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

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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SUBCOMMITTEE ON RADIATION PROTECTION AND

NUCLEAR MATERIALS

ISA/PRA COMPARISON

+ + + + +

TUESDAY

JANUARY 11, 2011

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ROCKVILLE, MARYLAND

The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:00 p.m., Michael T. Ryan, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

MICHAEL T. RYAN, Chairman

J. SAM ARMIJO, Member

SANJOY BANERJEE, Member

DENNIS C. BLEY, Member

DANA A. POWERS, Member

JOHN D. SIEBER, Member

CONSULTANTS:

JOHN FLACK

MOHAMMAD MODARRES

DESIGNATED FEDERAL OFFICIAL:

MICHAEL BENSON

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

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

12:59 p.m.

CHAIRMAN RYAN: Okay. I guess we're at the appointed hour. So, this meeting will now come to order, please.

This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Radiation Protection and Nuclear Materials.

I'm Michael Ryan, chairman of the subcommittee. Members in attendance are Dennis Bley, Dana Powers, Sam Armijo, Jack Sieber. And we may be joined by Harold Ray, we may not. We may also be joined by Sanjoy Banerjee, or may not.

So, we also have a consultant, Mohammad Modarres, who's with us today from the University of Maryland. Welcome all. And John Flack is the designated federal official for this meeting.

DR. FLACK: Well, actually -

CHAIRMAN RYAN: I'm sorry. Michael Benson's the designated federal official for this meeting.

MEMBER POWERS: John is just totally useless.

(Laughter.)

CHAIRMAN RYAN: The purpose of today's meeting is to compare two analytical methods for the use in safety assessment in fuel cycle facilities; Integrated Safety Analyses and Probabilistic Safety Assessment.

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 on December 29th, 2010.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice.

It is requested that speakers first identify themselves and speak with sufficient clarity and volume so they can be readily heard.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's meeting.

Today's meeting will include briefings on the following: One, NRC staff's White Paper entitled "A Comparison of Integrated Safety Analysis and

Probabilistic Risk Assessment," and stakeholder views regarding the choice of safety assessment methods for fuel cycle facilities and, third, the NRC plans and future activities on ISA and PRA methods.

We will now proceed with the meeting, and I call upon Marissa Bailey from the Office of Nuclear Materials Safety and Safeguards to open the presentations.

Welcome, Marissa. Nice to see you again.

MS. BAILEY: Good to see you, too. Thank you.

As Mr. Ryan said, I'm Marissa Bailey. I'm the deputy director for the Division of Fuel Cycle Safety and Safeguards in the Office of Nuclear Materials Safety and Safeguards.

And with me is Dennis Damon. He is a senior level advisor for risk assessment in NMSS. And we're here today to present to you our comparison, our ISA/PRA comparison paper.

Dennis will be doing most of that. But before he does, what I'd like to do is just take a few minutes and give you some background information.

First, though, I'd like to thank the staff from the Office of Research, NRR and Region II who contributed to this paper, who peer reviewed it and

reviewed it for technical accuracy and provided input.

I'd also like to thank NEI who met with us while we were developing this paper, and gave us their perspective and gave us the industry perspective.

NMSS conducted the ISA/PRA comparison in response to Commission's direction, which in turn was in response to a plan that we presented to them for revising the fuel cycle oversight process.

Okay. I have to figure out how to do this.

So, why did the staff propose to revise the fuel cycle oversight process?

First, I'd like to point out that the current oversight program, in our view, is adequate for ensuring safety and security. But it's also the staff's view that it could be better, that we could take the risk insights gained from the ISAs and make the oversight process more risk-informed, performance-based, predictable and transparent. That was the goal for revising the fuel cycle oversight process.

This view has been supported in previous Commission SRMs that were issued between 2005 and 2009. In those SRMs, the Commission essentially directed the staff to make the oversight process more transparent and risk-informed, and also to examine

whether objective, quantitative measures for performance were feasible.

MEMBER POWERS: What kind of risk information did the Commission want -

MS. BAILEY: I'm sorry?

MEMBER POWERS: What general type of risk information did the Commission want the staff to take into account?

MS. BAILEY: I think - well, Dennis, you might need to supplement this, but I believe they basically wanted the staff to take a look at the results of the ISAs and see whether that could be used for a more -

MEMBER POWERS: That does surely look at the results of the ISAs.

MS. BAILEY: Excuse me?

MEMBER POWERS: The staff surely does look at the results of the ISAs.

MS. BAILEY: Yes, we look at the results of the - we review the ISA summaries and we also do a more detailed review of selected portions of the -

MEMBER POWERS: No, the ISAs do not yield anything that could be legitimately called "risk."

MS. BAILEY: Do you want to -

MR. DAMON: I mean, it's information about

what can go wrong in the -

MEMBER POWERS: Yes.

MR. DAMON: Right?

MEMBER POWERS: Yes.

MR. DAMON: So, in that sense it does, but -

MEMBER POWERS: But, I mean -

MR. DAMON: - they don't calculate risk.

MEMBER POWERS: But if the Commission wants you to take into account risk and - they must surely have some idea of what kind of information that comes from a risk analysis that they want you to take into account.

MR. DAMON: Well, it's not clear what - one of the awkward things here is most of the instances where there was interaction with the Commission on this subject, was prior to the terms of most of the current commissioners.

MEMBER POWERS: Oh.

MR. DAMON: Okay. So, now we have a whole new set of commissioners. I mean, Commissioner - Chairman Jaczko has been here that long. He caught some of the tail end of it.

But this process of interacting between even the ACRS and the Commission and the subject of

possibly revising the fuel cycle oversight program goes back to before the ISAs were done. In other words, back to around the year 2000 or so when they were just in the process of doing them.

So, the staff's been thinking about it. The commissioners thought about it. The Inspector General mentioned it. So, it's been a long process. So, it's not really clear what the current commissioners think about this.

POWER MEMBERS: Well, the previous commissioners when they ask for risk, to take into account risk information, I would presume they could be questioning sequences or they could be questioning bottom line quantitative results or they could be questioning things like risk metrics or importance metrics. I just wonder what they had in mind.

MR. DAMON: Well, one point of reference is the current chairman before he became chairman, wrote a paper or delivered a speech, I forget which, at a conference in which he discussed briefly the idea that he liked - he liked the predictable, more or less, objective method by which the reactor oversight program marches through and assigns performance metrics to the licensees. He liked that and he said we ought to do that for fuel cycle facilities.

So, we have that one piece of information that the chairman thought that was a good idea.

MEMBER ARMIJO: I'd like to get some just basic stuff of why is this happening.

You've got an effective process that ensures safety and security and you want to make it better by risk informing it, make it performance-based and predictable.

These are all nice words, but what improvement in safety are you going to make by virtue of these changes, and then how much is it going to cost in time and effort by the staff and by the industry to make this, what I suspect, is an incremental improvement?

Well, you can argue it's a great increment or a small increment, but it's going to - nothing comes free. And I'm just trying to see what the gain is and what the cost is to get that gain.

MS. BAILEY: Yes, I think that, you know, as I said before, that we feel that the current oversight process is sufficient for ensuring safety. So, we're not really looking at necessarily an improvement in safety.

What we're looking at is more an improvement in the efficiency and in the effectiveness

of our oversight process. It's more, probably, a way of helping us focus where we want to put our inspection resources given that we don't have unlimited resources.

And, also, to make the process more structured and more predictable.

MEMBER ARMIJO: So, just let me follow up to make sure I understand it.

So, this is really to help the staff do a better job.

MS. BAILEY: I guess you could put it that way, yes.

MEMBER ARMIJO: That's what I'm hearing, but I just want to make sure I understand.

MS. BAILEY: It's to help the staff do a better job. It's to help the staff do its job more efficiently in the oversight arena, and also to be more predictable.

MEMBER ARMIJO: Okay.

MEMBER POWERS: Now, you said "efficient," but "efficient" doesn't appear on this slide.

Is efficiency a consideration?

MS. BAILEY: Efficiency in terms of maximizing our resources in terms of putting the resources where we think the risk are.

MEMBER POWERS: I think that in recent explorations of fuel cycle facilities that I've been privy to, I think "efficiency" is not the word that came to mind. They were rather dogged examinations of highly-detailed and arcane documents and plans and things like that.

Efficiency in the sens of identifying those things that were of greatest importance to safety at the beginning and plunging detail into those was not a hallmark. Rather, it took quite a little effort to identify the things that were most important to safety.

And we spent quite a little while understanding how that was done and assuring ourselves collectively that it was done well, and it was. I mean, you've seen our letters. We were very - we praised highly all the work that was done.

But efficiency, I don't think, was the word that came to mind when I looked at that.

CHAIRMAN RYAN: If I look to the slide, you know, I see four things; risk-informed, performance-based, predictable and transparent.

And I guess I second Dana's thought that efficiency isn't really the word I would use to describe how one gets through to those end points.

MS. BAILEY: Okay.

CHAIRMAN RYAN: Sometimes it is a daunting task to get through it. But at the end of it, you know, I take away the insight that in trying to improve fuel cycle facilities, understanding of the facility's risk profile, if I could just use that word loosely, so that they could do a better job of managing their facilities that they're licensed to operate.

And in turn, maybe that gives the inspection process some leg up on understanding if there's a common currency for operator thinking, there might be a common currency for inspection. But that's sort of a side benefit to the fact the facilities are operated with some line toward more efficient or more improved operation. That's at least the way I'm -

MEMBER ARMIJO: Well, I still think we would like to get -

CHAIRMAN RAY: I'm reaching for that.

MEMBER ARMIJO: - even a qualitative response on the benefits of going through this change.

MS. BAILEY: Okay.

MEMBER ARMIJO: And the cost. And who does the work? Is this work going to be done by the staff to make all these improvements and provide all the

data and analysis to achieve your goal, or will it be done by the industry?

And, you know, I'm just trying to find out is this trip really worth taking?

MEMBER BLEY: Can I ask it a little different way, Sam?

MEMBER ARMIJO: Okay.

MEMBER BLEY: I sat through the - I tried to work my way through the ISA for the MOX facility.

MEMBER ARMIJO: That's a tough one.

MEMBER BLEY: I guess I'd ask the question having seen PRAs of other process facilities besides better information about understanding the risk and risk comparisons of different approaches, do you have any real feel for the level of effort between a PRA and at least an ISA like the one we saw in the MOX facility?

And if you do, maybe you can give us a little bit of the reasons for the difference in level of effort. I have my own opinions, but that's not what we're after here.

MR. DAMON: Yes, it - that subject is broached, I would say, in Section 5 of the paper. I'm trying to communicate how I see it. And that is there's a big difference between trying to do an

assessment of the risk of every single process in a plant and capture that and structure it and present it and everything else.

Big difference in the orders of magnitude between that and a violation occurs at one facility in one process, and you take a few staff members and they communicate with a few staff members at the facility, and they do a little risk assessment of the impact of that one deficiency.

So, that's what the example is in Section 5 is to illustrate how small a scale you're normally - normally, not always, but normally operating at.

Because I've been here - I came to FCSS in 1994 before the ISA rule was in place. I participated in the process. So, having worked for Sam Armijo at GE for 15 years before that -

MEMBER ARMIJO: Oh, God. I feel so old.

(Laughter.)

MR. DAMON: Having done PRA for 15 years before that, naturally when I came here every time something would happen, I would sit down with my little envelope, back of the envelope and do a little risk assessment of what the impact is, because it informs me about whether or not the thing is important or not.

And so I've been kind of playing this game for 15 years, and that's what I'm trying to communicate in Section 5 is, in general, that's kind of the scale of the problems you work.

Now, it's not always true. Sometimes you run into something that's complicated, you know, more like a reactor PRA-type thing that, you know, you can't easily do in a short time with small resources.

But this business of trying to do an assessment, I mean, we have done - I'll give you an example of the range of difference in scale of these ISAs.

At least one of the centrifuge enrichment plants only had sixty IROFS. The number I keep hearing quoted for MOX is 12,000. There's this huge range in terms of complexity of the facilities.

And when you go and you want to do a - if you want to do like a risk profile like Dr. Ryan is talking about, and you want to know, okay, what in all this stuff is - and do a profile of everything, well, if you're going to do MOX, you better bring your checkbook, you know. It's a big, huge, complicated thing.

Whereas for the centrifuge plants, we actually did that. We actually sat down and went

through and rated all the IROFS in the centrifuge plants because there's only sixty of them, but you can't do it for MOX, you know.

MEMBER ARMIJO: Too many processes. Too many -

MEMBER SIEBER: Isn't the level of -

MEMBER ARMIJO: It's not even, you know, it's not UF6 -

MEMBER SIEBER: -— this some proportion to the consequences of the effect that you're trying to utilize?

For example, pretty hard to have a problem in a fuel cycle plant that affects offsite populations to a major degree.

And, you know, this - but all this gets down into the area of industrial safety that we're concerned about as opposed to radiation exposure to masses of people.

Now, where is the balance between the amount of effort that you put in to figure out what the risk is versus if the accident occurs, what's the harm to the public and what's the harm to the worker?

How do you come up with that balance?

MR. DAMON: Well, of course the rule itself is structured to point the licensees in the direction

of, you know, focusing on things that have high consequences.

MEMBER SIEBER: Right.

MR. DAMON: And that's the way the rule is structured is it talks about high - in fact, I was going to get into that, you know, the definition of what is a high consequence event.

But as you point out for fuel cycle facilities, the number of scenarios where you would do that where you would get to the point where you might actually seriously affect the health of the public offsite is, you know, just a few. There are just a few scenarios where that can happen.

MEMBER SIEBER: But the NRC is responsible for radiological events as opposed to chemical mishaps or -

MR. DAMON: Well, that's another thing. The rule itself, that was actually promulgated - one of the two major reasons for the ISA rule was because Congress directed - after the Sequoyah fuels event where there's a cylinder rupture and a worker was killed, we were directed that we would regulate the chemical consequences of licensed material.

MEMBER SIEBER: Of licensed material.

So, it's the consequences of a chemical

that contains a licensed material as opposed to fuel oil in some emergency generator someplace that might flood.

MR. DAMON: Right. So, that's what the rule does is it delineates what that scope of NRC's authority is.

And the ISA concept actually came from a technique called process hazard analysis that was - had already been put into the regulations by OSHA to regulate chemical facilities.

MEMBER SIEBER: All this stems from the chemical industry, right?

MR. DAMON: Right.

MEMBER SIEBER: Okay.

MR. DAMON: So, that's how this all came about was we were told to regulate chemical safety. So, it was consciously decided and it says so in the statement's consideration for the rule, that it was done in a way to be congruent with the way OSHA was already doing it. So, we weren't reinventing the wheel.

So, that's really why it has the flavor it does. And if you read the OSHA rule, which actually is the last - the citation of it is the last slide in my SlideShow. They actually list the analysis

techniques right in the regulation, you know. You can use these techniques. It mentions fault trees explicitly in the rule.

So, they already were doing this in the chemical industry, and we were just hitching onto the same concept.

MEMBER SIEBER: Well, is it also not a fact that in a lot of places the responsibilities under the OSHA rules are carried out by the NRC?

For example, if you had an accident in a power plant that was not radiation-related, OSHA would often use an NRC inspector to carry out the OSHA requirement for an investigation.

MR. DAMON: Well, we have a - there's a written memorandum of understanding between OSHA and NRC on this specific subject. And in there, it says something like if an NRC inspector sees something that's -

MEMBER SIEBER: OSHA.

MR. DAMON: - OSHA, a thing that's exceptionally hazardous, they'll inform OSHA, you know.

MEMBER SIEBER: And they take it from there.

MR. DAMON: Yes.

CHAIRMAN RYAN: And vice-versa. If there's a radiological something that an OSHA inspector sees, they'll notify NRC.

MR. DAMON: Yes, so there is that kind of an agreement.

MEMBER SIEBER: Okay. Thank you.

MEMBER ARMIJO: Okay. Well, maybe in the course of the discussion, I'll understand it, but I still want to get a feel for the magnitude of the work that has been done, the magnitude of the benefit that the staff -

CHAIRMAN RYAN: Dennis, you may want to take your microphone out from under your papers so the reporter doesn't go deaf.

MS. BAILEY: Yes, we'll try to answer that question as we go through our presentations.

CHAIRMAN RYAN: Before we move on, I'm just going to check is there anybody on the bridge line?

MEMBER BENSON: They probably can't talk. It's probably muted.

CHAIRMAN RYAN: Okay.

MR. GODY: Yes, I'm on. This is Tony Gody. I'm from Region II. I am on the bridge line.

CHAIRMAN RYAN: Thank you, Tony. Appreciate you being with us today.

MR. KENNEDY: Al Kennedy from Global Nuclear Fuels is on.

CHAIRMAN RYAN: Okay. Anybody else?

All right. Thank you.

MS. BAILEY: Okay. I think the only other thing I want to point out on this slide with respect to why were down the path of revising the oversight process, is that in 2007 in a OIG audit report the OIG did recommend that the staff develop a more structured oversight process that would be similar to the reactor oversight process or using the reactor oversight process as an example.

And so in March of 2010, we put before the Commission a plan for revising the oversight process. That's in SECY 10-0031. And what's up there is basically the elements of that plan, which I'm not going to go into.

What I'd like to point out is that in the plan, the staff did propose to use the result with the ISAs to prioritize the focus of our baseline inspection program similar to what we did for new facilities where we used the ISAs to prioritize the focus of our operational readiness inspections of the Items Relied On For Safety.

In that plan, we also proposed to build a

significance determination process that would use the existing ISAs.

Ultimately, the Commission disapproved of the staff's plan to revise the fuel cycle oversight process. Instead in the SRMs that followed, the Commission directed the staff to first prepare a paper comparing ISAs for fuel facilities to PRAs for reactors, and submit that comparison to the ACRS for review.

The Commission also directed the staff to develop cornerstones that could be applied for a fuel cycle oversight program. And once the ISA/PRA comparison was completed and the Cornerstone Project was completed, to basically take the insights gained from those two activities and assess them and then provide to the Commission a recommendation for a path forward.

The Commission also directed the staff to make incremental enhancements to the oversight process to enhance its effectiveness and efficiency, including providing incentives for licensees to maintain a strong corrective actions program.

MEMBER ARMIJO: Marissa?

MS. BAILEY: Yes.

MEMBER ARMIJO: I'm not familiar with all

the fuel cycle facilities, but I am familiar with quite a few, and I don't know any that don't have corrective action programs.

And we can argue some are better than others, but are there licensees that don't have corrective action programs in place -

MS. BAILEY: Maybe some -

MEMBER ARMIJO: - and how can that be?

MS. BAILEY: - of the staff members here can address that. What I know is that it's not necessarily a regulatory - it's not a regulatory requirement under Part 70.

Patti, are you aware?

MS. SILVA: It's not a regulatory requirement.

MS. BAILEY: Use the mic.

MS. SILVA: I don't think it's on.

CHAIRMAN RYAN: It is on.

MS. SILVA: Oh, it is on. Okay.

There's no regulatory requirement, plus we don't - we haven't provided any kind of guidance of what we would consider to be an adequate corrective action program.

And it's not - it's also not used in enforcement or - so, we would need to identify what

would be considered a good corrective action program. And then we would -

MEMBER ARMIJO: When you do your inspections, do you inquire - are you allowed to inquire if whether they have a corrective action program?

MS. SILVA: Yes, we do look at their corrective action program. We look at - we look at events and things that they've found. And we look at the corrective action program.

We look at how they - how they address what they find that they need to fix, and we look at the process of them doing it, but we don't - I guess we don't inspect against a certain type of corrective action program that that's what it needs to be.

MEMBER ARMIJO: It's not a regulation.

MS. SILVA: It's not a regulation.

MEMBER ARMIJO: Okay.

CHAIRMAN RYAN: Do you, therefore, look at non-radiological events?

I'm a little confused. If you don't have an inspection obligation under a radioactive material license, you must be inspecting some other aspect of that and so forth.

I'm not following what you're actually

doing and what you're looking at in particular.

MS. SILVA: Okay. I can bring an inspector up to explain what we look at when we look at the corrective action program.

CHAIRMAN RYAN: Sure.

MS. SILVA: Dennis.

COURT REPORTER: Patti, could I have your last name?

MS. SILVA: I'm sorry. I'm Patti Silva, S-I-L-V-A.

MR. MOREY: Dennis Morey. I'm a criticality safety inspector in fuel cycle.

CHAIRMAN RYAN: Does your inspection extend to things that are not radiological and not under an NRC license, you know, if they have some other corrective action they're taking for whatever reason that's related to - I guess it doesn't make sense as a question, but something outside of what -

MR. MOREY: No, the only thing we inspect are the things that they're required to have under the license.

I think all they're telling you is there's no - there's no license requirement to have a particular type of corrective action program, but they - all of the licenses require them to correct

deficiencies.

So, when we're inspecting them, we're just checking - we're just looking to see if they're correcting known deficiencies.

CHAIRMAN RYAN: So, you might see a broad range of approaches to corrective action for deficiencies in the licensees you look at.

MR. MOREY: Right.

CHAIRMAN RYAN: Okay.

MEMBER ARMIJO: So, they could correct their deficiency just on an ad hoc basis, or they could have a formal corrective action program that takes all the deficiencies routinely in their facility?

MR. MOREY: Like, they could correct it ad hoc, but all the licensees I go to have a program.

MEMBER ARMIJO: So, that's where I'm confused here about corrective action programs do exist at least -

MS. BAILEY: Yes, and I think what the Commission is wanting us to do is to basically incentivize a strong corrective actions program and develop, basically, a strategy for allowing credit for licensees having a corrective actions program when we disposition or take - when we disposition violations

or take an enforcement action.

MEMBER ARMIJO: I just misinterpreted that sentence to mean that these programs were haphazard or didn't exist, and that's not what you're saying.

MS. BAILEY: Right.

MEMBER ARMIJO: Okay.

MS. BAILEY: And I think the point of the slide that I'm trying to make here is that because we're here to present the ISA/PRA comparison, is that the ISA/PRA comparison is one piece of the staff's overall efforts to implement the direction that the Commission has given us that's related to revising the fuel cycle oversight process.

MEMBER POWERS: If you don't have a standard to use for your examination of a corrective action program, how do you know that they should get credit for that program in enforcement actions and the like?

MS. BAILEY: I think that that's probably -

MS. SILVA: That's what I was talking about that we need to provide guidance on what would be a good corrective action program and to incentivize using corrective action programs and having an adequate one that we could inspect against and actually formally do that versus just looking and see

something happened, what did you do with it.

We're looking at more of the what did you do with it and whether you have that program in place. So, we need to develop kind of the best practices for corrective action programs across the board.

MEMBER POWERS: I would think that the biggest challenge that I could think of in a corrective action program for a fuel cycle facility is root cause analysis. I would think that would be a real challenge.

MS. BAILEY: Got a staff member in the back there.

MR. CAMPBELL: This is Larry Campbell.

Keep in mind that even the - some fuel cycle facilities have committed to an Appendix B-type QA program and NQA-1.

Those facilities that have not, there's management measures. And one of the management measures is incident investigation. That's as close as they come to corrective action.

So, under the incident investigation, that - I think that's what - that Marissa and Dennis is saying we want to enhance a bit, that particular management measure.

MR. DAMON: I think - I think we're maybe

miscommunicating, because my feeling of what the commissioners were alluding to in the statement about the corrective action program wasn't that the corrective action programs needed some kind of work. It's that they wanted to use them in the same way that they use them in the reactor program.

And I'll give you an example. We already sort of tried this out. And that is in the reactor program, what they do is if they identify something as a - they do a risk significance determination on an inspection finding. And if it's a green, it's turned over to the licensee to correct and the - it's not a violation and the staff doesn't follow up on it very much. They just check to see in the end, whether it got corrected or not.

Whereas if it's a violation currently, we have a whole process we have to go through, an enforcement process. And so, they're alluding to the fact you -- what I see as the corrective action program. We'll take these low-risk significance things and let them take care of them and not spend our resources, you know, tracking them.

MEMBER ARMIJO: And if they don't, then it has to go into the enforcement kind of - turns into a violation that you have to -

MR. DAMON: Well, if there's a dispute of some kind, I guess, yes, you have to go through the process. But, I mean, normally, you know, the kind of things they find, they're going to fix them.

We actually, like I say, we tried this out with all the - we looked at all the criticality and chemical safety violations at the fuel cycle facilities for the last five years.

I sat there and went through every single one of them and we developed qualitative criteria for screening for low-risk significance. Half of them screened to low significance on these qualitative criteria.

The next step would be if you have a quantitative process, you do a quantitative evaluation like in the example in Section 5, and then you could screen some more of them to green.

And then those greens, they go in the licensee's corrective action program and they're not processed through our enforcement process anymore - or there is some processing, but it's not - we don't treat it like we currently do.

MEMBER ARMIJO: So, that's kind of your vision of how this thing would work?

MR. DAMON: That's what I think is the -

was the vision of where to put that in the SRM.

MR. TSCHILTZ: If I could interject, my name is Mike Tschiltz. I'm the acting director of fuel cycle revision.

And I think just to give you some more context of where this whole issue came up, I believe, is if you look at the reactor oversight process, one of the principles that it's based upon is that licensees have strong corrective action programs that they can rely upon to correct minor deficiencies without the NRC going in and providing strong oversight in those areas.

So, I think the context that this comment was provided in was that, okay, well, if you're going to move toward a more risk-informed oversight process in the fuel cycle arena, then you need to figure out a way to incentivize or build a program around this basic premise that licensees have very strong corrective action programs that you can rely upon to correct minor deficiencies before they escalate into more serious problems.

CHAIRMAN RYAN: Thank you.

Should we proceed, Sam?

MEMBER ARMIJO: Yes.

CHAIRMAN RYAN: Okay. Continue, please.

MS. BAILEY: Okay. The next slide basically just points out what the focus of the ISA/PRA comparison paper is on it. And, basically, we're focusing on comparing the ISAs and PRAs for two different applications.

One is the demonstration for safety under 10 CFR Part 70, and the other is for performing risk significance determination. And Dennis will go into the details of the paper.

What I'd like to do is I'd like to just point out or emphasize some key points from the ISA/PRA comparison.

First, I'd like to point out that the fuel cycle ISAs and the reactor PRAs are performed for different purposes. The PRAs for reactors are performed to provide risk estimates, and the ISAs really are not.

An ISA is performed to identify the potential hazards at a facility, to identify the Items Relied On For Safety, to basically prevent or mitigate those hazards, and then to identify the management measures that would be put in place to ensure the availability and reliability of the IROFS. So, the ISA is really a part of a fuel facility safety program.

The second thing that I'd like to emphasize is that we believe that based on, really, ten years of experience in implementing the ISA rule, we believe that the ISAs are sufficient for establishing the safety basis for a fuel facility. That they are sufficient to support safety decisions.

A fully quantitative analysis like a PRA, the processes might give you more information, but it would likely come at significant cost and resources both to the licensees for developing them, and also for the NRC for - to the NRC for reviewing them.

MEMBER BANERJEE: Can I just ask you a question?

MS. BAILEY: Sure.

MEMBER BANERJEE: Pardon my ignorance. Are these partly batch processes?

MS. BAILEY: Yes.

MEMBER BANERJEE: So, operating procedures, I mean, are very important, right?

CHAIRMAN RYAN: Yes.

MEMBER BANERJEE: So, typically in a chemical plant, one has procedures to do this using HAZOPs, as we all know.

How do you do that in a PRA?

MR. DAMON: I'm not sure what you mean.

MS. BAILEY: Yes.

MEMBER BANERJEE: Well, for example, let me give you - imagine I'm running a batch plant to make something. Doesn't matter. A pharmaceutical.

You fill one vessel. So, there's a procedure, okay, which is empty this, put it in there, you know, the typical - and you can do a HAZOP on each operating instruction and go through it in a systematic way.

There are procedures for doing this. We know how to do this because we build chemical plants, which are batch plants.

PRAs are not typically used in situations like that, that I know of. You might enlighten me. Dennis might, actually.

MR. DAMON: Well, you can - you can do both, you know.

MEMBER BANERJEE: It's not that easy because it doesn't fall into the -

DR. MODARRES: There is human - there are human actions in the control room which are essentially proceduralized and step by step. You go through many steps.

MEMBER BANERJEE: Okay.

DR. MODARRES: Those are all considered in

the PRAs as sequences of events done under human action.

MEMBER BANERJEE: And you sort of add it for the probability of success, of failure or -

DR. MODARRES: With a probability of success, which is conditional upon previous tasks being done. So, that's done.

MEMBER BLEY: I've never seen a PRA of a process facility done that did not do HAZOP to help it define the scenarios it was going to evaluate.

MEMBER BANERJEE: HAZOP is the first step?

MEMBER BLEY: Absolutely.

DR. MODARRES: Yes.

MEMBER BLEY: Absolutely.

MEMBER BANERJEE: I've never seen a PRA done for a chemical plant.

CHAIRMAN RYAN: Sanjoy, I think the idea of a simple batch process where you mix three ingredients and you get some product out the bottom end of the tank after stirring it for five hours, is pretty straight forward in a simple batch. But very quickly, a batch process really becomes a continuous process when you start having lots of feeds, lots of mixing and, you know, continuous feed of product. So, you very quickly get out of a batch process.

MEMBER BANERJEE: Yes, but a lot of the issues are related to the operations.

CHAIRMAN RYAN: Yes.

MEMBER BLEY: Absolutely.

MEMBER ARMIJO: They may be fairly long-term batch processes, but they're still batch processes.

CHAIRMAN RYAN: Sure.

MEMBER ARMIJO: Phase changes are important, you know, but it's really a simple thing. Take UF6, evaporate it, turn it into UO2. There's a whole bunch of little steps.

And do you really need PRA and will PRA really help you do a better job with respect to safety or even assessing the risk? I don't know.

CHAIRMAN RYAN: Well, one phase we haven't mentioned yet is, you know, a process hazards analysis, which is an OSHA process.

As Dennis said, you know, it has a lot of the same attributes as a PRA without the probability part as much.

MEMBER BANERJEE: Well, that must be based on a HAZOP, right?

CHAIRMAN RYAN: Yes.

MEMBER BANERJEE: The process hazards

analysis.

CHAIRMAN RYAN: But it's designed, you know, to kind of be tailorable to a wide variety of processes, not just batch processes.

MEMBER BANERJEE: I think what Dennis said is useful. You can use a HAZOP as a basis, and then put some probability on each of these.

MR. DAMON: Yes, the probability modeling is usually - it's different, you know. Like you said, a HAZOP is a useful thing to - it's a nice structured thing to help you try to think of what can go wrong.

What I found in looking at HAZOP results is they usually - they're parameter oriented in the following sense they still - they'll say, well, what if the flow is too high, what if the temperature is too high?

Okay. And then at that point, you say, well, then I've got something to protect me from the adverse consequences of that or I've got something to control that parameter.

But when you get into PRA, you usually end up modeling things of a more refined level of detail. How did - how did you get that high temperature? What exactly went wrong?

And then you've got to specify that much

more precisely because you're going to want to quantify how frequent that is.

So, my view is the PRA, you do the HAZOP first, and then you start talking about making a quantitative model, you know. Some kind of a probability model that would come out of a fault tree or event tree or some other kind of probability.

MEMBER BANERJEE: But that's an enormous amount of work.

MR. DAMON: It could be, yes.

MEMBER BANERJEE: Right. Because, I mean, that's really what people don't do if they can help it.

MEMBER BLEY: Take a look at the MOX ISA and take a look at the 12,000 or however many IROFS that have been beefed up and re-expensed to ensure for every one of those there was coverage with no risk ranking to decide some weren't important and others were and, you know, it's expensive either way if it's a complex facility.

I have a question back to where you were a little bit ago talking about your confidence in the current oversight process.

Have there been complaints about your oversight process either from the Commission or from

the regulated, of the kind that we used to have for the previous reactor oversight process that it was - it was too arbitrary and random based on the judgements of the people involved in the particular reviews that were there?

Do you have that kind of problem that existed that led to the rope that we've now got for reactors?

MS. BAILEY: You know, I'm going to let the industry answer the part about complaints from the industry.

MEMBER BLEY: Well, can we interpret what the Commission told you that you're getting that kind of complaint from the Commission?

MS. BAILEY: I think from the previous Commission, you know, I mentioned SRMs being issued between 2005 and 2009. So, that really was the previous Commission.

But I think from the previous Commission, that there was a sense that the oversight process could be more structured, that it could be more predictable or less arbitrary in how we disposition our -

MEMBER BLEY: And we haven't heard from the new Commission on these issues yet, as far as I know.

MS. BAILEY: I don't think so.

Do you recall?

CHAIRMAN RYAN: Not yet.

MEMBER SIEBER: Latest SRM was in September, I think.

MS. BAILEY: And, again, the OIG recommendation back in 2007 to make our oversight process, the framework of it to follow a more structured framework similar to -

MEMBER BLEY: We'll hear from the industry later, I guess.

CHAIRMAN RYAN: We do have -

MEMBER BLEY: Yes. Okay.

MS. BAILEY: But the discussion previous basically feeds into, I think, the second point that I was trying to make, which was that the cost of developing a PRA for all the processes in the fuel facilities, I don't think that it's clear that the cost can be clearly justified given that we believe that the ISAs are adequate for ensuring safety and that the facilities are relatively low risk compared to power reactors.

And I think the third point that I wanted to make that I think is emphasized in the ISA/PRA paper is that as I mentioned before, the ISAs were not

intended to provide risk estimates.

And so, we acknowledge that the methodology, the ISA methodology may not be fully right for use in a quantitative significance determination process.

However, we believe that if we did decide to go with a quantitative SDP, that we could perform that quantitative analysis for that specific violation to determine its risk significance. And that could be done on a case-by-case basis.

We believe the -

MEMBER ARMIJO: Excuse me. Is that the example that Dennis is going to go through?

MS. BAILEY: Dennis will get into that, yes.

MEMBER ARMIJO: Okay. Just so I understand it, how would you do this.

MS. BAILEY: Right. But basically believe that based on the review of previous violations, that the number would be very few that we would have to do that quantitative analysis.

And so, a pre-evaluation or a quantitative pre-evaluation of all sequences for all processes we don't believe is sufficient or necessary.

And then my next slide gets into the next

steps which I'll get into later. And so, I'll turn it over to Dennis now.

MR. DAMON: For the record, my name is Dennis Damon. I work for Marissa in the Division of Fuel Cycle Safety and Safeguards.

The next slide. This is the same two points that Marissa mentioned. What I'm going to very briefly do is just go over the structure of the paper and why it's structured the way it is.

When I read the SRM, it said perform a comparison of ISA to PRA, a comparison and critical evaluation. And so, I interpret that to mean not simply - not simply describing ISA as an apple and PRA as an orange, but rather comparing points in the context of how good a job they do at some function.

So, the two functions I - that occurred to me - and there are others. There are other many other ways of using PRAs, for example. And, in fact, we have used them for other purposes than these two.

But the two - one are - the first one is establishing the safety basis, which is what basically the ISA and the rule is trying to do.

And then the second application is this business of quantitative analysis to do risk significance determination for inspection findings,

which is what's done in the reactor oversight program.

So, there's these two different contexts of where I'm going to look at ISAs and PRAs and how they play out.

And the obvious - kind of the obvious conclusions this was pointing is that, well, we put this ISA concept in place in the rule to do the first thing. And now if you want to do this, if you want to do quantitative risk significance determination, these ISAs were not done for that purpose. And as Dr. Powers says, they don't really calculate risk in the ISA.

So, when you go and you want to do that second function, you're going to have to do something - you're going to have to - it's not that the ISAs don't have any risk information. They give you a basis to start from, but they weren't done for that purpose.

Consequently, what you'll find are little - not little, but in some cases big flaws where you have to be careful that you use that information and supplement it with other information in order to get a true risk significance of some finding that you -

MEMBER BANERJEE: So, I don't know exactly what's in an ISA, but it doesn't incorporate things

like risk indices like, you know, typically one would use a Dow Index or a Mond Index or something.

MR. DAMON: Yes.

MEMBER BANERJEE: Does it have that stuff in it?

MR. DAMON: Yes, they do.

Of course, like I said, there's like about ten ISAs that are currently approved.

MEMBER BANERJEE: Right.

MR. DAMON: One of them was done non-quantitatively. Two of them were done quantitatively. So, the accident - they identify accident sequences and they assign frequency of initiating event, probabilities of, you know, occurrence of the subsequent events, and they get a frequency of that accident sequence quantitatively. Two of the licensees do that.

The rest of the ten, they use a Risk Index method which is - it's structured like a quantitative evaluation. It's very rough.

Its starting point is to say that, for example, that a human error has an index of minus one, which stands for 10 to the minus one. And active controls of minus two, and then a passive controls minus three. So, as frequencies of events.

So, most of the licensees use that method, but they don't - they don't always just go with this simple assignment of indices. They look at actual plant experience, too, you know.

I know - I don't know to what percentage of the time they do that, but I have - I know of specific instances where I've been - I've sat in on how they did that.

They adjusted - came up with a number based on their own experience that this - there's really much more or less frequently occurring than whatever came out of this Risk Index thing.

So, that's what the licensees do. There is information there.

CHAIRMAN RYAN: Dennis.

MEMBER BLEY: Given the two, though, the quantitative assessment for each of these scenarios, as far as I understand, none of them have found a way to aggregate those in a way to give you meaningful comparisons.

Is that true or am I -

MR. DAMON: Yes, they're not - I'll go into that.

MEMBER BLEY: Oh, okay. We can wait.

MR. DAMON: The rule actually dictates to

them that they're going to do it sequence by sequence and they're not going to sum up anything.

And if we did, we'd have to tell them how to sum it up and what to sum up and, you know, what metric do we want out of this, you know?

We didn't do that. The rule was structured on a sequence-by-sequence basis because it wasn't intended to be used for something like this risk significance thing.

And if you'll notice in the example in Section 5, there are two accident sequences. And I did that deliberately so that you had to add them up to get the total to show that, yes, if you do the significance stuff, yes, you have to add things up. And so, yes, they don't add things up even when they do it quantitatively.

So, an ISA is never like a PRA. It's a different animal.

MEMBER BANERJEE: If it uses the tools of the chemical industry as - I get the impression it's sort of a potpourri of tools that have been put together that they use in some way, which includes many of the tools which are used.

The chemical industry does get, you know, maximum probable property damage and fatalities and

all that sort of stuff comes out of the analysis. So, there are quantitative measures, certainly.

MR. DAMON: Yes.

MEMBER BANERJEE: I mean, they go through this systematically area by area, vessel by vessel. I mean, all this is done, right?

It's not done with the infinite level of detail. There's a lot more qualitative stuff there where you get credits for having this and debits for not having it and having hot oil or not hot oil. It goes on.

But it's a qualitative method which comes up with numbers, right, based on experience?

MEMBER SIEBER: Yes, but that's for individual accidents, which there could be quite a few. There is nothing equivalent to the reactor-type core damage frequency -

MEMBER ARMIJO: No. Criticality event, that's -

MEMBER SIEBER: And so what you end up with is -

MEMBER ARMIJO: That will put you out of business.

MEMBER SIEBER: - a lot of little PRAs.

CHAIRMAN RYAN: Correct me if I'm wrong,

Sanjoy, but there's a lot of uniformity across chemical industries.

For example, just on things like pumps, I mean, people have a pretty good, large database on the reliability of pumps of a certain type, you know, vessels of a certain construction and materials and all that.

So, I mean, to me, that helps the chemical side of the house do what you're describing in coming up with something that if they do it in one plant and do it in another, they're going to come up with something close if they have the same process.

MEMBER BANERJEE: But, you know, a reprocessing plant is a chemical plant. It's not a nuclear reactor.

MR. DAMON: Right.

MEMBER BANERJEE: I don't see why you would not use the methodologies used, why one would move in a different direction.

MR. DAMON: Well, like I said, that's in fact what the licensees have done. And, in fact, if you go to Slide 17, what the licensees do on the consequence end is quantitative.

Consequences are quantitative because the rule requires it. It defines high and intermediate

consequences to the workers and the public.

And so, you know, as you see, this slide is all high consequences. The top group there is to the workers. And the bottom is for the outside public.

So, an event producing a hundred rem dose to a worker or endangering the life of a worker to a chemical exposure, that's a high, quote, high-consequence event for the workers.

So, this part here is quantitative. And what that means is, is that when the licensee identifies something such as a large chemical release that might actually - and, by the way, these chemical endanger the life and stuff, the licensees define those quantitative. They set quantitative criteria for how they will evaluate that phrase "endanger the life."

So, they establish quantitative criteria and then they do calculations, you know. And they usually do - what they usually do for a chemical release is a worst case weather dispersion analysis, stability Class F, you know, two meters a second wind or something. The wind blowing right at the nearest offsite person.

And they'll do that, calculate that

number. And if it reaches the threshold number that - and in this case for offsite public, it's irreversible chemical injury - then that's a high-consequence event.

And that's all they want to do is identify is this a high-consequence event or intermediate? The next slide has the criteria on it for intermediate. And so, that part is quantitative.

Now, for a criticality event, you really don't have to calculate anything. Okay. If you're standing within ten feet of it, you're going to get a fatal dose. And so, there's no need to calculate anything.

A criticality is basically assumed to be a high-consequence event if somebody is standing there.

But these offsite things - the onsite chemical releases are problematic, you know. Endanger the life of the worker. Some licensees have in order to simplify their analysis, they assume if they have any chemical release in a room, the worker - it could endanger the life of the worker. So, they just take a hit on - it's conservative assumptions, basically, what it is.

And I've been told that some of those licensees have gone back now and sharpened their

pencil and they're trying to, you know, figure out which ones of these really are endangering the life of the worker.

But, initially, some of them would just say, okay, if I get a chemical release in this room and there's workers there, it's endanger the life.

And so, that's all they do is this front part, you know, so they go through - the ISA does the three things that you do in a risk triplet.

They identify what can go wrong and they use HAZOP a lot. They use what-if checklists. They have other checklists for dependancies. Checklists for human factors. They go through these things and some of them use fault trees and some of them use event trees.

So, they use these structured techniques and identify what can go wrong. They do this consequence analysis to see what bin it goes in. It either goes in high, intermediate or low.

If it's low, they're done. If it's high or intermediate, that triggers other requirements in the rule. And finally we come - let me back up here to Slide 5.

An ISA basically just - it's part of the structure of the regulation in Subpart H of Part 70

and it has a role to play in that. And its role is to do two things; identify and evaluate.

The identify part is I've just walked through. It identifies sequences that may be intermediate or high consequence.

The evaluate part is to see if those - is to see if it meets what are called performance requirements. And the performance requirements are - that basically the performance - two of the performance requirements are that high-consequence event sequences shall be highly unlikely, and intermediate consequence events shall be unlikely.

But the rule does not give any guidance as to what constitutes highly unlikely or unlikely. But such guidance as exists, is in the standard review plan for fuel facilities. There is some guidance in there. But, basically, licensees have decided how to do that themselves, what they're going to define as highly unlikely and unlikely.

And the staff has said in the standard review plan, what we would consider - what we think about that. And each licensee has submitted a method for making these likelihood determinations. The staff has reviewed it, and ultimately approved the ones that have been approved.

So, that's - the process is that the ISA identifies what can go wrong, it categorizes it, and it evaluates compliance where the objective here is to assure that, yes, the safety design of the plant is adequate to make these more consequential events sufficiently unlikely, which is the goal.

That last stage is the thing the chemical industry - some of the chemical people do that kind of thing, and some of them don't, is my impression.

MEMBER BANERJEE: As part of the HAZOP, what you do is you fix the plant as you go along, right?

It depends when it's done. If it's done at the design freeze stage or the commissioning or the design stage. So, it's sort of an active process.

You have all these engineers working together and they - so, say, okay, we gotta do this or gotta do that to make sure we don't have this high-consequence event.

It's a bit qualitative, but it doesn't work always, but it can handle a very different variety of plants.

MR. DAMON: And that's basically what we were trying to achieve with this rule. We just, you know, framed it in a - slightly more in terms of

likelihood and consequences than you might see in the OSHA rule, but it's basically the same thing.

They go through and identify what can go wrong. And they make sure that what - they've got stuff in place to prevent it or mitigate it and that they believe that that's adequate.

MEMBER BANERJEE: Right.

MR. DAMON: The whole point of - I've taken the OSHA, you know, the classes and the OSHA technique. And, I mean, the whole point here is to get somebody to sit down, like you say, with a bunch of knowledgeable people and make that decision that this is an adequate design, you know. That's the whole point. And put it down in writing, right?

MEMBER BANERJEE: Systematically vessel by vessel, line by line, auxiliary by auxiliary.

MR. DAMON: Right.

MEMBER BANERJEE: You go through every piece of it.

MR. DAMON: Yes. So, the real basic objective of the ISA was to make sure that this process was not only gone through, but documented. And then what happens at the end of the process is an ISA summary gets sent to the NRC.

That was an important thing in this. I

can tell you from having been one of the staff persons, that's what they really wanted.

The problem with the previous way of regulating was that - was licensees were - licenses were renewed every five years. And so, in between license renewals the NRC didn't get any information about what the design changes might be made except by the inspection process.

Inspectors going out and they can determine that, yes, some changes have been made, but we didn't get regular reports.

I mean, now we get an annual report called an ISA summary that lists all the Items Relied On For Safety in the plant. And so, that was really what - that was what the staff wanted.

The rule wasn't written to make the plant safer. It was written so the NRC staff got more information and more current information about the plants. That's really what was desired.

DR. MODARRES: Dennis, I have a question.

In evaluating the frequency part, you develop sequences of events, I presume. Does the ISA-type sequences of event any different from the PRA in level of detail in the types of things you consider or -

MR. DAMON: I would say usually they're the same as what you might do if you do a PRA model. Of course, remember two of the plants do in fact use fault trees and event trees. So, they're doing it the same way.

But I would say level of detail is usually similar to what you would do if you would do a quantitative model. But sometimes like I was saying about HAZOP, the events are not - they're not refine enough. It's just occurrence of low flow or high temperature without saying, okay, well, how did this happen exactly, you know?

So, if you did a PRA, you would have to try to figure out what exactly - how this exactly happened so that you could get some idea of how -

DR. MODARRES: So, technically speaking you would be able to find at least at the level of sequence, what contributes to that sequence. Either qualitatively if you analyze it or quantitatively, you are still able to say what contributes to that frequency from those elements of the sequence, can't you?

MR. DAMON: Yes, that's what I was trying to communicate is that even though, as Dr. Powers says, the ISAs don't calculate a risk metric, they've

got all this information about what's going on.

They've got the sequence there and the events that are happening and so on. So, it's telling you what they've figured out could happen.

DR. MODARRES: The area I was - actually I was getting to, because you commented on that the ISA is not identifying the contributors to risk, I'm saying that if you identify all these scenarios, either evaluate them qualitatively or quantitatively, you might as well do that also.

I mean, you have all the material. You don't add them up, but at least sequence by sequence you can do that analysis. And at the end, certainly then appear very often and you say so, these are probably the most significant ones.

MR. DAMON: Well, you can like I - like I said, the example that's in Section 5 of the paper marches through a qualitative analysis of a risk significance determination in which you do that.

And what you're doing is you're saying - it's a criticality accident. And in that accident, people might not notice this, but there's a reasoning process here in which you say, well, if a criticality accident happens in this process, the operator who's standing there could get a fatal dose.

So, by having said that, there's a fatality involved in that example in Section 5 that's not emphasized, but that's what we're talking about.

Criticality happens, operator dies, and what's identified in the example are there's two sequences that could cause that, that particular kind of criticality. The one that's due to a leak in a safe - a geometrically safe process. It leaks. There's a containment dike underneath the process, but the containment dike also has a leak in it. The liquid goes somewhere and collects and goes critical.

So, that's the - and there's two different ways in the example that that can happen. So, yes, you can - if - an ISA would not calculate the sum of the two things. Even if they did it quantitatively, they wouldn't add the numbers up.

But when you go to do this significance determination, you do add the numbers up, you know. That's what I'm saying is you have to - if you want the right answer, you have to add things up.

And so - but your - typically if an ISA was done with some quantitative information, you would have in front of you quite a bit of information to work with.

One of the peculiar things, though, is if

you try to do sort of a comprehensive PRA-like thing, it's not quite as - it's not often as easy as that.

I did the easy one where I'm only going to look at the operator standing in front of the process. If I really want to know what the total risk is to that person, because that's what you would do in a PRA, you would want to know the total risk to that person not just from a criticality, but a chemical accident or anything else that could happen for that individual.

Well, when a criticality happens in a room, if the guy that's standing close to it gets like thousands of rads, right, the guy that's standing on the other side of the room might get hundreds. Okay. That's still a serious health effect.

And so if you try to do a true PRA to calculate sum total risk, you've got a summation problem here. You've got multiple sources and multiple receptors, you know.

The plant consists of a whole bunch of processes, a whole bunch of operators all spread all the way around the plant. So, it's not a trivial thing to add up the sequences, is what I'm trying to say.

A reactor PRA is much simpler. You got

one source. Now, you've got multiple receptors. Okay. And that's more tractable, but this one is multiple in both.

DR. MODARRES: You mean the health effects are difficult to compute -

MR. DAMON: No, no.

DR. MODARRES: - because of the multiple exposures or what?

MR. DAMON: I would have to calculate the magnitude of the criticality, find out what the doses are to these various individuals and add them all up.

DR. MODARRES: Okay.

MR. DAMON: Then do another criticality. A criticality in that process. A criticality in this process. A criticality in that - and all again I'm adding up.

So, I'm adding up over all accidents and over all personnel in the plant to get the total risk.

DR. MODARRES: More difficult, but it's not undoable.

MR. DAMON: No, no, it's not undoable, but I would want to program it on a, you know, a computer.

MEMBER BANERJEE: Also, I think the - if you - when you do the HAZOP-type thing, what happens is somebody says this is credible, but they don't - so

that what passes is either it's credible or we just discount this, whether this Chemical A can come into this line or not.

If there's another line into that line, you say it could be substituted Chemical B by A, because A could come out of this, but you don't give a probability or anything.

You just say credible or not. Should we consider it or not, you know? So, it's sort of like an on/off decision to a first approximation.

You're not assigning a likelihood to this happening. You're simply saying it can happen. Let's guard against it in some way.

CHAIRMAN RYAN: I mean, my experience, Sanjoy, is that everything - those are exactly what happens, but it starts with what's the worst thing that can happen. Okay. It's a criticality. Or the other is, let's say, a spill of very large quantities of, you know, of acid, concentrated acid.

And they say, okay, well, those are the end points we want. And now when we back up, can those happen by all these different routes?

And, again, it's without the probability part of it. It's either on or off.

MEMBER BANERJEE: That's a different

analysis from what -

CHAIRMAN RYAN: But it's the same kind of a -

MEMBER BANERJEE: Right. It's very qualitative.

CHAIRMAN RYAN: There's qualitative information, but it's not in any way analytic with regard to the risk probability.

MEMBER BANERJEE: Yes, it doesn't normally. I mean, you could -

CHAIRMAN RYAN: Could.

MEMBER BANERJEE: - make it more structured and make it - put a risk - I mean, put a probability so that you could get a frequency, but it's not normally done.

DR. MODARRES: Isn't it possible to actually go through the HAZOP and find out what dose sources, which of those sources are really contributing in this, in the PRA, on those source terms that are actually of significance?

MR. DAMON: Well, we want, like I said, the rule, like I said, on Slide 17 and following, there's some quotes from the rule.

Unlike what's done in OSHA in a PHA analyses, we have this extra step. It's likely - we

call it the performance requirements in 70.61. So, we want licensees to make a finding that all the high-consequence sequences are highly unlikely.

So, we do want them to look at everything that comes out of the HAZOP and take this one extra step, which they typically don't - like I say, they don't necessarily do in a chemical plant, but our regulation requires it that they do this one extra step. And that is make a finding that each accident sequence that ends in high consequences is highly unlikely.

But it isn't, as I say, exactly a risk calculation. It's identifying the -

MEMBER BANERJEE: That can be done. I think what you're asking for it could easily - or not easily, but can be done as a part of the HAZOP.

MR. DAMON: Could be, yes.

MEMBER BANERJEE: It could be part of it because you do have a determination as to whether, you know, something happening meets to a high consequence or not. You're supposed to do that as part of that.

MR. DAMON: Right.

MEMBER SIEBER: Is it appropriate, though, to say - let's say there's ten possible accidents with ten risk profiles.

Is it appropriate to add those all together to determine what the overall facility risk is?

Because you're only going to get one at a time. And once you had one, that's the end of the operation.

MEMBER BLEY: But the risk is that any one of these might happen.

MEMBER SIEBER: Right.

MR. DAMON: It's like - yes, it's like when you go out on the highway, you know, you can get hit by any one of those cars.

MEMBER SIEBER: Actually, you can run into a building.

MR. DAMON: You're probably only going to get hit by one, you know.

MEMBER SIEBER: Right.

CHAIRMAN RYAN: The first one is the only one that will matter.

MEMBER SIEBER: You haven't been on the Beltway recently.

MR. DAMON: You can get hit by multiple, yes.

So, let's go to Slide 1.

(Laughter.)

MEMBER SIEBER: Dennis, you're doing great, but you're awfully slow.

(Laughter.)

MR. DAMON: So, it's the list of the supplied sections in the paper here. Yes, that one. So, this is - I mean, what we've been talking - the structure of the paper is the first two sections sort of say what an ISA is, where they came from, what PRAs are like and what they're used for.

And then Section 3 is just this evaluation of ISAs and by implication, also, should we be doing more PRA-like stuff for compliance for safety of the fuel cycle facilities.

So, it's the use of ISA and PRA in the context of safety. So, there's a discussion of that subject. There's a table in there that goes through the different technical points of ISAs and PRAs and says what - says some things about, you know, what you might see in an ISA for assuring safety.

Then Section 4 is kind of an introduction to Section 5. It does what Marissa did. It sets the context that risk significance determination is just one element of an oversight program revision that was envisioned in the SECY paper.

So, Section 4 just does that, it

introduces. And Section 5 is to do an evaluation of using ISAs or, quote, PRAs in doing risk significance determination. And it has an example.

So, I put the example in so that you could - when you got into saying things about this application, we want to have something very concrete to think about. So, there's an example of a risk significance determination.

It's done basically the same way you do reactor risk significance determination. It's calculating what happens when you have an inspection finding.

Inspection finding is some kind of a deficiency that has a risk significance. If it doesn't, it will have been screened out previously in a qualitative screening, but it has some kind of impact on risk.

And what you do is you - and what I mean by impact on risk is usually what happens is you have some Item Relied On For Safety that has been disabled, and that's what happens in this example, the dike is found to have been in a leaking condition, and that fact that that defect exists has elevated the frequency of accident sequences that could affect the worker. And that elevated frequency of accident

sequence of an accident exists for some period of time.

So, you calculate the elevated - the change in frequency and you multiply by the length of time that it existed, and you get a metric that is what I would call the incurred probability of the outcome, in this case, high consequences to the worker, that was caused by that inspection deficiency.

So, it's a metric of how serious the risk impact of the deficiency was. So, we're doing the same thing basically doing in the reactors, only of course our consequences are quite different.

In this example, you know, typically it would only be one or two workers that would be at risk of fatality from an event like that, whereas a reactor accident you've got a big offsite contamination, maybe many, many people offsite affected by that one event.

So, it's different in that sense, but it's conceptually the same thing. To get a significance metric, you do this calculation.

And of course it's like it's sort of tautologous. I mean, it's like if you want a quantitative evaluation, you got to do it quantitatively. Well, ISAs don't necessarily give you all the quantitative information you may need.

I don't know where in here I've got the example, the list of things that can go wrong, but basically I've looked at enough of the ISAs to say that there's a certain set of kinds of things that are not - that you have to supplement the ISAs with to do this kind of risk significance thing.

One of them is when licensees don't - they don't necessarily credit all their safety controls because they're not required to. The rule only requires that they identify a sufficient number of IROFS to make the argument that the sequence is highly unlikely, and then they're done. So, they sometimes choose not to tell you of additional safety controls they have.

Well, that affects risk significance. I mean, if you've got another safety control there to protect you, you want to know that.

Another one is the one I also previously mentioned for offsite consequences, is frequently they calculate that if a release occurs, a - they'll do a worst case weather calculation.

Well, in point of reality, it wouldn't always be wort case weather. So, there's a big factor of frequency that you're not taking credit for.

Another thing that's often not credited

are safety margins that are built into the criticality area. Very often if you lose - when I got - first got here years ago, the division director had me do a study of all the, what they called, 9101 criticality reports that had occurred in that time. There were 64 of them.

I found six instances where - out of the 64, there were only six instances where the parameter that was being - in all 64 cases, some control had failed. There was a failure of a control.

But in only six out of the 64, was the parameter that was being controlled actually exceeded safety limit. That's what I mean by a safety margin is these things are built with big safety margins. So, even though you lose control, you don't necessarily go into an unsafe state.

And so, those are normally - those are not credited in the ISAs. There's no credit taken for this margin - these kind of safety margins.

So, what I'm trying to say is if I were to do a risk significance determination of something that was put in front of me, I would want to go down my checklist and make sure that I was, you know, doing it properly and giving credit for everything that's there.

And of course there's things that you don't give credit for, but those are the big ones that I can say from experience, those are the ones that, you know, will make a big difference in the outcome of an evaluation.

So, anyway, basically that's the story. As Marissa said, the - I mean, I could go over all the stuff that's been done over the last 15 years to - the licensees have done these ISAs. They've spent a lot of money doing them. They've done - they've put a lot of staff to work.

I counted one licensee had 128 people on his staff work on an ISA, you know. These are not undertaken lightly, you know. They did a good attempt here at doing this analysis. We had workshops. We learned - the licensees were learning how to do these things. The staff was learning.

As a result of that process, there were a number of interim staff guidance documents written on various topics that came up as to how to treat various things in an ISA. Those documents are now incorporated into Rev 1 of the standard review plan.

MEMBER BANERJEE: Did they incorporate some of this in the design process?

When you say 128 staff, I mean, were they

actually there during the design process or -

MR. DAMON: No, these are -

MEMBER BANERJEE: No, these were post-design.

MR. DAMON: These are post-design.

MEMBER BANERJEE: Post-design freeze they're doing this.

MR. DAMON: Right. And the reason you get a large number of staff is of course you have to put together - you have to get the staff engineer that knows that process, the operator who operates that process, and maybe the criticality safety engineer who did the criticality safety evaluation of that process.

So, you have to get all the people that apply to that process. So, you've got multiple, large numbers of processes. So, you'll have a whole bunch of teams to cover the whole plant.

CHAIRMAN RYAN: I mean, even the maintenance folks that maintain the equipment -

MR. DAMON: Yes.

CHAIRMAN RYAN: - have insights into failure rates and things of that sort.

MR. DAMON: Right. So, they put together these teams. And so, it tends to involve just about -

CHAIRMAN RYAN: Everybody.

MR. DAMON: - everybody, yes. And they sit and they do these - they march through the ISA process trying to identify what could go wrong.

MEMBER BANERJEE: And how long does this take, typically? I mean -

MR. DAMON: Well, the existing plants were given four years. Some of them had a heard start a little bit, but it took, you know, four, five years to do the existing plants.

MEMBER BANERJEE: So, they normally would do an area or a process or something at a time, right? And they would sort of write this -

MR. DAMON: Right.

MEMBER BANERJEE: - and then they go away and then come back and do it again and it would go on. So, the process is protracted.

MR. DAMON: Right.

MEMBER BANERJEE: Even though it's taking four years, not 128 people involved in it -

MR. DAMON: No, no.

MEMBER BANERJEE: - during these four years.

MR. DAMON: No, the team - yes, the teams, like I said, you got -

MEMBER BANERJEE: Five or six people,

right?

MR. DAMON: - five or six people.

MEMBER BANERJEE: Yes.

MR. DAMON: And I don't know how long it takes to do one process, but, you know, you have to gather all the information and talk about it and analyze it and -

MEMBER BANERJEE: You probably can do one a week or so. I mean, it takes - depends on what it is, but it takes a fair amount of time to get the information together and to brainstorm.

DR. MODARRES: The level of effort doesn't seem to be compatible with the PRA level of effort. Maybe even more unless you -

MR. DAMON: You don't do all, you know, the quantitative - there's certain quantitative things you don't do. But, yes, the level of effort is quite substantial.

MEMBER BLEY: But those things you don't do, much of that you can automate.

MR. DAMON: Yes, once you reach a certain point. See, that's the other thing I didn't - I didn't get into that, but the NRC did not spend any money to develop any methodologies, tools, computer codes. We didn't have the staff sit down and try to

do ISAs ourselves before we had the licensees do them.

So, licensees were just tossed into the lake and they had to swim, you know. And so, we didn't develop - I mean, like you say, you could do PRA of these facilities, but nobody has spent the money to develop the tools.

MEMBER SIEBER: Is there any kind of a standard doing these things?

MR. DAMON: No, there is not an industry -

MEMBER SIEBER: Like the chemical engineering -

MR. DAMON: - that sets the standards, no.

MEMBER BLEY: There's guidance.

MR. DAMON: Guidance, yes.

CHAIRMAN RYAN: And there are tools that have been developed commercially. There are, say, tools.

MEMBER BLEY: But no standard.

CHAIRMAN RYAN: There are tools out there. I don't know if they're standardized as much as they are commonly used.

MR. DAMON: Yes, the chemical industry had - I mean, they had those reg books before we even had the rule.

CHAIRMAN RYAN: Yes.

MEMBER BANERJEE: But they have software to guide you through the process -

CHAIRMAN RYAN: Oh, sure.

MR. DAMON: Yes.

MEMBER BANERJEE: - and, you know, teams have access to that.

MR. DAMON: Yes, the licensees use that, use some of these software products that came out of the chemical industry to march through the structure of the process.

Yes, so there's - it's not that there aren't any tools at all. But when we talk about PRA, nobody at the NRC spent any money to help licensees develop tools.

DR. MODARRES: The AICHE has the guide for doing a quantitative risk analysis.

MR. DAMON: Yes. Right. They do.

DR. MODARRES: Which essentially has the data and the guide that comes with it.

MR. DAMON: Yes.

MEMBER BANERJEE: They use the fault trees and things.

MR. DAMON: Yes.

MEMBER BANERJEE: And a few risk analyses are done already or something.

MR. DAMON: Oh, yes. There's no doubt. Like I say, two of our licensees have done quantitative. They call them QRAs just the way they do in the chemical industry. They call them - that's what they call them.

But I might mention something. They don't have criticality accidents in the chemical industry. Okay?

MEMBER BLEY: But they have BLEVEs.

(Laughter.)

MR. DAMON: Well, but as I say, a criticality accident is a peculiar thing if you try to quantify, because I thought about this. Being a PRA guy, I said how would I do a PRA with criticalities, because you got this thing.

If you have a criticality-given magnitude, there's this essentially 1 over R-squared dose dependence here that's dosing a whole bunch of people, but the other thing is what's the magnitude of the criticality?

Criticality magnitudes vary by orders of magnitude depending on how the - what exactly happened. How you entered into the process.

MEMBER SIEBER: Plus the geometry and -

MR. DAMON: So, now you've got to - if I

want to do it right, I mean, you know, I would model the probability distribution on the magnitude of the criticality. I've never seen anybody try anything like that, you know.

There are people out there, Tom McLaughlin and a couple others, who have done criticality modeling, you know, to determine what the magnitude is if something is this way, but nobody's done it probabilistically.

MEMBER BLEY: If you were to move toward PRA, that doesn't say you would have to mandate doing all of those things to all the detail one could imagine either. We don't do that for reactors.

MR. DAMON: No.

DR. MODARRES: Just for critical scenarios. Just for -

MEMBER BANERJEE: Yes, I think that is - that is certainly possible. I mean, in fact, the chemical industry does that for a few critical plans. That's certainly feasible, but not for the whole plant, I don't think.

But there's another issue. I suppose you could add sort of an expert elicitation as part of this process where these people are getting together, you know, and you could get numbers out of them.

MEMBER BLEY: If they were the right guys.

MEMBER BANERJEE: If they were the right people who - well, usually these guys have a pretty good idea of how often something can happen or not.

MR. DAMON: Yes.

MEMBER BANERJEE: That's how they make their qualitative decisions as to whether -

MR. DAMON: I mean, the thing is there's no formal database that was -

MEMBER BANERJEE: No.

MR. DAMON: - maintained by somebody that fed failure data from all these plants because - the other thing to point out about these plants is they're commercial competitors with one another. The ISAs are proprietary information.

MEMBER BANERJEE: Right.

MR. DAMON: So, they don't share the entire contents of their ISAs with each other. Now, they do talk to each other, but they don't - you can't entirely share everything.

CHAIRMAN RYAN: Dennis, just on the criticality question, there are a fairly finite number of criticalities that have occurred probably worldwide.

Is that database sufficient to, you know,

bound what a criticality accident might look like?

MR. DAMON: For solution criticalities it's pretty good information.

CHAIRMAN RYAN: Yes.

MR. DAMON: Because they were all solution criticalities -

CHAIRMAN RYAN: Right.

MR. DAMON: - except for one. Okay.

CHAIRMAN RYAN: Right.

MR. DAMON: But the other ones like a criticality - there's never been a criticality in wet powder or there's never been, you know, whatever other scenario you can -

CHAIRMAN RYAN: All right. So, for that specific set of liquids, solutions, you'd be okay, but maybe others not.

MR. DAMON: Yes, like I say, if I want to know what the magnitude of the criticality is, I have to go out and hire somebody like Tom McLaughlin to do a calculation to tell me what the magnitude is if a certain scenario unfolds, you know.

I think like Dennis Bley says, you don't have to do everything, you know, as detailed, but there's a certain amount of modeling there that would have to be done to try to capture what actually might

happen.

Now, if all you're interested in is doing what we do for our Step 1 here, which is making sure the operator is safe, all we really care about is that the criticality doesn't happen with a certain frequency. And then we're done, because that's all we need.

But if we really want to know what the number is, then you get into all this other stuff. And, like I said, the probabilistic offsite weather calculation stuff, I think there are codes that do that kind of thing. I'm not sure they exactly calculate the risk metric that I think they should use, but -

MEMBER BANERJEE: Well, in the Netherlands you have to get risk contours around your plants. So, what they do is they have codes that move fairly rapidly to the different class weathers, wind directions, you know. They do some sort of consequence analysis around the plant.

So, they don't - these codes are fairly fast, I mean, because they can be reasonably empirical. They use these Pasquill, you know, weather classes and just zap around and do this. Gaussian, too.

MR. DAMON: Yes. I mean, I had a guy - before I came here to the NRC, I mean, I actually went to two iterations. I had a guy write a code like that that implemented a model like that.

And then I wrote or got involved in writing one myself for space applications, which is different because you - these are - ground-based releases are different than releasing up in the stratosphere someplace. So, you have to -

MEMBER BANERJEE: Well, you have to take into account elevated releases because a couple of the worst accidents that have occurred, actually, is when emergency release systems have vented through that didn't get flared.

In Bhopal, for example, the flume that came out was from the emergency release system. And Seveso was the same out of the flare.

So, elevated releases need to be treated, but you can treat that too. It's not such a big deal. Yes, it can be done.

MR. DAMON: So, I think I've basically presented our, you know, story of what is in the paper and why it's structured the way it is.

CHAIRMAN RYAN: So, you're on Slide 5 now.

(Laughter.)

MEMBER BLEY: Dennis, could you go through that example?

You have them back here in the slides. I just -

MR DAMON: Yes, it's way back there at the very back. Slide 29.

MEMBER BLEY: Can't read the slide numbers in here.

ME. DAMON: I didn't really put a lot in the slides. The example is a process that has enriched uranium in solution. Because as I mentioned, all but one of the actual criticality accidents in the world have been in solution - fissile solution systems. Most of them high-enriched or plutonium, but you can do it with low-enriched uranium as well.

So, that's what the process is imagined to be is some kind of process that's got a substantial amount of enriched uranium in solution. And it's subcritical because its geometry is subcritical, because that's the usual - in other words, what I mean by saying that is that regardless of the contents of the thing, it's subcritical.

You can put in the worst case concentration of the worst, highest enrichment material you can find, and it won't go critical. So,

that's what I mean by subcritical by geometry.

And that's a common - it's the most important, I believe, technique that's used to make things safe for criticality is to use safe geometry equipment.

So, you don't have to be - if you make a mistake with concentration or something else, amount of material or whatever, you don't - still won't go critical.

So, that's what I'm imaging the process is, is some kind of process tank, equipment, that is safe by geometry.

And then in addition if the - so, how could you get in trouble?

Well, you could get out of that safe geometry and go somewhere else. And so, typically, a process like that would have a containment dike under it for multiple reasons.

But one reason is if it does leak, it leaks out into a flat geometry which, again, is subcritical.

So, the thing has two safety features. It's safe by geometry where it is. And if it leaks out, it's still safe by geometry.

And the deficiency that's modeled or

postulated is that for some - somebody did something wrong and they caused this containment dike to have a leak path through it.

And this condition was eventually discovered by an NRC inspector and found to have been in this condition for - I think it was four years is what's -

CHAIRMAN RYAN; Four years, yes.

MR. DAMON: - assumed in the example. So, then what I do is I march through this risk significance calculation and say okay, what was the - what was supposed to be there was that I had - that in order to have the accident, I have to have a leak or I have a process overflow when you're transferring into the process. You put too much into the - try to put too much into the process.

So, those are the two initiating events is a process overflow or a leak in the process. So, you get liquid down in the dike.

And of course the frequency of having each of those accidents is of course the frequency of those two initiators times the probability that the dike is in a leaking condition at the time that that happens.

DR. MODARRES: Is it possible you have any source of water, for instance, a sprinkler or

something else that could spray on that dike?

MEMBER SIEBER: As a moderator.

DR. MODARRES: As a moderator. Any, like, sprinkler up there or something that could be -

MR. DAMON: Yes, I don't see - I'm not sure what you're thinking in terms of how that would affect the accident scenario.

DR. MODARRES: Well, just add water moderator and you could go critical even in that space.

MR. DAMON: Well, normally the way the things are arranged is they - that's what the crit engineers do is they find out how much material is in that process. And they put it on the floor. And then they set the concentration to the optimum. They look for the optimum, okay, of all conditions.

You know what I mean? The maximum amount of material that could be in there and at optimum moderation.

So, it would be like 400 grams per liter is usually around where the optimum is or something. And they'll make it so that that - in that geometry at the optimum condition, it's still subcritical.

DR. MODARRES: Even if water falls on it?

MR. DAMON: Right, even if you get

additional water. It's subcritical for - that's the usual trick with criticality safety is pick one or two parameters to control. All the rest of them are analyzed as their optimum possible reactivity so that you don't have to control those.

DR. MODARRES: Yes.

MR. DAMON: Anyway, that's the scenario is that you - the example marches through these two accident scenarios. The leak and the overflow goes into the dike.

Well, normally the dike, there's a certain probability that it could be failed under normal conditions. But in this case, it was failed due to some fault of somebody's and it was left in that condition for an extended period of time.

So, the example calculation goes through and finds, well, how much risk was actually incurred, you know, how much additional risk was actually incurred because of this defective condition?

And that's the same kind of process you march through when you do a risk - significance evaluation in the reactor oversight program. They do the same thing.

They say given the deficiency, what was the additional incurred probability? Usually it's a

delta LERF is what they're looking at times the length of time.

CHAIRMAN RYAN: Dennis, for the NRC or agreement state licensees, are there any that are highly-enriched uranium or plutonium driven or - I'm thinking of the case where there might be accumulation of fissile material in air ducts or some other kind of air pathway as opposed to a liquid pathway.

Are there any criticality issues on that side of the house?

MR. DAMON: Oh, yes. There are two high-enriched, you know -

CHAIRMAN RYAN: Licensees.

MR. DAMON: - licensees that make naval reactor fuel.

CHAIRMAN RYAN: Yes.

MR. DAMON: And then to that, that exact scenario actually happened. I mean, we didn't have a criticality, but there was an accumulation of uranium oxide powder in ducts, ventilation ducts.

Yes, we have all kind of - there are all kinds of scenarios. All I'm saying is in actual practice, all of them have been in solutions. One was a deal with uranium bricks, I think, but that's just because that's an easy way to do it, you know.

And the other thing, I've read all the cases of the actual criticalities. In the old days, these are the bad old days, all this stuff was back in the `50s and `60s. They were not using safe by geometry. That's why they had the criticalities.

They were working in unsafe geometry vessels -

CHAIRMAN RYAN: So, how long has it been since a criticality accident occurred in the United States?

MR. DAMON: `79. 1979.

CHAIRMAN RYAN: `79.

MR. DAMON: It was in Idaho's reprocessing plant. They had several criticalities up there, but they didn't - nobody gets killed because you got shielding. There were some doses, but not - whereas these other events that happened where you're in a completely unshielded condition about - of those, about one out of every three you get a fatality. And usually about two out of every three somebody gets a big dose, you know. Not us.

That's about what the statistics are.

MEMBER SIEBER: I would imagine that PUREX processing of plutonium would be more difficult because you can bury the concentration of fissionable

isotopes by chemical means as opposed to separation by mechanical means like a centrifuge or diffusion plant.

MR. DAMON: Are you saying that it would - are those kinds of accident scenarios that -

MEMBER SIEBER: Probability would be more variable because there is - there are chemical ways to change the concentration as opposed to enriched uranium where it's more stable.

Know what I mean?

MR. DAMON: Yes. Well, yes, the enriched one is hard to - enrichment changes slowly, right?

MEMBER SIEBER: Right.

MR. DAMON: Yes. Although, there was one criticality which it took them literally decades in Russia to build up the material until it got to the critical point.

MEMBER SIEBER: Concentration.

MR. DAMON: So, some of these - that actually does happen where the - whatever is going wrong, goes wrong for a long, long time until finally it builds up to the point where something bad happens.

MEMBER POWERS: Lets you know about what's going on.

(Laughter.)

MEMBER POWERS: That's not good. The

criticalities would cause one biggest - biggest number of sleepless nights or actually moving materials, because the potential of human error could violate criticality standards.

At the plutonium finishing plant, you're moving around pucks of plutonium metals. And you have carts that are listing how many pucks they can take. Well, those numbers tend to get overlooked when you're in a hurry to move things.

MEMBER ARMIJO: Dennis, I can see the value -

MEMBER BANERJEE: Do you know was Mayak a chemical explosion?

MEMBER POWERS: I really honestly don't know.

MEMBER BANERJEE: Nobody really knows. But I think what I have heard is it was a chemical explosion, not a criticality incident.

MEMBER POWERS: I don't know why it would be, but -

MEMBER BANERJEE: Yes.

MEMBER POWERS: I mean, I don't study it. So, I don't know.

MEMBER BANERJEE: Well, nobody really knows.

MR. DAMON: When you say "Mayak," there were multiple incidents at Mayak.

MEMBER BANERJEE: Well, I'm talking about the `57 --

CHAIRMAN RYAN: It was a waste tank that -

MEMBER BANERJEE: Yes, it was a waste tank, I think, that went.

MEMBER ARMIJO: Dennis, criticality is - risk significance, you know, you've already got it. It's a huge thing. But for the lesser things, you know, what do you do with this?

For example, you find an accumulation of UO2 in low-enriched stuff. It's a big deal to any plant that gets that. It's not supposed to be there, but let's say that was a finding in a fuel cycle facility.

How would you use this approach to make a risk significance -

MR. DAMON: It might not actually get to this stage of doing a quantitative thing. Because if the significance - we have these - what we did with the actual violation the last five years, we divided them into chemical and criticality. And we had a bunch of criticality guys sit down and go through them.

We developed a set of criteria, screening criteria, that are qualitative. And one of them would probably be the where are you with respect to the control parameter, you know?

If you just exceed the control parameter as just a little bit off, well, that's obvious that's not as significant as one where, yes, you got a critical mass there.

And so -

MEMBER ARMIJO: It's leading and it shouldn't have been there in the first place.

MR. DAMON: Right.

MEMBER ARMIJO: So, how do you treat that with this quantitative approach?

MR. DAMON: Well, like I say, if it's the one you're saying and they're really nowhere near critical, then there's not much risk significance to it. And you know that right off up front. So, it would be screened - it would be screened to green. Something like that because -

CHAIRMAN RYAN: But three or four of those on the same inspection, you might say, well, it looks like there's something systematic there and you might elevate it someway.

MEMBER ARMIJO: There would have been about

three or four different managers it would have gone through before they got there.

MR. DAMON: I mean, there are occasional recurrences of similar kind of things, but I don't - I don't know. It's hard to generalize. Each plant is different.

Some plants have certain kinds of violations that are similar to one another. There's other ones, every time it's something different, you know.

MS. BAILEY: I think what you would do, Dennis, if you didn't screen it to green, then you would do the calculation to sort of understand where the delta is in -

MEMBER ARMIJO: See, where I'm at is if so many things screen to green, you don't really need to do more.

MS. BAILEY: Right.

MEMBER ARMIJO: And then the big ticket items, it's obvious that it's highly significant, you know.

So, what are the things in between where this process would really be useful?

MR. DAMON: Well, the way you get the in-between things is what was the - what was - what it

really comes down to was what was the reliability of the control that was left?

Because usually something - what's happened is something has been defective. Usually it's a control has become inoperative. And if the parameter actually, like I say, got out of control and exceeded its safety limit, now it's serious in that sense. So, that's a nontrivial one.

But if the control that you've got left is very robust and you may have even redundant backup controls, well, then that's very different from one where -

MEMBER ARMIJO: That was your -

MR. DAMON: Where you have basically maybe nothing left. Maybe you had no control. There have been instances where there was no remaining criticality control. All of them had failed, you know. And all that - the reason they didn't have an accident is that it was just luck, you know.

And so, that's a, you know, that's obviously much more significant. So, there is at least that breakdown of at least three levels, I think, that is fairly clear to me, anyway.

For example, I'll give you an example of a chemical one that's like this extreme case, you know.

And that is you have an actual cylinder, UF6 cylinder rupture. But the wind is - the weather conditions are such and the wind is blowing in such and such a direction nobody gets an exposure. Okay?

Well, you were just lucky, you know. That was a very significant event whereas something in between would be, you know, maybe they had a - found a defective pigtail or something like that, you know. They used a - hadn't exercised proper procurement for a pigtail or something like that is in between.

MEMBER ARMIJO: Yes. Okay.

MR. DAMON: So, I think there is - now, that brings up a point which many other people say this, is why do it quantitatively if it's going to be that crude?

And I still say even if it's crude, you want to think quantitatively because it leads to clarity of thought. And, you know, lots of times if you don't think quantitatively, you get into fuzzy, fuzzy thinking and I think it's more useful.

But getting exact - I think you're right. There's a point to be made here. You don't need, you know, three decimal point accuracy to do this significance determination stuff.

It's a rough order of magnitude kind of

process is all we're looking for.

CHAIRMAN RYAN: Anything else?

MEMBER BENSON: Yes, Dennis, you mentioned that two of the ISAs were quantified to some extent.

Does that help you in any way above and beyond the ones that aren't quantified and using it for other applications?

MR. DAMON: Well, it - as I say, when you quantify something, you have to say what it is. And that's helpful because you have to be very much clearer about what you're talking about.

Whereas some of the other ones, somebody says the Risk Index thing and says, well, it's an active control and gives it a minus two.

Well, for that kind of stuff, you kind of have to check and see is that really reasonable, you know? What kind of active control is this? Because that's kind of an awfully broad category.

CHAIRMAN RYAN: Dennis, you're making an important point, I think, because in a way it's sort of not qualitative. And if you score things in the same way for yourself each time, you have at least in your own process in mind and outcome kind of the same result for the same case even though they might be different facilities, because you're going to rank

things the same way.

Whereas if you're qualitative, you know, what did you get on your test, Johnny? I got a good grade. What was it? 65. So that, I think, is an important part of the rigor of the process.

And then it gets to what you were saying, Sanjoy, that folks can come up with these analyses without a lot of variability because they think that, you know, they're doing the kind of analytical analysis, if you will, that you just talked about.

That seems to me, to be a real important point in this process that it's not just qualitative, is this okay or not okay, it's wrong, going to rank it this way with this score and, you know, that's something you can carry from one analysis to another.

MR. DAMON: Yes, see, in the slides somewhere in here I mention the fact of course all these ISAs have been reviewed by NRC staff.

Now, we only get an ISA summary. It doesn't have all the information. And they go over that, but they also visit the plant and look at a few things in detail.

CHAIRMAN RYAN: Sure.

MR. DAMON: And the nature of those reviews really is to see - is to see if the licensees are in

fact doing what the staff thinks is a good job of doing these evaluations and making a determination, yes, this design is safe enough. That kind of decision.

The staff - I read the safety - they call them Technical Evaluation Reports to see what the staff was doing. And they were very - they were very skeptical and critical. And they dug in and they weren't just rubber-stamping whatever the licensee had done. They were looking for things to find to challenge, you know, to say is this really good enough?

So, yes, I was - I was satisfied that the staff had done a good job reviewing them. And so, like I say, drawing this conclusion that the ISAs are acceptable isn't based on some theoretical - it's not a theoretical finding. It's based on experience.

CHAIRMAN RYAN: Okay.

DR. FLACK: Could I just ask another question?

CHAIRMAN RYAN: Yes, sure, John.

DR. FLACK: On follow-up, I mean, I was involved in the develop of the ROP earlier on. And we actually put together inspector notebooks based on, you know, the results of a lot of the PRAs that were

performed and so on.

I guess the question in my mind is without going through that, how do you know what's important?

I mean, at the plant or the facility, you have some sort of importance measure to generate somehow to put things in perspective.

I mean, okay, criticality is important. Okay. We understand that. But how do you know what else is important at the plant other than - I mean, do you start there? I mean, how do you put it all together?

And, like, if you walk through the door and you say well, let me start to look at things that are important to me, you know, from a risk perspective, can you really do that here or do you have to rely on people that just know the business?

MR. DAMON: Yes, well, like I said, the ISAs weren't done to provide that kind of perspective. And, consequently, they don't generate the information in a form that helps you a lot.

We have, in fact, done something like that for the centrifuge plants, you know. They did have, you know, they did have these Risk Index scores for their sequences. And they only had sixty IROFS to work with. So, we went through them all and did the

deltas.

DR. FLACK: So, you could pull it out.

MR. DAMON: Yes, we managed to, you know, Chad Cramer from Region II put it all on a spreadsheet and we ground through them all.

DR. FLACK: Could you extend that process to something like MOX, I mean, a facility?

MR. DAMON: No.

(Laughter.)

MR. DAMON: There's a difference between 60 and 12,000.

DR. FLACK: Yes, well, 15,000, I think, was said in the SER.

MEMBER BANERJEE: Is it true that 60 million was spent on the ISA for the MOX facility?

DR. FLACK: 80 million was what they said at the meeting.

(Off-record comments.)

MEMBER POWERS: The question comes up, then, suppose that I am a manager at NRC because of some crime I committed in a previous life -

(Laughter.)

MEMBER POWERS: - and I have to marshal the sources to do an inspection on this facility with 15,000 IROFS. And I wanted to tell my inspector, go

inspect that subset that's most important.

How does this poor inspector understand which ones are the most important?

MS. BAILEY: Dave, do you want to take that?

MR. TIKTINSKY: Dave Tiktinsky for NRC MOX, project manager. It may give a little more insights into what we tried to do with MOX.

Yes, there's 12,000 IROFS, but they define IROFS a little differently than some other facilities. That's 12,000 components that are IROFS.

So, in some areas you might have a temperature pressure meter. And that particular meter is 500 of them.

Really, the ISA summary had about 200 or so IROFS that recovered the big events. And what we tried to do with those is go through the events that had the most significance, pick out those ISA summary IROFS that related to those, and then go into the list of component types that related to those particular ones and take sampling of the ones that were most important. Things like instrumentation. Things that aren't as common that are used compared to using particular things like maybe if someone uses a pump or something that's, you know, standard in industry. We

would consider that less significant.

So, we actually did go through and for helping out in ways we're doing our inspection verification plans that we're writing up for what things we will look at as we do our PSSC review to identify things that are most significant, first, down through the ISA summary IROFS, down through the component types.

So, we do have some risk level things of what we're going to focus on in our inspection program.

CHAIRMAN RYAN: That sounds a little bit less challenging than 15,000.

MR. TIKTINSKY: Yes, going - we learned that quickly you can't go from 12 or 15,000 and come up with the answer. We had to do it a different way.

MEMBER POWERS: Well, the only thing that bothers me is that if I - because of some crime that I committed in a previous life, I do get the chance to go through LERs. And I do find pumps that are poorly maintained and poorly operated that are critical to safety. So, it's a standard thing that everybody uses all the time.

And so I wonder -- on what things to inspect here because it's unusual versus something

that's normal.

MR. TIKTINSKY: Well, I mean, what we tried to do is, you know, with the first step was this, you know, when we did our kind of risk-informed safety review, there were areas that we emphasize in our review for certain events.

You know, the way ISA summaries are, it shows something that's an IROF, but it doesn't say - but all IROFS are not created equal. We know that. There's certain events that will have higher consequences, you know, of - like for MOX, having a significant chemical event that caused an explosion is different than an event that has a leak from the waste pipe that goes out to a building that's underground.

So, we know that and we did the review. We screened out the ones that we felt were most important. Then we tried to go into the ones - the areas that were of higher importance then others, we would look in more areas. So, we would look at more component types.

And we're trying to make it flexible enough that if there were some identified things that particular component types had issues, we would emphasize that.

Even in the inspection program as we're

laying it out, we're not setting it in concrete to say, you know, everyone is going to do this and then we're done.

If we go through and we find that there's additional things that need to get looked at, additional inspections, additional vendors, then we'll do that, but we have to try and lay out something of what we think is the most important one just to lay out the program that we can get reasonable assurance on that things are as they're supposed to be.

CHAIRMAN RYAN: Well, you kind of described what is the process of trying to get to the importance ranking.

MR. TIKTINSKY: Yes, that's pretty much what we tried to do.

MEMBER POWERS: The only thing that bothers me about that is that if in 1979 I had spoken to the folks at Surrey, they would have assured me that they have done those things.

Every PRA that's ever been done in Surrey, and it's been done multiple times, finds something that got omitted in that process. Some combination of things that turns out to be crucial.

Mohammad will agree with me that Surrey has been the most analyzed plant by PRA on the face of

the planet, and every one of them finds something. Even the IPE, they found something.

Something big, in fact.

DR. MODARRES: Well, the kinds of things that - are you referring to the - what event are you referring to that -

MEMBER POWERS: Every single Surrey PRA comes up with something, some pipe that turns out to be critical, has a high risk importance metric that nobody recognized before. Some new accident sequence gets identified.

DR. FLACK: Yes, the expansion joints, for example, I mean, that was just dominated everything --

(Laughter.)

DR. FLACK: It was never noticed that the other two big analyses were done.

Well, the other thing was that Brookhaven actually did quantify the rad oil at, you know, for the MOX facility. That piece of it, anyway.

I mean, there was no surprises there, but how - I mean, did you feel that was a valuable thing to do at this point that it provide value to the review process or are you familiar with that?

MR. DAMON: You'd have to ask the MOX project. I mean, I think the gist of having them look

at it was to just get another independent perspective on things, you know.

It was really done more for that reason than to do some accurate - to make sure that they had not overlooked something. I mean, it was a pretty straight forward design.

MR. TIKTINSKY: This is Dave Tiktinsky. I guess I could actually answer that.

What the staff did in its review, it used the Brookhaven information to help it form its decision of reasonable assurance, as well as things like experience from the French facilities, other types of analyses that were done.

The SER had about 30 pages of analysis of things that backed it up of why we, you know, the staff thought there was reasonable assurance. And the Brookhaven one was part of it.

It was useful to help inform that all the other pieces of things that were looked at, that's just one more piece of information that we thought that was okay.

MEMBER ARMIJO: Dennis, I was trying to look at the - well, I looked at the SECY paper 10-0031. And they list the - you listed the deliverables from this project.

And some of these deliverables I don't understand what they are, but I'll read them to you and maybe you can clarify it.

MS. BAILEY: Could you tell us what page you're on?

MEMBER ARMIJO: It's on the SECY 10-0031. It's Page 1. It's a letter from Mr. Borchardt.

MS. BAILEY: Okay.

MEMBER ARMIJO: But, anyway, he says the ultimate deliverables will be; one, risk-informed program level documents presented in inspection manual chapters like that explained; two, specific inspection procedure guidance for activities not currently contained in the fuel cycle oversight process; three, a revised enforcement policy and; four, a more objective and predictable performance assessment process.

And, you know, we - I just - maybe you haven't thought these things through or haven't - you have to find what they're really going to be, but can you tell me something about each of those items, what that really means?

I'm just trying to see, you know, how big a deal is this and how much work and how much effort and how much benefit you get for it.

MS. BAILEY: Yes, I'm going to ask Patti Silva to sort of take a first cut at trying to answer/explain those deliverables.

MS. SILVA: Okay. The SECY paper has - is the entire revision to the fuel cycle oversight process.

MEMBER ARMIJO: Right.

MS. SILVA: Which is a completely different framework from what we're working with now. So, basically the first deliverable is about the inspection manual chapters, and we would have to change the inspection manual chapter to reflect the framework which includes cost-cutting issues, cornerstones, the significance determination process and the action matrix and some other things. So, the inspection manual chapter would have to reflect the new format.

The inspection procedures would then need to be changed to focus on those things primarily what's in the cornerstones, and the things that we - the cornerstones are the things we find most important. And so, those - it would change a lot in there.

Then I think the next one you have -

MEMBER ARMIJO: Revise enforcement policy.

MS. SILVA: Revise the enforcement policy, and that - a lot of that has to do with the corrective action program where you would have the licensees taking care of, basically, the lower risk significant findings instead of having the NRC doing that.

So, basically they wouldn't - the enforcement manual, we've already changed it to look at risk informing -

MEMBER ARMIJO: The inspection manual, is that the -

MS. SILVA: The enforcement manual.

MEMBER ARMIJO: Enforcement manual?

MS. SILVA: I'm sorry. Enforcement policy.

MEMBER ARMIJO: Oh, okay.

MS. SILVA: There is a manual that goes with it that says how to use the enforcement policy. I'm sorry.

So, the enforcement policy would cover giving credit for the corrective action program and having the licensees actually work on the kind of lower safety significant items.

And the next one was -

MEMBER ARMIJO: That -

MS. SILVA: - the performance assessment, I think you said.

MEMBER ARMIJO: Predictable performance assessment process.

MS. SILVA: Right. Right now we have the license performance reviews - the licensee performance reviews, which are the LPRs. And we're trying to get those more structured so that - so that everything that goes through the process you know what's happening and you know what the result is going to be, whether it's going to be more inspection or a shorter time period between when we do the performance assessments and things like that.

So, that's all part of like what comes out of the action matrix.

MEMBER ARMIJO: And what does a licensee have to do different as a result of all of these changes?

What will they have to do differently, and then will you need - this is within the current regulatory -

MS. SILVA: Right.

MEMBER ARMIJO: You don't have to get new regulations -

MS. SILVA: Right.

MEMBER ARMIJO: - no new rules, no -

MS. SILVA: Right. We don't need new

regulations for this.

MEMBER ARMIJO: Okay.

MS. SILVA: This is a different way of how we're going to actually do the assessment - do the inspections, how we'll do enforcement and how we'll do assessment of the licensee.

MEMBER ARMIJO: So, if I was a fuel cycle licensee and I had a facility, what would I have to do different in order to, let's say, comply or be responsive to what you're going to do differently?

MS. SILVA: I think the only thing - I don't know how the licensees react to what we do. So, I -

MEMBER ARMIJO: Well, no, they've got ISAs and they're meeting all the current regulations.

MS. SILVA: I'm not sure that they would have to do much.

MEMBER ARMIJO: Okay.

MS. SILVA: But one thing for the corrective action program, they would have to demonstrate their corrective action program is acceptable.

MEMBER ARMIJO: Okay.

MS. SILVA: And we would inspect it. There would probably be other areas that we're inspecting

that they're already doing these things, but we're just focusing on other areas.

I don't know that they would have to do much different.

MEMBER ARMIJO: Okay.

MS. SILVA: We would be changing the way we were implementing oversight.

MEMBER ARMIJO: Okay. And if you had a finding, then you'd use a process similar to what Dennis described to kind of determine its significance. And the licensee really wouldn't have much of a role except to provide information.

MS. SILVA: Right.

MR. DAMON: Well, yes, that remains to be seen exactly how the - what the interaction is because typically the - because it depends on what the heck the thing is.

MEMBER ARMIJO: Sure.

MR. DAMON: But typically the - obviously the licensee's engineers know a lot more about how the process actually works. And you have to talk to them.

MEMBER ARMIJO: Yes, that's what I meant. Provide information and -

MR. DAMON: Yes, you'd have to - my vision of this significance determination thing is it has to

be done at the time the inspector's still there at the plant.

It's, you know, he has to sit there and ask questions to get the information to do this kind of a thing.

And the SECY paper presented sort of two - they were stated as qualitative and quantitative. The way I look at it, they're just two different quantitative ways of doing it, you know. A simpler way and a completely quantitative.

MEMBER ARMIJO: And you'd provide the training or the methods that the inspectors could - not every inspector -

MR. DAMON: Right.

MEMBER ARMIJO: - will know how to do this.

MR. DAMON: No, that all remains to be seen. My view is it is not clear how exactly this will all work. The program that was laid out in the SECY paper, really, the way I look at it is as a developmental project to see if we could do this kind of a thing, you know.

MEMBER ARMIJO: Okay.

MR. DAMON: Would it work? Would it be efficient? Would it, you know.

And the only way to do that is to, I think, is to test - develop a method for doing this stuff and then test it out on a bunch of actual findings that have happened in the past, plus some hypothetical ones that you would make up that would be - because most of the stuff that's happened in he past has not been of any great risk significance.

There are only a handful of risk significant things that have ever happened at the facilities.

We have never had a criticality at an NRC-licensed facility. And so, you have to make up some hypotheticals here to test this stuff and see how it will work, you know.

MS. BAILEY: Yes, I think -

MR. DAMON: See what we'd get into.

MS. BAILEY: The program that was laid out in the SECY paper was a framework for what a revised fuel cycle oversight process might look like, you know. I'm not going to say that all of the details were worked out.

MEMBER ARMIJO: Sure, but the SECY paper is the staff's marching orders, isn't it?

MS. BAILEY: No, it's not the staff's marching orders. It was -

MEMBER ARMIJO: Okay. I didn't understand that. Okay.

MS. BAILEY: Let me clarify. It was the staff's proposal for how we would go about revising the fuel cycle oversight process.

The Commission disapproved the staff's proposal.

MEMBER ARMIJO: That's the one that they - okay. I thought -

MS. BAILEY: But as a result of them disapproving our SECY paper, they basically through two SRMs, directed the staff to do the ISA/PRA comparison to develop the cornerstones, and then take the insights that we gained from those two activities and propose a path forward for how we would want to move towards revising - recommendations for moving forward with the revised fuel cycle oversight process.

Separate, but related, the Commission also directed us to look at how we can incentivize licensees having a strong corrective actions program and giving credit for that when we disposition violations.

MEMBER ARMIJO: Okay. Thank you.

CHAIRMAN RYAN: We're kind of at a place in the schedule we're due for about a 15-minute break.

And we'll come back - are you all set now? Is there anything else you guys want to say in closing or are we -

MS. BAILEY: You wanted me to go about - talk about path forward. So, I can take a few minutes to do that and -

CHAIRMAN RYAN: Why don't we do that when we come back from the break?

MS. BAILEY: Okay.

CHAIRMAN RYAN: We'll finish up and then we'll hear from NEI and go from there, because I don't want to rush you through that part.

MS. BAILEY: Okay.

CHAIRMAN RYAN: So, we'll take a 15-minute break and reconvene at 3:30.

(Whereupon, the proceedings went off the record at 3:13 p.m. for a brief recess and went back on the record at 3:30 p.m.)

CHAIRMAN RYAN: Okay. We'll go back on the record, please. I think on everybody's behalf, the subcommittee in particular, I'd like to thank Marissa and Dennis both for your participation so far this afternoon. It's been very helpful.

And by the interaction, you've conveyed a lot of good information to the subcommittee. So, we

really appreciate your time and effort in putting your presentation together. We've learned a lot.

I think now we're ready for some comments from the industry. I think Janet Schlueter is here from -

DR. FLACK: No, there is another one scheduled. The plans and future activities I think we have to -

CHAIRMAN RYAN: Oh, I'm sorry. I skipped over that. Well, in that case please go ahead and let's get started. I went ahead. My error.

MS. BAILEY: This should not take very long.

CHAIRMAN RYAN: Please take your time.

MS. BAILEY: You wanted us to kind of go over our next steps.

CHAIRMAN RYAN: Yes, please.

MS. BAILEY: And, again, I want to point out that this ISA/PRA comparison is really just one piece of the activities that the Commission directed us to perform as part of looking at revisions to the fuel cycle oversight process.

We are scheduled to go before the full committee to present this paper in February, I think, almost exactly a month from now. And so, we'll await

ACRS' review and feedback on the ISA/PRA comparison.

In the meantime, we will begin to develop the cornerstones as directed by the Commission. And then once we've gotten your feedback on the ISA/PRA comparison and we've completed the development of the cornerstones, we'll then integrate the knowledge that we've gained from those two activities and provide to the Commission recommendations for the next steps for enhancing the fuel cycle oversight process.

MEMBER BLEY: Have you done any work on the cornerstones as yet?

MS. BAILEY: We had developed an initial set of cornerstones when we developed the plans. So, we have done some work, but I think that there's still a lot of flushing out to do with the cornerstones.

MEMBER BLEY: Well, do you have a schedule for that part of the work?

MS. BAILEY: Hopefully we're able to begin that work this month and early next month and have some - and begin engaging our stakeholders on cornerstones later in February or March time frame.

MEMBER BLEY: Okay.

MS. BAILEY: As far as the schedule for providing recommendations for the Commission for next steps, we expect to do that in July 2011 through a -

in a Commission paper in that time frame.

And then separate, but related activity, we start to work with Region II in the Office of Enforcement and also engage our stakeholders as far as looking at what we can do with the corrective actions program basically developing what is an acceptable corrective actions program, and then start to identify and coordinate changes that would be necessary in the enforcement policy.

And we want to time that so that by the time the next revision to the enforcement policy is due sometime in 2012, we would have some proposed revisions to the enforcement policy that would incorporate crediting an effective corrective actions program.

So, that's essentially the next steps for us and for the fuel cycle oversight revision activities that we're doing.

And so, what I'd like to do is I'd just like to leave you folks with two key points that I think I mentioned and that Dennis mentioned. One is that we believe that the ISAs are sufficient for establishing a safety basis for fuel facilities.

The methodology can be quantitative. It can also be qualitative. So, we think that it can

handle the variety of processes that we see in the diverse set of fuel cycle facilities that we regulate.

The second point, though, is for the SDP. I guess there's still a question mark as far as the utility of the ISAs for a quantitative SDP. And part of the thing that we need to do is really identify what a significance determination process would look like for a fuel cycle facility.

We think, though, that if we did go with a quantitative significance determination process, that it's still not necessary for us to have an up front quantitative pre-evaluation of all of the sequences for all of the processes.

We think that that qualitative analysis can be done one a case-by-case basis depending on the violation. And so, it's not cost effective and not efficient to have this up front PRA, maybe, of all of the processes. And we think that that type of analysis would only be done for a very few number of violations.

So, those are the two points that I'd like to leave with you.

CHAIRMAN RYAN: Thank you.

MS. BAILEY: Dennis, did you -

MR. DAMON: Yes, that last conclusion was

not just a wild guess. We, like I said, went through every single violation for the last five years. And after we screen them, it comes down to two per plant per year that would go through a risk significance evaluation.

So, there's no point in - the point is there's no point in evaluating everything in the plant when you're only going to be looking at two things a year. You'll never get around to - 90 percent of the stuff will never show up.

CHAIRMAN RYAN: Sure.

MR. DAMON: And so, you're just wasting your efforts there. You're better off just do the analysis when - now, the downside of that is if you wait to do the analysis when the thing happens, you may find that it's - you're missing something. You don't have the data. Something impedes you from doing it and you don't have the time because you need to make a determination right then.

So, that's the downside of doing it that way, but I'm just saying I think it's the way to go, myself.

MEMBER ARMIJO: But you have that situation right now to make a determination on judgment, really.

MR. DAMON: Yes - well, sometimes people -

licensees have in fact submitted risk assessments that were on argument that something was a low risk significance.

They actually hire a consultant, get a risk assessment, send it to us and say see, this is low safety significance.

And so, it's been going on and happening, but just on occasion. It's not done routinely.

MEMBER ARMIJO: Yes.

MEMBER BLEY: I guess there's just one piece of this that puts me off a little bit. And that is if we do PRA, we have to do PRA for all the sequences for all the systems in the plant.

And if we go back to the first PRA that was done on reactors, it was WASH-1400, and they spent - I forget the numbers, but by far the biggest system and the most work they put into that PRA was on the containment isolation system.

And after they finished, they realized they misspent and they wouldn't do that again. And nobody has since then.

It would seem to me that some thought about how you can go top down given the kinds of things you're already doing and identify and maybe narrow the definitions a little, high-consequence

events, especially anything that have consequences offsite and fairly large numbers of people onsite, and maybe use that kind of top down approach to narrow the scope of what one might do, our priority in PRA.

So, if things popped up that affected dose scenarios, you'd have a real good picture of what the risk might be. And it sounds like all the thinking has been if we do PRA, we have to do it in the greatest possible detail for everything in the plant, and that never works.

Places where people have tried it, it's gone dry. They've run out of money before they got anything useful. That's all I wanted to say.

CHAIRMAN RYAN: All right. Well, thank you. That's helpful.

Any other comments as we close this portion of the meeting?

DR. FLACK: Well, can I just follow up one thing?

CHAIRMAN RYAN: Go ahead.

DR. FLACK: Would you expect to develop models in-house to do these kinds of work?

I mean, right now you say you're doing back-of-the-envelope-type calculations. Would it require more of an infrastructure on the part of the

staff to -

MR. DAMON: Well, that, you know, that all remains to be seen, you know. How much - it all depends on how much you want to spend and how much money you got and, you know, all kind of things like that.

I personally would expect - see, you would - what I say is you try to do it. Then you learn what you need by trying to do it, see?

And what I think would happen is you'd learn that we need a little bit more work on human error modeling and we need - but - and you need to establish - one of the issues, I call this an issue, something that has to be determined, but if you - what you want is consistency, right?

DR. FLACK: Right.

MR. DAMON: You want to do a consistent evaluation of risk significance. Then it has to be against one set of criteria and data - failure data that you use, you know.

You can't - some people think we can - oh, we can just use whatever the licensees did, you know. But if this licensee is doing something and it is conservative, and this guy is doing something and it's not conservative, then you're unfairly biasing against

the guy who did it conservatively who was being safer.

DR. FLACK: Right, right.

MR. DAMON: So, you have to have a level playing field to do this significance evaluation. That's my view.

DR. FLACK: Yes, I think that's very important because, I mean, we develop spall models for that reason so we can have a baseline across the board with the same assumptions for all the plants, you know. Seal models were important for the reactors, pump seal models. So, you didn't want to have that impact, you know, your decision. You want to sort of work from a generic level.

And that's why I raised the question. Seems like you would want to do that.

MR. DAMON: Yes, yes. I think if you try to do this, if we didn't decide to do it, the industry would tell us that they wanted it done that way.

DR. FLACK: Yes, that's for sure.

CHAIRMAN RYAN: Okay. Again, thank you, folks. We appreciate it. You're more than welcome to stay if you want.

(Off-record comments.)

CHAIRMAN RYAN: Okay. Janet, I guess you're going to start us off.

MS. SCHLUETER: Okay. Sure.

CHAIRMAN RYAN: Janet Schlueter from the NEI.

MS. SCHLUETER: Sure. I'm Janet Schlueter. I'm the director of fuel and material safety at NEI. I facilitate the Fuel Facility Operations Committee where we have all of the operating committees. And those sites that are under application for the NRC, have routine exchanges of information.

And I represent them in instances like this. And Charlie Vaughan will be making the presentation. He has decades of experience at operating fuel facilities.

And the slides represent a consensus of position or views of the fuel facilities. They did all contribute to the formulation of the slide content and our remarks today.

I'd also like to take a second just to say "thank you" to the staff for having the public meeting back in November. A very productive public meeting on the use of ISA at the fuel facilities.

And we've of course read their December 15th version of the paper which we thought was very comprehensive. And I think we're generally in alignment with the discussion and the consensus that's

reached in that paper.

And Charlie will provide a lot more detail on the use of the ISA, what it is, what it is not and the value of it, and hope that it will influence and you find it informative.

And we'll try to be as timely as we can to stay within your constraints and to be responsive to your questions. Okay?

CHAIRMAN RYAN: Thank you, Janet. Appreciate it.

MS. SCHLUETER: Thank you.

MR. VAUGHAN: Okay. For the record, I'm Charlie Vaughan.

If I may before I get into the presentation, there were a couple of subjects that came up that I wanted - in the earlier discussion that I would like to make a comment on, in part, based on my interaction with the fuel facilities and, in part, from some personal experience.

One, on the oversight process, the licensees generally have not made any kind of a request that says this process needs to be revised. That didn't originate within industry.

However, when industry heard that there was some consideration, there were a couple of points

that we suggested if this work was undertaken, that it would be good to look at the reproducible nature of these oversight reports that we get and, also, with the transparency of the information.

And we committed that should the process go forward, that we would be willing to work in that endeavor.

The other item was the corrective action program question that came up. And all of the licensees at the fuel facilities have corrective action programs.

Now, all of those corrective action programs are not precisely the same, but they are all documented, they're all proceduralized and they're all used.

I mean, in today's environment, it's very difficult to have a decent compliance record unless you've got a corrective action system that takes things that you identify and others identify, tries to determine the root cause, I'll use that term, for why they happen and correct them.

So, while we don't have hard, fast commitments in the license to do that, those programs are in place. They are observable. And the compliance records of the facilities today are, in

part, you know, the result of having that type of assurance program in place as one of the management measures.

MEMBER BLEY: Can I ask a question about that?

MR. VAUGHAN: Yes.

MEMBER BLEY: In the reactor business over the last year, there have been a couple particularly difficult events that occurred in plants. And when they were traced to their root, part of the problem in each of those cases was even though there was a good corrective action program, what was missing was a process to ensure identified problems actually made it onto the program instead of just into a, you know, work-to-be-performed-later file in the maintenance shop.

Can you say anything about that? Is there - do these programs have a way to push things onto the corrective action list rather than letting them sit somewhere else?

It was kind of surprising, the ones that we saw.

MR. VAUGHAN: I'm not sure what you mean by a way to push them onto the list. The programs that I'm familiar with -

MEMBER BLEY: Let me explain a little -

MR. VAUGHAN: Okay.

MEMBER BLEY: - because the corrective action program at these facilities was a very structured process. And if something got on, it was tracked. And it was evaluated as to its importance. And more important things were -

MEMBER SIEBER: Root cause.

MEMBER BLEY: Yes, the whole business.

Separately, if somebody noticed something broken, instead of getting on there, it could get onto a maintenance list in the maintenance department.

MEMBER SIEBER: Maintenance work orders.

MEMBER BLEY: Maintenance work orders. And there wasn't, apparently, a good enough process to make sure anything that might have significance that was reported to maintenance actually got onto the corrective action plan.

And a couple things lasted for almost a year, and eventually caused major upsets in the plants.

MR. VAUGHAN: Right. I won't say that that couldn't happen, but the programs that I'm aware of procedurally dictate the types of things that have to go on into the corrective action program.

Now, that doesn't mean that there can't be a mistake made and something could be missed, but the programs that I'm aware of require certain things to go into the corrective action program.

And so if it's a particular event or a situation that by written definition and procedures is required, it has a high probability of going into the program.

MEMBER BLEY: Okay. Something to think about.

MR. VAUGHAN: Okay. So, if there aren't any other questions on that, we'll get on with the particular presentation.

And as Janet said, we certainly appreciate the opportunity to work with the NRC and others on this particular subject.

With regard to the NRC's white paper, the industry constituents have looked at that and they agree with the background discussion of the ISA development, the discussion of the roles of the ISA in the regulated safety environment. So, in that regard, we're pretty well in tune with the NRC's white paper.

There is one concern that people in industry have. And that is the suggestion that PRA techniques might be used in the significance

determination process.

And I think as I go through the presentation, there will be some evidence of why we bring that point up.

One of the things that we need to think about is the facilities that are all - that are all lumped together in this group of fuel cycle facilities. And it's quite a broad spectrum of facilities and activities.

There is a very significant diversity. It's not just some words to use. There is significant diversity.

And if you look at that listing of facilities and the numbers of the different types of facilities, each of which use different equipment, processes, you know, chemical processes, et cetera, there really is not a lot of synergy to be able to develop databases and uniform models and approaches.

So, you know, when Dennis talks about these applications and dealing with making significance determinations, I think this lends a lot of credibility to what he's talking about because the frequency of things that the NRC has to look at on an annual basis is fairly low.

And when you look at the diversity of the

types of activities that these things may apply to, developing uniform approaches and uniform models to any high degree of detail is - could be relatively time-consuming and difficult.

The other thing is these processes, the term "batch" was mentioned. I wouldn't characterize them necessarily as batch processes anymore, but they are sequential and stepwise processes. In other words, there are disconnects along the way so that things are not connected in long chains.

And these facilities are not required to run through failures. In other words, if there's a failure in one step, they don't have to run through that failure.

And the Items Relied On For Safety that we've been talking about are generally designed to stop accident sequences before they develop.

For example, in the criticality area it is required that we not use mitigating types of IROFS. It has to be a positive stop type of situation. And that's the approach that's used for high-consequence events is that we use IROFS that perform a stop as opposed to mitigation.

With regard to the ISA methodology, we've talked a lot about that today, but I think industry

would like to highlight a few things that should be taken away.

First, it's a systematic identification and evaluation of accident sequences. That's what we do with ISA.

The industry uses tools with extensive long-term application by the chemical industry and others. And we've talked about it. HAZOP, fault tree, event trees, what-if, Risk Index. All of those tools are used in the ISA process.

The Risk Index that's been discussed is generally based on operational experience, but not so much on formal operational databases as have been developed for reactors.

The IROFS are identified and implement to meet the performance requirements of the 70.61 regulation. That's what they were - that's the tool that was designed to do that.

And then management measures are required to be identified to assure that IROFS remain in place and functional when they're required to perform their duty.

And the ISA methodology approach provides a current and adequate safety basis for each facility. And I might mention one thing that is sometimes

overlooked. IROF failures have to be recorded and investigated. And if IROFS fail too frequently, then they have to be looked at in terms of replacement.

So, there's a feedback mechanism in this ISA process that it's not a one time through. If things aren't working and you're getting error signals, you're getting feedback that says that you have to go back and look at what's going wrong.

MEMBER BLEY: Now, as I understand it, the ISAs are not quite part of the regulatory process.

These problems with IROFS, do they need to be reported to NRC or they're just - they need to be tracked internally subject to audit -

MR. VAUGHAN: They don't necessarily always have to be reported to the NRC. The reporting criteria is one thing, but IROF failures do have to be recorded -

MEMBER BLEY: Internally.

MR. VAUGHAN: - internally and the licensee is responsible to investigate them. And that information is available for and open to NRC inspection.

MEMBER ARMIJO: Charlie, would you normally provide, let's say, a summary in your annual summary, a chapter or section on IROF failures?

MR. VAUGHAN: IROF failures are not included in the annual report, but they are maintained at the facility. And the inspectors typically look at that list.

And, I mean, obviously they don't go through and look at all of them, but it seems that they are somewhat trying to risk inform their effort.

In other words, they look at failures and they look at the systems that they're associated with. And some way in their mind, they decide some of the ones that may be of - in higher risk areas than others. And they will typically run through the licensee's treatment of that - those particular ones that they select, but they're not part of the annual report.

MEMBER ARMIJO: Okay.

MEMBER BLEY: Just an organizational question for you.

I wasn't aware that you had a committee at NEI of all these groups. My familiarity with the chemical processing business is very different and there's very little sharing.

Through NEI or some other form, is there sharing of problem areas and maintenance ideas -

MEMBER SIEBER: Operating experience.

MEMBER BLEY: Yes, operating experiences among the various facilities.

MR. VAUGHAN: Yes, this particular committee that Janet heads up and I help out with periodically is very good to share. Now, I mean, this is a competitive industry.

So, occasionally you get into situations where you have to draw a boundary to protect some competitive information, but the operation of this committee has actually been, I think, very good for safety in the industry because there is a very significant sharing of the experiences. And people that have problems are - the facilities are quite willing to share, you know, up to the point that you don't get into proprietary type of information. And that's been helpful.

MS. SCHLUETER: It's a small community, as you can see.

MEMBER BLEY: Right.

MS. SCHLUETER: And so there really aren't other forum for them to do this. So, in our biweekly and sometimes weekly calls, we dedicate time to operational experience issues, events, observations, licensing matters, inspections and regulatory issues that are generic to the industry as a whole.

MEMBER BLEY: Good things.

MS. SCHLUETER: Yes, I mean, it's a very, you know, timely, ongoing forum. And then we meet in person some as well.

DR. FLACK: Is that similar to what INPO does for reactors?

I mean, they go into plants every two years, I think, and assess their performance.

MS. SCHLUETER: No.

DR. FLACK: You don't do anything like that?

MS. SCHLUETER: No, no. This is a committee and a forum primarily for the exchange of information between the plants. We do not do facility visits, in part, for the proprietary reasons we just mentioned.

DR. FLACK: Thank you.

MEMBER SIEBER: You track IROF failures. My understanding of an IROF is like a trip device or relief valve or some instrument someplace.

Do you keep track of the basic device that was the root cause that required the IROF to operate or do you just look at whether the protective devices work when they were needed?

MR. VAUGHAN: The reason I hesitate - the

answer to that is, in general, the whole aspect of the IROF system, in other words, what would cause it to trigger as well as the protective action, all of that is looked at when the investigation is done.

And the reason I hesitate a little bit is, is the licensees have the opportunity to define these IROFS either as individual items or on a system basis. And so, depending upon how the IROF is identified may have a bearing on how the investigation goes.

But in general, they get to the information that you were interested in.

MEMBER SIEBER: Yes, just as an example, let's pretend for a moment that you had a process where you had to have some pump that had to run.

MR. VAUGHAN: Yes.

MEMBER SIEBER: And you had a protective device that would sense that it wasn't running, you know. Maybe it's a coolant pump or something like that.

And the protective device never failed, but the pump itself was failing once a month or twice a month or something like that.

Does your process, your safety analysis, determine that sooner - that this pump keeps failing and sooner or later it's challenging the protective

device over and over and over again, and the likelihood of a failure of both increases sharply when the demand is present on a very frequent basis?

MR. VAUGHAN: Yes, it would be hard for me to answer that for everybody because I haven't operated - I haven't performed everybody's process.

But, in general, based on the discussions within industry, I think that that is the case.

MEMBER SIEBER: Well, I would hope so. And I would think the staff would go and look for underlying causes of IROF operations in order to determine what the overall safety posture in the facility is.

MR. VAUGHAN: Right.

MEMBER SIEBER: Thank you.

MEMBER BLEY: Well, these aren't generally reported to staff. So, it would take, you know, a plan on staff's side to go out and do this proactively, I would think, right?

MR. VAUGHAN: Let's go back. Remember, we have routine inspections by the regional office.

MEMBER BLEY: Okay.

MR. VAUGHAN: And one of the things that I - these records are required to be kept under the terms -

MEMBER BLEY: So, on those inspections they could get -

MR. VAUGHAN: And so on the inspections, that is one of the elements that is on their list of things to inspect.

And, you know, they have - I don't know what their method is, but they have a method of looking at that list and deciding which ones they want to follow up on. And I think it's kind of a risk-type informed basis.

MEMBER BLEY: We heard that there are like on the average, two violations a year per facility.

MEMBER SIEBER: Per year.

MEMBER BLEY: I don't know what I said. That's what I meant.

IROF failures, do you have any wild idea of how frequent that happens? Is there four a year, one a day? Wildly different plant to plant?

MR. VAUGHAN: They're probably different by plants. There aren't a lot, but there are some. I think Mike had a -

MR. TSCHILTZ: Yes, I just want to point out that Part 70 has reporting requirements via Part 21 for IROF component failures that could create a substantial safety hazard. So, there is a mechanism

for component failures to get formally -

MEMBER BLEY: Public safety hazard, right, if it's Part 21?

MR. TSCHILTZ: Well, I'll - it says substantial safety hazard, is what's in the regulation. So, that's kind of like similar to subjective judgment. There is no numerical threshold for that.

MEMBER BLEY: Okay.

MR. TSCHILTZ: But it is required to be - those failures are required to be reported.

MEMBER BLEY: Do you got any of those reports?

MR. TSCHILTZ: Yes.

MEMBER BLEY: Oh, okay. I just wanted to know how often things got classified that way.

DR. MODARRES: I think some of those IROFS are like passive systems like containment.

MR. VAUGHAN: Yes.

DR. MODARRES: So, I wouldn't see that that fails that often.

MEMBER BLEY: Well, some of -

DR. MODARRES: And there you could probably see more often failures especially if you are in harsh environments, you know, corrosive and all that.

MR. VAUGHAN: And of course some of them are administrative and, you know.

DR. MODARRES: Some IROFS are administrative, right.

MR. VAUGHAN: Right. So, the potential for failure is significantly different for different types of IROFS.

DR. MODARRES: And how do you record the administrative failures if IROF is an administrative -

MR. VAUGHAN: At the facilities that I've worked at, we don't have any administrative IROFS, but some of the licensees do. And so, I can't speak exactly for how they record them.

MR. TSCHILTZ: If I can add, Mike Tschiltz, I think if you trip the threshold for no longer meeting a performance requirement, that's a reportable event.

So, if you have an administrative IROF that causes you not to meet one of the 70.61 performance requirements, that's a reportable event.

For other administrative failures that fall below the threshold where you still meet the performance requirements even though this IROF failed, then that's not reportable.

MEMBER BLEY: Thanks. That helps.

MR. VAUGHAN: And in some cases, administrative IROF failures may be observed during audit or by an over check.

For example, if an administrative routine requires a certain recording and check-off, you know, on a check sheet or something like that and some items have been missed and an over check finds that those items have been missed or an audit finds that those items have been missed, then that would be considered a failure of an administrative IROF.

DR. MODARRES: Well, it could be asleep or something in that time. It's not the procedure may not be wrong, the administrative -

MR. VAUGHAN: No, it's not the procedure wrong, but the act was wrong.

DR. MODARRES: The act was, yes.

MR. VAUGHAN: Okay. In terms of the PRA methodology, there weren't a lot of - a lot of things that we wanted to mention here, but there's a lot of similarities in terms of what's done for ISA and what's done for PRA at least in the initial steps.

And it really boils down to the results for PRAs are determined differently than they are for ISAs, and the results are typically used somewhat differently for PRAs in terms of ISAs. So, it's

really kind of a different tool to do a different job from our perspective.

And we talked a little bit about ISAs. There has been a significant amount of industry effort and expense used in the development of the ISA technology. I mean, performing these ISAs at the facilities was - just the cost alone of the facility was well over a million dollars in, you know, in person effort. And some people have reported, you know, numbers that are way significant more than that.

And of course the NRC spent some degree of effort in working out the rules and going through all of the reviews and acceptance criteria. So, there's been a significant amount of effort spent on the development and implementation of ISA technology similar to the effort that was spent by reactor operators and the NRC to develop the PRA methodology that's been used with reactors.

So, implementing these different methodologies, these different tools to do things, is an expensive proposition. And that has to be considered in terms of what does it cost to do this and relative to the benefit that comes out of it.

MEMBER BLEY: You know, there's a question I have for you. And Sam and I are approaching this

from different ends.

The only ISA I've looked at, and that puts me in a lack of knowledge compared to the whole process, is the one for the MOX facility.

And given the large numbers of things that were found and the fixes that were added and the total cost we heard for that thing, it just - I can't help but believe that if they had used a PRA method, they would have screened out as low probability, low consequence a number of things quite low compared to others. They would have cut down the number of fixes that they did by an enormous amount.

And I just wonder if you've thought about that because it seems that at least in that case, everything that was found, no matter what, got fixed. And that's a really expensive process when you do it that way.

DR. MODARRES: Did it include, also, the amount of effort that went into it to do it actually -

MEMBER BLEY: I think the $80,000 we heard, I think - 80 million, I mean, included that. Ten years of effort, from what they told us in the meeting.

And I've seen large-scale facilities done with PRA in the chemical business for a heck of a lot

less than that.

MEMBER ARMIJO: I think the MOX facility is really an outlier compared to the other fuel cycle facilities as far as complexity and -

MEMBER BLEY: Yes, but it's not an outlier in terms of complexity to other kinds of process chemical plants.

MEMBER ARMIJO: No, no, I think with chemical plants, I agree. But for typical fuel cycle facilities, I think it's much more complex.

MEMBER BLEY: I'm sure it is.

MEMBER ARMIJO: Yes.

MEMBER BLEY: I'm sure it is.

MEMBER BANERJEE: That 80 million, was it only ISA or did it include -

MEMBER BLEY: They didn't design. It included design fixes, of course.

MEMBER BANERJEE: Yes, because what happens is this is sort of part of the design process, you know. So, it's not that you can separate it and say this is exactly what was spent on that. It's part of an integral bottom line.

MEMBER BLEY: If you forget about the cost and look at the documentation of the summary that they gave us, it's astounding.

MR. VAUGHAN: It is. No question about it.

MEMBER BLEY: Astounding to me. Maybe not to everybody.

MEMBER BANERJEE: $80 million worth?

MEMBER BLEY: Yes.

MR. VAUGHAN: One other big difference is that MOX -

MEMBER BLEY: But I was wondering if you folks had thought about the idea of if you had a method that would allow you to prioritize what's forced to change, whether that would be valuable.

I mean, I know just thinking about, God, if we have to do one more thing, it will cost an arm and a leg.

MR. VAUGHAN: Well, most of the - most implementations of the ISA methodologies at the facilities have some degree of screening.

Now, it's not the precise degree of screening that you could do with necessarily a PRA. I mean, you can get right down to the decimal point if you've got data to do that, but you may not want to do that anyway.

MEMBER BLEY: No.

MR. VAUGHAN: But there are ways to screen. and the regulation has performance criteria. And

you're screening to, in a way, to that performance criteria.

Now, because most people are using kind of a matrix-type approach to put things in bins, you don't get a fine degree of screening, but you do have some opportunity to put different situations in different bins in terms of priority and in -

MEMBER BLEY: Any likelihood function into that?

MR. VAUGHAN: Yes.

MEMBER BLEY: Okay. I need to see some of the other ones.

MR. VAUGHAN: So, most people are looking at a consequence and likelihood type of a matrix, and certain things are screened out depending on where they are on that matrix, but the matrix, in general, is somewhat conservative.

So, yes, you probably do a little bit more in a lot of cases than you might have to do if you did a little bit more precise method, but then the question is what's the cost benefit of -

MEMBER BLEY: That may well be different for different kinds of facilities.

MR. VAUGHAN: The other thing is at the fuel facilities, there are a lot of people there that

understand PRA methodology. And you heard about the teams that have been used to do the ISA. And you bring in the maintenance man, you bring in the process operator and those kinds of people that are familiar with what's going on with the process.

And those kind of people don't work real well with PRA methodology. So, you have to have a little different type of person then to work through the PRA part of this.

I don't know what the bottom line is. But as you'll see when we go on through the summary, the way the rules were written, the ISA approach was adopted as the tool to demonstrate that the licensees met, you know, the regulation.

If we need a different regulation, heaven forbid, then maybe we need to talk about our different set of performance criteria, maybe we need to look at that.

But given the task, the tools seem to fit.

MEMBER BLEY: Thank you.

MR. VAUGHAN: Which kind of leads into the ISA appropriateness slide. And, again, this - we're repeating this an awful lot, but it does demonstrate that the performance requirements of 70.61 are met.

And the fuel facilities, I think if we

look at them, are fairly simplistic in nature from an integration viewpoint. In other words, there's little or no domino effect for accidents.

An accident is generally fairly localized with a few - there are a few exceptions for facilities. But, in general, the accidents would be fairly localized in the facility.

And the source term for accidents in these facilities are somewhat smaller than relative to -

MEMBER POWERS: Do you think that a release from a radioactive material from a facility would have lower case type on the front page of the Washington Post?

MR. VAUGHAN: Probably the type wouldn't be lower case, but ultimately -

MEMBER POWERS: I don't think so either. I think they would have an equivalent headline.

MR. VAUGHAN: The type size would be about the same. Possibly. It depends on how well the - how well the release was managed and what the significance of it was. But in terms of doing real harm to people, the offsite impact would be negligible.

And if you look at fuel cycle facility accidents, they generally rank low on the INES reporting scale and they're predominantly chemical.

We mention that because one of the - one of the problems that we have is putting risk in the right perspective in total for the industry. And we tend to compartmentalize and don't really look at the whole spectrum of risk and someway we need a yardstick.

And not suggesting necessarily that the INES reporting scale is the right one, because personally I'd just assume stay off the scale in total. But as we're talking about data and we're talking about situations, the Tokaimura criticality is about the worst accident that has happened at a fuel cycle type of facility. And there were actually worker fatalities in that one.

And on the INES scale, that ranks a four compared to several reactor-related accidents that rank significantly higher.

MEMBER BANERJEE: So, you don't include Mayak as a fuel cycle facility?

MR. VAUGHAN: I did not put that on this particular chart. I mean -

MEMBER ARMIJO: It's there. Kyshtym and Mayak are up there.

MR. VAUGHAN: Yes, Kyshtym, but that -

MEMBER BANERJEE: That is the one at Mayak.

It's because they didn't know the name of the town. That's why it was called Kyshtym.

MR. VAUGHAN: Okay, but was that actually -

MEMBER BANERJEE: It was the waste storage tanks which were dried waste and they had cooling on it. And one of the coolers failed or some of the coolers, and it exploded and it blew the top off the concrete bunker.

MR. VAUGHAN: Okay.

MEMBER BANERJEE: Was about 70 tons of TNT, roughly, estimated as.

CHAIRMAN RYAN: Yes, and tens of millions of curies of mixed fission products.

MEMBER BANERJEE: Yes, and it formed a cloud. The immediate vicinity didn't get it, but the cloud moved and deposited.

CHAIRMAN RYAN: 70 kilometers across downwind.

MEMBER BANERJEE: And then there was about - they estimate a couple of hundred fatalities.

MR. VAUGHAN: And the reason this one wasn't put in the fuel cycle facility category is because that was one that involved mixed fission products and -

MEMBER BANERJEE: No, no, it was just

radioactive waste. It was the decay heat. It was mainly strontium and cesium.

MR. VAUGHAN: Right. But the fuel cycle facilities don't have those types of risk.

MEMBER BANERJEE: Oh, you're not talking about reprocessing?

MR. VAUGHAN: No, we're not talking about reprocessing here. We're not into reprocessing here. This is -

MEMBER BANERJEE: No, that's fine. If it's not reprocessing -

MR. VAUGHAN: And of course the Kerr McGee event, which was a chemical event, and it had to do with nuclear activity, but it was a chemical event.

(Off-record comments.)

MR. VAUGHAN: Anyway, it's not necessarily that we're suggesting that this is the right reporting scale or the right measurement scale, but it just begins to take some information that is available and show how these - accidents at these facilities that are bad stack up on the overall list. But, again, we'd all like to stay off this list, period.

Again, talking about the justification for the use of ISAs at the facilities, again, to meet the regulations, source terms are small relative to power

plants and pose a negligible - or a minimal or negligible impact to offsite.

There's been a significant amount of effort put forth to develop the ISA process. These processes are simplistic and sequential. And the ISA methodology generally adheres to a risk-informed performance-based philosophy.

MEMBER POWERS: If the ISA does not compute risk, how does it conform to a risk-informed performance-based - I mean, I don't understand the statement. Come to think of it, I don't understand any of this statement.

Where does performance come into this thing?

MR. VAUGHAN: Performance comes into it because you're required to perform so that you don't exceed the requirements in the regulation.

MEMBER POWERS: A different definition of "performance" from what I would -

MR. VAUGHAN: Well, the regulation there has very specific - Dennis put up some of the definitions of high-consequence events and medium-consequence events. And they are - they are quantified in measurable terms. And that's the reason we refer to them as performance.

DR. FLACK: Just to follow up a little bit on that, that's for licensing the facility. You design your plant to meet those performance requirements.

Once the plant is operating, then how do you assess the performance? I think that's the question on how much risk does it, you know, present during its operation. How do you know how much risk it presents?

I understand that if you exceed, if you find an IROF that is down and you say, well, this sequence is - will not - no longer meet the performance requirement, I'll go fix it, I mean, you go and fix it, but you don't really know what the risk is of it, you know. That's the thing.

You just, you know, kind of -

MR. VAUGHAN: Well, you know that the controls that you put in place, the Items Relied On For Safety -

DR. FLACK: Right.

MR. VAUGHAN: - you know that they have been demonstrated to be if it's a high-consequence event, that means that they have to be highly unlikely, which is - has a definition. And it's a facility-by-facility definition, but the measure of

highly unlikely or unlikely is defined for each facility.

So, while you don't have a precise number, you know that in accordance with their procedures those risks have been made to be either highly unlikely or unlikely in accordance with the definitions in their license.

MEMBER POWERS: Suppose I'm operating one of these facilities and by dint of outrageous circumstance I find I have to maintain an IROF.

Do I have to shut the facility down?

MR. VAUGHAN: You have to -

MEMBER POWERS: Shut the facility down completely?

MR. VAUGHAN: What was the question?

You have to do what now?

MEMBER POWERS: I find that I have to maintain an IROF and do something with it.

MR. VAUGHAN: Oh, if you have to take an IROF out of service while you're operating, then you'd have to shut down.

MEMBER POWERS: For any IROF. Any one of them. Temperature control.

MR. VAUGHAN: Most likely.

MEMBER ARMIJO: Unless you have redundant

ones.

MR. VAUGHAN: Unless you have redundant ones.

MEMBER POWERS: Oh, if I have redundant ones, how much redundancy do I have to have?

MR. VAUGHAN: You don't have to have any if you're willing to shut down.

MEMBER SIEBER: In other words, a manual control of redundant IROF?

DR. FLACK: So, there is an action statement. You go into an action similar to a tech spec where you have to shut the plant down within some period of time after you IROF?

MR. VAUGHAN: You don't shut the plant down. You only shut down that unit operation which the IROF is protecting.

MEMBER ARMIJO: And that happens in just normal operation. Let's say you're running a lower level of enrichment through a fuel factory. And you now come in with a higher enrichment level. They're batched. You have to clean out, you've got to shut down, you got to do a bunch of stuff.

So, stop and go is not a - nothing that is unusual. So, if you failed an IROF and you didn't have a backup, you'd shut down and it wouldn't be the

end of the world.

DR. FLACK: Well, when there's 12,000 IROFS, it's pretty amazing you can get them -

MEMBER ARMIJO: Well, obviously all -

MR. VAUGHAN: I mean, all of the plants don't have - all of the plants don't have this 12,000 number.

MEMBER ARMIJO: I think it was a little bit misleading that there were 12,000 because there were similar components that were probably labeled as IROFS because they were all the same kind of thing.

DR. MODARRES: If one IROF fails and there's a redundant IROF exists, aren't you concerned about common cause failure possibly and continue to operate?

MR. VAUGHAN: Again, it depends - it depends on the configuration of the redundant IROF.

MEMBER BLEY: You bring up an interesting point. We've had discussions with staff on this when they brought the reg guide to us. There's no useful guidance on treating dependencies or on treating human actions, really.

Now, they might be well done in some of the actual ISAs, which I haven't seen, but the guidance in those areas is meager at best.

MR. VAUGHAN: We've had a lot of discussion about independence and -

MEMBER BLEY: And leading to?

(Laughter.)

MR. VAUGHAN: Well, it's hard to - it's hard to establish things as totally independent in the universe. So, the discussion has a hard time finding an end point.

MEMBER BLEY: But Mother Nature has a way of showing us independencies sometimes.

MR. VAUGHAN: Right. And we're not always as smart as Mother Nature.

But, yes, the subject of independence is one that there's been a good bit of discussion. And generally the way we've gravitated in this part of the industry is in the direction of the definition that the criticality people have used for "independence," which is not perfect, but it's a pretty rigorous definition of "independence."

MEMBER POWERS: Once again that leaves me quite confused. It's not rigorous, but it's a good definition.

MR. VAUGHAN: Okay. A good definition.

MEMBER POWERS: It's an adequate definition.

MR. VAUGHAN: It's a good definition.

(Laughter.)

MR. VAUGHAN: Anyway, just kind of in summary, some of these points are a little bit redundant, but the one key here is the ISAs are routinely updated and they always contain a current basis of safety for the facility. And as I mentioned earlier, there's a feedback loop in this.

If IROFS fail too frequently, they have to be investigated. And if they are proving not to meet the performance requirements, then they have to be replaced with something that will. So, there is a feedback loop that helps out there.

And the mixing of ISAs and PRA techniques at the facilities, we really don't embrace that idea that much. It's partly driven by the diversity of the facilities and the fact that it's very difficult, you know, to put any number of facilities together to develop a uniform approach or a model and develop the data to support it.

The cost of adding PRA to the ISAs, which we've already demonstrated have been a fairly costly effort for the facility.

And, also, what we would consider to be a diversion of effort since both the NRC and industry

seem to feel like that the ISA methodology is adequate to meet the requirements of the regulation.

And it would seem that the significance determination for these kind of facilities when you look at the diversity, when you look at the low frequency of things that require significance determinations, should be some form of a more simplistic process than trying to apply any rigorous PRA techniques to them.

So, that was the industry side of the message. And I think as we've gone through that, you can see that we're pretty significantly in line with what was in the NRC's paper other than maybe a little difference about significance determination and what might be the right approach there. But we are interested in working on that problem to see if we can't make some improvement there.

CHAIRMAN RYAN: Thank you.

DR. FLACK: I do have one more question, if I may.

CHAIRMAN RYAN: Please.

DR. FLACK: Yes, this intrigues me this IROF and where you stopped the - when looking at the MOX similar to Dennis did at - the ISA, there's areas - I mean, there's a discussion on defense-in-depth of

which no credit is taken, but, you know, you meet your performance criteria with the IROFS.

If you find an IROF unavailable, do you take any credit for the defense-in-depth in meeting the performance criteria at that time or is it strictly that's it, we stop until we get the item fixed?

I was kind of curious about the use of this defense-in-depth piece that's added into or added onto the sequences, you might say, in the ISA.

MR. VAUGHAN: The only time that defense-in-depth is fair game in terms of credit, is if the defense-in-depth mechanisms have to meet and are subjected to the same degree of requirements and controls that IROFS are.

And that's not -

DR. FLACK: Then it becomes an IROF.

MR. VAUGHAN: That's not necessarily the case.

DR. FLACK: Yes, right, right.

MR. VAUGHAN: Well, some people have done that and they don't necessarily identify them as IROFS. Because what that does is, is just drives up the number of IROFS, but there's no - there's no free ticket.

In other words, to get credit for defense-in-depth, it has to have the same quality as what an IROF would have, which means it has to meet the same requirements.

DR. FLACK: If you'd take credit for it for some reason. It doesn't seem like they take credit for it in the ISAs

MR. VAUGHAN: Right. If you take credit for it in -

DR. FLACK: Right, right.

MR. VAUGHAN: They don't take credit for it in the ISA.

DR. FLACK: So, then you don't rely on that as a means of meeting performance criteria during operations should an IROF become unavailable.

That was my question. I guess your answer is, no, you don't take credit for -

MR. VAUGHAN: Yes, typically not.

DR. FLACK: Okay.

MR. VAUGHAN: Again, most of these processes are so that if they need to be shut down for a period of time to fix an IROF or replace an IROF or something like that, it can happen.

DR. FLACK: Yes, yes. Sure. I mean, if you did a PRA, you would take credit for it. I mean,

that's - but since it's not a PRA, you wouldn't take credit for it because you're simply meeting some regulation. You're saying that - the performance criteria in the regulation.

So, it would seem to work against you in that case.

MR. VAUGHAN: Right. And it's - it also has to do with the ground rules that are written into the regulation.

DR. FLACK: Right.

MR. VAUGHAN: I mean, as to what you can take credit for and what you can't.

DR. FLACK: Yes. Well, okay. Yes.

MR. VAUGHAN: And, you know, if you had a different set of ground rules, you could play to a different set of rules, but -

DR. FLACK: Okay.

CHAIRMAN RYAN: Any last questions?

We had on our agenda that Marissa was going to make some final comments.

(Off-record comments.)

CHAIRMAN RYAN: I just didn't want to miss an opportunity if you needed to say something else. Any other questions or comments from the members?

Thank you for your participation to our

consultant today and to members. I think it's been a real interesting and helpful discussion both with the staff and with the industry. And good dialogue and discussions like this really help us do our job.

So, anything else?

DR. FLACK: Well, just bringing up before the full committee, are you going to get into that now to talk about the next step?

CHAIRMAN RYAN: Well, our plan is to have a briefing, I guess, with the full committee in February.

DR. FLACK: Yes, and how much time and that sort of thing?

CHAIRMAN RYAN: You know, I would - I would - it was slated for, what? An hour and a half?

DR. FLACK: Well, they penciled in an hour and a half.

CHAIRMAN RYAN: That sounds about right.

DR. FLACK: Yes. Okay.

CHAIRMAN RYAN: So, you know, I'm sure the full committee will have some of the same questions and maybe some new ones. So, we'll be prepared for that and I think we can shape the briefings according to that time slot and go from there.

DR. FLACK: Okay. And it would just be a

staff presentation, I guess? I mean, I wouldn't necessarily come in for that.

CHAIRMAN RYAN: Yes, I think in that kind of time slot, either that or a shorter staff presentation. And perhaps if you felt like you wanted to make comments to the full committee, we could certainly make a slot to do that.

You can think about it. You don't have to answer today. If you're satisfied and you're on the record now with what you want to say, that's fine, too.

MS. SCHLUETER: Yes, thanks for the opportunity today. You know, the ISA, the corrective action program, the SDP, how the staff plans in the future to enhance the oversight process are all, of course, extremely important to the industry.

CHAIRMAN RYAN: Sure.

MS. SCHLUETER: And to that degree, that the staff chooses to re-engage industry this spring and begin to work on these matters again as we had back in `08-`09, that we look forward to those public discussions so that we can help inform that process.

CHAIRMAN RYAN: Okay. Thanks, Janet.

Any other comments?

With that, then, we'll adjourn the meeting

and thank you all for your participation.

MS. SCHLUETER: Okay. Thank you.

CHAIRMAN RYAN: We'll close the record here.

(Whereupon, the meeting was adjourned at 4:39 p.m.)

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

BACKGROUND: FUEL CYCLE OVERSIGHT PROCESS AND ISA/PRA COMPARISON

Marissa Bailey, Deputy Director
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Material Safety and Safeguards

January 11, 2011

Why Revise the Fuel Cycle Oversight Process

- Existing process is effective and ensures safety and security
- To make the process more
  - risk-informed
  - performance-based
  - Predictable
  - transparent
- Commission guidance and direction
- OIG recommendation

Staff's Proposed Plan for Revising FCOP

- Oversight Framework
- Risk–Informed Baseline
- Significance Determination
- Performance Assessment
- Enforcement

Commission Direction

- Prepare a paper comparing ISA for fuel facilities and PRA for reactors
- Develop a set of cornerstones
- Provide assessment and recommendations for next steps

- Provide incentives for licensees to maintain a strong corrective actions program

ISAPRA Comparison - Focus

- Safety Under 10 CFR Part 70
- Risk Significance Determination

ISA/PRA Comparison – Key Points

- ISAs are performed to
  - identify potential accident sequences
  - designate IROFS to prevent or mitigate them
  - describe management measures
- ISAs are adequate for establishing the safety basis for fuel facilities
- Quantitative analysis to determine risk significance to be done on a case-by-case basis

Next Steps

- ACRS review and feedback on ISA/PRA comparison
- Develop cornerstones
- Integrate knowledge gained to provide recommendations for next steps

- Develop criteria for an acceptable CAP and coordinate changes to the Enforcement Policy

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

A COMPARISON OF INTEGRATED SAFETY ANALYSIS TO PROBABILISTIC RISK ASSESSMENT

for the

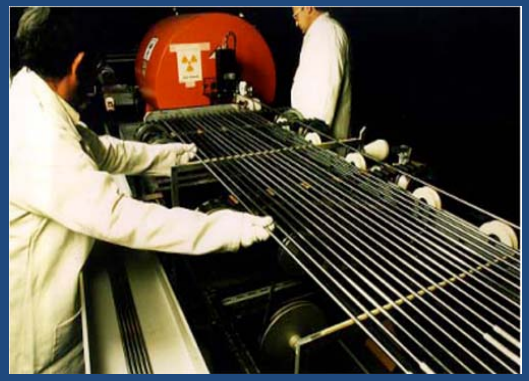
Advisory Committee on Reactor Safeguards

Dennis R. Damon

January 11, 2011

ISA-PRA Key Points

- ISAs are adequate for establishing the safety basis for fuel facilities
- Quantitative analysis to determine risk significance: a case-by-case basis is efficient



ISA – PRA Comparison

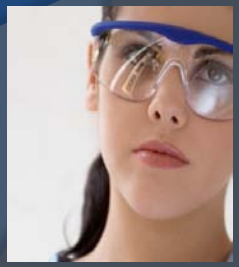
- A comparison and critical evaluation with respect to use…
  - for safety under 10 CFR 70 Subpart H
  - for risk significance determination of inspection findings

Contents of Paper

I. Integrated Safety Analysis
II. Probabilistic Risk Assessment
III. Evaluation for safety under 10 CFR 70
IV. Potential risk significance determination for fuel cycle oversight program
V. Evaluation for use in risk significance determination, with example

Sections I ISAs and II PRAs

- Functions of ISAs under Part 70:
  - Identify hazards, accidents, and items relied on for safety
  - Evaluate compliance with (likelihood / consequence) performance requirements
  - Aid programs to assure safety
- Functions of PRA:
  - Quantify risk metrics as needed to inform regulatory decisions



III. Evaluation for Safety under 10 CFR 70

- ISA consequence-likelihood evaluations differ from PRA: conservative evaluation establishes adequate safety
- ISA concept was based on extensive chemical industry / OSHA Process Hazard Analysis (PHA) experience
- ISAs involved substantial efforts by licensees using PHA methods, including PRA-type fault trees

III. Evaluation for Safety under 10 CFR 70

- NRC staff reviewed ISA summaries. Selected processes reviewed in detail on site.
- Development, review, and revision process for ISAs was substantial
- NRC lessons learned are in NUREG-1520 rev. 1 (SRP)
- NRC staff conclusion: that approved ISAs provide an acceptable safety basis under 10 CFR 70

V. Evaluation for Risk Significance Determination

- This section has an example quantitative risk significance determination, analogous to reactor oversight SDP
- Quantitative risk significance determination requires reasonable quantitative delta risk estimation
- ISAs were not done for this purpose, hence sometimes results need to be supplemented

V. Evaluation for Risk Significance Determination

- Example is typical: few accident sequences, out of hundreds in a plant, are affected by one inspection finding.
- Based on staff screening of actual inspections, very few findings per plant per year require risk evaluation. High risk significance cases rare.
- Key point #2: Thus it is efficient to do risk-significance evaluations on a case-by-case basis

ISA-PRA Key Points

1. ISAs are adequate for establishing the safety basis for fuel facilities
2. Quantitative analysis to determine risk significance on a case-by-case basis is efficient

Questions?

Supplementary Slides

- More detailed discussion of ISA-PRA comparison follows.

Contents of Paper

I. Integrated Safety Analysis
II. Probabilistic Risk Assessment
III. Evaluation for safety under 10 CFR 70
IV. Potential risk significance determination for fuel cycle oversight program
V. Evaluation for use in risk significance determination, with example

I. What is ISA?

- 10 CFR 70: ISA is a systematic analysis to identify:
  - (1) hazards
  - (2) accident sequences
  - (3) consequence and likelihood of each sequence
  - (4) items relied on for safety (IROFS);and
  - (5) evaluate compliance with performance requirements of sec. 70.61.

I. ISA defined in Part 70

- ISA results are used by other requirements in Part 70
- 10 CFR 70.62(d): "..management measures shall ensure that…IROFS…are available and reliable to perform their function when needed to comply with the performance requirements of 70.61 of this part."

I. What is ISA?

- ISA was based on chemical industry PHA.
- Differences from chemical PHA:
  - Integrated analysis of radiation, nuclear criticality, and chemical hazards
  - Evaluation of compliance with consequence – likelihood “performance requirements” of 70.61

I. ISA Performance Requirements

- High consequence accident sequence must be “highly unlikely”

  - Worker high consequences =

    (1) 100 rem or more (criticality or rad)

    (2) Chemical – ‘endanger the life’

  - Public (outside “controlled area”) high consequences =

    (1) 25 rem or more

    (2) ≥30 mg soluble U intake

    (3) Irreversible chemical injury

I. Performance Requirements

- Intermediate consequence accident sequence must be “unlikely”

  Worker intermediate consequences:

  (1) 25 rem to 100 rem

  (2) Irreversible chemical injury

  Public intermediate consequences:

  (1) 5 rem to 25 rem

  (2) Chemical transient illnesse

I. Performance Requirements

- Environment (outside “restricted area”)

  Conc. > 5000 times 10 CFR Part 20, Appendix B, Table 2 values
- Evaluation is of single accident sequences, not the sum to an individual as in PRA
- The structure of the evaluation of performance requirements is dictated by the regulation

I. ISA Guidance

- NUREG-1513, “Integrated Safety Analysis Guidance Document,” May 2001
  - Accident identification methods based on extensive experience with chemical industry / OSHA Process Hazards Analysis
- NUREG-1520, “Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility, Rev. 1”, May 2010

III. Evaluation for Safety under 10 CFR 70

- ISAs identify (hazards, accidents, IROFS)
  - This function is, in principle, the same as PRA
  - But fault/event trees only for complex events
  - Problems are mostly in execution, not methods. (e.g. unanticipated scenarios)
- ISAs evaluate likelihoods and consequences; but not fully quantitative
  - quantitative better in some cases, but generally ISAs are conservative, which is acceptable and efficient.

III. Evaluation of Technical Features

- End states:
  - ISA – high or intermediate consequence sequence,
  - PRA – sum of frequencies
- Completeness: in principle no difference.
- Accident quantification:
  - Most ISAs have some sequence frequency information
  - PRA – quantified sequences
- Human error – Simple error lists, sometimes very conservative.
- Hardware failures – ISA at level of IROFS

III. Evaluation of Technical Features

- System interactions – 70.4 Definitions. ISA: "…An ISA can be performed process by process, but all processes shall be integrated, and process interactions considered."
- Dependencies / common cause: Some ISAs evaluate via checklists. Some use dependency factors for likelihoods. Criticality safety: double contingency standard (ANSI/ANS 8.1)
- Uncertainties: ISAs usually handle with conservative assumptions
- Importance metrics: Not used in the safety program under Subpart H

III. Evaluation for Safety under 10 CFR 70

- ISAs have been developed, updated, reviewed, revised, and improved over an extended time frame
- Methods borrowed from chemical industry
- NRC reviews of ISAs were substantial. A risk-informed selection of process designs were reviewed in detail

III. Evaluation for Safety under 10 CFR 70

- PRA methods have been used in certain areas; and could be applied in others as recommended in NRC guidance.
- Difficulties in doing ISAs: anticipating all credible accidents, large number of processes, errors of commission
- Bottom line evaluation: NRC Staff has approved ISA programs as acceptable for safety

V. Evaluation for Risk Significance

- ISAs were not done to provide a good estimate of risk.
- Most ISAs do have some quantitative risk information, but…
- ISA quantitative results sometimes very conservative
- ISA quantitative evaluations not consistent between different licensees

V. Evaluation for Risk Significance

- Common large conservatisms:
  - Not crediting a safety control (non-IROFS)
  - Worst case dispersion for offsite releases
  - No credit for safety margins
- Other risk quantification gaps:
  - No NRC validated hardware failure data
  - Quantifying human errors of commission
  - Probabilistic chemical consequences
  - Criticality magnitudes

V. Evaluation for Risk Significance

- Factors that aid in quantifying risk significance of fuel cycle inspection findings:
  - Very few significant findings per plant per year
  - Simple designs: few accident sequences are affected by one inspection finding
- Risk significance metric: delta frequency of high consequence event caused by deficiency x duration of deficiency
- Fuel cycle needs multiple metrics: worker/public, high/intermediate, other

V. Example Risk Significance Calculation

- Example Risk Significance Evaluation
  - Typical simplicity: few affected sequences
  - Only need delta risk for these sequences
  - but has none of the quantification difficulties (failure data is provided for all quantities).
- Key point: Quantitative risk significance can often be done for fuel cycle inspection findings on a case-by-case basis. A priori re-evaluation of all sequences by licensees would not be efficient.

V. Example Risk Significance Determination

- Process: geometrically safe tank, containment dike
- Potential accident scenarios:
  - fissile solution leaks or overflows into dike, dike leaks, solution accumulates into critical geometry, criticality accident
  - Two scenarios: 1) leak initiator 2) overflow
- Normal accident frequency = initiator frequencies x dike failure probability

V. Example Risk Significance Determination

- Deficiency: dike found to have been in leaking condition for 4 years
- Frequency of accident during these 4 years had increased to frequency of initiators
- Significance metric = delta frequency x duration of deficiency

ISA – Chemical Industry PHA

- 29 CFR 1910.911 Process safety management of highly hazardous chemicals
- 1910.911(e) Process Hazards Analysis (PHA): what-if, what if-checklist, HAZOP, FMEA, fault trees
- OSHA-NRC Memorandum of Understanding

FUEL FACILITY VIEWS ON COMPARING ISAs to PRAs

Presented by Charles M. Vaughan, NEI

ACRS Subcommittee

January 11, 2011

NEI
NUCLEAR ENERGY INSTITUTE

Introduction

- Industry appreciates the opportunity to contribute publically to the NRC effort
- Industry agrees with the background discussion of ISA development and the role of ISAs in the regulated safety environment
- Industry is concerned over the suggestion of the potential use of PRA techniques for a yet to be developed Significance Determination Process (SDP)

Part 40, 70,76 Facilities

- Broad spectrum of facilities and activities
- Significant Diversity – Little synergy in small numbers
  - U Conversion (1)
  - DU De-conversion (1 *pending)*
  - LWR Fuel Fabrication Facilities (3)
  - Cat I Fuel Cycle Facilities (2)
  - Enrichment – Diffusion (1)
  - Enrichment – Gas Centrifuge (3), (1 *pending*)
  - Enrichment – Laser (1 *pending*)
- Sequential, Stepwise processes
- Not required to run through failures
- Items Relied on for Safety (IROFS) designed to stop accident sequences before they develop

ISA Methodology

- Systematic identification and evaluation of accident sequences
- Using tools with extensive, long term application by the chemical industry (HAZOP, Fault & Event Trees, What-If, Risk Index)
- Risk Index is based on operational experience
- IROFS identified and implemented to meet §70.61 performance requirements
- Management Measures are assigned to assure IROFS remain in place and functional
- Provides current and adequate safety basis information for each facility and includes a feedback loop

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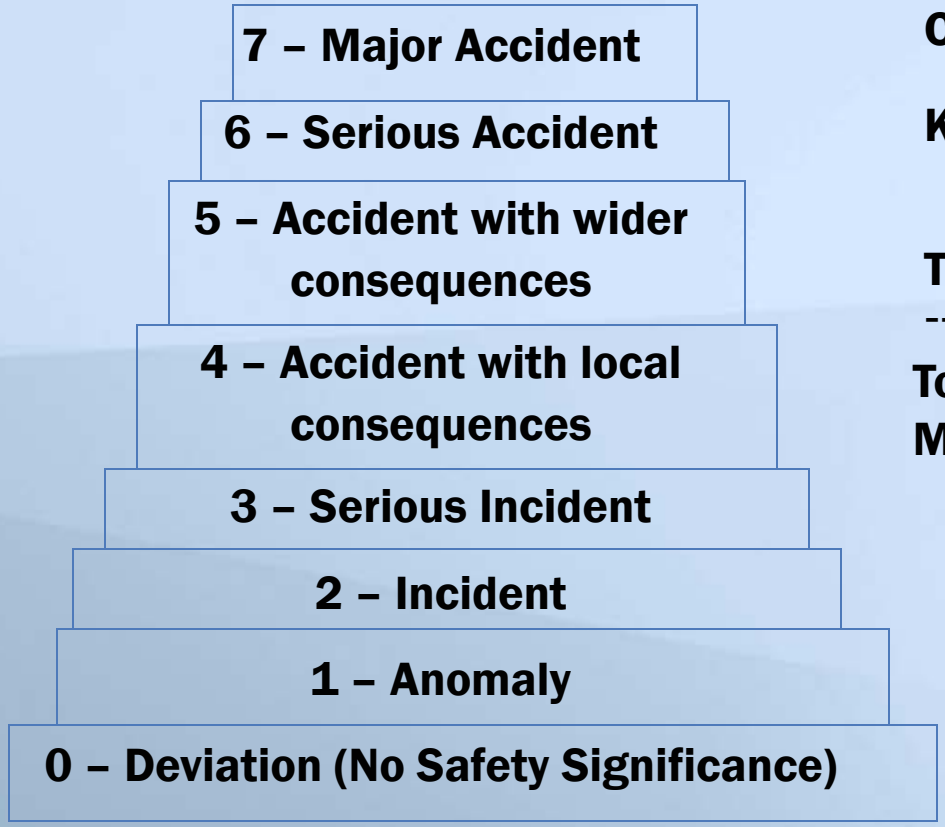
PRA Methodology

- Identification of potential accident scenarios
- Estimates frequencies and consequences to produce risk matrix
- Useful where risk must be accumulated
  - i.e. “sum all accident sequences that can lead to *X* expressed as a frequency of some outcome”
- Accuracy dependent on the accuracy and inclusiveness of the supporting data base
- Extensive time and resources applied to reactors

ISA Appropriateness

- ISAs demonstrate that the performance requirements of 10 CFR 70.61 are met
- Fuel Cycle Facility operations simplistic in nature from an integration viewpoint (i.e. little or no domino effect for accident sequences)
- Fuel Cycle Facility source terms are small relative to power reactors - accidents result in minimal or negligible impact to offsite members of the public
- Fuel Cycle Facility accidents have ranked low on the INES Reporting Scale – predominantly chemical risks

INES Reporting Scale



Chernobyl

Kyshtym at Mayak

Three Mile Island

Tokaimura Criticality, Kerr McGee UF6 (*chemical*)

Steps Approximately 10X on seriousness scale

Justification for Use of ISA at Fuel Cycle Facilities

- ISAs have been found to be acceptable to meet performance requirements of 10 CFR 70.61
- Source terms are small relative to power reactors; accidents result in minimal or negligible impact to offsite members of the public
- Significant amount of resources expended by Industry and NRC to meet existing regulations
- Simplistic, sequential processes without domino effect
- ISA Methodology adheres to a Risk Informed Performance Based Philosophy

Industry Summary

- ISA Methodology acceptable to meet 10 CFR 70.61 Performance Requirements
- ISAs are routinely updated, always contain a current basis of safety, and include a feedback loop for identifying and correcting deficiencies
- ISAs were not performed to produce risk matrix – only to demonstrate meeting performance requirements
- ISA Methodology relies on conservative safety assumptions
- Accident significance is small when compared to reactors (INES ranks three orders of magnitude less)
- Mixing of ISA and PRA techniques at these facilities is not advisable
- Significance Determination Process should be simplistic in nature and commensurate with the facility risk profile

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Acronyms

- ISA – Integrated Safety Analysis
- PRA – Probabilistic Risk Assessment
- SDP – Significance Determination Process
- IROFS – Items Relied on for Safety
- INES – International Nuclear and Radiological Event Scale