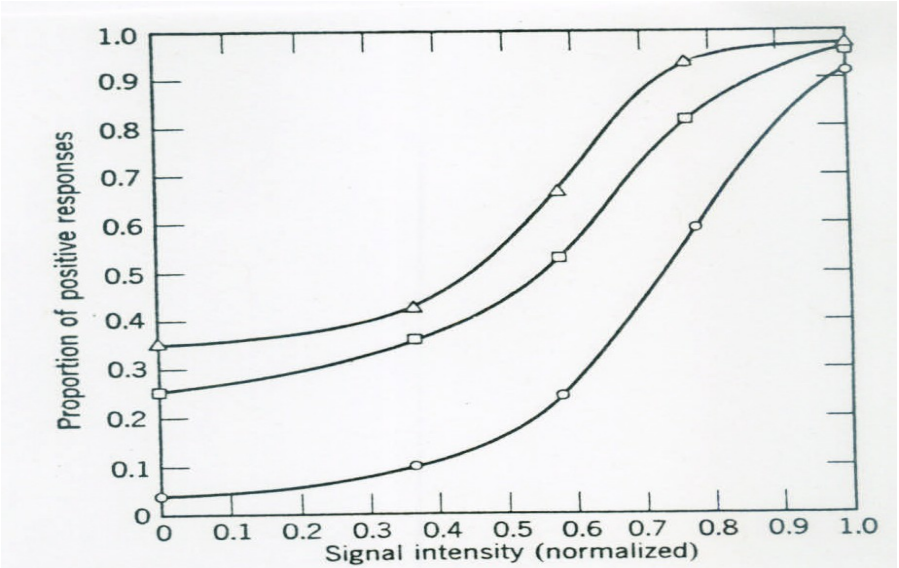


FIG. 5-2*a* Psychometric functions showing false-alarm proportions of 0.35, 0.25, and 0.04. (Data from Swets, Tanner, and Birdsall, 1961.)

Quantification model – Base HEP

The base HEP P_0 can be estimated as a nominal value when information sensitivity and criterion specificity are considered as good enough.

CFM	Conditions for "Good-enough"	HEP*
Failure of Detection	1) Information is accurate, reliable, and clearly recognizable 2) Criteria of judging the state of information are simple and concrete	1E-3 (E-4 ~5E-3)
Failure of Understanding	1) Information is complete and reliable 2) Crew has adequate knowledge and develops mental models for the object being understood	1E-2 (1E-3 ~ 5E-2)
Failure of Decision-making	1) Information needed for decision-making is adequate and correct 2) Decision criteria are concrete and manageable	5E-2 (1E-2 ~ 1E-1)
Failure of Action execution	1) Action scripts, instructions, or procedures are explicit and can be feasibily executed 2) Criteria for correct execution are specific and can be assessed	1E-3 (1E-5 ~ 1E-2)

* The HEPs are derived from the literature and should be estimated through expert judgment.

Quantification model – Calculating base HEP

When information sensitivity and criterion specificity are not nominal, the base HEP can be calculated from P0= 1/[1+exp(-k Rs)]. Rs can be assessed through a checklist:

CFM	Information sensitivity	Specificity of the criteria
Detection	☐Sensors or indicators may become unstable due to degradation or out of function (e.g. due to station black-out) ☐Information may not be available in time. ☐High false /alarm rate ☐Information is unrecognizable	☐Multiple dimensions of criteria to be met ☐Criteria are not applicable to the information
Understanding	☐Inadequate information from system to understand the situation due to reasons such as I&C failure, malfunction, environmental factors ☐Information may be inaccurate due to inherently unreliable sources, degraded sensors, problems in communication, or flaw in system state indication ☐Inadequate updates of plant information due to infrastructure (Could be the information perceived by a party (e.g., MCR) but failed to inform another party (e.g., TSC))	☐No existing mental model for the situation ☐Procedures or guidance is not adequate to develop a mental model of the situation; Crew has to rely on knowledge to develop a mental model ☐Information /Cues and do not match procedures / guidance (No obvious answer – can have multiple explanations) - There are multiple, alternative, explanations for the pattern of symptoms observed.
Decision-making	☐Inadequate information for decision-making -The key indication is false because environment effects ☐Uncertainties in the information - Sources and reliability of information are unclear to decision-makers	☐Decision criteria are unclear ☐Decision criteria are too complex to assess
Action execution	☐Procedures or instructions for action scripts ☐Physical feasibility (e.g., visibility of action site, Location accessibility, etc)	☐Criteria for action are explicit and concrete ☐Operators trained on the action (actions scripts and criteria) so that they know how to monitor and correct action errors

Quantification model – Benchmarking P_0

P_0 can be benchmarked from experimental data or expert judgment, for example in the table:

	Rs	P
100% Sensitivity and specificity	1	E-3
90% Sensitivity and 100% specificity	0.9	5E-2
50% Sensitivity 100% specificity	0.5	0.5
50% Sensitivity 100% specificity	0.5	0.5
50% Sensitivity 50% specificity	0.25	→1

Quantification model – The effect of PIF

Modeling the effect of PIF: **W= (∑ Wi) * Recover factor**

- **Wi** is the weight of an individual PIFc on the failure of the cognitive function. It can be binary, discrete, or varying continuously.

- Recover factor assesses the recovery potential for the error conducted. For example, in air traffic control communications, ~3% of omission errors and ~10% commission errors are recovered.

- The combined effect of multiple PIFc is additive.

Quantification model - Cognitive basis for the PIF model

The contextual factors or PIFs, such as workload, complexity, HSI, are characterized by more explicit, objective traits or characteristics:

- Cognitive studies elucidate the relation between PIFc and cognitive processes / mechanisms.
- Thousands of cognitive experimental studies reported data of error rates varying with individual PIFc; Studies of operational experience analysis typically reported data about correlation between PIFc and error rates or ranked the contribution of individual PIFc to human errors.
- Many cognitive experiments reported data or error rates varying with individual and combinations of two or more PIFc. The combined effect of PIFc could be inferred from the data.

Development the PIF model based on findings from the cognitive research

1) Developed a comprehensive list of PIFc

2) Inferred the links between PIFc and cognitive function / processes / mechanisms

3) Initially estimated the weights of the PIFc based on data from the literature (will be estimated through expert judgment and calibrated using HRA database in the long run)

4) Analyzed experimental data in the literature on the combined effect of PIFc and inferred the quantitative relation between the PIFc and human error probability.

PIF model: 1) A comprehensive list of PIFc

- Most PIFc were reported in the literature or human performance databases
- A few PIFc were inferred from studies of cognitive mechanisms
- The PIFs in existing HRA methods were included.
- We developed instances of the PIFc with respect to human actions in NPPs.

Examples of PIFc:

Workload

- Unfamiliar scenarios
- Multitasking
- Distraction / Interruption
- Unpredictable system dynamics
- Time at work (Long-working hours)

Complexity for action execution:

- Number of action sequences
- Size of action sequences (i.e., non-automatic action steps)
- Control actions (relying on system feedback)
- Duration of action sequence
- Number of exceptions
- Distribution of actions across locations, personnel, and team

PIF model: 2) Link between PIFc and cognitive process / mechanisms

- The cognitive basis framework (NUREG-2114) grouped cognitive mechanisms into proximate causes (i.e., failure of steps in the cognitive process)
- For every step of the cognitive process, we analyzed the literature to identify the PIFc relevant to the associated cognitive mechanisms
- One PIFc may be relevant to multiple mechanisms

Examples of links between PIFc and cognitive process / mechanisms:

Decision-making: D1 – Manage the goal
Cognitive mechanisms: A-Incorrect goals selected. B- Incorrect prioritization of goals. C- Incorrect judgment of goal success.

Mechanism	PIFc
AB	Conflict goals: chose one goal (or option) will block achieving the other goals; Multiple competing goals cannot be prioritized
C	Competing strategies: Multiple strategies can achieve the end goal but with different benefits and drawbacks
ABC	Organizational complexity in decision-making (too many levels of authorities, inter-locked authority entities, variety of entities involving in decision-making)
A	No procedure/guidance available for making the decision

PIF model: 3) Initial assessment of PIFc weights

- ***Wi*** inferred from experimental data measuring error rates with varying PIFc, meta-data studies that synthesized the experimental results for a given PIFc, and operational experience data about the correlation between PIFc and error rates.
- Some PIFc, such as multitasking, directly challenge cognitive capacity limits and can lead to high human error rates when the cognitive demand exceeds the limits. Other PIFc, such as some HSI features, only moderately increase error rates.
- The reported error rate data are generally convergent across different studies. For example, most studies on dual-tasks show that the detection error rate in dual-tasks is between 1 to 2 times higher than that in a single task.

Examples:

PIFc	Wi for Failure of Understanding
Multi-tasking	Single task =1, Dual task =2, HEP=0.5 for triple and 1 for more
Task complexity	Wi exponentially increases with level of complexity
Scenario familiarity	0 for familiar, frequently trained scenario 2 for infrequently (> 6 months) trained scenarios 10 for unfamiliar scenario

PIF model: 4) Combined effect of PIFc

- We analyzed two ways of combining the weights of individual PIFc:

  Multiplicative - $W = W1 * W2 * W3$

  Additive - $W = W1 + W2 + W3$

- Analysis was based on experimental studies that examined the individual as well as combined effects of two or more PIFc.
- The multiplicative rule tended to over-estimate the combined effect of PIFc on error rates, while the additive rule could roughly fit the results.
- The individual and combined weights of PIFc were typically in the range of 1-5 and rarely exceeded 10.
- The combined effect of some PIFc did not follow multiplicative or additive rules when the task demand on cognitive resources exceeded the cognitive limits.

The PIFc worksheet

- Analysts check the boxes for applicable PIFc

PIFc FOR FAILURE OF DETECTION			
Cognitive process / Mechanisms		**PIFc**	**Weight**
All steps D1-D5	**A**	❑ **W1 – Unfamiliar scenario**	**0.5**
	DF	❑ W2 – Multitasking	1 - 2
	DF	❑ W3 – Interruption/distraction	3
	E	❑ W4 – Unpredictable system dynamics	0.5
	DF	❑ W5 – Time pressure	0.5
	C	❑ W6 – Timing (Short-term mental fatigue, lack of vigilance)	5
	C	❑ W7– Time in work (Long-term mental fatigue)	0.5
D1 -A		❑ The instruction received for checking the information was insufficient or incorrect for the individual(s) to obtain the correct information	
D1 -AE		❑ Expectation on information detection is biased	1
D1 - A		❑ Detection aids: Inadequate guidance or procedures for detection – ○ Multiple guidance documents must be referenced or open at the same time ○ No place-holders to maintain one's place in the document ○ Document nomenclature does not agree with equipment labels	0.1
D2 -BCDEF		❑ The information source (e.g., procedures and instrument) is similar to the surrounding information sources or information.	0.2
D2 -B		❑ Information source is obscured due to environment factors ○ Labels on the source are difficult to read	0.5
D2 -BE		❑ Inexperienced with sources of information	0.2

Summary of the General Methodology development

- Overall framework and process initially developed, ready for piloting / revising.

- Several elements need further research and development:
  - HFE identification and interface with PRA
  - Minimum HEP
  - Dependency model

- Operational data needed to benchmark the time model (accounting for the effect of time on the overall HEP)

- Domain experts needed to verify and refine the PIF model

- Expert judgment needed to estimate / calibrate the base HEPs and weights of the PIFc

- Document the references and operational examples for the PIFc.

Insights on using SACADA database to inform IDHEAS Methodology

- Preliminary SACADA Data Analysis for HRA

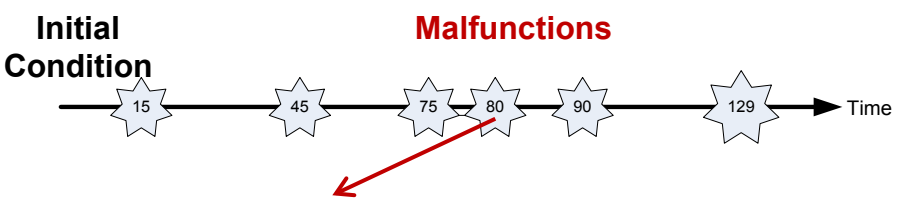
Y. James Chang, Ph.D.

SACADA Context Factors & Data Classification

- Primarily based on cognitive type
  - Detecting & Monitoring
  - Understanding & Diagnosis
  - Deciding & Response Planning
  - Manipulation
  - External Communication
- Each cognitive type associates with a set of Performance Influencing Factors (PIFs) or context factors
  - Factors specific to the cognitive type
  - Factors have overarching effects (overarching factors)

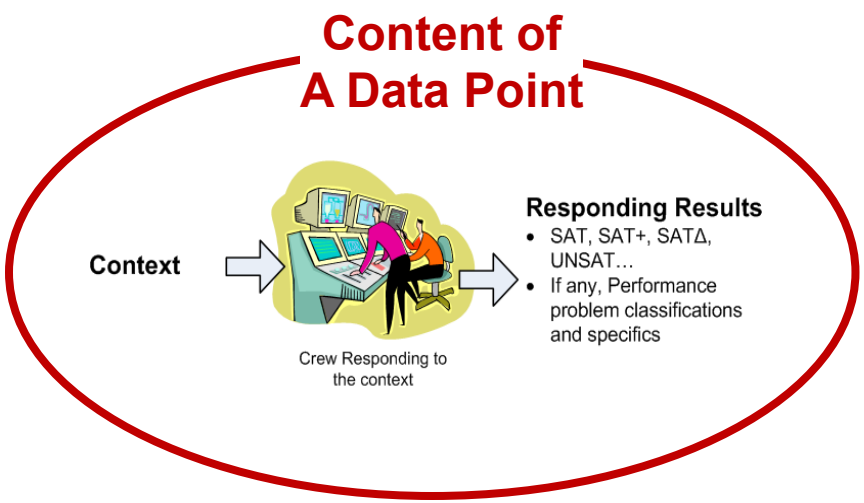
Data Glance

	Operator Training	US HRA Benchmark	Halden Experiment	TOTAL
# of Scenario	28	3	4	35
# of Data Point	6771	176	95	7042
# of UNSAT	67	12	10	89
UNSAT Ratio	1%	7%	11%	--



A Data Point

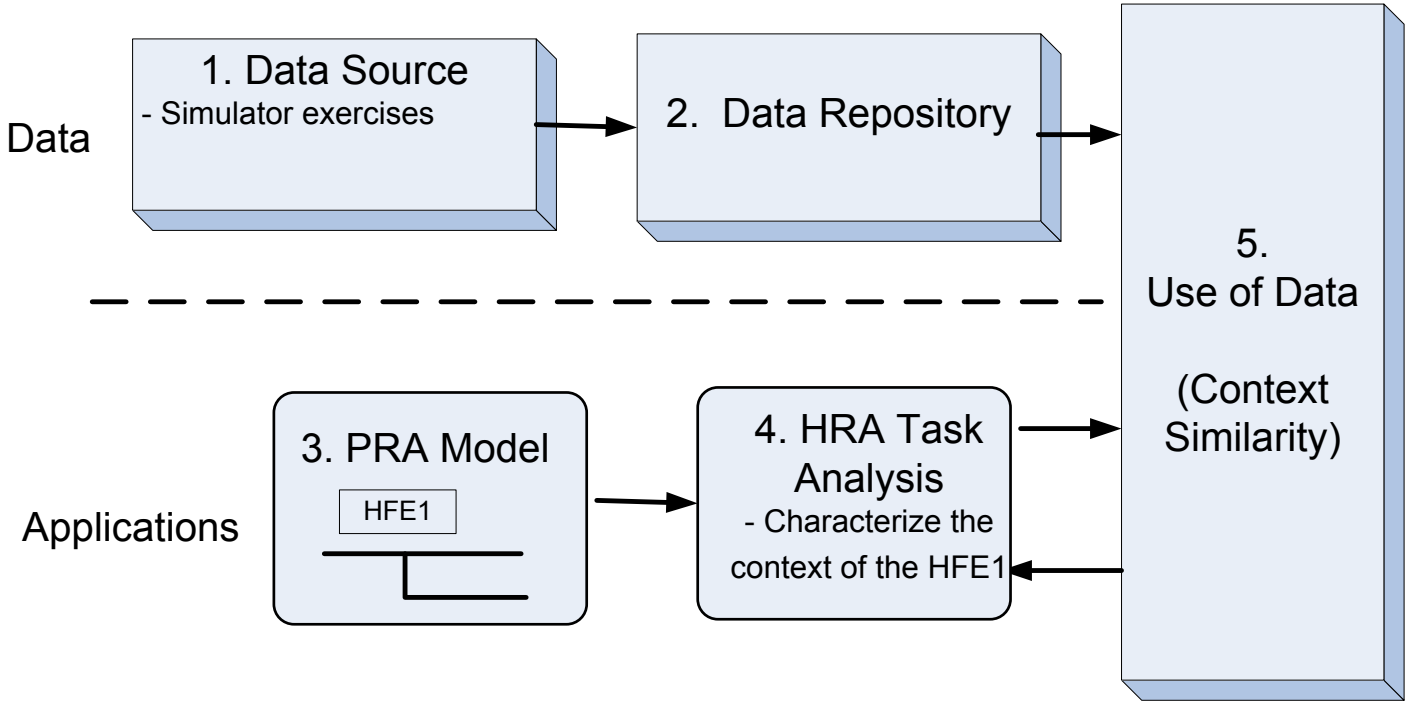
Loss of ECW 1A	
POSITION	EXPECTED RESPONSE
CREW	Recognize loss of EW flow to A train.
Crew	Secure ECW pump 1A
SM	Manually trip Diesel Generator prior to any of Diesel Generator trips
Crew	Ensure CCP 1A is in service
Crew	Verifies Natural Circulation
SM	Determines need to cooldown
SM	Declare an Alert HA1/EAL2 due to damage to EW structure or notify ED that escalation is appropriate.



Data Glance – Cognitive Types

	Data Points	UNSAT	UNSAT Rate (%)
Monitoring & Detecting	1367	10	0.73
Diagnosis	1001	16	1.6
Response Planning	1990	17	0.86
Manipulation	1838	33	1.8
External Communication	846	13	1.5
TOTAL	7042	89	--

Context Similarity Based Data Analysis



Context Similarity

- To increase data usability
  - Context is represented by the context factors
  - Data points of different elements in different scenarios can be pooled together to provide statistic indication
- Two types of context similarity
  - Based on the same PIF combinations
    - More context specifics
    - Less data points match the context specification
  - Based on the same number of negative context factors
    - Less context specifics
    - More data points match the context specification

Backup slides for “SACADA database to inform IDHEAS Methodology”

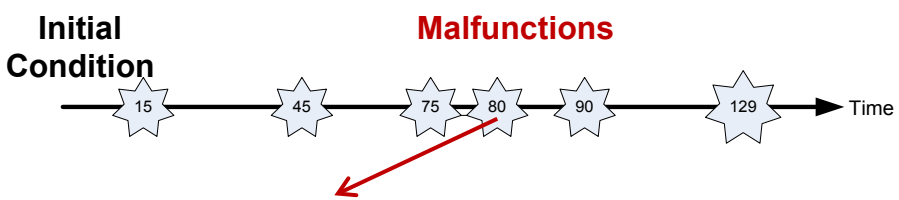
\

Preliminary SACADA Data Analysis for HRA

Y. James Chang, Ph.D.

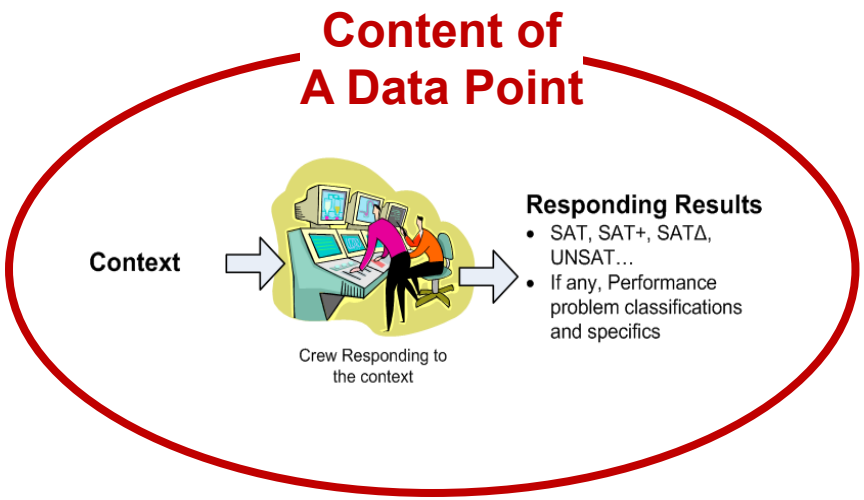
Data Glance

	Operator Training	US HRA Benchmark	Halden Experiment	TOTAL
# of Scenario	28	3	4	35
# of Data Point	6771	176	95	7042
# of UNSAT	67	12	10	89
UNSAT Ratio	1%	7%	11%	--



A Data Point

Loss of ECW 1A	
POSITION	EXPECTED RESPONSE
CREW	Recognize loss of EW flow to A train.
Crew	Secure ECW pump 1A
SM	Manually trip Diesel Generator prior to any of Diesel Generator trips
Crew	Ensure CCP 1A is in service
Crew	Verifies Natural Circulation
SM	Determines need to cooldown
SM	Declare an Alert HA1/EAL2 due to damage to EW structure or notify ED that escalation is appropriate.



A SACADA Output for Data Analysis (Partial)

- Context, Performance Placement, and # of Data Points

AllData for coding analysis.xlsx - Microsoft Excel

F178 | 0

	A	B	C	D	E	F	G	H	AB	AC	AD	AE	AF	AG	AH
1	Scenario	Year	Cycle	TOE	CognitiveType	DetectType	AlarmDetectMode	AlarmTileStatus	Memory Demands	UNSAT	SAT	SAT Δ	SAT+	TOT	UNSAT Rate(%)
169	RST 213.22	2013	5	Enters 0POP04-MS-0001 Excessive Steam Demand	3	0	0	0	0	0	11	0	0	11	0.0
170	RST 214.03	2014	2	Determines that Steam Dump PV-7493 is NOT responding	3	0	0	0	0	0	9	0	0	9	0.0
171	RST 214.02	2014	1	Enters 0POP04-TM-0004	3	0	0	0	0	0	9	0	0	9	0.0
172	RST 215.02	2015	1	Determines Primary to Secondary leakage is > CCP capacit	3	0	0	0	0	0	15	0	0	15	0.0
173	RST 213.17	2013	4	Enters 0POP04-AC-0003, Loss of Closed Loop ACW	3	0	0	0	0	0	13	0	0	13	0.0
174	RST 214.10	2014	3	Enters 0POP04-EW-0001 and takes actions to restore ECW	3	0	0	0	0	0	13	1	0	14	0.0
175	RST 214.07	2014	3	Enters 0POP04-SS-0001	3	0	0	0	0	0	15	0	0	15	0.0
176	RST 213.13	2013	3	Enters 0POP04-DA-0001 Loss of Non-Class 125 vdc	3	0	0	0	0	0	12	0	0	12	0.0
177	RST 213.10	2013	3	Place DA level control valve in manual and control level 6	3	0	0	0	0	0	14	0	0	14	0.0
178	Multiple SGs Tube Break	2014	1	Long term strategy for cooldown and release minimizatio	3	0	0	0	0	0	2	0	0	2	0.0
179	Multiple SGs Tube Break	2014	1	RCS pressure reduced as close as pressure in faulted SG #	3	0	0	0	0	0	1	0	0	1	0.0
180	ISLOCA	2014	1	RHR trains isolated (and leak in aux building terminated)	3	0	0	0	0	0	2	0	0	2	0.0
181	ISLOCA	2014	1	Plant information diagrams (PIDs) consulted	3	0	0	0	1	1	1	0	0	2	50.0
182	RST 214.07	2014	3	Determine the threat is a PROBABLE Threat Condition upc	2	0	0	0	0	0	15	0	0	15	0.0
183	RST 214.07	2014	3	Declare an Alert based on HA7 EAL-1	2	0	0	0	0	0	15	0	0	15	0.0
184	RST 214.14	2014	4	Declare an Unusual Event based on SU7 EAL-1 Unidentifie	2	0	0	0	0	0	14	1	0	15	0.0
185	RST 214.14	2014	4	Place CVCS charging in service to restore RCS Inventory p	2	0	0	0	0	0	14	0	1	15	0.0
186	RST 214.14	2014	4	Does NOT trip RCPs due to RCP Trip Criteria is NOT meet c	2	0	0	0	0	7	7	0	1	15	46.67
187	RST 213.14	2013	3	Direct actions of 0POP04-RS-0001	2	0	0	0	0	0	13	0	0	13	0.0
188	RST 213.14	2013	3	Recover rod D-4 per 0POP04-RS-0001, Addendum 1	2	0	0	0	0	0	13	0	0	13	0.0
189	RST 214.15	2014	5	Identifies RCS leakage as "in RCB" and performs Addendu	2	0	0	0	0	0	15	0	0	15	0.0
190	RST 214.15	2014	5	Declares Unusual Event per IN01, SU7 EAL-1 due to under	2	0	0	0	0	0	14	0	0	14	0.0
191	RST 215.02	2015	1	Determine 12B Essen Chiller will NOT start and secures Tr	2	0	0	0	0	0	15	0	0	15	0.0
192	RST 214.14	2014	4	Declare an Alert based on RCS leakage greater than the ca	2	0	0	0	0	1	14	0	0	15	6.67
193	RST 214.12	2014	4	Declares Unusual Event based on HU1 EAL-5 or HU3 EAL-1	2	0	0	0	0	0	14	0	0	14	0.0
194	RST 215.01	2015	1	Determines that PDP is NOT available and dispatches Plar	2	0	0	0	0	0	15	0	0	15	0.0
195	RST 215.01	2015	1	Determines Power can NOT be restored EXPEDIOUSLY and	2	0	0	0	0	0	15	0	0	15	0.0
196	RST 214.16	2014	5	(IF NOT isolated in 15 minutes) Declares an Unusual Event	2	0	0	0	0	0	12	0	0	12	0.0
197	RST 213.17	2013	4	Directs reactor trip due to surge tank level out of sight lov	2	0	0	0	0	0	10	0	0	10	0.0
198	RST 214.06	2014	2	Determine from 0POP04-ZO-0008 CIP that 0POP04-ZO-000	2	0	0	0	0	0	10	1	0	11	0.0
199	RST 214.06	2014	2	Classify the event as an ALERT (HA2, EAL-1). Fire or explos	2	0	0	0	0	1	10	0	0	11	9.0
200	RST 214.12	2014	4	Directs/Trips reactor, secures 3 RCPs to secure spray flow	2	0	0	0	0	0	13	1	0	14	0.0
201	RST211.02	2014	1	Determines SG being fed is Ruptured.	2	0	0	0	0	0	4	0	0	4	0.0
202	RST 213.19	2013	4	Identifies during addendum 5 performance, The B train Es	2	0	0	0	0	0	13	0	0	13	0.0
203	RST 213.19	2013	4	Properly select and maintain target temperature for cool	2	0	0	0	0	0	13	0	0	13	0.0
204	RST 213.19	2013	4	Refers to 0ERP01-ZV-IN01, Emergency Classification. Decl	2	0	0	0	0	0	13	0	0	13	0.0
205	RST 213.19	2013	4	Performs Immediate actions of 0POP05-EO-EO00, includir	2	0	0	0	0	0	9	3	1	13	0.0
206	RST 213.10	2013	3	Dispatch an operator to determine the cause of the alarm	2	0	0	0	0	0	14	0	0	14	0.0

Context Factors

Performance Displacement

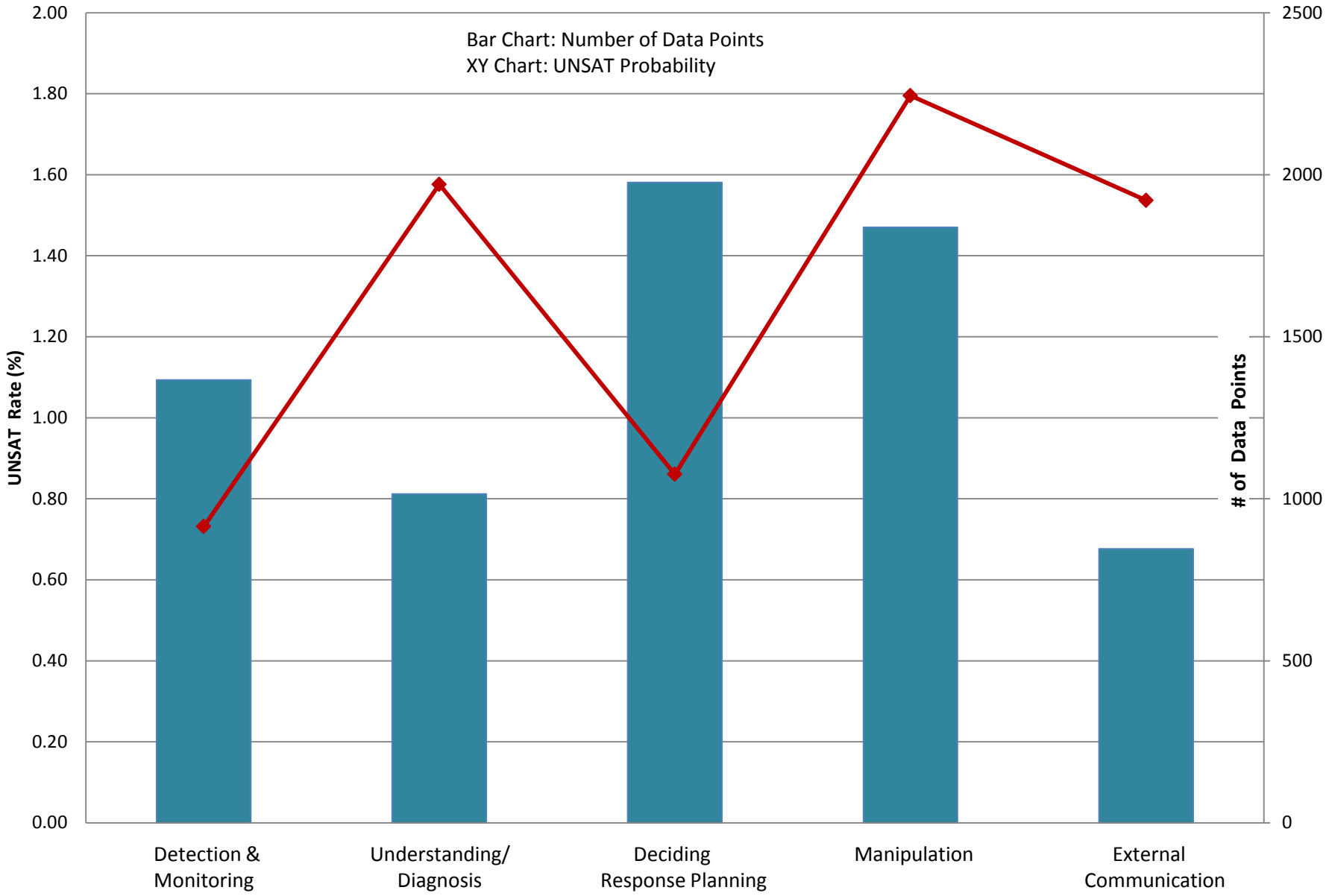
Context Factors & Data Classification

- Primarily based on cognitive type
  - Detecting & Monitoring
  - Understanding & Diagnosis
  - Deciding & Response Planning
  - Manipulation
  - External Communication
- Each cognitive type associates with a set of Performance Influencing Factors (PIFs) or context factors
  - Factors specific to the cognitive type
  - Factors have overarching effects (overarching factors)

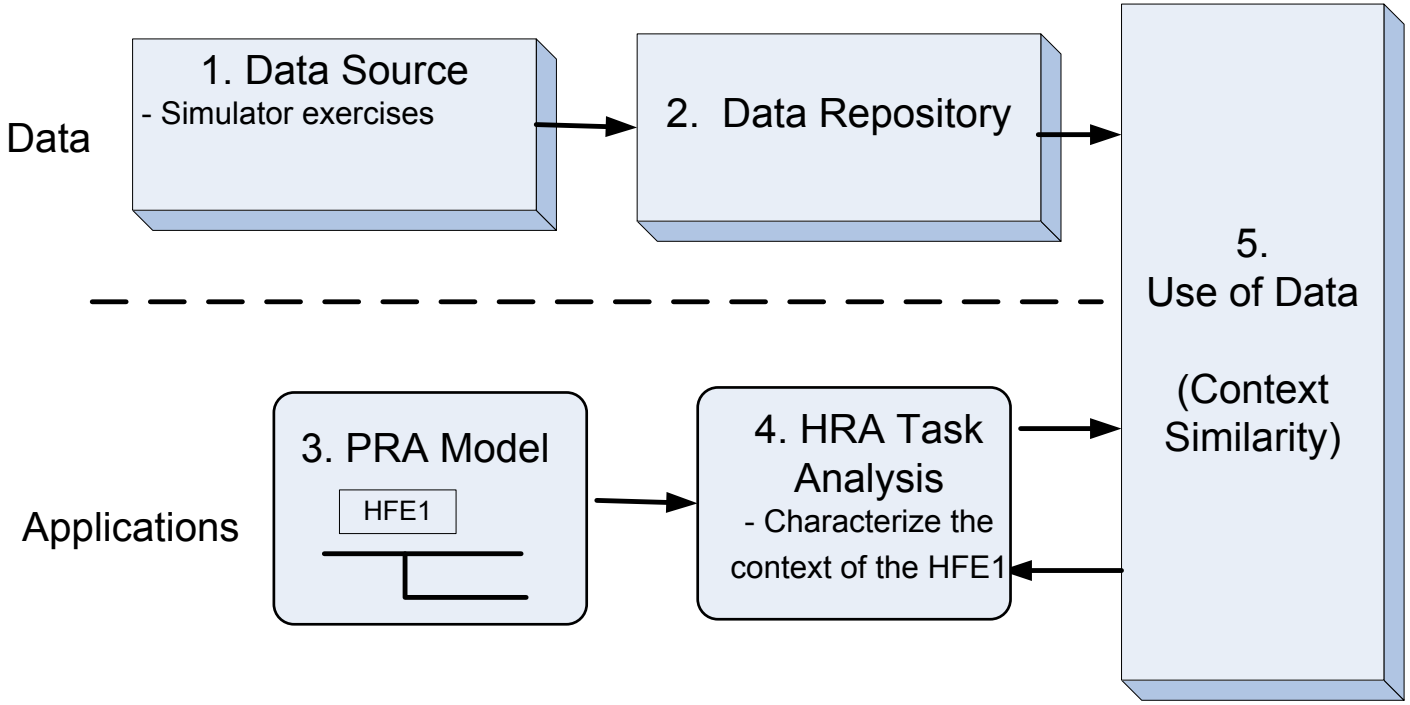
Data Glance – Cognitive Types

	Data Points	UNSAT	UNSAT Rate (%)
Monitoring & Detecting	1367	10	0.73
Diagnosis	1001	16	1.6
Response Planning	1990	17	0.86
Manipulation	1838	33	1.8
External Communication	846	13	1.5
TOTAL	7042	89	--

Data Distribution (All Databases)



Context Similarity Based Data Analysis



Context Similarity

- To increase data usability
  - Context is represented by the context factors
  - Data points of different elements in different scenarios can be pooled together to provide statistic indication
- Two types of context similarity
  - Based on the same PIF combinations
    - More context specifics
    - Less data points match the context specification
  - Based on the same number of negative context factors
    - Less context specifics

An Example of Identifying the Elements with the Same Context Factor Combination

PIF	Status 1	Status 2	Status 3	Status 4	Data Points
Cognitive Type	Response Planning (R.P.)				1990
R.P. Basis	Skill	Procedure	Knowledge		1282
R.P. Familiarity	Standard	Adaptation Required	Anomaly		959
R.P. Uncertainty	Clear	Uncertain	Competing Priority	Conflicting Guidance	861
Workload	Normal	Concurrent demand	Multiple concurrent demand		523
Time Criticality	Expensive	Normal	Barely adequate		408
Communication Required	Normal	Extensive Within MCR	Extensive Onsite		226
Miscellaneous	Non-Standard	Noisy Background	Coordination	Communicator Unavailable	201
	Memory Demand				

16 Elements of 9 Scenarios Have the Same Context

Elements	UNSAT #	Data Points
Announces transition to 0POP05-EO-ES01	0	9
Enter POP05-EO-EC00 Loss of All AC Power and perform immediate actions	0	15
Enters 0POP05-EO-EC00	0	15
Directs/Sets up/Commences Main Turbine load reduction @ < 5%/min	0	11
Verifies the Reactor and Turbine are Tripped	0	15
Transitions to 0POP05-EO-ES13 at 75,000 gallons in RWST	0	10
Initiates RCS cooldown to Cold Shutdown at < 100 degrees per hour	0	13
Directs/Performs EO immediate actions	0	15
Perform load reduction to <50% per 0POP04-CD-0001, Addendum 3	0	13
Continue through POP04-RC-0003 in an attempt to identify and isolate the source of the leakage.	0	14
Direct a transition to POP05-EO-ES12, Post LOCA Cooldown and Depressurization.	0	14
Stops SDG 13	0	1
Determine and report that RCS leakage has exceeded charging capacity to maintain pressurizer level.	0	14
Transition to POP05-EO-EO10 based on RCS leakage to containment.	0	14
Directs/performs actions of 0POP05-EO-ES01 Reactor Trip Response	0	14
Transition to POP05-EO-EO10, Loss of Primary or Secondary Coolant.	0	15
TOTAL	**0**	**201**

An Example of Identifying the Elements with the Same Context Factor Combination

PIF	Status 1	Status 2	Status 3	Status 4	Data Points
Cognitive Type	Response Planning (R.P.)				1990
R.P. Basis	Skill	Procedure	Knowledge		626
R.P. Familiarity	Standard	Adaptation Required	Anomaly		459
R.P. Uncertainty	Clear	Uncertain	Competing Priority	Conflicting Guidance	373
Workload	Normal	Concurrent demand	Multiple concurrent demand		245
Time Criticality	Expensive	Normal	Barely adequate		189
Communication Required	Normal	Extensive Within MCR	Extensive Onsite		124
Miscellaneous	Non-Standard	Noisy Background	Coordination	Communicator Unavailable	115
	Memory Demand				

8 Elements of 5 Scenarios have the Same Context

Elements	UNSAT #	Data Points
Enter POP04-ZO-0004, Personnel Emergencies	0	15
Perform EO00 immediate actions from memory; close E1C1 and E1C2 LC supply breakers if SI actuated	1	14
Enters 0POP04-CD-0001	0	14
Enters 0POP04-RC-0003, Excessive RCS Leakage	0	14
Enter POP05-EO-EO00, Reactor Trip or Safety Injection	0	14
Directs/Performs 0POP04-ZO-0003, Secondary Plant Stabilization	0	14
Enters 0POP04-TM-0004, Failure of Turbine Impulse Pressure Transmitter (PT-505/506)	0	15
Enter POP04-RC-0003, Excessive RCS Leakage and transition to Addendum 3.	0	15
TOTAL	1	115

Similarity in Number of Negative Factors

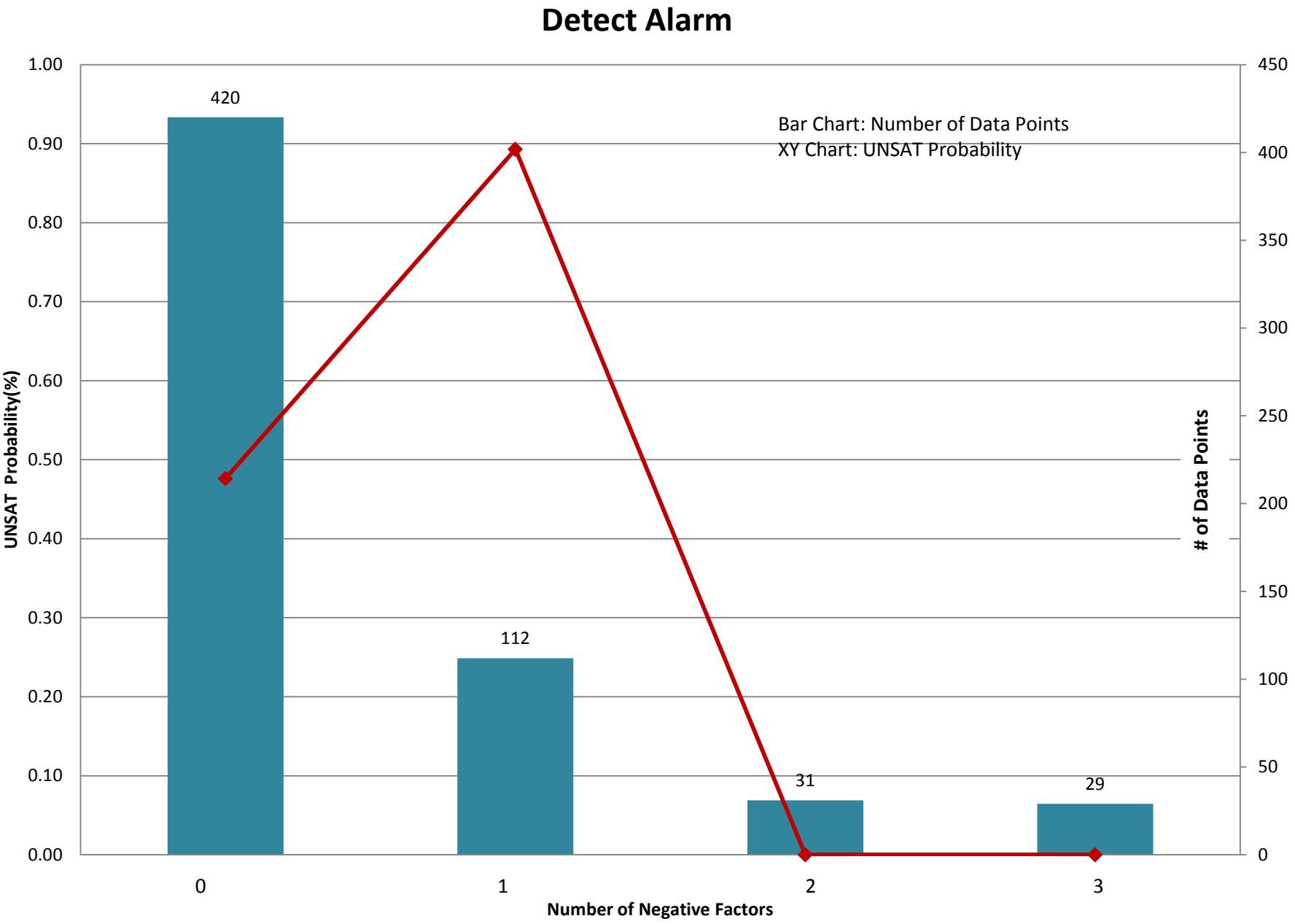
- A relation between the number of negative factors and UNSAT rate
- An alternative way to indicate combined PIF effects
  - Benefit: Based on larger data population (comparing to having the same PIF combinations)
  - Disadvantage: Does not have context specifics

Negative Factors for Detecting Alarms

PIF	Status 1	Status 2	Status 3	Status 4
Cognitive Type	Detect/Monitor			
Detect Type	Alarm	Meter	Indication light	Computer
Detect Mode	Self-Revealing	Procedures Directed Check	Procedure Directed Monitoring	Awareness/ Inspection
Alarm Tile Status	Dark	Busy	Overloaded	
Workload	Normal	Concurrent demand	Multiple concurrent demand	
Time Criticality	Expensive	Normal	Barely adequate	
Communication Required	Normal	Extensive Within MCR	Extensive Onsite	
Miscellaneous	Non-Standard	Noisy Background	Coordination	Communicator Unavailable
	Memory Demand			

Detecting Alarm Data

Neg.#	UNSAT#	Data Points	UNSAT %
0	2	420	0.48
1	1	112	0.89
2	0	31	0.00
3	0	29	0.00


Detect Alarm
Bar Chart: Number of Data Points
XY Chart: UNSAT Probability
UNSAT Probability(%)
# of Data Points
Number of Negative Factors
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
450
400
350
300
250
200
150
100
50
0
420
112
31
29
0
1
2
3

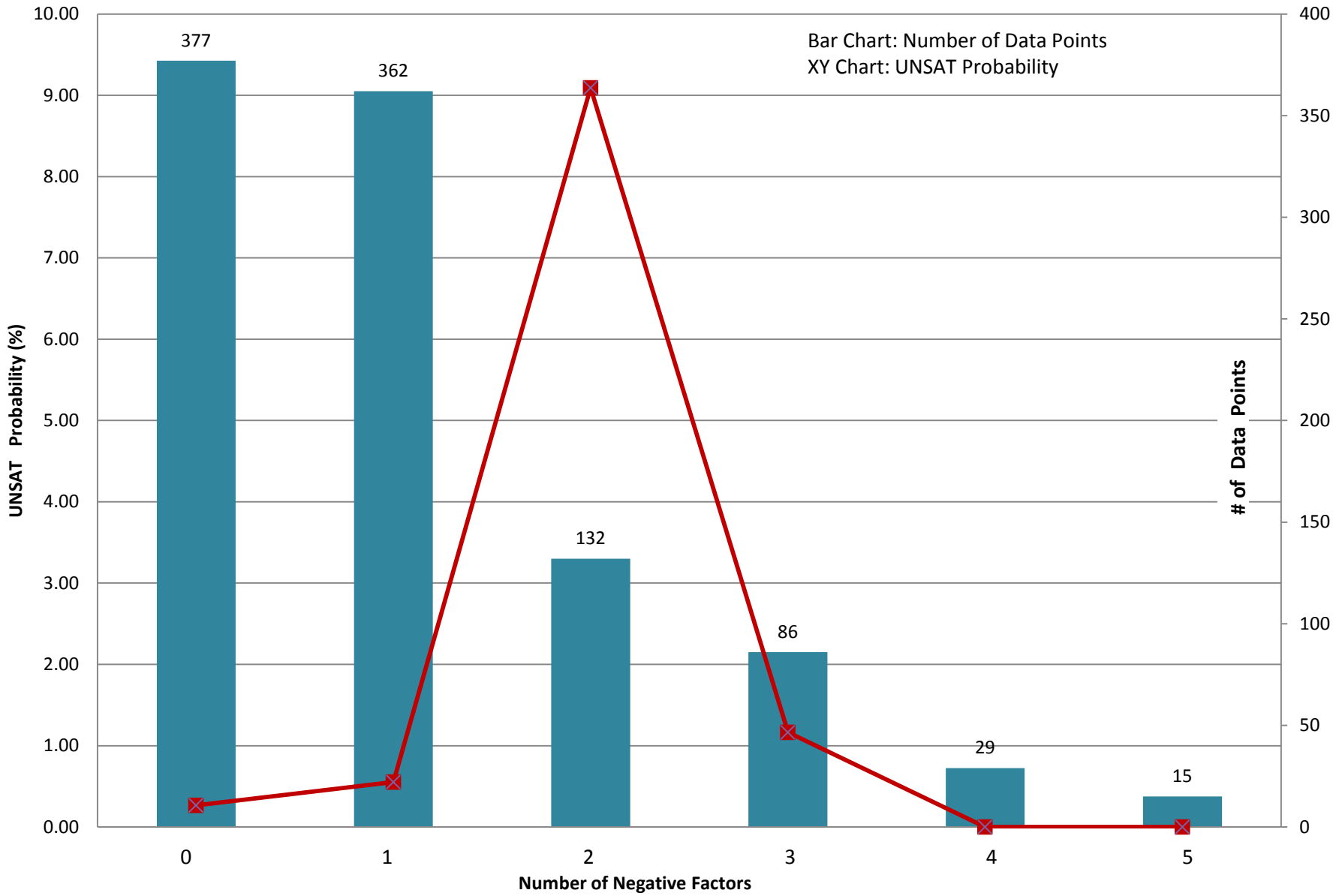
Negative Factors for Diagnosis

PIF	Status 1	Status 2	Status 3	Status 4
Diagnosis Basis	Skill	Procedure	Knowledge	
Diagnosis Familiarity	Standard	Novel	Anomaly	
Workload	Normal	Concurrent demand	Multiple concurrent demand	
Time Criticality	Expensive	Normal	Barely adequate	
Communication Required	Normal	Extensive Within MCR	Extensive Onsite	
Miscellaneous	Non-Standard	Noisy Background	Coordination	Communicator Unavailable
	Memory Demand			

Diagnosis Data

Neg.#	UNSAT#	Data Points	UNSAT %
0	1	377	0.27
1	2	362	0.55
2	12	132	9.09
3	1	86	1.16
4	0	29	0.00
5	0	15	0.00

Diagnosis


Bar Chart: Number of Data Points
XY Chart: UNSAT Probability
377
362
132
86
29
15
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
UNSAT Probability (%)
400
350
300
250
200
150
100
50
0
# of Data Points
0
1
2
3
4
5
Number of Negative Factors

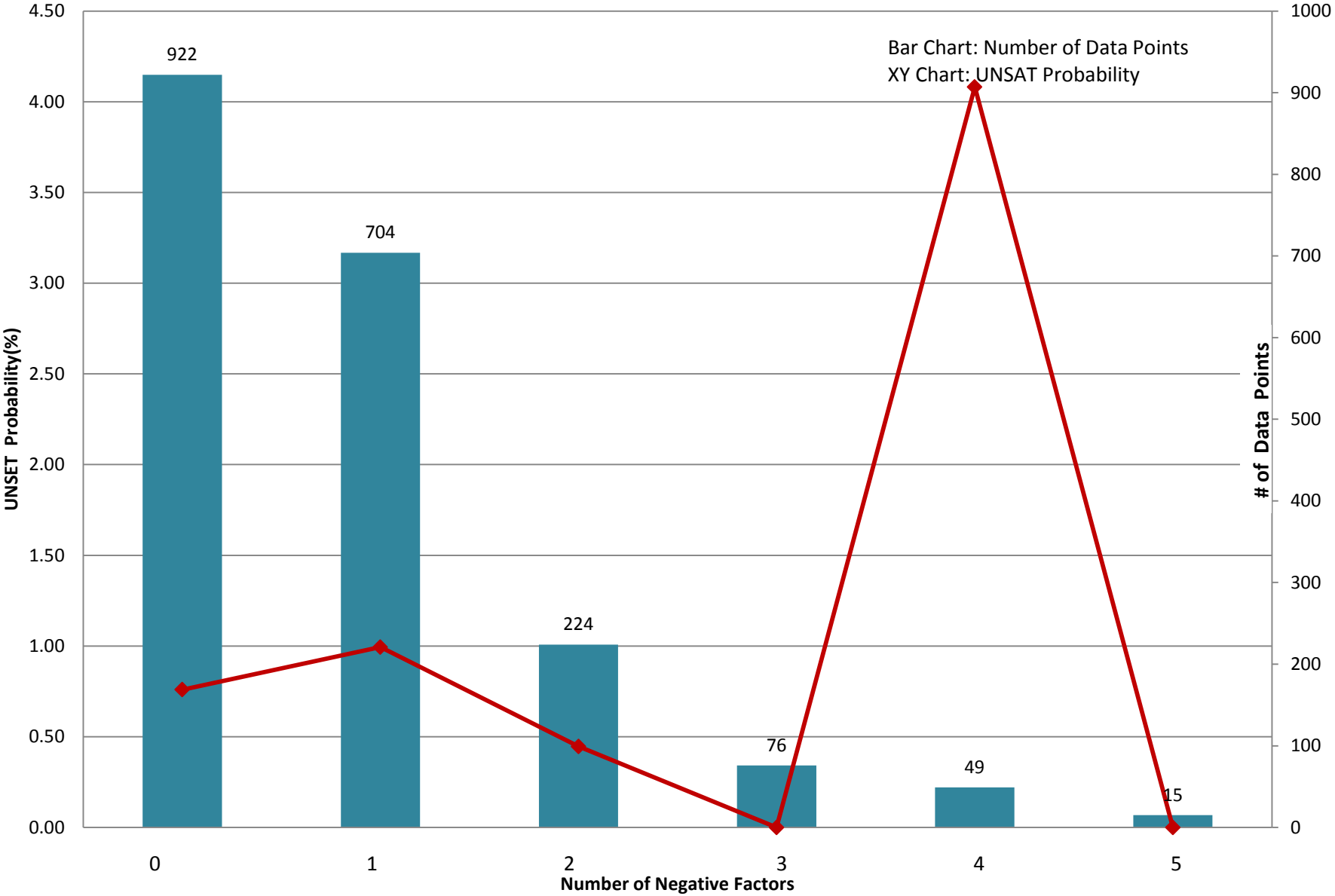
Negative Factors for Response Planning

PIF	Status 1	Status 2	Status 3	Status 4
R.P. Basis	Skill	Procedure	Knowledge	
R.P. Familiarity	Standard	Novel	Anomaly	
R.P. Uncertainty	Clear	Uncertain	Competing Priority	Conflicting Guidance
Workload	Normal	Concurrent demand	Multiple concurrent demand	
Time Criticality	Expensive	Normal	Barely adequate	
Communication Required	Normal	Extensive Within MCR	Extensive Onsite	
Miscellaneous	Non-Standard	Noisy Background	Coordination	Communicator Unavailable
	Memory Demand			

Response Planning Data

Neg.#	UNSAT#	Trail#	UNSAT %
0	7	922	0.76
1	7	704	0.99
2	1	224	0.45
3	0	76	0.00
4	2	49	4.08
5	0	15	0.00

Response Planning



Negative Factors for Manipulation

PIF	Status 1	Status 2	Status 3	Status 4
Workload	Normal	Concurrent demand	Multiple concurrent demand	
Time Criticality	Expensive	Normal	Barely adequate	
Communication Required	Normal	Extensive Within MCR	Extensive Onsite	
Miscellaneous	Non-Standard	Noisy Background	Coordination	Communicator Unavailable
	Memory Demand			

Manipulation Data

Neg.#	UNSAT#	Trail#	UNSAT %
0	12	1113	1.08
1	4	309	1.29
2	6	288	2.08
3	6	96	6.25
4	5	32	15.63

Manipulation