Official Transcript of Proceedings ACRST-3301

NUCLEAR REGULATORY COMMISSION

ORIGINAL

Title: Advisory Committee on Reactor Safeguards
Reactor Fuels Subcommittee

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

SISP REVIEW COMPLETE

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Wednesday, December 15, 2004

Work Order No.: NRC-142 Pages 1-363

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

December 15, 2004

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

REACTOR FUELS SUBCOMMITTEE

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WEDNESDAY,

DECEMBER 15, 2004

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. Dana A. Powers, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

DANA A. POWERS	Chairman
MICHAEL T. RYAN	ACNW Chairman
MARIO V. BONACA	Member
ALLEN G. CROFF	ACNW Member
RICHARD S. DENNING	Member
F. PETER FORD	Member

COMMITTEE MEMBERS PRESENT:

STEPHEN L. ROSEN Member
VICTOR H. RANSOM Member
JOHN B. SIEBER Member
GRAHAM B. WALLIS Member
RUTH WEINER ACNW Member

ACRS STAFF PRESENT:

MAGGALEAN WESTON

ALSO PRESENT:

DAVID BROWN
JOSEPH GIITTER
STU MAGRUDER
ALEX MURRAY
RENE PEDERSEN
BILL TROSKOSKI
REX WESCOTT

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P R O C E E D I N G S

(8:31 a.m.)

CHAIRMAN POWERS: The meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguards, Subcommittee on Reactor Fuels. I'm Dan Powers, Chairman of the Subcommittee.

In attendance for the ACRS are the members Mario Bonaca, Richard Denning, Peter Ford, Victor Ransom, Steve Rosen, Jack Sieber, Graham Wallis. We're also being ably assisted by members of the Advisory Committee on Nuclear Waste, Allen Croff, Michael Ryan, Ruth Weiner.

The purpose of the meeting is to discuss the mixed oxide fuel fabrication facility construction authorization application and the staff's draft final safety evaluation report. The subcommittee, of course, will be gathering information, analyzing relevant issues and facts in order to formulate a proposed position and action as appropriate for deliberation by the full ACRS.

Mag Weston is the cognizant ACRS staff engineer for this meeting.

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 8th, 2004. 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 that they may be readily understood.

We have received no written comments from members of the public regarding today's meeting.

This is, I believe, the third meeting of the Reactor Fuel Subcommittee on the MOX facility, and what we're going to be looking at is the safety evaluation report that the staff has put together on this facility.

In setting up the meeting, we set it up not to spend a lot of time on the general layout and design of the facility since most of the members of the Reactor Fuel Subcommittee have been through this facility at some length.

Some of the people who have not done that that, I understand, have made heroic efforts to bring themselves up to speed on this, and I thank you very much for doing that.

What we would like to get out of this

subcommittee meeting is a strategy of action in preparation for presentations to the full committee. So we really are trying to put together a proposed position and plan of action for that full subcommittee meeting that we now anticipate will take place in February. So there are some, especially tomorrow, protracted periods for subcommittee discussions.

Now, the members have received, I'm told, 2,700 pages of information, some of which is brand new, 555 pages of which is brand new, and some of which has been amended from what they've seen in the past, and I think there is no chance that members have digested all of that in completion, except for Mr. Sieber, who I know is encyclopedic in his knowledge on the subject.

So in setting up our proposed actions, we may well have to allow time to plunge in to examine material more carefully. One of the possibilities, of course, is that we may need to get together again to refine our positions, but I would very much like to come out of this meeting with a pretty good outline of what a letter on this facility would actually look like.

I don't intend to actually craft language, but an outline I would like to get, and that may involve members of the subcommittee taking assignments to develop a paragraph here and there, and the like.

Are there any comments from other members?

(No response.)

CHAIRMAN POWERS: Seeing no one anxious to speak on this hot topic on a chilly day, I think we can go ahead with the meeting. Is David going to start off or is Joe?

MR. BROWN: Joe is going to start off.

CHAIRMAN POWERS: Okay, Joe. Joe, you're on.

MR. GIITTER: Thank you.

My name is Joe Giitter. I'm the Chief of the Special Projects Branch, which is doing the safety review of the mixed oxide fuel fabrication facility.

The last time we met with you was in November of 2003, over a year ago, and at that time we had just learned from DCS, the applicant, that they had been directed by DOE to make another significant change in the construction authorization request for the proposed facility.

That change involved reducing the boundaries of the controlled area from an area that corresponded to roughly the Savannah River site boundary, which was about five miles from the facility at its closest point down to an area 160 meters from the stack.

In June of this year, the NRC received a revised construction authorization request from the applicant to reflect these changes.

Another change since we last met with you is we have a new project manager, Dave Brown. Mr. Brown this morning will provide an overview and status update on the MOX program, and he'll describe in more detail the staff's review of the applicant's revised CAR.

The staff has completed a draft of the final safety evaluation report, which was provided to you on November 26th. The draft FSER contains no remaining open items and the staff has concluded that the applicant has met the safety requirements necessary for the issuance of a construction authorization.

As you will recall from the last meeting, there were about a dozen open issues remaining, primarily in the area of chemical safety. Today we will discuss in more detail the basis for closing those open items. We plan to issue a final SER in February and request a letter from the full committee to the Commission supporting the staff's conclusions by that time.

We are planning to brief the full committee in February, as you had indicated, Dr. Powers.

Following our presentation and later this afternoon, Mr. Murray, one of the chemical safety reviewers for the MOX facility will discuss the open issues, two of the issues that he has that have been handled through the differing professional view and opinion process.

As you are aware, the agency recently modified its process for handling differing professional views and opinions. One change is that the Office of Enforcement is now the focal point within the agency for coordinating differing professional opinions.

Rene Pedersen, the DPO Program Coordinator from the Office of Enforcement will be here this afternoon to answer any questions about the new process and will also be prepared to discuss the status of the DPS file related to the MOX fuel fabrication facility.

And that concludes my opening remarks.

CHAIRMAN POWERS: Let's see. You indicate that you have no open items.

MR. GIITTER: That's correct.

CHAIRMAN POWERS: Could I call your attention to page 5.0-15 of the SER, last line on the page?

MR. GIITTER: I'm aware of that. There are some areas within the draft FSER where it still states that there are open items, and that was an oversight on our part.

CHAIRMAN POWERS: You recognize that it makes a fair amount of challenge for us to review a document on which we have statements to the effect that they don't meet a particular part of the 10 CFR regulations?

I mean that's fairly challenging for us to read the material and then say, "Well, that doesn't count," because there's not a mark on it that says this is an oversight.

MR. GIITTER: Yes, well, we understand that. We can provide a revised --

CHAIRMAN POWERS: Can you flag those for us or do something that says this statement doesn't count?

MR. BROWN: I think we've already received some of those comments back, and we can certainly do that. Just make sure that you're aware of editorial changes.

CHAIRMAN POWERS: I mean, I come to that sentence and said, "Good. I don't have to read this anymore," and put it aside.

MR. BROWN: Right.

MR. BROWN: We'll definitely work with Mag to make sure, especially when we're changing the meaning of the sentence, that you're aware of it.

CHAIRMAN POWERS: Actually it produced a much different response from me. I don't have to read this. I have to come up with what are they asking me for, to resolve these issues for them one way or another?

I mean, this particular statement creates a lot of work.

MR. BROWN: Yes, I apologize for those statements. We will certainly keep you informed as we go through the process of making those final edits until February.

I want to thank you, Dr. Powers and the members for this opportunity to speak with you.

This is, as we pointed out, our opportunity to ask you for your endorsement of our safety evaluation. I do want to provide a brief, but fairly comprehensive overview of the project, especially for those of you who may be new to the project. I'll talk about briefly why we're here and the status of the project and the progress of the project since roughly 2000.

The purpose is, as we stated, to seek your endorsement of the staff safety evaluation, unlike the previous two meetings where we were merely providing you information on the status of the staff's review.

CHAIRMAN POWERS: Yes. You understand that the ACRS will not give you an endorsement at this meeting?

MR. BROWN: Yes, I do.

CHAIRMAN POWERS: That the subcommittee will only evaluate the material, draft a position --

MR. BROWN: I understand.

CHAIRMAN POWERS: -- and come up with a strategy?

MR. BROWN: And this perhaps should have been clear to say to provide information towards seeking your endorsement. I realize this is an ongoing process.

DR. WALLIS: I'm not quite sure how I would give an endorsement. I read all of these pages. I was looking for technical information with equations and criteria and things like that, and I didn't find it.

CHAIRMAN POWERS: Well, you're --

DR. WALLIS: So I don't know what I'm endorsing.

CHAIRMAN POWERS: You're looking too early in the process.

DR. WALLIS: Too early in the process?

CHAIRMAN POWERS: Yeah. You will see equations and whatnot in the integrated safety assessment for the license application.

DR. WALLIS: Later?

CHAIRMAN POWERS: Yeah. This is just establishing the design basis.

MR. ROSEN: I look at this as an immense number of promises for the future.

MR. BROWN: There are many of those, commitments for future license application, which we are expecting this spring, and I'll get into that as I complete my presentation, how we're doing things in two stages, as it were.

CHAIRMAN POWERS: And if you want quantitative performance criteria, 10 CFR 70.6.1 and 4.

MR. BROWN: Yeah, 70.61

CHAIRMAN POWERS: Sixty-one and 64 or

something like that?

MR. BROWN: I'm sorry?

MR. GIITTER: Seventy, sixty-four is baseline design criteria, which is akin to the general design criteria in Part 50.

DR. WALLIS: I guess we might get into some of the technical issues later then.

MR. BROWN: Oh, we will. Yeah, I'll try to conclude my remarks as briefly as I can, but we'll get right into the technical issues.

DR. BONACA: The other place where I have difficulty with this was in some of the areas where, you know, the applicant claims preventative actions as a means of providing defense and protection, and it's not clear to me when I read it if those actions are going to be automatic or built into the process so that there are physical reasons why you will not have a challenge, or if they are tied to human action.

Now, then I have difficult in the sense that what does it take to approve a construction process. Okay? I mean, if I'm saying that certain considerations to prevent an explosion seem to be appropriate or there is no statement that says it will be considered, you know, this is good enough to approve the construction process, does it mean that any means of deliberate action is going to be acceptable or is it going to be an issue to be dealt with at the operation review phase?

MR. BROWN: No, rarely did we accept the commitment that any means of preventing the accident would be acceptable. We did require pretty detailed information on what the system structure or component was that prevented the accident or would prevent and what its function is and then an additional level of detail is what is its design basis.

DR. BONACA: No, I understand that.

MR. BROWN: What pressure would not be exceeded? What temperature would not be exceeded?

DR. BONACA: It troubled me the fact that there was no discussion of operators involved. So I couldn't tell how these actions would be accomplished. I mean some of them may be automatic. Some of them may be -- that's a fundamental issue, too, the risk.

MR. BROWN: I understand your comment. Certainly our preference is that engineered controls be selected over human controls.

DR. BONACA: Yeah, and we will have some opportunity as you go through the open items to --

MR. BROWN: I think as we go through each one we'll see specific instances where you be able to raise that point. I believe it will answer your question.

CHAIRMAN POWERS: I believe the Code of Federal Regulations require a bias in favor of things other than administrative controls.

MR. BROWN: that's right. There is a preference actually stated in our regulations.

I'll say that what we're doing here is the Department of Energy is implementing this agreement with Russia to disposition 34 metric tons so that the point here is that the Department of Energy is the owner of the mixed oxide fuel plant. NRC is regulating it, and then there's a third party, the top bullet here.

The Department of Energy and National Nuclear Security Administration selected Duke Cogema Stone and Webster to design, build, and operate this plant. They are the applicant, and they would be a future licensee, not the Department of Energy.

And when the program was first conceived, there was the concept of an immobilization plant where about eight and a half metric tons of plutonium was to be immobilized, not turned into MOX fuel. As of April 2002, now all 34 metric tons will be converted to MOX fuel, which means there are now two plutonium disposition facilities.

One is the pit disassembly and conversion facility, again, owned by DOE, designed, built and operated by a DOE contractor, not DCS, and then the mixed oxide fuel fabrication facility.

The pit disassembly and conversion facility would receive weapon components, convert those components to plutonium dioxide, which is then feed material for the MOX facility, which would be next door.

CHAIRMAN POWERS: Is the pit disassembly and conversion facility -- does it actually exist?

MR. BROWN: It does not exact yet either. In fact, the plan is that the initial feedstock for the MOX facility would be existing plutonium dioxide surplus, and that the pit disassembly and conversion facility will actually be brought on line after the MOX plant to provide the remainder of the 34 metric tons.

CHAIRMAN POWERS: I suppose then it is fairly difficult at this stage to assess whether an event at the PDCF affects activities at the MFFF.

MR. BROWN: At this point, you know, we have not identified and the CAR does not identify events at the proposed PDCF. We would expect that to be considered in the future integrated safety analysis that will be provided next spring with the license application.

And it would be expected to consider all nearby industrial facilities, nuclear and industrial facilities.

This is just essentially an artist rendering of what I just said, which is essentially the blue boxes on the left are the DOE owned and regulated activities, and then the mixed oxide fuel fabrication facility DOE owned, but NRC regulated, and then, of course, the reactors are commercially owned NRC regulated.

MR. ROSEN: Is your slide right? You've got -- oh, okay, yes. The NRC's regulation is on the yellow.

MR. BROWN: Right.

DR. WALLIS: So how many tons are going into Catawba and McGuire?

MR. BROWN: Well, what it is is the conversion of 34 metric tons of plutonium that's plutonium metal.

DR. WALLIS: That's from each?

MR. BROWN: To fuel.

DR. WALLIS: Is it 34 or 68?

MR. BROWN: Thirty-four total So each reactor, I don't know that it's divided perfectly in half, but let's say that it is. So each reactor gets 17.

DR. WALLIS: Gets 17.

MR. BROWN: Certainly more than one core reload. It goes on for several years, many years.

CHAIRMAN POWERS: And the facility itself has a finite lifetime, is my understanding.

MR. BROWN: Yes. The reactor facilities.

CHAIRMAN POWERS: I mean the fabrication facility. Once this campaign is over, that facility is to be retired?

MR. BROWN: The facility will be deactivated, in the DOE parlance, and then they could be turned back over to DOE for decommissioning.

DR. WALLIS: Well, they might even be some more excess plutonium by then.

MR. BROWN: We could speculate, yeah, that there would be more mission for this facility later down the road, especially given the additional unilateral strategic arms reductions.

CHAIRMAN POWERS: It seems to me that understanding the design lifetime in the facility is important, and then understanding the design basis.

MR. BROWN: It is certainly a consideration, especially where aging effects have to be considered on materials. And so, you know, if, for example, it was intended that the vessel would not need any maintenance for the duration of the mission, you would have to take that into consideration, sure.

This is a flow chart that's indicating roughly how we're performing this review. You'll see on the top row there that, you know, the third box from the left is ACRS review, and that's where we are, the first review by the ACRS of the staff's review of the construction authorization.

We plan to issue the EIS and the SER in January-February of 2005, and then we will continue on with the construction hearing at that point.

DR. WALLIS: When is it that we get to look at these equations?

MR. BROWN: I think the more your review of our evaluation of the integrated safety analysis is --

DR. WALLIS: Down there.

MR. BROWN: -- in a corresponding position, you know. You followed our construction authorization review and --

DR. WALLIS: This was already being built by then?

MR. BROWN: It will have been probably partially built. I doubt that it will have been completed by that point, although I'm speculating somewhat. We're anticipating a two-year review starting this spring, and with a construction start later than early summer of 2005, it's possible we could finish the license review before they finish building the plant.

MR. ROSEN: It would be helpful to me to have more than just the postage stamp size picture of this slide. Right now all we have is that.

MR. BROWN: Only that.

MR. ROSEN: It's pretty hard to read.

MR. BROWN: Okay. I can certainly for the record provide the larger slides. I'll work with Mag on that.

MR. GIITTER: We can probably get copies at the break and give them to you.

MR. ROSEN: Yeah, just of this one is all.

MR. GIITTER: Sure.

MR. BROWN: As we indicated in that flow charge, there will be two approvals, the construction permit and then the license to possess and use licensed material.

What's required for a construction permit is what I've cited there on that regulation. The applicant must provide a safety assessment of the design bases of principal structure, systems and components, a description of the quality assurance program, and we, NRC, have written an environmental impact statement based on the applicant's environmental report.

For the purpose of this review, we've adopted the Part 50 definition of design basis, and this is really what has guided these years of review of the construction authorization. We're proving the function that a structured system and component has and the values for controlled parameters.

So, for example, the function might be to prevent a rupture of a vessel. The control parameter is pressure. Design basis value might be 100 psi. That's the extent of the information we would be approving at this point, and that, for example, would not include the location of the vessel, its size, its shape and that sort of thing.

DR. WALLIS: Well, is there anything in this which gives assurance that these controlling parameters can control what's going on in this structure, system, or component?

MR. BROWN: That's of course, what the applicant must do. They must be able --

DR. WALLIS: But we don't at this time get that assurance?

MR. BROWN: We don't have --

DR. WALLIS: Sort of promise that they'll be able to do it; is that what we get?

MR. BROWN: Well, in some cases these things are well known. For example, an acceptable design basis can be an industry code and standard. It's a consensus standard.

DR. WALLIS: There may be some things that are well known, but there may be other things where the chemical reactions are rather complicated and controlling them may not be as simple as simply specifying some numbers.

MR. BROWN: Right, and we will have examples of those, too, as we go on where, for example, the values for the control parameters are based on industry experience and some research. Given even that, the applicant has committed to do additional research to support those values.

DR. FORD: The chemical plant, nuclear plant, you have all underground, time dependent materials degradation issue, which must impact, therefore, on the design basis. Where do we hear about those specifics?

What's your materials degradation mechanism and how does that impact on your margins, et cetera, according to your design basis? When do we hear about that?

MR. BROWN: Where the materials degradation is an important part of the reliable function of a principle SSC, that's when we would look for those details.

In some cases, for example, what I mean by that is if the safety function is to contain a potential release, say, resulting from a corrosion event, what we're focused on is that mechanism, that SSC that's containing the release in a process cell and we may not be focused just on the corrosion of the pipe in the process cell.

In other words, we'd be looking at --

DR. FORD: I'm still stuck trying to hear the answer to my question. When are we going to hear being exposed to the specific data upon which you determine how quickly it is that a component is going to degrade?

MR. BROWN: Well, most of that information will be -- that sort of detailed information will be provided in the integrated safety analysis with the license application this spring.

MR. GIITTER: I think it's important to point out, too, that what we're looking at, Part 70, was developed with a one step licensing process in mind, and Dave is going to talk about that, but what we're doing here with the MOX facility is unique. We're actually doing a two-step licensing process under a regulation that was intended to be used for a one-step licensing process.

So at this point the only thing the staff is doing and the applicant has to provide us with is the design basis for the principal structure, systems, and components that are really controls to insure that the facility will be designed against natural phenomena and accidents.

And Dave will talk about that in more detail in a minute.

DR. FORD: But are there any lessons being learned from the chemical industry, for instance? They're very sophisticated when it comes down to evaluating materials degradation and how that impacts on the design of their plant.

Are there lessons learned being taken from that industry to this?

MR. MURRAY: Yes, if I could just comment very quickly. I'm Alex Murray. I'm the lead chemical safety reviewer.

Just to let you know, there are several codes and standards which have been identified as design bases for addressing corrosion concerns. Those codes and standards have methodologies for deriving specific corrosion monitoring, maintenance, and/or replacement programs.

For the construction permit stage, they tend to be top level. Is this sort of thing generally done in the chemical process industries or the nuclear industry? Are known corrosion phenomena being addressed?

And overall, at a design basis level the staff has concluded they are, and this is written up in the draft FSER.

DR. FORD: So it details such as titanium versus carbon steel, for instance?

MR. MURRAY: Titanium versus 304/316 stainless steel would be a good one, yes.

DR. FORD: And that would be spelled out at this stage or not until the spring of next year?

MR. MURRAY: Top level selection of materials for components has been spelled out in the construction permit. Specific details, such as time of surveillance, such as actual corrosion rates, presence or absence of corrosion type probes, corrosimeters, and so forth on the staff would expect those in the license application in this coming spring.

DR. FORD: Okay. So we won't see that data until then.

MR. MURRAY: You will not see specific data. You will see there are specific controls in the revised application, which the applicant has identified for addressing corrosion concerns.

For example, the destruction of the silver II species so that it is not capable of corroding stainless steel components downstream, as an example.

Does that answer your question?

DR. FORD: It answers my question, but it really does worry me that it's fairly late in the proceedings that we start to look at the details of the degradation mechanisms. Forget anything else, and from a business point of view, it's pretty darn late for people to be making decisions about --

CHAIRMAN POWERS: Business points of view, of course, are outside our domain.

DR. FORD: Pardon?

CHAIRMAN POWERS: Business points of view are outside our domain.

DR. FORD: Oh, I recognize that, Dana, absolutely, but it does come into our personal thinking as to how you evaluate this.

MR. MURRAY: Yes, and I think with this being a two step approach, a construction permit followed by an operating license application, I think we get, if you will, the best of both worlds. We get an initial general look at does this seem qualitatively in alignment with what industry actually does, with the top level corrosion phenomenon, et cetera. Details will come forward in the license application.

DR. FORD: Jolly good.

MR. SIEBER: Actually this kind of a plant is not a new concept. It seemed to me that solvent extraction and Purex type plants have been around for some years.

CHAIRMAN POWERS: And they pre-date me. I know that.

MR. SIEBER: Well, unfortunately they don't pre-date me.

(Laughter.)

MR. MURRAY: They pre-date me, too, but

I'm only 29.

MR. BROWN: Thanks, Alex.

MR. MURRAY: You're welcome.

MR. BROWN: I just wanted to point out quickly that you may ask the question: why don't we identify what's a principal structure system and component and what isn't. In the safety assessment if the event is not unlikely, if it's a likely event, which for this applicant is always their first assumption, that this event could happen, and as a high consequence, then that, of course, appears in the bin in the upper right.

And the goal is then to drive it down to the lower left. Then --

DR. WALLIS: I'm sure we asked you before what likely and unlikely mean.

MR. BROWN: Yes. And for this application that's defined qualitatively, unlikely is --

DR. WALLIS: Is it once a week, once a year, once a century?

MR. BROWN: Not likely to occur during the operation of the plant. It is unlikely.

DR. FORD: Is that 40 years?

MR. BROWN: In this case the actual mission will be finished in something under 14 years.

DR. FORD: So highly unlikely means it wouldn't occur if the plant were run for 1,000 years or something?

MR. BROWN: Well, highly unlikely would be, again, defined qualitatively as, you know --

DR. WALLIS: Qualitatively doesn't mean anything to me though.

MR. BROWN: And we've had this discussion before.

DR. WALLIS: Sure, we have.

MR. BROWN: You're right. We're not requiring a quantitative --

DR. WALLIS: So you refused to define "likely."

MR. BROWN: I'm sorry?

DR. WALLIS: You define consequence here with numbers.

MR. BROWN: WE did.

DR. WALLIS: But you don't define likelihood.

MR. BROWN: And that is how the regulation is written.

DR. WALLIS: Us there something tabu about that? The word "probability" is impermissible?

MR. GIITTER: It's permissible to use a

quantitative approach if you read Part 70, and the guidance associated with Part 70 in NUREG 1718, which was developed specifically for MOX.

However, the applicants also are allowed the option of using a qualitative approach, and in fact, most of the fuel cycle -- in fact, all of the fuel cycle licensees have taken qualitative or semi-qualitative approach.

And part of that is you just don't have the type of data that you would have with a reactor facility and a fuel cycle facility. You rely more heavily on administrative controls, on human action than you would in a nuclear power plant.

DR. BONACA: That's why I had difficulty when I was reading.

DR. WALLIS: Well, it's appropriate, I think, at the level of 10 CFR 70, that there be some vagueness. It's very appropriate.

But when you're looking at a specific plant, maybe you need to be more definite about how you interpret those terms.

MR. BROWN: At this point we have accepted the qualitative definitions. That doesn't preclude, as Mr. Giitter points out, that later in the integrated safety analysis there are other methods for safety analysis that are more quantitative, and in this case, DCS may use those to make their case.

DR. BONACA: For reactor facilities, you know, the '60s and '70s they used also qualitative definitions frequently and frequent and so on, but there were some of understanding. For example, frequent meant -- infrequent meant that it would happen maybe once in the life of the plant.

MR. BROWN: That would correspond to our--

DR. BONACA: I'm trying to understand the difference between highly unlikely and unlikely. I mean for unlikely would you have an expectation that possibly it could happen once in the life of a plant?

MR. MURRAY: There is guidance on likelihoods provided in the standard review plan for MOX which is NUREG 1781 and also in the standard review plan for fuel cycle facilities in general, which is NUREG 1520. Very round numbers, unlikely means basically one event, one potential event, in round numbers 100 years to perhaps 1,000/10,000 years, and the upper bound for highly unlikely is generally given a numerical number somewhere ten to the minus four, ten to the minus fifth per year or one in 10,000 to one in 100,000 years.

DR. BONACA: Okay.

MR. MURRAY: That's in the guidance. It's not in the regulation. That gives you some feel for it.

DR. BONACA: Some feel for it. Okay. So unlikely you said it's possible once in the life of the plant. Maybe.

MR. BROWN: Well, for this application it's not likely to occur --

MR. MURRAY: In the plant, yes.

MR. BROWN: -- during the life of the plant.

DR. WALLIS: That's a dangerous definition because an accident which destroys the plant is only going to occur once in a life of the plant.

MR. MURRAY: Well, that's why the guidance does give some numerical bounds.

DR. WALLIS: I like your numbers. Thank you.

MR. MURRAY: Oh, you're welcome, sir.

MR. BROWN: And so where we are is we did get this construction authorization request in 2001. We have had issued two draft safety evaluation reports, and last year we met with the full committee. There were 11 remaining open items in the draft safety evaluation report, and at that point there was also, as Mr. Giitter pointed out, DOE had just announced it was going to change its controlled area boundary, which was significant because that was a point at which the doses were calculated for the safety assessment.

And so you know, that is a picture of the entire Savannah River site in South Carolina. I realize it's not terribly easy to get the perspective from that scale, but that's roughly 300 square miles of territory, and so a member of the public, that evaluation point was some five miles away from the facility, but now the controlled area boundary is essentially contiguous with the site boundary.

The site is the box on the left side. That's the MOX fuel fabrication facility site. The site down to the lower and to the right is the pit disassembly and conversion facility site. The MOX site is about 41 acres. So that now is the controlled area, and the evaluation point for an individual at that controlled area boundary is only 160 meters away rather than five miles.

So they made that announcement in November of last year and by June of this year had revised the construction authorization request. There was one additional principal system structure component as a result of the change, which is now the process cell exhaust system, is a PSSC.

The reason there was only one change is because there was already a large amount of margin in the safety assessment. So moving the boundary really did not result in significant changes to the outcome of the safety assessment.

There were some other changes. DOE and DCS took the opportunity from November to June of this year to remove the uranium oxide dissolution system. The original concept was for depleted uranium oxide to be delivered to the plant, and where it needed or DCS needed to make up uranyl nitrate solutions, they would just simply dissolve the dioxide.

Now rather than do that, they will receive uranyl nitrate as a reagent.

There's an additional unit for dealing with the waste solvent from the Purex cycle. They did slightly modify their chemical inventory list, and as a result of some refinements in the process chemistry, of course, that results in an update in your waste stream inventory. So that was updated.

By the time of the June 2004 CAR, we had closed several of the open items. So those are now reflected in the June 2004 CAR as I've listed here, and, of course, I've made some other corrections.

At this point if we do approve the CAR, in February we will start construction inspections. We have been working with regional office to set up a construction inspection program, and of course, really DCS will be treated as a licensee. Even though they have a construction permit, for all other purposes they're essentially treated as a licensee.

Shortly after that, they plan to follow a license application and ISA summary and all the other application materials that would be required for facility security and so forth.

So without further delay, I'd be happy to answer any additional questions. I'll allow the technical review staff to give their presentations, starting with Mr. Murray. Are there any other questions for me at this point?

CHAIRMAN POWERS: It's important to understand the basic philosophy here, that under shall we say ordinary circumstances you would never see this stage of the operation. You would see the stage where they are granted a license to receive and hold special nuclear materials. So this is kind of a sneak peek in on the process in which we're really focusing on what the hazards are and what the design bases for a material or any steps taken to control those hazards.

Now, it seems to me, Dave, it might be useful to point out that in your slide where you had the unlikely and likely in consequences, those are consequences, unmitigated consequences that are used to assess whether mitigation or prevention is needed.

MR. BROWN: That's right. I mean, your determination of what's acceptable and not acceptable is based on, first, the unmitigated consequences. In other words, you're analyzing a preliminary design based on what's there, and then if you're in the not acceptable bin, you're adding system structures and components to produce the risk of that hazard, those new things or the principal structure systems and components.

CHAIRMAN POWERS: It seems to me that it's also useful to explore just a little bit what the safety philosophy is because the regulations require a defense in depth type of approach, and that gets crated in the structure of the facility. So it is not uncommon for the applicant, when he identifies something as being unacceptable to take a preventive approach because his inherent mitigation is already built into the structure of the facility.

So it can appear in the responses that there's an imbalance between prevention and mitigation, but that's because the mitigation has already been built into the construction of the facility.

MR. BROWN: Right. It really does become an issue of, I think, as you said, philosophy. For example, when we're looking at a particular event, it may be that in a way, the safety assessment is written it looks as though only a preventive feature is credited to, for example -- where do I -- in other words, to get to that bin. In other words, there doesn't appear to be any credit taken for mitigative features in the facility, but under the defense in depth concept, there really are in almost all cases mitigative features, and namely, for this facility that's the confinement ventilation system, the HEPA filters, if you will, and the tertiary confinement of materials.

For disbursable materials in this plant, there will be at least three boundaries of confinement. So the fact that I may have only credited philosophically, you know, the preventive feature does not in anyway mean that there aren't other features present. That's right.

And usually what it is is the HEPA filters, if you will, the confinement barriers are also credited, but for other events, and what we'll see in the future I would think with the integrated safety analysis is a little more integration of those things, where we understand the effects of -- you know, that certain components will be there to prevent all sorts of different hazards.

CHAIRMAN POWERS: Allen.

DR. CROFF: One thing I was unable to find in reading through this mass of paper is what I'll call the operation and maintenance philosophy and how that is factored into the design of this plant, and that's in consideration of occupational dose, in ALARA and how the plant is designed to facilitate that.

Is that in there or do we know this philosophy and how they're approaching it?

MR. BROWN: We do know it, and the information is contained in Chapter 9 of the construction authorization request for radiation protection. It is also contained elsewhere.

DR. CROFF: Which would mean?

MR. BROWN: Because a fundamental design philosophy for this plant is that it's highly automated. Unlike many existing U.S. plutonium processing facilities, such as in the DOE complex where there is much more hands on operation and gloveboxes really mean gloveboxes with glove portals, this plant doesn't have that look to it. Gloveboxes contain automated systems that are monitored at remote locations by and large.

DR. CROFF: And maintenance?

MR. BROWN: One of the things that they did describe in Chapter 15 of the CAR is their commitment to management measures. You know, a part of maintaining these principal structure systems and components, which by the way when we receive a license application, that name will change to items relied on for safety, and that's just an artifact of our regulations. We call them something different for construction, but they're essentially the same thing in the license application. They're just called items relied on for safety.

One of the management measures that would be appropriate for items relied on for safety is maintenance and surveillance, and DCS will provide most of that detail later with the license application.

DR. CROFF: I understand that. I do remember Chapter 15 in reading through that, and it was pretty -- well, it was pretty terse, to be charitable, in terms of the maintenance philosophy, basically saying, "We're going to have a maintenance plan."

But my point is ALARA and the routine occupational doses received during operation and maintenance is a function of how the plant is designed, how cells are laid out, whether they have to enter them, the extent of clean-out, and can they clean them out, and worrying about that later when the die is cast on construction on the plant design, you've sort of got to do what you've got to do when the plant is built.

And I'm just not seeing that as a consideration. It's focused on safety, which means accidents for the most part, not routine operation and ALARA. Maybe it's an artifact of this two step thing, but they're going to be a long ways down the road before they worry about it.

MR. BROWN: Well, they're certainly considering that in design, and there are commitments to ALARA design methodologies, and they're described in the CAR, but you kind of hit on it. It's not effective, the two-step process. What we're focused on now are accidents and the effects of natural phenomena hazards on the facility.

DR. CROFF: It seems that the focus maybe needs to be on considering everything that's a concern when the die is cast on the construction and design.

I understand that opinion.

DR. RYAN: Just a follow-up question on waste management. As I understand reading through everything, the hand-off is DOE will manage the waste produced by the facility. It seems like that's sort of a curtail to me. How do you know that they're going to be capable and robust and keep the waste moving so that it doesn't choke out the plant or cause a back-up or cause interruption of service? That's one.

And the second is in licensing the facility, how do you assure yourself that the waste management plan is going to work and that they've done other things that won't have a backward impact on the facility itself.

MR. BROWN: Well, at this point the waste management systems in the plant have to be considered as part of this safety review for the effects of potential accidents and natural phenomena, but the regulations allow for transfer of custody of that waste from our licensee back to DOE, at which point it does become DOE's responsibility.

I understand your question. There could be problems which could affect, you know, future operation of the plant, but unless I can tie that to safety at the plant, we didn't raise that as an issue now.

DR. RYAN: And maybe I didn't bore into the details enough to understand this, but it wasn't clear to me that the facility, that which the NRC is going to license, is going to process all of the waste to come endpoint ready for disposal.

MR. BROWN: Okay.

DR. RYAN: I understand that they're not.

MR. BROWN: They're not going to process all of the waste suitable for the endpoint.

DR. RYAN: There seemed to be a mix that they were going to take care of some things, but perhaps not others.

MR. BROWN: Right.

DR. RYAN: And it's those wastes that are going to be sent out for processing and preparation to DOE that just put the question in my mind: well, what if that doesn't work right?

And that's certainly something that --

DR. RYAN: I mean, is that going to say,

"Okay, you can't produce anymore waste now. We're not ready to receive it"?

It seems to me that hand-off isn't as clear as it needs to be for the NRC to feel comfortable in taking an action to move forward.

MR. BROWN: Well, at this point, the best description of all of that sort of the waste disposal because actually in our draft EIS, which is assumed to be final, where we look at the waste management impacts, because under NEPA, you know, we did take that broader view and looked at were there going to be unacceptable or high impacts of adding this waste to the existing Savannah River site waste management program.

DR. RYAN: But not in any detailed quantitative way. I mean you haven't revised SRS' area dose assessments or any of that sort of thing.

MR. BROWN: No, not us.

DR. RYAN: The devil is in the details on all of that.

MR. BROWN: We did it in a way to insure ourselves that there was sufficient waste management capacity at Savannah River site.

Something you may recall is initially when we received this application, the plan was to send the high alpha activity waste, the highest radioactivity liquid waste, to the Savannah River site tank farms, which were already nearing capacity at that point, which is why, partly why, they now have this new concept which is the waste solidification building which will treat that waste and not send that waste to the tank farms.

So DOE is certainly well aware of the issues they have to deal with, as we are.

DR. RYAN: And I understand that, and you know, they are complicated, and there's more than one. But the question still remains in my mind and maybe the information is out there to answer it, but how confident are we that there isn't a choke point that will cause the "don't produce anymore waste" light to go on?

And, again, I'm not saying it's not there. I'm just asking that question. How is that hand-off made?

CHAIRMAN POWERS: I'm struggling with, I mean, so what. I mean, you just stop producing, right?

DR. RYAN: Well, does that raise any safety issues? Does that raise any --

CHAIRMAN POWERS: Yeah, I guess that's

what I'm asking. Does it raise any safety issues?

DR. RYAN: And I think it has got to be viewed as a system, not just as a bunch of components.

CHAIRMAN POWERS: Dr. Weiner.

DR. WEINER: I just have a couple, and I recognize that you've discussed the chemical hazards in the document, but I was wondering if there is a parallel matrix to this one for chemical hazards because you're putting your workers at considerably greater chemical risk than at radiological risk.

MR. BROWN: Thank you for pointing that out.

Yes is the answer. There is an essentially identical matrix with the chemical hazards entered on the left there. then that's the slide I should have used. It would have been clearer.

DR. WEINER: The second question is how is this nitrate solution going to be transported into your process. If you're accepting uranyl nitrate solution, where does that come from and how is it transported?

MR. BROWN: Well, at this point -- Alex, correct me if I'm wrong -- it will be transported by truck. I don't know who the supplier is at this point. You know, that's not information that we've asked for at this point, but it will be transported to a secured warehouse on the MOX facility site and then from there also transported by truck to the MOX facility.

DR. WEINER: I'm concerned about the safety of transporting nitrates. That's the burden of my question.

MR. BROWN: Okay.

MR. MURRAY: Just to let you know, they would be transported under existing DOT and NRC regulations. I don't think that we went into too great a depth into the specific details, but they would be essentially purchased like an outside reagent.

DR. WEINER: So it would be transported under the DOT hazardous materials packaging.

MR. MURRAY: Exactly, probably in a Type A container, yes.

DR. WEINER: Yes. I would imagine Type A container, but they have special ones for nitrate.

And then this is just a question, and I suppose it should be directed at DOE, not you. There is a pit disassembly facility in operation today at Pantex. Is it out of the question to have the disassembled pits transported?

I mean, we do have experience transporting pits and disassembled pits. Why are we spending zillions of dollars to build a pit disassembly facility when one exists?

MR. BROWN: And I can't answer that question.

CHAIRMAN POWERS: It does seem somewhat out of our jurisdiction.

DR. WEINER: Yeah, I'm sure it is. I said it was probably a question for DOE, not for you. But there isn't -- well, it is out of our jurisdiction.

CHAIRMAN POWERS: Mr. Rosen.

MR. ROSEN: Yes, Dana. In the document I was looking at presumption or philosophy that's given here. You're dealing with two very serious risks. One is the risk of nuclear criticality safety, and the other one is a risk of fire.

And in the document there's a paragraph. I forget exactly where it is, probably in the NCS section, that says if we have a problem where we're comparing those risks, we're going to make sure that the nuclear criticality safety doesn't occur, and that is embodied by the fact that, you know, you end up with not using water to prevent moderation excursions, excessive moderation excursions.

And so there are cases where you're going to have to make a choice and use these clean agent suppression systems to put first out where you don't want to use water. On the surface of it, if you don't think about it too much, I think you come to that conclusion very easily. You want to have it.

In one case I guess you're protecting the workers, in the case of nuclear criticality safety. In the other case, you'd mainly be protecting the public, that is, from a fire, the effects of a fire.

And it isn't obvious to me just from reading what I've read that that choice is a simple one. Maybe that's too complex a question for this, and yet at some point I would feel it needs to be addressed, some sort of analysis provided for when you decide clearly not to suppress a fire by the most effective means, which is water.

MR. BROWN: I don't know exactly where that statement is. I hope it doesn't convey the point that, you know, we need to worry about crit. safety. Therefore, we're going to have to let the fire happen. You know, both risks have to be reduced to acceptable levels, but you know, what was probably intended there was that we need to make sure when we're righting the fire we're not causing another event.

And so they'll have to show that that clean agent system adequately reduced the risk.

MR. ROSEN: Well, you know, clean agent systems may be good at suppressing a fire, but they don't take much heat out, and when oxygen gets back into a compartment where you've suppressed it with a clean agent fire, it's likely to flash. And that's the concern.

MR. BROWN: Okay.

CHAIRMAN POWERS: Dave, just a point of clarification. It seemed to me with the new site boundary that a recreated accident assumed much greater consequences than it did when we had the longer four mile boundary.

I think I saw 900 millirem at the site boundary as the bounding recreate accident dose.

MR. BROWN: Okay. Yeah, since that accident is mostly dosed from the least noble gases in volatile fission products, sure, it would have gone up by the proportion of how the atmospheric dispersion is, now less at that point.

CHAIRMAN POWERS: I mean, you go from having basically an alpha hazard with your fire to now having a gamma hazard.

MR. BROWN: Yeah, that is considered as

part of the hazard safety assessment, sure.

CHAIRMAN POWERS: That's a significant change.

MR. BROWN: Yeah.

CHAIRMAN POWERS: You go from having an inhalation toxicology to having an exposure kind.

MR. ROSEN: I'm interested in this area, and anything you can do to help me through the difficulties I have with this would be helpful.

MR. BROWN: Okay. Yeah, I do want to go back and take a look at -- and I'll talk to our expert about --

DR. FORD: This seems to be a fairly fundamental question though. I would have thought it would be answered, the question about using water to put out fires and thereby the possibility of moderating the --

MR. BROWN: Yeah, what I'd like to go back and check, the feature most relied on for fire safety are the fire barriers, passive barriers to the spread of the fire, and then for areas where there's disbursable material there's also the clean agent suppression system.

What I would like to maybe examine a little bit more is this question of, well, yes, the clean agent system is not as effective as water in removing heat. Is that still okay? Because I have a two-hour fire barrier there or three hour fire barrier there that can withstand the full heat of the fire.

MR. ROSEN: Yeah, and I think I agree with you that it can withstand the fire effects and prevent the spread of a fire, but you still have the fire in that area, and it needs to ultimately cool that area. And that's where you end up with this, I think, discussion.

MR. GIITTER: I just wanted to remind you, too, that the integration of those two issues, criticality safety and fire protection, is going to happen in greater detail as part of the ISA process. So, you know, that's something that the applicant will have to address in their license application. We will be looking much closer at later on.

MR. TROSKOSKI: And that process will also consider the past operating events that we have had, including -- I'm sorry. Bill Troskoski. I'm one of the chem. safety reviewers.

The ISA process in addition will also consider the operating events that have occurred in the industry and the lessons learned from those, including the fires at Rocky Flats.

CHAIRMAN POWERS: I don't want to rely totally on the future to resolve this question. I think I need to understand it philosophically here, not necessarily in quantitative detail, but philosophical approach. I mean now you look at this particular kind of accident because this was one we raised what, a year and a half ago or something like that?

MR. MURRAY: And just to let you know, Chris Tripp, the criticality safety reviewer, will be discussing criticality safety tomorrow morning.

MR. BROWN: That would be a good time to bring that up again.

MR. ROSEN: Well, I'm more interested in the fire safety.

MR. BROWN: Okay.

MR. ROSEN: It ends up being a fire safety issue.

MR. BROWN: That's right.

MR. ROSEN: So Mr. Wescott --

MR. BROWN: He will be here this afternoon.

MR. ROSEN: And I need to talk to him.

MR. MURRAY: Yes, Rex will be here this afternoon.

CHAIRMAN POWERS: And just for the members' information, I have asked that Dr. Diamond at the DNL look at the criticality portions of this, both the SER and the CAR, and he'll provide us a report prior to our February meeting.

MR. BROWN: Well, thank you.

CHAIRMAN POWERS: Vic.

DR. RANSOM: In terms of the safety aspects and design philosophy, are things like this red oil explosion and HAN explosions and even the recriticality considered design basis accidents?

MR. BROWN: They are essentially. That vocabulary just isn't in the Part 70 regulations. So that's just not a term we use.

DR. RANSOM: I know you spoke in terms of confinements and often our closed reactors have venting systems, and the design of those presumably would hopefully lead to mitigation.

MR. BROWN: Yeah. I think what effectively happens is as the applicant goes through and identifies all of the hazards in all of the hundreds of rooms of a plant, it effectively comes out looking like several hundred, if not thousands, of design basis events, all of which have to be considered in their integrated safety analysis.

DR. RANSOM: The other one would be what is the history of these kinds of systems. I mean, the French have built them.

MR. BROWN: Right.

DR. BONACA: And maybe others, too, and I'm wondering is this facility going to be similar or based on a lot of that history.

MR. BROWN: This facility, as the name of the future licensee implies, is Duke Cogema Stone & Webster, and Cogema is a significant partner in this enterprise, and is using their experience at the La Hague reprocessing plant and the systems installed there for the design of the aqueous polishing step in the U.S. MOX plant and is also using their experience at the MELOX mixed oxide fuel plant in the south of France, which has now been operating, I think, nine years and many of those systems are components in the U.S. MOX fuel plant.

There is a step where those designs are Americanized, if you will, to comply with U.S. codes and standards. So there will be subtle changes associated with code compliance in the U.S.

DR. WALLIS: And change all of the dimensions to feet and inches?

(Laughter.)

CHAIRMAN POWERS: I will just remind those of you that are new to this that several members were able to visit La Hague and MELOX, and I think they came away reasonably impressed with the sophistication of the operation. Certainly it's a much more modern facility than those in the United States that I'm more familiar with.

MR. MURRAY: Yes. I will just add one comment on this question. As part of the staff's review, we have looked at historical events at DOE and/or other facilities, and also what is currently good practice in the industry. Sometimes the jargon "RAGAGEP" reasonably and generally accepted good engineering practice is used, and we have looked at that to get to some measure of the evaluation of the proposed controls for specific events and hazards.

MR. BROWN: If there are no other questions, I'll have Alex begin his first presentation.

Let me see if I can help you get that started.

MR. MURRAY: Good morning, everybody. Thank you so much for inviting the NRC team here to inform you and make presentations for today.

For the two people in the room who don't know me, my name is Alex Murray. I am the lead chemical safety reviewer for the MOX program, and I'm in the NMSS office.

Now, I want to give some discussion about the closure of open items which we had in the revised safety evaluation report or RDSER and also some of these open items were discussed at the November 2003 ACRS meeting.

I have listed the specific open items which we will go through today. Myself, Bill Troskoski and Rex Wescott will be splitting the presentation between us. The open items are as shown and include a number of potentially high consequence events which the applicant has elected to essentially prevent or has identified a preventative strategy for them.

And then at the end of the presentation, myself and Dave, we will provide brief summary.

Now, the first specific open item we're going to discuss is CS-01, which is termed "red oil." In the proposed process, there's an aqueous polishing, which is really a single cycle Phrex solvent extraction step for purifying the plutonium and separating it from impurities. Those impurities include americium, gallium, and uranium.

Because this is a solvent extraction process, you have two phases. You have an aqueous phase, which is essentially concentrated nitric acid up to about 13.6 molar.

You also have an organic phase, and this is essentially the standard Purex extractant mixture, which is tributyl phosphate in a branched dodecane mixture.

CHAIRMAN POWERS: Alex, can I ask you a question?

MR. MURRAY: Sure.

CHAIRMAN POWERS: In the document, you used the term "hydrogenated propylene tetramer."

MR. MURRAY: Yes, that's branched dodecane.

CHAIRMAN POWERS: And how you use branched dodecane. The organic chemistry profession has gone to heroic limits to standardize its nomenclature. What are these things?

MR. MURRAY: Well, it turns out that the main, if you will, component of constituent of the diluent is a branched dodecane, and essentially it is made, if you will, from joining propylene molecules together. Okay?

However, it is also distilled when it is manufactured. So you do get some other species in there as well. So you essentially have what in the chemical process industry is called a boiling point curve for the mixture.

MR. ROSEN: Do you have a chemical symbol for this thing? Could you draw it for me? I mean not today, but I mean --

(Laughter.)

MR. ROSEN: I mean, let's go back to fundamentals.

CHAIRMAN POWERS: I think what Alex is saying is it's a mess. You get a bunch of branched dodecanes and they don't want to specify it out. I mean --

MR. MURRAY: It's a commercial product.

CHAIRMAN POWERS: -- in the DOE literature, it's called normal paraffinic hydrocarbon, and it's still a branched dodecane, but I mean, I'm just surprised that there's so much diversity of nomenclature both in the SER and the CAR and the viewgraphs. They're all different.

I mean, it doesn't matter. I mean, the point is you've got a bunch of organic that can burn.

MR. ROSEN: It doesn't matter, but my chemical engineering sensibilities are offended by the idea that I don't really know what I'm dealing with. And so during the break perhaps, Alex, you could take a piece of paper and draw something and say this is --

MR. MURRAY: Sure.

MR. ROSEN: -- it's mostly this stuff.

MR. SIEBER: You can draw anything. He won't know.

CHAIRMAN POWERS: It's kerosene, yep. The hydrogenated --

MR. MURRAY: I'll draw it properly.

CHAIRMAN POWERS: -- hydrogolene propylene tetramer, which is a new one to me.

DR. WEINER: Yes.

MR. MURRAY: Yes, but it is a branched dodecane. It is comparable to the normal paraffinic dodecane which has been used in U.S. facilities. That is more of an exact straight chain with little branching.

Now, red oil refers to the formation of nitrated organic compounds in this mixture. Okay? So red oil is really a collective term. Okay. It's not a precise term. It can refer to the mixture containing butyl nitrate. It can refer to a nitrated tetrapropylene hydrogenated dodecane. So we just use the collective term "red oil."

CHAIRMAN POWERS: Which is neither an oil, nor is it necessarily red.

MR. ROSEN: Although sometimes it is.

(Laughter.)

MR. MURRAY: What I've shown on this slide, I like to try and bring in some illustrations. A picture is worth 1,000 word. Okay. This is from some tests which were conducted in I guess it was more like the mid-1990s for people by contractors in the Department of Energy complex on the -- if I don't zap myself here with the laser -- on the far left, this is the normal organic solvent with tributyl phosphate in a dodecane mixture.

As you go from left to right over here you have where the mixture has been exposed for more time and/or more temperature to nitric acid, and as you can see, it generally starts getting a little darker, and as you go into high temperatures, high temperatures meaning reflux type conditions, 110 to 120, even 130 Centigrade, you get more rapid reaction and more of a reddish hue.

And the sample on the far right was from a test where it actually underwent if you will the decomposition reaction.

CHAIRMAN POWERS: These were from the

tests that were done up at LANL?

MR. MURRAY: Los Alamos, yes.

DR. WALLIS: Besides color, do you have a description of the kinetics of these reactions that you can estimate how rapidly they will occur?

MR. MURRAY: There are some kinetic equations out there. As part of the staff review, we have looked at some of the presented equations and converted these to temperature rises, potential temperature rises on --

DR. WALLIS: Yeah, particularly on the right-hand end when you have potential for uncontrolled reaction.

MR. MURRAY: Yes.

DR. WALLIS: It would seem that there must be criteria for whether or not you can control and how much margin you need to have and all of this sort of stuff.

MR. MURRAY: We will get into that as we go more into this presentation.

DR. FORD: When you say there's some kinetic data, is there enough kinetic data so you can control this adequately?

MR. MURRAY: I would say the majority of the information for controlling red oil species and red oil reactions is based on empirical operational experience and empirical laboratory testing. I would say for the most part, fundamental analysis using kinetic rate equations, continuous attack ester tank reactor mechanics, for example, to a large degree has not been done, historically for defining operational limits or in the construction permit application.

DR. FORD: The way you described it, you gave the impression at least that it was almost an autocatalytic effect, i.e., took off in a rush.

MR. MURRAY: It can be thermal runaway reaction.

DR. FORD: And, therefore, is there enough time to control this before --

MR. MURRAY: As we get more into the controls and the proposed strategy in our evaluation, I'll try and answer that, but I think it's very important to remember the applicant has identified a preventative strategy. Okay? So the applicant does not want the event to occur. So you don't want to get into, if you will, waiting for seconds to tick down on the clock.

CHAIRMAN POWERS: When people look for detailed understanding on this, the difficulty, I think it's my impression that the fundamental difficulty with red oil is that we have never been able to persuade ourselves that what gets created in the laboratory is, in fact, what caused the event.

And of course, the difficulty is the event is only detected after you've blown up your facility, and so it's hard to find what actually did the blowing up. And so you've never persuaded yourself that this red stuff is, in fact, whatever caused the event.

DR. WALLIS: Well, this makes it difficult to scale up and all that kind of thing if you don't have some sort of equations or --

CHAIRMAN POWERS: No, it doesn't, Graham.

DR. WALLIS: It doesn't?

CHAIRMAN POWERS: This is where I think just what Alex said. It is like most chemical processes in this world. Most industrial chemical processes are not based on equations. They're based on when I do it this way, I get the right stuff. If I do it any different way I blow up my facility, and that is true of, I would dare say, 95 percent of the chemical processes run worldwide.

Is that a fair --

MR. MURRAY: I would say it's a very large percentage. I'm not sure exactly 95 percent, but it's getting there.

CHAIRMAN POWERS: It's awfully close to that.

DR. WALLIS: So it's the same as we read about on page 602 of our criticality safety where it's said to be based on skill of the craft and said to require intuitive understanding of neutron physics. That seems to me --

(Laughter.)

DR. WALLIS: -- pretty hopeful. I mean, I would like to have more than an intuitive understanding of neutron physics in order to understand criticality.

MR. MURRAY: Well, as we get more into this discussion, I think that what is presented will help.

DR. WALLIS: So you are going to reassure us, are you?

MR. MURRAY: Well, perhaps when we get to the end you'll be assured.

DR. WALLIS: Or are you going to convince us?

DR. RANSOM: Are these vapor phase or liquid phase on interphasial reactions?

MR. MURRAY: They are liquid phase reactions primarily, and I want to emphasize "primarily." They tend to occur more violently around the interface between the organic phase and the aqueous phase, okay, and normally with a few exceptions, in all of these processes the organic phase is lighter and is on the top.

DR. WALLIS: So mixing comes into it, does it?

MR. MURRAY: Mixing can come into it, yes.

DR. WALLIS: Do you think it's stirred up by its own reaction?

MR. MURRAY: Yes. Now, one thing to keep in mind. Gaseous phase reactions can contribute to the brisance, the explosiveness, of the event if those gaseous phase products are not removed. These species can include butyl alcohol, butyl nitrate, some others, sometimes butane. Okay? So they can be quite flammable in case your species evolve, and if they are confined within the vessel, they contribute to the event.

DR. FORD: Just in terms of the process, the discussion process, it's my understanding right now all you're doing is identifying an issue and how qualitatively you're going to control it. The specifics of how you're going to control it, whether you approve of the Cogema's strategy for managing this issue, that doesn't come until some time next year, and that's when we will be asked to make comments about the adequacy of that control?

MR. MURRAY: For most of the open items which we are discussing today, there are some specific control parameters identified. All right? Now, as regards to what will happen with the license application, we expect that the identify principal structure systems and components will be fleshed out in more detail from a systems level to more of a component level: how many thermocouples or RGDs do you have monitoring the process? Where are they located? Are they adequate to give an accurate temperature measurement and so forth?

DR. FORD: That will come later.

MR. MURRAY: That will be later, but we have some specific parameters identified already.

Also, with this being the construction authorization phase, we are not looking at set points. We have looked at the set point methodology, which is part of the design basis.

Well, let me move on. Just to get some feel, I'm a chemist, chemical engineer, and -- I'm sorry. Is there a question?

DR. BONACA: No, no. I said, "There you

go," meaning you were asking about some.

MR. MURRAY: This is just a sample, a diagram which shows sample reaction pathways, and I'll just point out to you tributyl phosphate is the actual extractant in the diluent mixture. It can go under various reactions to form DBP and MBP, which are dibutyl and monobutyl phosphate esters, respectively.

All right. These compounds all over here can react further in the presence of heat and nitric acid and radiation to go to the C4 species, even to some of the C3 species. Okay?

In the end, if you have a red oil event, you're essentially taking the organic and converting it to a mixture of the gases, all right, nitrogen, CO, CO_2, some of the nitrogen oxides.

DR. WALLIS: This is exothermic?

MR. MURRAY: And it is exothermic, yes. So you have both the energy release, which heats up the mixture, and you also have the evolution of significant quantities of gaseous species, which also contributes to, if you will, the event.

And I will say there are some other reactions beyond these, but this is a pretty good summary.

MR. ROSEN: This is another one of those

slides I'd like to have that I can't quite see.

MR. MURRAY: The reaction pathway one?

DR. WALLIS: It's not just exothermic. It makes a lot of gases.

MR. MURRAY: Right.

DR. WALLIS: So there's going to be a pressurized --

MR. MURRAY: Exactly, exactly. You get a double whammy, if you will.

Okay. Let's see. This is a little hard to read in the handout. So I just wanted to identify generically in the process where this is a potential concern, where potential red oil events can occur. They are primarily in areas where you have the solvent and the solvent extraction processes.

However, one thing from operating plant experience is the solvent can move around and accumulate in other areas, such as what is termed in this facility the oxalic mother liquor recovery area, into the precipitation steps, even to acid recovery and waste.

And on this slide I have summarized the safety issue, and what I want to point out is these species -- it turned out pretty well. That is actually from the American Institute of Chemical

Engineers on overheated reactor.

These red oil species can undergo exothermic reactions, and they can do it with relatively small quantities. Estimates for some of the advance up in quantities, well under 100 gallons. One of them it is postulated might have been around 50 gallons.

Okay. These are --

DR. WALLIS: And the more you have, the worse it is then.

MR. MURRAY: Yes, yes. That's correct, but --

DR. WALLIS: Why does quantity come into it? I mean, if it's an exothermic reaction and the right conditions, it's going to happen.

MR. MURRAY: This is the amount that participates in the event. All right? It's not, if you will -- if you have more quantity of material, you can have more exothermicity, more of a pressure rise and, if you will, more of an explosion.

However, the significant thing for our purposes here is that the quantities which are formed and reacted in historical incidents and events are comparable to quantities at their proposed facility or quantities which could form at the proposed facilities.

MR. ROSEN: But Graham's point is still of interest to me. If you just had a little cup of this stuff someplace, it would experience a reaction.

MR. MURRAY: Yes.

MR. ROSEN: It might not be important, but --

MR. MURRAY: Right. And if you have 1,500 gallons of the material, you can blow out four foot thick shield plugs and do quite a bit of damage.

DR. WALLIS: If you were doing research, you might do it with a small quantity.

MR. MURRAY: Exactly.

(Laughter.)

MR. MURRAY: Preferably a very small quantity.

CHAIRMAN POWERS: I believe that in the solvent recovery facility in Purex, they came to the conclusion they were probably getting the events on time.

MR. MURRAY: Yes.

CHAIRMAN POWERS: And it was only when they shut down for a clean-out of a facility accumulated a lot of it and then started up that they got an event that anybody knew was actually happening.

MR. MURRAY: Yes. I should just clarify the point. In Purex time systems, red oil reactions happen all the time, except they happen at a slow rate, and the relative concentrations of the degraded products and other species are relatively small.

It's a classic kinetic type of consideration: higher concentrations, higher temperatures, higher nitric acid concentrations. Ultimately those can, if you will, increase the kinetic rates to a point where they become a concern.

MR. ROSEN: And in the process of getting to the garden variety end products you end up with, which no one would be concerned about: nitrogen, carbon dioxide, et cetera.

MR. MURRAY: Exactly, exactly.

MR. ROSEN: And you have all of the fun.

MR. MURRAY: Yes.

MR. ROSEN: The end products don't matter much to you is what gets you there.

MR. MURRAY: It is what gets you there, and if those end gaseous species cannot escape.

CHAIRMAN POWERS: And, Mr. Croff, this is an area that you might be particularly interested in because I think you can track every single major event to some change in operations, either stopping them, starting them, a different way of doing things than coming back.

So operations does seem to affect this process.

DR. FORD: So many of those instances have had a human factor route to them?

MR. MURRAY: I don't know if I would say exactly a human factor route, but they have tended to involve unnoticed accumulation of organic material in a tank vessel or evaporator, and often that involves, if you will, human monitoring by chemical sampling analysis, sometimes as simple as looking at the two phases showing on the site glass or on the remote TV camera, what have you.

Okay. Just in simple terms, if you remove aqueous phase from a solvent extraction system, say it's at 60 degrees Centigrade, okay, a not uncommon temperature, and you put it into a vessel, again, just the aqueous phase, as that aqueous phase cools down, organic materials that have dissolved in that aqueous phase become less soluble. So they tend to separate out and coalesce as a separate organic layer on top of the aqueous phase in that tank or vessel.

And in many of the Purex type facilities around the world, it is that type of phenomena which has contributed to these events.

CHAIRMAN POWERS: I think that everyone that I can bring to mind something got changed.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Some disruption. Weekends seem to be particular --

MR. MURRAY: And shift changes, yes, yes.

DR. WALLIS: Can you control this reaction? It seems to be what they're going to do. There's no defense in depth, and if it does run away, it gets vented into something where you can keep it under wraps. It's vented in some way?

MR. MURRAY: Well, ultimately this is a reaction which occurs within vessels, piping, evaporators, all of those, if you will, vent either through the off gas treatment system or there's a vessel vent system as well.

DR. WALLIS: So if the reaction got out of control, stuff would come pouring out the vent. Is that what would happen?

MR. MURRAY: And that is one of the reasons why the applicant has selected a preventative strategy, yes.

MR. ROSEN: And that stuff pouring out the vent is hot and being blasted, and it's likely to be a fire, ignition source; am I correct?

MR. MURRAY: It could be.

MR. SIEBER: Could.

MR. MURRAY: It could be, yes. It is likely to be hot.

DR. FORD: But the preventative action is primarily engineering monitoring systems, i.e., remove all human dependencies.

MR. MURRAY: It's a combination of what I would call engineered controls and administrative controls.

MR. MURRAY: And do we know of the reliability of those engineered controls? Is there a database from the chemical industry, for instance?

MR. MURRAY: The staff as part of its review and analysis, we have looked at some of the ranges of reliability for some of the proposed controls and have made some conclusions regarding those controls.

DR. FORD: And will that in much more detail come into the part that's going to be done next year?

MR. MURRAY: Yes, it will have to come into more detail and be integrated safety analysis, which will be -- the summary of which would come in with the license application.

And here I'm discussing the applicant's safety approach. First off, the applicant has identified this as a high consequence event, and they have selected a preventative strategy to render the event highly unlikely, in effect, stop the event from occurring.

All right, and I want to point out that when we received the initial application, which is almost four years ago now, at that time there was only one PSSC or control identified with one safety function.

In the revised application, which we received this past June, there have been additional PSSCs added and additional safety functions identified, and also there's a commitment to further research and experiments to understand the phenomenon better.

DR. FORD: Now, when you say it's a preventive strategy, vent highly unlikely, you mentioned earlier on that was about a frequency of ten to the minus four per plant year. Was there any PRA done to justify that conclusion that you have gotten there?

MR. MURRAY: We did not do PRAs. We have used some top level fault tree types of analyses. We have used some of the guidance from the appendix in the MOX standard review plan to get some, if you will, gauge of how responsive, how reliable some of these proposed controlled strategies, these PSSCs and safety functions can be.

DR. FORD: Well, a more PRA-type exercise be done next year?

MR. MURRAY: That is entirely up to the applicant. The applicant has the option of doing this in a qualitative mode similar to what they've done now. They can do it in a semi-quantitative mode or they can do it in a quantitative mode. I think we'd have to wait until next year.

DR. FORD: Is there some reason why we're not insisting that they use a PRA?

MR. GIITTER: The regulation --

CHAIRMAN POWERS: Peter, you need to look at the regulation. What Alex described is called an integrated safety analysis. This is not PRA land, and so if you contest that, you contest a battle that we've already been through at some length, and the Commission has made a decision. Okay? So they are the people you should interrogate, I think.

DR. FORD: I recognize there's two worlds we live in here. There's the world that was formulated when the regulations were written versus what is technically state of the art.

CHAIRMAN POWERS: Well, now, hold it. Integrated safety assessment is recognized as the state of the art within the chemical community. You sit next to a guy that's got PRA on the brain usually. There are other people who have to deal with safety and have found effective ways of doing it.

DR. FORD: Yeah, I know, and I accept that. It's just that sprinkled in here we have talked about what was the definition of highly unlikely before, and we got one out of here, and thank you.

MR. MURRAY: You're welcome.

DR. FORD: But I'm trying to delve down to find out how much quantitative knowledge --

MR. ROSEN: I applaud your question line, Peter, but you're almost to the bottom of what they're willing to do in terms of heading in that direction, and Lord knows for me I would certainly encourage more, but that's what the regulations embody and rely on and require, is what you're hearing.

DR. FORD: Okay.

MR. GIITTER: I would just add that Part

70 is performance based and risk informed regulation. It was recently promulgated in 2000. So as Dr. Powers indicated, it is state of the art in terms of looking at risk for fuel cycle facilities. They are different beasts than reactors. I want to remind you of that, although in terms of complexity, the MOX facility certainly is probably the most complex fuel cycle facility that we're currently looking at from a safety perspective.

DR. FORD: I guess I'm kicking against the system here just to see how much it will give. If this thing blew up, heaven forbid, we would be crucified if we didn't kind of come up with that you didn't apply knowledge from, for instance, other industries, et cetera, to this chemical plant. I'm kicking at that.

CHAIRMAN POWERS: I think you're taking an inferior position. There has been over the last 25 years a huge, enormous effort that makes the PRA effort pale in comparison as far as number of dollars spent on developing strategies for handling, assessing the safety of operations in chemical processes.

In fact, the American Institute of Chemical Engineers maintains a center on exactly this. I think Alex is more familiar with it than I am.

MR. MURRAY: Yes.

CHAIRMAN POWERS: There are shelves of books on how to do this sort of thing. Now, that particular community has struggled with the fact that every single chemical process is different, and that PRA methodologies just don't seem to interface well in that, and they've taken a somewhat different tact.

Now, I look at it, and I say, well, they're really only missing a final integration step, and it would look and smell and walk and talk much like a PRA, but it's a reasonably sophisticated field, and, I mean, to say, well, it's not identical to the reactors and, therefore, it's not state of the art is fairly unfair, I think.

Some of these, they have a very, very much more sophisticated view on how to handle worker safety than we do in the reactors area.

MR. SIEBER: Right.

CHAIRMAN POWERS: It's much better, I think. It's a nice societal risk assessment.

Well, enough said. Go ahead.

MR. MURRAY: Okay.

DR. DENNING: Could I interrupt just a bit? But perhaps you would like to first.

DR. WEINER: I just had a quick question.

How can you really justify classifying this reaction as highly unlikely by putting mitigating efforts on it when it is, in fact, a reaction that has occurred quite frequently over and over again?

I mean, if you say that your unlikely range is everything from once in 100 years to once in 10,000 or whatever it was, and your highly unlikely range is really a highly unlikely range of ten to the minus four, I would not classify this as highly unlikely.

And I'm concerned that that gives a false impression that, yeah, we know what we can do to virtually absolutely prevent this from happening.

MR. MURRAY: First off, let me say this is the applicant's proposed safety approach. As we get into the staff's evaluation of it, I think you will see that that is more of a preventative type approach, and we tend to -- we, the staff, who have reviewed this -- tend to agree that the proposed approach has the ability; it hasn't been demonstrated yet, but it has the ability to achieve unlikely likelihoods, if you will, to prevent this event.

Okay. In the license application, which we're expecting next year, they have to supply the proof, if you will. The applicant has to give the demonstration by either heuristics, by more detailed analyses be they hazard indices or a layer of protection analysis of some type to give us the confidence, the assurance, if you will, that, yes, not only did you say you have the ability to get to a highly unlikely, if you will, prevention of this potential event, but, yes, you've given us enough information to give assurance that that is, indeed, the case.

MR. BROWN: Alex, I'm sorry. If I may interrupt, in your next slide you do talk about open systems. I think it's important to emphasize we're not preventing the red oil reaction. We're preventing an explosion or rupture of vessels resulting from the uncontrolled reaction.

MR. MURRAY: Yes, that's a good point.

MR. BROWN: I think that's an important point.

DR. DENNING: The point that I wanted to make was that I think with regard to the discussion of probabilities, I think the really important issue here is one of we put a lot of emphasis now on the reliability of the PSSC, and if we're not very quantitative about that, and it's very difficult to know is the PSSC really adequate in reducing the frequency adequately of events.

And so one of the questions I have for you is when the applicant went here from one PSSC with a single safety function to three PSSCs with different safety functions, is the reason because that they didn't develop enough believe that the one PSSC was adequate to provide the kind of reliability of prevention that we're looking for?

How do you really make this judgment of how much credibility we really need for that PSSC, particularly if we mix in administrative controls into that which have a lot of uncertainty associated with it?

MR. MURRAY: Well, let me see if I can answer that this way. As part of the staff's review, okay, when we first started this almost four years ago, we noted there was just a single control for this phenomenon. All right. We looked at the presented information from the applicant. We looked at open literature information. We conducted some of our own analyses which are more akin to a layer of protection analysis or a hazard indice sum, if you will, and we concluded that with the information presented at that time, the applicant could not assure us that their proposed safety strategy could prevent this event.

Now, as part of the interactions over the past four years between the NRC staff and the applicant staff, the applicant has also reviewed this phenomena in more detail, and they came to the conclusion that more controls were needed, partly based on simple analyses, partly based upon more interactions with DOE facilities and French facilities as to how, if you will, what is the good engineering practice for addressing these types of events.

Okay. So it's a combination of many things.

DR. BONACA: Well, one observation I wanted to make is regarding the statement we heard here. It is very important, and I think it has confused me from the beginning. I mean, you presented us a MOX regulatory frame work in which you did essentially classified as highly unlikely and likely, and not the initiator, but the actual endpoint, which is the release, okay, the exposure, public dose credited at 25 rems is almost akin to say that for current reactors you're using the criteria of LERF, large early release, and anything that is before that, they call it preventative rather than we don't. It's a mixture of preventative and mitigative.

And I think it's important that that point be clarified for us because, you know, then I understand what you're saying there, and this becomes much more credible. It could be a highly unlikely event.

MR. ROSEN: Well, I think Mario has made an excellent point. I would want to follow what Rich was saying before about thinking about the reliability of these safety functions, both human and equipment. If you're going to present the safety function and take credit for it, making something highly unlikely, and that function has a hardware component, especially active hardware, something that has to change state, like a valve that has to open or close or something like that.

Then I cannot see how I can agree to any kind of number, any kind of functional criteria for it or performance criteria for it unless you tell me something about its quantitative abilities, its -- excuse me -- split fraction at the point of whether it opens or closes, something about its reliability.

You're forced if you're going to use safety functions of PSSCs and their active components to talk in that language or else it's pretty much meaningless.

MR. MURRAY: I just want to say that as

part of the staff's review, we did look at, if you will, ranges of reliability for some of the proposed safety strategies. Again, as part of a construction organization review, we'll looking for approaches that have the ability to meet the regulations and the license application. The applicant has to provide the proof, if you will, the demonstration.

MR. ROSEN: Right, and I understand that when you come back the second time to the ACRS you'll have all of that looked at, and you'll be able to tell us. If we put our hand on a valve on a drawing someplace and ask you, "Is this important, Alex?" and you say, "Yes, it makes the event highly unlikely," then how reliable is this thing?

And it's a .99 reliability or a .9 reliability, and what is your basis for saying so? You have the data.

MR. MURRAY: Yeah.

MR. ROSEN: And if so, let me see it. You know how this goes.

MR. MURRAY: Yes, yes.

MR. GIITTER: Dr. Rosen, again, all we are required to do at this stage is to have a reasonable assurance, and I think that's where the staff is at at this point in time. And whether the applicant comes in in the future with a detailed quantitative evaluation, which they can do, or a qualitative evaluation, we still have to be able to have a high degree of assurance that the IROFs are reliability and available to prevent the undesirable consequence.

MR. ROSEN: Does that mean that you'll look at that data before you come in here and ask for it, look at the reliability data for active components that are used in this facility?

MR. MURRAY: Yes.

MR. ROSEN: Okay. Good.

MR. BROWN: If I may point out just one more thing, too, one of the things we did approve already is the applicant's quality assurance program plan, which is for plutonium processing facility for an NRC license has to comply with the Part 50, Appendix B criteria, and so you know, one of the things that falls out of that is the items relied on for safety are designated quality level one and have all of the associated, you know, quality assurance measure applied to them.

A lot of that detail is part of the design process now and will help determine later what additional surveillance requirements, maintenance measures are required to maintain high reliabilities.

A pump on its own may have only an average reliability, but with additional surveillance requirements, again, those details are to be provided later in the license applications. It may be made more reliable, that sort of thing.

MR. MURRAY: Let me continue on. I just want to point out on this slide some of the definitions for the two cases that the applicant uses. The applicant has defined open and closed systems. In an open system there's a vent provided, and its main function is pressure release. The vent doesn't allow over pressurization of the vessel from the full runaway reaction of --

DR. WALLIS: So what goes out the vent? Is it a single phase or is it a mixture?

MR. MURRAY: It would be a single phase.

DR. WALLIS: Because this reaction if it's energetic enough is going to make a foaming or two-phased homogeneous mixture which will swell up and go out the vent.

MR. MURRAY: The applicant has committed as part of the experimental studies to investigate that phenomenon.

DR. WALLIS: It's very difficult to be sure that you won't get this sort of homogeneity when you get a reaction which is happening throughout the mixture.

MR. MURRAY: Yes, they have --

DR. WALLIS: It's like opening a shaving cream.

MR. MURRAY: Yes, yes. Now, there have been tests conducted which have been sponsored by the Savannah River company where these tests showed -- and I'll get to it in a moment -- where venting was a very effective means to prevent, if you will, the incident from propagating into an event.

MR. ROSEN: And you can show that when you vent through a relief valve that the valve is capable of not only passing fully homogenized, gaseous material, but also can tolerate the two-phased flow, and the forces that can be caused on a component from two-phased flow because I presume these valves are relied on to close at some point, to shut off and retain some of the inventory.

MR. MURRAY: That sort of more detailed information would be with the license application, not as part of the construction authorization, which we're discussing now.

DR. WALLIS: When this stuff comes out of this relief valve, what does it go into?

MR. MURRAY: It goes into the off-gas treatment system for red oil.

DR. WALLIS: A gas treatment system?

MR. MURRAY: There's an off-gas treatment system.

DR. WALLIS: I could see this stuff pouring out and then continuing to react. I don't know what its kinetics are. If it's hot enough --

MR. MURRAY: Again, at the construction authorization stage we're just looking at the design bases, the PSSCs. Does the proposed safety strategy have the ability to render this highly unlikely?

DR. WALLIS: This is based on some experience that this sort of thing --

MR. MURRAY: Often it's based on experience, yes.

Now, a key thing about an open system is if everything in that vessel container or pie were the organic phase, the open system can adequately vent it without any pressurization of that container or vessel.

For a closed system, however, there's a vent provided, but it has a different function. It is a pathway for evaporative cooling. In essence, some of the aqueous phase, as well as some of the intermediate species from the breakdown of tributyl phosphate are vented through this vent. They carry a certain amount of enthalpy or heat with them, and that allows the system as a whole to cool.

MR. ROSEN: It's a pressure relief valve. It pops. Is that what it is, when you have a closed system?

MR. MURRAY: In a closed system, it could be a pressure relief valve.

MR. ROSEN: Or ruptured disk?

MR. MURRAY: Or ruptured disk. That sort of specificity we'd expect in the license application.

DR. RANSOM: Out of curiosity, it would sound like an open system was better, but there must be some reason why they selected a closed system.

MR. MURRAY: Yes. The applicant expects most of the vessels or containers, if you will, to be open systems. As part of our interactions with the applicant, we had asked the question: can we have all of the vessels as open systems?

And the applicant said, no, there will be a few systems which we would designate as a closed system. Details would be provided at the ISA stage with the license application.

But the great majority of the vessels or systems would be open.

Okay. Let me just discuss the PSSC. The first one is the off-gas treatment system. This provides venting and avoids pressurization of the vessel itself and allows a path or evaporative cooling.

In the open system, it has a safety function to avoid pressurization, and a design basis has been identified by the applicant. Okay? And I'll get to that in a little more detail in a moment, but that basically defines the size of the vent on the vessel.

For a closed system, the applicant has based it upon the safety function upon evaporative cooling, and it is essentially a 20 percent margin above the energy put into the system, and that is energy which comes from the steam heating, which is used, if you will, in the evaporator, say, to concentrate the material, recover nitric acid, and also the heat or enthalpy which comes from the red oil reactions themselves.

DR. FORD: Are these numbers here your specifications or their specifications? How are they arrived at?

MR. MURRAY: These are numbers from the

applicant. They are design bases. Okay? They're not specifications.

DR. FORD: Okay, and you're approving these at this time or is it -- do you approve them at this time or do you just do it enough to have reasonable assurance that you have safety, or have you done it?

MR. MURRAY: We do this as reasonable assurance.

DR. FORD: And how is that arrived at?

MR. MURRAY: We're getting there.

DR. FORD: Okay.

MR. MURRAY: First I wanted to go through the PSSCs proposed by the applicant. The second PSSC is the safety control subsystem. This is essentially an active engineer control, and I've listed the parameters here, limiting steam temperature. Okay?

This value comes from experience. Limit organic compound residence time.

DR. WALLIS: How hot does it have to get before it's in trouble? Is it 134 or 150 or 200 or what?

DR. BONACA: Very close.

MR. MURRAY: We'll get to that in about four slides.

DR. WALLIS: Okay.

MR. MURRAY: Stay tuned with me.

MR. ROSEN: Not much.

DR. WALLIS: I think it's not much.

MR. MURRAY: For closed systems, okay, the process safety control system would limit the temperature of that reacting mixture to 125 degrees C., and it also would limit the temperature-ramp rate to nothing greater than two degrees Centigrade.

DR. WALLIS: Presumably if you use evaporative cooling, you're going to have to make up whatever you evaporate.

MR. MURRAY: Yes. That's why it's called aqueous phase addition.

DR. WALLIS: Aqueous phase addition, right. Put water in and take steam out. Is that --

MR. MURRAY: In essence, yes. And as the water evaporates into steam, it absorbs energy from the mixture and cools it down.

MR. ROSEN: And the controllers that do these are solid state controllers, the PLCs or things like that, right?

MR. MURRAY: That's correct.

MR. ROSEN: Which have a reliability which we know, and this will be discussed because these are items relied on for safety in the ISA, I presume.

MR. MURRAY: Yes, in more detail in the ISA. That is correct.

Okay. Let me just mention the third control, and this is essentially a chemical safety control, which is more of an administrative control.

It has been found from both experiments, plus also investigation of past incidents and accidents with red oil, that organic compounds which are cyclical in nature, cyclohexane derivatives, for example, can contribute significantly to the event by lowering the initiation temperature.

To address that concern, the applicant has a safety function for this chemical safety control to prevent any cyclical compounds from being in the diluent and, if you will, getting into the system to react.

DR. FORD: Do you know why they lower the initiation temperature?

MR. MURRAY: If you look at the --

DR. FORD: The reason why I'm asking the question, is there something else that could do the same thing?

MR. MURRAY: There are some degradation products which can do the same thing as well, but those are removed in the solvent treatment system at the proposed facility. You know, dibutyl phosphate, for example; it would be some of the butyl compounds.

Okay. So the solvent is treated before it is reused in the Purex process, and that's where those are removed. Okay?

DR. WALLIS: In my experience in consulting with disasters in chemical plants is that there's an awful lot of shakedown. You build the thing, and then you do a lot of experimentation, and then you fill it with things and you change the temperatures and pressures until everything works right, and then you find, gee, whiz, we're making some cyclical organics. Therefore, you'd better do something about it.

Is this what happens here, is sort of a year or two of shakedown at the facility, or is it something that you just build and it works?

MR. MURRAY: I will hypothesize that this facility will have a shakedown period and that the NRC staff would be involved with inspections during that shakedown period.

DR. WALLIS: This is where you get some more assurance that these things really work --

MR. MURRAY: Yes.

DR. WALLIS: -- and that 125 degrees C. is okay and all of that?

MR. MURRAY: Right.

MR. ROSEN: But is there a way to do it without plutonium and uranium dioxide powder?

MR. SIEBER: Yes, that's the way you do it.

MR. MURRAY: Yes, that's how you do it.

MR. ROSEN: So the shakedown period is non-radioactive. It's cold.

MR. MURRAY: The shakedown period will -- again, this is something which would come in as part of a future phase of this program, but the shakedown period usually will start with non-radioactive species, and it might end, say, with the introduction of something like uranium just to check out how well the process would work with, if you will, some real radioactive material.

It is possible in the future the applicant might even decide to use some compound or element which has similar chemical properties as plutonium just to check out the facility.

MR. ROSEN: In the reactor world which we're burdened with there's something called a start-up test program which sounds analogous to your shakedown period. It's part of the -- the start-up test program is part of the application, which the staff reviews.

Is there an analogous section of the ISA with the shakedown program in it that you review and approve?

MR. MURRAY: The integrated safety analysis will have to look at start-up of the process, steady state operation, upsets in the process, ranges that the process or facility would experience, and shutdown.

MR. ROSEN: Not quite the answer to my question.

MR. MURRAY: I'm sorry.

MR. ROSEN: No, I think you almost hit it. You said start-up of the operation. Did you mean routine start-up or first time start-up?

MR. MURRAY: It should address both.

MR. ROSEN: Okay.

MR. MURRAY: Again, you know, the devil is in the details, but those details should come in with the license application next year.

DR. DENNING: Let me just challenge one response you had to Graham in terms of whether you really addressed what he was saying, and that was

Graham said that in the start-up period you'll do things like determine the acceptability of like the 125 C. limit, and I don't think you really do. I don't think in the start-up period you really do anything that really determines what's the acceptability of the limits or reliability of --

MR. MURRAY: Well, let me just clarify something. The applicant has committed to an experimental program to essentially define and, if you will, make sure that the temperature value 125 degrees Centigrade, for example, is reasonable and appropriate as a design basis.

MR. ROSEN: I'll push your button. That is not my slide there?

MR. MURRAY: Okay. Here it is. This is a commitment they've made. The applicant will define the reaction kinetics in more detail, quantitatively, determine effects of impurities, and then from that experimental data probably as part of testing establish some operational limits and set points.

DR. WALLIS: How long is this going to take?

MR. MURRAY: That has not been discussed yet.

DR. WALLIS: Quite often research seems to be done to confirm something you've already decided, and you find the plant is running before you've actually finished the research.

MR. MURRAY: It is our understanding from our discussions with the applicant that this is a near term research experimental program.

DR. WALLIS: It may be very hard. You said that we don't really know these reactions. They my turn out to be very tough.

MR. MURRAY: It could be difficult.

DR. WALLIS: So this is going to hold up the whole plant?

MR. MURRAY: If problems are encountered during the test program, it is possible, but that is hypothetical at this time.

DR. FORD: What would trigger, if you go back one slide, just following up on Professor Wallis' question --

CHAIRMAN POWERS: Let me interrupt just for one second. We are running behind time. This is the only opportunity we have to plunge into the details. So I don't want to cut off, but I would like to stay focused on the issue at hand here, which is the construction permit. And if you need to understand the limits of the construction permit to understand what's going on in the licensing permit, that's fine, but if you're just curious, I would prefer to stay on schedule.

DR. FORD: I withdraw my question.

MR. MURRAY: Okay. That's fine.

Let me get into the start, evaluation, and conclusions, if I could please, and first off, for open systems, the staff agrees that a preventative strategy is the best approach, okay, due to the potential severity of the vent, and we've noted and have analyzed the multiple PSSCs and safety functions identified by the applicant.

One key point I want to make is the design basis for the vent PSSC is well within the experimental range which has been determined by tests conducted for the Department of Energy. Because of this, that system cannot over pressurize.

Okay. Again, this is predicated upon the fact that the vent is designed properly. I want to emphasize that. Details would have to be in the ISA stage.

Because the system cannot pressurize, it is physico-chemically limited to the normal boiling point of the mixture. It cannot go above that, and that is up around 120 degrees Centigrade. That is well below the red oil runaway temperature conditions which start at around 130 or so degrees centigrade, and this has been accepted by the staff.

And if I go to the next slide, as you can see, the blue line on this curve was determined by experimental studies conducted on behalf of the Department of Energy. A key point to point out here is that somewhere just beyond this organic mass vent area ratio of about 32 kilograms per square centimeter, there's a very rapid rise in the pressures which were measured.

And because of this, the Department of Energy and its contractors have identified this value of about 32 as being the boundary between safe and unsafe for red oil reactions. All right?

MR. ROSEN: Without uncertainty? There's no uncertainty on that 32, or is it a degree or four degrees or nine or do you have any sense of it?

MR. MURRAY: This data as regards uncertainty, these were a series of tests. Okay? I don't think the researchers went into great detail about uncertainties. From our perspective, I would just like to point out, again, we're looking to the ability of the proposed strategy to, if you will, keep the system safe, render the event highly unlikely.

I think it's important to realize that what the applicant has proposed is considerably away from this range here and well into the recommended safe range. And it would seem even if there are some uncertainties into where this line is exactly drawn, it would seem that they would still be in the safe range.

MR. ROSEN: It looks like it ought to be based on what --

MR. MURRAY: Yeah.

MR. ROSEN: -- but on the other hand, I don't know what the experiments were, and so I have no sense of whether 12 versus 32 is a good number. If the uncertainties are 20 on 32, it isn't. The 95 percent confidence limit is 20 on that 30. Then it isn't.

So I would recommend --

MR. MURRAY: That sort of detail we would expect to see in the integrated safety analysis as part of the operating license review.

Now, this information I would like to point out is all in the open literature. In fact, everything which we are discussing today is in the open literature. This was actually from a paper authored by Paddleford and Fauske.

DR. BONACA: If they use the expression, that to me would read that they had some consideration of uncertainty in that ramp. That's a good question.

MR. MURRAY: Again, I think uncertainty is a very good question, but I think at this stage with the other information presented in the literature, this gives the staff assurance that what the applicant has proposed has the ability to render the event highly unlikely.

Again, more specifics. Details which demonstrate that the applicant has rendered this event highly unlikely would have to be in the license application.

Okay. Let me move on.

Let me just mention about closed systems. Now, in closed systems, the applicant has identified a solution temperature of not exceeding 125 degrees Centigrade.

DR. WALLIS: I think it has to have a tolerance on that or accuracy or something. Because if you can only measure it within five degrees C, then you could well be up to the initiation level.

MR. MURRAY: That sort of specificity on tolerance, how quickly can controls react, you know, lag time, accuracy of controls, that would have to be considered in the set point analysis in the license application.

Okay. So, for example, if the applicant were using a certain type of temperature detector, for example, which had an error bound of plus or minus three degrees C., they would have to adjust their, if you will, set point appropriately.

If they went with an RTD, a very nice, accurate one, that only allowed .1 degrees Centigrade variation. That would have less of an effect upon the set point.

Okay. In addition, I just want to note about the temperature. This is approximately five degrees Centigrade below the DOE safe initiation limit, and somewhere around ten degrees Centigrade below runaway reaction temperatures based on Savannah River site data. And, again, that information is published.

Okay. Also, there are controls on exposure of the organic materials, both TBP and diluent to, if you will, the temperatures and conditions which can lead to red oil, and these controls from the staff analysis indicate that these would prevent participation of these other, if you will, species, again, cyclical compounds being one example, from participating in the red oil reactions.

Hence, that should not depress any of the reaction initiation temperatures below 130 degrees Centigrade.

DR. WALLIS: Most of these systems don't really have an initiation temperature. They have the criterion for runaway, which has something to do with the rate at which things change with temperature.

MR. MURRAY: Yes, yes, but in the chemical process industry parlance, for example, that is normally identified or rolled into the single parameter of an Alvina (phonetic) initiation temperature; that if you are below that temperature, even though you could have, if you will, thermal release or enthalpy from reactions, the system as a whole can cool down and the temperature will not keep increasing.

DR. WALLIS: We went into this whole thing with spent fuel pools. There really isn't an initiation temperature for an overheating event. There's the initiation condition in which temperature plays some role, and I guess this is all going to be figured out properly somehow?

MR. MURRAY: The details would have to be in the license application.

DR. WALLIS: Be careful about saying that temperature is the only thing that matters.

MR. MURRAY: Well, that's why one of the controls is keeping out these other organic materials, because if they are present, they can depress that, if you will, initiation temperature significantly, you see.

Moving right along, temperature ramp control. That essentially addresses the concern from, if you will, runaway reaction enthalpy or heat of reaction effects

DR. DENNING: Is the temperature ramp control system a PSSC then?

MR. MURRAY: This is identified as a safety function for the safety control system. It is a PSSC, yes. Again, this is at a small system level for the construction authorization, whereas for the license application, there would be more at the component level.

And let me just also mention there would be an aqueous phase addition system which would provide, if you will, water to evaporate and help cool the system. All right? And this is controlled, again, by that process safety control subsystem.

The staff also looked at the commitment

that the applicant has made to do further reaction testing. Part of it is related to the fundamental understanding of the kinetic reactions, kinetic rate equations involved in red oil phenomena. Part of it is also related to understanding where this initiation temperature might be when other species or impurities are present.

All right, and the staff has looked at this in a total integrated perspective, and we have concluded that we have assurance that the proposed safety strategy, the design bases, and PSSCs can prevent the event.

DR. CROFF: Have there been any red oil events at the French plant on which this is based?

MR. MURRAY: I'm not aware of any significant incidents or accidents being reported from French facilities, and the applicant, as part of the application or any subsequent information they have submitted on the docket have not cited any French experience.

CHAIRMAN POWERS: There surely must be French interest because we had a young man come and give us some discussion on research he was doing in the red oil from France, and it was a very sophisticated research program he outlined for us. I think the subcommittee wished him good luck and said, "Fat chance," because I think, again, the fundamental problem is you can do all of the laboratory research in the world and it's very difficult to assure yourself that what you have in the laboratory is what was in the pot.

DR. WEINER: How uniform is the temperature in these reaction vessels?

MR. MURRAY: That sort of detail we would expect to come in the license application. Okay? For what we've looked at for the construction authorization phase, we've looked at this very top level. The single temperature parameter would apply to everything that's in the vessel.

Okay. In the real world, we know there are such things a temperature gradients, and again, I will hypothesize that as part of the license application and the set point methodology, the applicant will have to take that into effect for defining its temperature and other set points.

DR. RANSOM: Have all of the DPOs or DPVs that were raised been resolved?

MR. MURRAY: That discussion we'll have starting at 4:30.

CHAIRMAN POWERS: You really shouldn't ask the staff to speak to this issue. It has been separated out --

MR. MURRAY: Yes.

CHAIRMAN POWERS: -- into a separate, and we'll get to explore it a little bit.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Thank you very much. That was nice.

What I would like to do is take about a 15 minute break. We are running about a half an hour behind, which is an inevitable feature of subcommittee meetings, and I'll ask that everybody have forbearance for us on this.

This is the only time the members will get a chance to explore these things in detail. When you come to a full committee meeting, we're constrained by the time schedule much more rigorously than I'm going to constrain us here. But you may want to inform subsequent speakers that we're running a little bit behind. I'm not going to make any effort to catch up on it, save to ask the members to focus on the issue at hand, but if you need to go a little broader to understand and put it in context, feel free because otherwise you'll never get your questions answered, and then you will bring them to the full committee.

DR. BONACA: The positive thing, the philosophy that we're addressing these other issues, so hopefully we --

CHAIRMAN POWERS: Yeah, I think this first one on red oil, first of all, it is the most curious and interesting phenomenon, but the philosophical approach needs to be understood, and that might be a good understanding here. It's very important here for us to understand the philosophy. So don't be afraid to wax philosophical.

And so let's resume at 11 o'clock.

(Whereupon, the foregoing matter went off the record at 10:48 a.m. and went back on the record at 11:05 a.m.)

CHAIRMAN POWERS: Let's reconvene.

Bill, get ready to teach us about HAN.

I take it in the SER when it refers to hydroxy nitrate it really means hydroxylamine nitrate.

MR. TROSKOSKI: Yes, sir, it does. Absolutely, it means what you would have right here.

CHAIRMAN POWERS: And you might want to go through and check it. It's different nomenclature in different places.

MR. TROSKOSKI: Sure. HAN is hydroxylamine nitrate. There's an excellent DOE technical report out on the subject. It's EH-0555. I believe it's still on the Internet, and it's a good introduction.

Basically, we're in the aqueous polishing system, and it's a Purex system that's been around for quite a few years, almost as long as some of us. Right now what has happened in the process is you dissolve the plutonium material with the impurities in nitric acid. You contacted it with the organic phase, which has the tributyl phosphate. The tributyl phosphate grabs both the uranium and the plutonium, and then you're going to separate the organic phaseout, and you're going to hit it with another dilute nitric acid solution containing HAN and hydrazine, and the purpose of the HAN and hydrazine is basically to extract the plutonium by changing its valence from four to a three where it's soluble again in the aqueous phase.

So the plutonium now leaves the organic. It goes back to the acid phase, and then you can go and further concentrate it. You've now left basically most of the impurities behind, and you've got the high priority product that you're after.

A similar process is also used to recover unstripped plutonium in the last stage of the plutonium barrier prior to sending the solvent back to the regeneration process.

Hydrazine has a couple of functions. It stabilizes the HAN and it also reduces some plutonium while four to three. One of its functions is that it reacts very quickly with nitrous acid, which is the prime intermediate that we're concerned about with these types of reactions.

Within the process itself, you can expect to see HAN in both the purification systems and the solvent recovery systems.

HAN is not a benign chemical. It's a very reactive chemical. It almost could be classified as an explosive under the right conditions. It can undergo very rapid autocatalytic decomposition, much more so than even red oil.

Red oil you can kind of control it by controlling the off-gas because about 90 percent of the energy release in a red oil reaction comes from the chemical intermediates that are put off. But HAN is just much quicker by orders of magnitude. So pressure control is not a viable option here.

There are large quantities of gases involved, noncondensables with this type of reaction. Consequently pressure excursions for any kind of closed vessel or pipe are of a concern, and we do have a number of incidents that have happened both at Hanford and Savannah River site that are detailed in the DOE report where these have ruptured various process vessels.

The quantities of HAN that they intend to use at the MOX facility are comparable with what they have used before at both Savannah River and at Hanford.

The applicant has identified this as a high consequence event, as well they should. They've selected a preventive strategy to render this event highly unlikely.

The original application had some of the DOE recommendations that you've had in the 0555 report, but not all of them. During subsequent meetings with the staff, subsequent questioning, they have revised their approach until they have provided multiple parameters and controls. It has most, but not all of the recommendations, and they basically have tailor suited it to their process.

Now, the safety strategy that they have are based on two different cases. In one case, you're going to have vessels where you have HAN and hydrazine, but not MOX addition, and what you want to do in a case like that is to avoid the decomposition reaction together.

In Case 2, they are going to want to destroy HAN and hydrazine before further processing. So that's why they have the NOX addition. The NOX will react with it, and you'll get nitrogen, oxygen, water and other gases there with very little additional liquid waste that you'd have to process.

So they induce the composition to avoid recycling accumulation of the HAN in other parts of the process where you would not want it.

Now, for Case 1, where they want to avoid the decomposition reaction altogether, they've developed a kinetic model based upon multiple reaction mechanisms. The model will involve five partial differential equations that are coupled, that have to be solved simultaneously.

They used kinetic parameters from the literature from a variety of sources that have been printed throughout the years. They solved the model using a commercial software program. It provided predicted regions of stability and safe design base limits.

The applicant committed to confirmatory testing to substantiate the model, and a lot of the safety bases and safety limits are concentrations and temperatures that are in good agreement, in general, with the instability index that DOE has developed

Yes.

MR. SIEBER: Yes, before you move on, what are the parameters of importance that would lead to --

MR. TROSKOSKI: I'll get to that.

MR. SIEBER: -- stability?

MR. TROSKOSKI: That would lead to stability?

MR. SIEBER: Yes.

MR. TROSKOSKI: Yes. I'll get that in just a second.

MR. SIEBER: All right.

MR. TROSKOSKI: Excellent. For the control case, what they want to do is maintain temperature below 50 degrees C. Temperature, of course, is a big input for any kind of reactor reaction kinetics.

MR. SIEBER: Okay.

MR. TROSKOSKI: You want to maintain concentrations of key parameters at certain levels. You want to maintain a design basis for nitric acid. You want to have a certain amount of hydrazine available.

You want to have HAN at a certain amount, and then the last one I think we can clarify a little bit more. Limit the time in nitric acid and radiation fields. What that really means is when you mix HAN with nitric acid, there have been events before where over a period of time a vessel has been left for months or years, and the nitric acid has evaporated off. So it has concentrated the HAN to a very critical level where you have the reaction that occurred.

The other thing for radiation is since they're going to have a HAN-hydrazine mixture, hydrazine is a nitrous acid scavenger which would kill the process, but hydrazine is also susceptible to radiolysis from contact with plutonium. So you need to limit the time that it is in contact with that so that you don't decrease the concentration of the hydrazine.

MR. SIEBER: Is it an oxygen scavenger, too?

MR. TROSKOSKI: Hydrazine?

MR. SIEBER: Yeah.

PARTICIPANTS: Yes.

MR. TROSKOSKI: Yes?

DR. FORD: You showed some very specific

limits, design base data. What is the extent of the data upon which those are based?

MR. TROSKOSKI: It comes from various literature sources.

DR. FORD: So you've looked at that database and assured yourself that having those 50 degrees C. maximum, for instance, is adequate safety margin?

MR. TROSKOSKI: Well, I believe it's the next slide.

Well, we did review the literature equations, and we developed an exercise to similar model, and by that I mean there are differential equations in the literature input. We used a different commercial program. I think Polymath 5.1, my colleagues did, and they ran a series of runs on that to find the regions of stability, instability, and the margin for the design basis.

And as a result of that, what we've found is that there is substantial margin in each of the key parameters there. You'll notice on the bottom the HN3. We're assuming a design basis of zero molar concentration. That's because it's also a nitrous scavenger, and that's a conservative assumption. They're ignoring that. It adds extra margin.

But there is a substantial margin in each of the parameters.

DR. WALLIS: Of course, 25 percent is completely inappropriate in the first line. You could have used Kelvin or something.

DR. WEINER: Yes.

MR. TROSKOSKI: Yes, yes. Guilty as charged, sir.

DR. WEINER: Absolutely.

DR. FORD: So just to follow up a wee bit on that --

MR. TROSKOSKI: Sure.

DR. FORD: -- sine it does relate to the design basis criteria, these staple values, that's a mean, is it, of the database? A staple value of 53, that's not a mean because it's a less than sign.

I'm trying to get just what is the real margin.

CHAIRMAN POWERS: My understanding is you're talking about a mathematical model.

MR. TROSKOSKI: Yes, a mathematical model. We used --

DR. FORD: It's a mathematical model based on a very scattered database presumably.

MR. TROSKOSKI: Yes. Yes, it is.

DR. FORD: Okay, and so if you take the database --

MR. TROSKOSKI: How scattered is it?

DR. FORD: -- how scattered is it around this mathematical model?

MR. BROWN: I did some of the computer runs for this. Being a mathematical model, the results produced by the model are very -- have no uncertainty associated with them. It's just very distinct values.

So in other words, at 64 degrees the reactions were indicated as unstable. But at 63 it was stable.

DR. FORD: I recognize that, but were the data points, you know, below 63 in which it was unstable?

MR. TROSKOSKI: Were the data points below 63?

DR. FORD: Were there data points? I recognize that these are a model.

MR. MURRAY: Let me try and help and explain this. Okay? If you go and look at the available experimental data, that is, in the literature, okay, there is a significant quantity of information. Okay? Many experiments, many data points.

One of the concerns that the staff had with all of that data was that the testing tended just to look at one or two of the phenomena in a multi-phenomena model, if you will, real system. All right, and we found from looking at it and running, if you will, our own simulation that, yeah, we were generally in agreement, I'll use the term "alignment" if you will, with both the results of the different literature articles, something like 25 major research articles, okay, things like industrial engineering chemistry, transcripts of the Faraday Society and all that sort of stuff, you know, a lot of very good, erudite work.

All right, but there isn't one single source which looked, if you will, at the complete phenomena.

All right. Now, we found that the model predictions, they were generally in agreement if we look at some of the specific test data that was there. We did not explicitly look at uncertainty. One of the reasons has to do with the fact that the applicant has committed to confirmatory testing to actually generate uncertainties.

When they do that testing and we on the

staff review that, then we'll have a much better idea of the uncertainties around these parameters and what needs to be done to, if you will, develop set points.

Okay. Either set points accommodate the uncertainties both in the original data and also in the monitoring --

DR. FORD: I understand what you did.

MR. MURRAY: Yes.

DR. FORD: And it's done in many other fields also, but I still don't have a feeling as to if you had -- presumably this model would give you an algorithm of the unstable temperature as a function of all the other variables. You could --

MR. MURRAY: You can numerically generate that, yes.

DR. FORD: So if you could just give me a feeling. If you then plotted, predicated instability temperature versus observed data, what would the correlation factor be?

MR. MURRAY: I don't think we have that information at this time. What we have found is that the results in the model at the simulations, if you will, agree with some specific test points, for example, the test data that is in the EH report.

But in terms of actual correlation

factors, is it always 20 percent below, you know, does it vary with other parameters, you know, five percent at low nitric, 20 percent at high nitric concentrations? We do not have that information.

DR. FORD: But we've been told that the passing grade, if you like, for this is to have regional assurance of safety.

MR. MURRAY: Right.

DR. FORD: So can we be reasonably assured that there will not be a data point which shows instability below 63 degrees Centigrade if you play around with your other parameters, which are all within the conceivable operating descriptor.

MR. MURRAY: Again, with the available information that we have, both test data and running the mathematical model, we have reasonably assured -- it's not proved; it's not demonstrated -- but we have reasonable assurance that there won't be, if you will, a temperature below 63 degrees C. where it can become unstable.

The proposed strategy appears to have the ability to render the event highly unlikely, and again, that's the criteria for construction.

MR. TROSKOSKI: Be careful of just picking the temperature out alone because it's an interaction between the concentration of the other chemicals, also the ratio between some of the other chemicals.

If one looks to the DOE instability index plot that they've got in 0555, they plot temperature verse the instability index, and that's basically a function, a logarithmic function of your nitric acid concentration and your nitric acid to your HAN ratio, and then also it takes into effect an R as a catalyst of concentration there, and it actually comes up with a slope, and they have test data that they have plotted up above the slope, and there's a good scatter there as you can see.

And when we compared the values that we came up with here with those, we found in general pretty good agreement. We didn't find anything that stuck out and raised a flag to us.

DR. FORD: Do I understand that that left-hand column there, design basis values, those are now immutable? You can't change them?

MR. TROSKOSKI: Those are what the applicant has proposed to us as a result of the testing. The two-part licensing process is a bit confusing. I understand that, but it's fully recognized and expected once they do the testing, once they do an ISA, they may end up having to go back and propose changes to existing PSSCs. They may have to propose new ones, and again, those would have to be reviewed and approved by the staff.

But we fully expect as a result of the testing and doing a unit level ISA on a component-by-component basis where you ask what happens if you have a temperature excursion, a pressure excursion or you have extra volume, whatever, there may be additional safety issues that will shake out then during that process.

And, again, a lot of this is going to be very unit design specific, and a lot of that essential design information is just not available at this time for the staff to review.

DR. CROFF: What is HN3?

MR. MURRAY: Hydrazoic acid.

MR. TROSKOSKI: It's one of the byproducts of the hydrazine reactions.

MR. MURRAY: I'm sorry. Yes.

MR. TROSKOSKI: You also have to be careful of some of the constituents that are byproducts that can do other things to other parts of the process. It's a complicated process.

MR. SIEBER: So the acid phase is building up with time.

MR. MURRAY: Are you talking about the hydrazoic acid?

MR. SIEBER: Yes.

MR. MURRAY: If there weren't controls to address it, the hydrazoic acid would accumulate in the system.

MR. SIEBER: That's right. Okay.

MR. MURRAY: There's a separate series of controls which have been proposed by the applicant which the staff has reviewed, and those proposed controls appear to have the ability to prevent accumulation of hydrazoic acid.

MR. TROSKOSKI: There are other limits placed on the hydrazoic acid to keep it out of an explosive concentration from forming in a gas phase.

MR. SIEBER: Okay.

CHAIRMAN POWERS: Isn't it true that everyone that drives a car in America is exposed to the sodium salt?

MR. MURRAY: Hopefully, they won't have many crashes, but, yes, it has been used as the gas generator for airbags, yes.

DR. DENNING: I don't understand a zero value for the design basis of HN3. Is that below detectable limits or what does that mean in a design basis?

MR. TROSKOSKI: Actually there's going to be some in there, but we used zero in the calculations because it would actually act as a nitrous acid scavenger. So it would tend to mute any hand reaction or put it further down.

So by just having the design basis of zero here in the assumption, it no longer has a positive contribution to safety.

Now, for Case 2 we're going to actually introduce NOX in a controlled manner to react with and basically destroy any remnant HAN in hydrazine. We've got a number of controls. We've got with the off-gas system and then we have chemical safety controls, and the parameters are basically listed in the CAR table for codes. They address pressure, volume, temperature, et cetera, and generally range from ten to 20 percent.

The staff concludes that with Case 1 where there is no NOX, the model and literature do predict stability. The applicant has a commitment to finish conducting a series of confirmatory tests which we will be reviewing during the license application phase, and we believe that that's acceptable for the construction phase.

With Case 2, we believe that the codes and standards are consistent with industry good practices. The code methodology leads to design base values and ranges, and again, we believe that this is also acceptable for the construction phase.

And that would conclude my formal presentation on this. Are there any additional questions?

CHAIRMAN POWERS: That was great. That was fine.

Are there any questions on this?

(No response.)

CHAIRMAN POWERS: Let's move to the titanium electrolyzer.

MR. TROSKOSKI: I'll turn it over to my colleague, Alex.

MR. MURRAY: Thanks, Bill.

Let us move on to the next subject then -- oh, he found it. Hey, I'm just an engineer. These things are too complicated.

Let us move on to the electrolyzer then. The open issues identified as AP-03, and it involves the potential for titanium reactions or fires in the electrolyzer area.

Now, just by way of introduction, the

purification process, the Purex process requires that you work or use dissolved species. The feed material to this facility is plutonium dioxide. So it first has to be dissolved.

Plutonium dioxide, depending how it's being produced or what the grain size is and so forth, can be very difficult to dissolve under some situations. To address this from a process perspective, the applicant has selected an electrolytic method based upon the Department of Energy and Pacific Northwest Lab program results and also based upon its use in the Cogema La Hague facility in France.

Now, it's important to remember that electrolysis doesn't dissolve the plutonium dioxide itself. The electrolysis just produces a very reactor species, a silver plus two ion, and it is that silver plus two ion which actually affects the dissolution, and I've given some nominal conditions there.

Because silver tow is a very aggressive species, okay, it's a very aggressive oxidant, it can be very corrosive. And the applicant has proposed the use of titanium because of its corrosion resistance to Silver II species.

And just to point out where this can

occur, essentially there are two units, if you will, operational areas, at the proposed facility which contain electrolytic dissolvers.

This is dissolution for the standard plutonium dioxide, and this unit here can dissolve the alternate feedstock materials, as well as the standard plutonium dioxide. There are a total right now of three electrolyzers in these two areas.

Now, let's get to the safety issue. The staff has found that, well, titanium is a great material, but it also can be a reactive metal. Its use basically depends upon the conditions that it is exposed to and the presence of a very stable corrosion resisting film.

Under normal conditions in this electrolyzer, however, we have some very large electrical currents. We have the presence of oxygen in various forms, and our concern, the staff's concern, has been that an electrical fault, in effect, a shorting between the electrodes could somehow initiate and involve titanium reactions.

We also, as part of our review, looked at the planned fire protection measures, and we determined they would most likely not be effective on titanium fires, and so we also noted that a titanium type event will be very difficult to predict and also to mitigate.

The applicant has identified this as a high consequence event and has selected a preventative strategy. In the original application, they had not identified any controls for this potential event. In the revised application, I should say, which involves both some other information, they've also put on the docket, the revised approach involves both passive and active engineered controls.

Now, what is an electrolyzer? In the open literature there are schematics of various designs of electrolyzers. Just to give you some idea of the concept, I found one related to the Pacific Northwest Lab experiments. Now, this is, if you will, an experimental model. It's only about a liter size, maybe four inches around and 12 inches high, but it does have similarities to what the applicant will be proposing for the actual electrolyzers.

Key parts. It is cylindrical. There's a center cathode compartment in here, right there. Okay? There's also a porous thread material which surrounds this compartment. All right? An then there's an annular anode outside of that, and then you have multiple electrical connections.

Here we go. There's the cathode connection. There's the anode connection. Various connector for gases and what have you. Insulating materials between the electrodes. I can't make it out too well here. Some means for annotation, cooling jacket in this example around it, and the key part is the Silver II reactive reagent is generated in this outer jacket area here.

DR. WALLIS: Where does the silver come from?

MR. MURRAY: Silver nitrate, which is silver plus one, is dissolved in the nitric acid to begin with, and when you run it through the electrolyzer it is converted to Silver II

DR. FORD: I'm sorry. Tell me again why is silver important.

MR. MURRAY: Silver as the plus II species is a very aggressive species which has been found to assist the dissolution of just about any type of plutonium dioxide in nitric acid.

CHAIRMAN POWERS: Alex, they need to understand that it's the plus VI state that's soluble. Plus IV has a limited --

MR. MURRAY: Yes.

CHAIRMAN POWERS: -- it's not insoluble,

but less soluble. So you've got to oxidize the stuff.

MR. MURRAY: Right.

DR. FORD: So if there were chlorides impurity, the thing would go crazy.

MR. MURRAY: In the dechlorination unit, the electrolyzer is initially controlled in a different operating manner to remove the chloride species, yes. That's correct.

DR. FORD: And presumably there's strict composition controls on how much chloride you have there.

MR. MURRAY: Yes, and those limits are down as a design basis in the revised FSER.

DR. CROFF: How much experience have they had with this dechlorinator thing? Has this actually been operated on any commercial or substantial scale or is this new stuff?

MR. MURRAY: For the dechlorinators, it is the staff's understanding that they have some limited experimental data from France. We have not seen that data. We've looked more closely at the safety issues involved. In the case of a chloride containing plutonium dioxide, that is the evolution of chlorine. How is it addressed?

Okay, and as noted in the FSER, the

applicant has a safety strategy to address that.

MR. ROSEN: Now, this thing is made of glass, right?

MR. MURRAY: This is just an example of a laboratory electrolyzer, a small one which was used for testing. The proposed electrolyzer which has not been designed yet -- I want to emphasize that -- from the information which has been given to the staff and which is mentioned in the draft FSER, it will be cylindrical. There will be an inner cathode compartment. There will be an outer anode compartment. There'll be a porous material or frit (phonetic) here.

The applicant has mentioned that for their proposed electrolyzer this will most likely be silicon nitride. They can have different electrode materials and so forth.

MR. ROSEN: You mean the body of it will be silicon nitride to replace the Pyrex?

MR. MURRAY: This right here.

MR. ROSEN: Oh, the frit. What's the outer?

MR. MURRAY: The outer container here in the applicant's proposal, that is titanium.

MR. ROSEN: So there's a titanium cathode, anode, and a titanium body in the applicant --

MR. MURRAY: There's a titanium shell.

MR. ROSEN: Okay.

MR. MURRAY: The electrode materials, I want to say they're platinum and tantalum, but don't quote me on that.

MR. ROSEN: So we're worried only about the shell here in the applicant's proposal, although here --

MR. SIEBER: Because it's aggressive.

MR. MURRAY: Yes, in this example, this is purely an experimental vessel which was made out of Pyrex.

MR. ROSEN: And the anode and cathode in here were titanium.

MR. MURRAY: They were coated titanium, if my memory is correct.

MR. ROSEN: And the applicant's machine is going to have a titanium shell with tantalum and perhaps something else.

MR. MURRAY: Yes.

MR. ROSEN: For the platinum cathodes and anodes.

MR. MURRAY: Yes, yes.

MR. ROSEN: Okay.

MR. SIEBER: Well, this is DOE's recommended way of generating a plutonium powder in the calcining process. So this must have been used someplace.

MR. MURRAY: This was part of a large experimental program which Pacific Northwest Lab had going at the time, and it was --

MR. SIEBER: At Hanford.

MR. MURRAY: At Hanford, and it was to come up with a method for uniformly dissolving plutonium dioxide.

MR. SIEBER: And that was in the 1970s?

MR. MURRAY: To about 1990.

MR. SIEBER: Okay.

MR. MURRAY: Okay?

MR. SIEBER: I'm familiar with that.

MR. MURRAY: Okay.

DR. FORD: Presumably when you were going through the safety aspects of this you must have looked at all of the variables which would give rise to disintegration of the titanium anode.

MR. MURRAY: Yes. There is information from the DOE PNL work. Some of that information is in the public arena, and they do give parameters, recommended parameters for controls.

DR. FORD: And one of the things that we're looking at quite apart from the plutonium dissolution was the integrity of the titanium anode as a function of potential chloride concentration, salt, and nitric acid concentration?

I keep thinking that chloride and nitric acid is not a very good mixture, even for titanium.

MR. MURRAY: No, no.

CHAIRMAN POWERS: It's a wonderful mixture. It's called aqua regia.

MR. MURRAY: That's right, royal water.

CHAIRMAN POWERS: It's a tremendous salt.

MR. SIEBER: It's a party mixture.

MR. MURRAY: That's right.

DR. FORD: So my point is that when you come out with this reasonable assurance aspect, you satisfied yourself that it wasn't within the operational parameters, chloride concentrations, polarity of nitric acid, et cetera, et cetera, that you weren't going to have a problem with the titanium anode dissolving.

CHAIRMAN POWERS: There is no titanium anode.

MR. MURRAY: This is they're talking about the shell. Okay? In this example, again, I just wanted to mention look at these key attributes in this experimental one. They had a titanium anode or cathode -- excuse me -- in the center. Okay?

All right. I don't think we have any specifics on what the applicant is proposing, but I seem to recall that it was tantalum and platinum which was presented at one of the open meetings.

And, again, just using this just as an example to point out these key parameters.

DR. FORD: Again, not to jump into the ISA, is it?

MR. MURRAY: ISA.

DR. FORD: ISA time period. At this point we recognize it's a problem, and we're going to put off control of that problem to the ISA stage; is that right?

MR. MURRAY: No. No, we're looking for a control strategy here. The applicant has proposed a control strategy.

DR. FORD: That control strategy will involve --

MR. MURRAY: That we'll be getting to shortly.

DR. FORD: -- chloride.

MR. MURRAY: Okay. The control strategy

is to address the concern about a potential titanium reaction incidence/fire. All right? And how is that addressed and what is our review of it? Okay?

Now, the applicant has proposed controls for the three situations which I pointed out here: maintenance, a seismic event and normal operations when you have an electrical fault.

Just to quickly summarize the controls during maintenance, these are primarily administrative controls. Okay? One of the key ones is you turn off the electricity to the electrolyzer.

MR. ROSEN: Good start.

MR. MURRAY: And that is an excellent start, right.

(Laughter.)

MR. MURRAY: Stranger things have happened in life.

MR. ROSEN: This is a good thing to do when you're shutting a process down.

MR. MURRAY: Yes, absolutely.

MR. ROSEN: Fairly elementary.

MR. MURRAY: Yes. Now, I just want to let you know the staff has looked at this and, first off, we noted from our review of the literature -- and this is cited in the draft FSER -- that administrative controls are the general good practice, the RAGAGEP, again, if you will -- reasonably and generally accepted good engineering practice for addressing, if you will, a shutdown situation. All right?

There are parameters, DOE standards, various NFPA and other industry guidance which bring these type of administrative controls out in more detail. That type of detail we would expect to see in the license application.

And we would conclude that the proposed controls for maintenance periods are acceptable for the construction stage.

MR. ROSEN: Well, now you see, you put this very vague "other controls." Is that because you don't want me to ask?

When anybody does that, they always get a question. "Other requirements" and procedures, can you give me a feeling for what those might be? Are they merge requirements?

MR. MURRAY: In the case of, if you will, controls during shutdown, there might be additional fire protection requirements. Okay? There might be limitations on hot work, covering by putting some clean-up requirement for the electrolyzer itself.

MR. ROSEN: Do they have to get inside

this thing during shutdowns to maintain it?

MR. MURRAY: It is in a large glove box. Again, we do not have the details of maintenance.

MR. ROSEN: It's in a large glove box. You've got this electrolyzer. Now do you have to open the electrolyzer to get into the inside of it to maintain anything in it?

MR. MURRAY: The staff believes that there are times when, yes, that might have to be done. If nothing else, just for inspections of --

CHAIRMAN POWERS: Cathodes and anodes have to be replaced all the time.

MR. MURRAY: Exactly.

CHAIRMAN POWERS: Yeah.

MR. ROSEN: Okay. Now we're getting to the meat of it.

MR. MURRAY: Okay?

DR. FORD: I'm sorry. Could you explain what administrative controls in this RAGAGEP -- RAGAGEP --

MR. MURRAY: Reasonably and generally accepted good engineering practice.

MR. ROSEN: We know that most of the fires have started during shutdown, and now we've got an electrolyzer that we know has cathodes and anodes, and you have to replace them. Getting close to this. How do you do that?

MR. MURRAY: Huh?

MR. ROSEN: How do you do that? It's in a glovebox. So you're in an inerted environment, a nitrogen environment, to begin with.

MR. MURRAY: This glovebox I don't think is inerted.

MR. ROSEN: Not inerted?

MR. MURRAY: Not inerted. It's not a --

CHAIRMAN POWERS: In fact, I think you would not want to inert the outer shell of a titanium vessel.

MR. MURRAY: Right.

CHAIRMAN POWERS: And so I don't see why you would inert it.

MR. MURRAY: Right.

MR. ROSEN: Well, trying to prevent a fire actually, but it may not be --

DR. FORD: I would try to use the Wall Street Journal headlines criterion.

MR. MURRAY: Okay.

DR. FORD: Where you can see an action occurs, and they say, "Hey, they used this RAGAGEP," and I'm just trying to delve down to how detailed is this. Could it withstand the Wall Street Journal headlines?

MR. MURRAY: At the license application stage it must.

CHAIRMAN POWERS: Alex, we've got to understand. What particular part of the Code of Federal Regulations refers to a Wall Street Journal headlines?

DR. FORD: Well, I'm just --

(Laughter.)

CHAIRMAN POWERS: I mean, I just don't recall that one, Peter.

DR. FORD: It's not.

CHAIRMAN POWERS: In fact, I think it would be Presidential Directive 101.

MR. MURRAY: Okay, and we --

DR. FORD: Because reasonably and generally accepted to me means it's something that is mundane, like you sweep the floor or you -- something that is mundane.

MR. MURRAY: Well, no.

DR. FORD: Whereas this is a very highly complicated --

MR. MURRAY: Reasonably and generally accepted good engineering practice can be quite complex. Okay? For example, DOE has a standard on handling reactive metals, and FPA has a standard for handling titanium. Okay? These are the things you are supposed to do, you know. You're not supposed to have it energized. You're not supposed to, if you're doing hot work --

DR. FORD: So it's far more sophisticated than --

MR. MURRAY: Right, right.

DR. FORD: Okay.

MR. MURRAY: And we expect that at the license application stage these types of things will be written into procedures, including addressing clean-out, addressing replacement of electrodes, that type of thing, inspection requirements for corrosion concerns, what have you.

DR. DENNING: As a general practice, you'd like to minimize administrative controls, right?

MR. MURRAY: Yes.

DR. DENNING: I mean, that is -- and you decided here that it is acceptable, however, to use administrative controls here.

MR. MURRAY: This is only when it is shut down. Okay? And it is our understanding from discussions with the applicant, plus the information they have provided on the docket, that it will be shut down a relatively small percentage of the time.

DR. DENNING: But this is something that you could automate. I mean, it isn't something that you -- and maybe I'm wrong. Maybe there really is a penalty here to go into things that would automatically terminate the power there when you did something, opened the door, went into a certain mode.

MR. MURRAY: Right.

DR. DENNING: Is there a reason why? I mean, did you look into that to say why not do something that's automatic rather than accepting administrative control?

MR. MURRAY: We did consider that, and we do anticipate that there may be some sort of maintenance related interlock at a later time. such information would be in the license application.

If you look at the standard codes, particularly the DOE and the NFPA code on titanium -- I keep wanting to say NFPA 481, but I don't quote me on that -- if you look at those, they are primarily administrative. Okay? I don't recall specific interlocks mentioned.

However, that is an option that the applicant has, and as we get more into review of the detailed designs in the ISA at the license application stage, we will proceed from there.

DR. DENNING: But you don't take the position and then challenge the applicant and say why -- or am I pressing this too much? Is this just not an important enough administrative control?

But I would think, in general, you would say, "I don't accept administrative controls. Explain to me why this has to be an administrative control."

Are you taking that position or just because it's accepted in other areas as good practice to allow it to be administrative control you would allow it?

MR. MURRAY: At the present time we have asked the question of the applicant: what controls would you apply during maintenance activities? Okay?

And we have expressed our preference for, if you will, engineering controls over administrative controls. That is a preference, not a requirement.

The applicant came back with a safety strategy based upon administrative controls. Evaluation at this time for a construction authorization is that what the applicant has proposed is reasonable, consistent with good practice, and has the ability to prevent the event, which is what we need at this time.

Now, the question which you're asking, if you were to challenge the applicant, are there specific interlock type controls that should be part of that administrative procedure, if you will, or the control strategy for maintenance? We would have to look at the license application. Okay?

MR. ROSEN: I think we have expressed our interest in controls during maintenance, and especially in the electrolyzer, and would expect to see quite a bit of detail in the ISA.

MR. MURRAY: Yes, yes, yes. That's correct.

MR. ROSEN: And in your review of it.

MR. MURRAY: Yes.

MR. ROSEN: Including such things as sequence, sequences of operations during maintenance.

MR. MURRAY: Yes, yes.

DR. CROFF: I'd like to generalize my -- I had previously asked about experience with the dechlorinator.

MR. MURRAY: Yes.

DR. CROFF: Is there any experience with the standard electrolyzer, the one that doesn't dechlorinate?

MR. MURRAY: There is at the Cogema La Hague launch, yes.

DR. CROFF: Okay. So they have used one of these for --

MR. MURRAY: yes.

DR. CROFF: Okay.

MR. MURRAY: It is used. I think it's in a scrap recycle part of the plant.

DR. CROFF: Okay, and any feedback on their experience? Any bad experiences?

MR. MURRAY: We've only had limited feedback, which we did not use in the safety evaluation.

Can we move on here?

CHAIRMAN POWERS: Could I just ask one more question about the maintenance?

MR. MURRAY: Certainly.

CHAIRMAN POWERS: If I'm doing maintenance on an electrolyzer where I have to shut off the power and presumably pull cathodes, in the worst conceivable event, that is, a total ignition, how much could I possibly release?

MR. MURRAY: How much plutonium material?

CHAIRMAN POWERS: Yeah. Obviously I will have emptied it.

MR. MURRAY: We would expect that the administrative controls would have some requirement for clean-out, yes.

CHAIRMAN POWERS: And if I'm cleaning it out, it seems to me like I'm going to have zip release.

MR. MURRAY: Yes.

CHAIRMAN POWERS: In the worst conceivable event I can get, I don't think I can violate any site boundaries with a cleaned out electrolyzer.

MR. MURRAY: Yes, yes, and if you look at the DOE standard, for example, for handling titanium vessels, they actually mention vessels should have all material drained, and they should be cleaned out.

CHAIRMAN POWERS: Yeah, you almost have to do it in order to do anything on the vessel.

MR. MURRAY: Yeah. The applicant did not identify the DOE standard or NFPA --

CHAIRMAN POWERS: That's interesting. That's interesting.

MR. MURRAY: -- yeah, as a design basis, but the approach is reasonable and in alignment with generally accepted practice.

CHAIRMAN POWERS: Yeah. I don't have any trouble with that.

MR. MURRAY: Let me move on to the seismic event. The applicant has identified two controls here. One is the electrolyzer structure, and the second is what they call the seismic trip system, which is part of the process safety control subsystem or PSCS.

And I've listed the safety functions there.

And the staff looked at this and reviewed it, and we note we even did a top level fault tree analysis of this, and we found that there were two independent controls. We also found that the frequency of potential seismic events was relatively low, and we noted that the termination of the electricity prevented the event.

And in conclusion, we noted that having these two separate types of controls, in addition to the low frequency of the initiating event, that the approach should have the ability to render the titanium event highly unlikely, and that's acceptable.

DR. WALLIS: What does "maintain geometry for criticality purposes" mean? Does that have anything to do with switching off for power?

MR. MURRAY: The electrolyzer structure is also identified for addressing criticality events.

That's --

CHAIRMAN POWERS: It's got to be critical safe --

MR. MURRAY: Yes.

CHAIRMAN POWERS: -- configuration.

DR. WALLIS: You mean it could get into a more critical configuration in the event of a seismic event?

MR. MURRAY: If the vessel itself, the structure itself were to fail, you could have unfavorable geometry form on the floor, on the bottom of the glove box conceivably.

CHAIRMAN POWERS: Right. I don't know how they design it, but I would expect that flooding would get you into a more potential criticality.

MR. SIEBER: I would think so.

CHAIRMAN POWERS: If flooding external.

DR. WALLIS: It's a moderator there.

CHAIRMAN POWERS: An additional moderator I would think. I don't know what the design basis is.

MR. MURRAY: That's in the criticality section.

MR. SIEBER: I would presume that they would control the size of the electrolyzer so that you would not have enough mass in order to have a critical assembly.

MR. MURRAY: Again, you're getting into the criticality safety area, and this component was reviewed and the control strategy --

MR. SIEBER: Well, I will be patient and wait for that.

MR. MURRAY: Yes, but just you know --

DR. WALLIS: So out of context really.

MR. MURRAY: But just to let you know, appropriate design bases were identified for addressing criticality concerns in this area and for more details, ask Chris.

CHAIRMAN POWERS: The problem in criticality analyses with plutonium is you get this obnoxious plutonium hydroxide if your nitric acid concentration drops -- I forget the limits -- like about three molar, and so it's no longer a homogeneous solution, and things that you thought were critical safe based on geometry suddenly become not critical safe. They get flooded.

MR. MURRAY: Yes.

MR. SIEBER: Well, there's some other aspects, too. You really don't know what plutonium isotopes you have.

CHAIRMAN POWERS: They probably know

pretty well here.

MR. MURRAY: Yes, yes.

MR. SIEBER: Well, it's not all that clear because it changes over time.

CHAIRMAN POWERS: It comes in with a sheet that says here are the isotopes.

MR. SIEBER: And a little box, right.

MR. MURRAY: Let me just move along then. Now, the controls for the electrical fault during normal operations, the applicant has identified both passive and active engineered controls. The passive controls are essentially the sintered frit barrier, which is, if you will, the porous material, semi-porous material between the two compartments, and also various elastomeric materials, which are listed here.

PTFE is polytetrafluoroethylene. Sometimes the brand name is called Teflon, and as you can see, these components have safety functions of preventing anode/cathodes, anode/ground from contacting each other.

In addition, the applicant has proposed an active engineered control, and I've listed the safety functions here. Basically these are related to shutting down the electricity into the unit, and that these two trip circuits would be part of the process safety control subsystem.

Now, the applicant did not provide any additional information, such as experience from France, reference or what have you. So the staff did a lot of analyses on this.

And we did do a top level fault tree. We used some generic information from Savannah River site, Idaho, and some codes and standards, and we found that the combination of both passive and active controls appeared to have the ability of making the event highly unlikely.

We also found stated in the literature that active engineered controls detecting fault conditions, shutting power off, over voltage, over current protection, et cetera are also, if you will, good engineering practice, which is often used in the electrochemical industry, and we concluded that this safety strategy was appropriate for the construction stage.

And I believe that concludes this part, and we're back on schedule.

MR. ROSEN: Most remarkable, Mr. Chairman, most remarkable.

CHAIRMAN POWERS: I'll have to admit every titanium fire I know of did not come from electrical current. It came from hot work.

MR. MURRAY: If you go and look at the events which have happened, okay, there have been somewhere between five and ten events which involved hot work, nearby sparks, in one case even a battery powered device, okay, that imparted sufficient energy to titanium tube materials to start the reactions, and that was the staff concerns.

Now, the staff did consult some experts at the agency here who have experience handling titanium materials. We presented the electrolyzer conditions, typical voltage, currents, and what have you, and they expressed concerns that in that situation it would be hard to argue that a titanium fire would not be initiated.

CHAIRMAN POWERS: Yeah, I don't doubt that it could. It seems to me maintenance in the glovebox is one of the bigger things to worry about.

MR. MURRAY: Yes, yes.

CHAIRMAN POWERS: Any other questions to Alex?

I presume that you're willing to cover this and previous topics as well.

MR. MURRAY: Sure, sure.

(Laughter.)

MR. MURRAY: Any depth or any breadth you'd like.

DR. FORD: Alex, I have a question of the electrolyzer.

MR. MURRAY: Certainly.

DR. FORD: Surely, aren't you going to have copious amounts of hydrogen being emitted?

MR. MURRAY: That will be discussed this afternoon in the flammability part. Okay? We actually have a nice, cute little figure to show you, which is also from the Pacific Northwest Lab results, and this shows hydrogen generation as a function of nitric acid concentration.

And the applicant has proposed a strategy based upon having a minimum nitric acid concentration. If you take that curve at that nitric acid concentration, the hydrogen generation will be below the lower flammability limit by a pretty good margin.

CHAIRMAN POWERS: And understand now you have a tradeoff in your criticality safety because the plutonium hydroxide polymer can be a real pain in the neck.

Any other questions?

(No response.)

CHAIRMAN POWERS: Well, seeing none, then

I'll recess this until one o'clock, I guess.

Thank you very much.

(Whereupon, at 12:02 p.m., the subcommittee meeting was adjourned, to reconvene at 1:00 p.m., the same day.)

AFTERNOON SESSION

(1:02 p.m.)

CHAIRMAN POWERS: Let's come back into session.

I think we're moving on toward one of the really exciting areas, uranium burnback, and I don't know what. Have we got a speaker? Oh, Dave is going to do it extemporaneously, right?

MR. BROWN: I will.

CHAIRMAN POWERS: This is one that you can do extemporaneously.

MR. BROWN: As soon as Alex gets here, I'll sit beside you.

The concern here is the fact that this mixed oxide fuel will, of course, contain a depleted uranium oxide component. That material has been observed to undergo what we've called burnback, which is oxidation from the UO_2 to U_3O_8.

The area where that is a hazard is where the uranium is a powder, not yet commingled with the plutonium, but it has been ball-milled to a very fine particle size and, as a result, has a fairly high surface area, specific surface area, if you will, and most of that -- and I'm sorry. I said when it was not commingled with plutonium. That hazard exists throughout so long as it's an unconsolidated powder through the barriers of the process that are here marked in red.

So when the powder has been consolidated into a pellet, that's when essentially the hazard of burnback has been removed because at that point there's no longer enough specific surface area to cause this high oxidation.

DR. WALLIS: Where is this oxygen coming from?

MR. BROWN: The oxygen that supports the burnback? From there in the vicinity of the powder.

I'm sorry?

DR. WALLIS: So it's in the air?

MR. BROWN: Yes, and so for example, where burnback has been observed before is anywhere where air has been allowed to get into that process area either by opening a drum containing the powder or by simply allowing air instead of allowing nitrogen to get into a glovebox, for example.

CHAIRMAN POWERS: Alex, we were running a test to see if the PM had been listening to you or not.

MR. MURRAY: Okay.

CHAIRMAN POWERS: He's doing pretty well, actually. He's doing real well.

MR. BROWN: But I will step aside.

(Laughter.)

MR. MURRAY: Maybe I should have circled the block.

(Laughter.)

MR. MURRAY: Thank you, Dave.

Okay. Sorry about that. Trying to get a CD burner to work and it is so far not responding.

CHAIRMAN POWERS: Too many safety interlocks.

MR. MURRAY: That must be it.

As Dave was just mentioning, you know, burnback reactions, they do require oxygen from the air or another source. They can occur quite rapidly and get to some reasonably high temperatures, several hundred degrees centigrade, maybe even up to the 600 degrees centigrade degree range quite quickly.

One thing about burnback, particularly with events which have occurred historically, they can initiate other reactions and/or disbursal of material, and at the proposed max facility, the main concern is with the ball-milled material because that is a very fine material. It also is being blended with plutonium dioxide. So you have, if you will, a decent source term there as well.

And one of the things to keep in mind which has been found is that the burnback is essentially a kinetically limited reaction. In order for it to occur rapidly, you have to have small particle sizes generally less than about ten microns.

CHAIRMAN POWERS: What do you mean by kinetically limited? You're talking about the chemical kinetics at the surface?

MR. MURRAY: I'm using the term "kinetically limited" to mean that the uranium dioxide is fundamentally unstable from a thermodynamic viewpoint under normal conditions. Okay? In the atmosphere with the 20 percent partial pressure fraction of oxygen.

However, if it is of a sufficiently large particle size, if you will, the amount of material that can participate in the reaction is so slow it cannot, if you will, heat up and react faster which would occur if you had a finer particle size, things of that nature. It is fundamentally kinetically limited.

So, for example, if you have a very fine powder, it can undergo burnback reactions if it can be initiated at room temperature. You just sufficiently disturb it or in the presence of air and it will react.

If you have material a little courser, generally, say, in the 20 microns range, you generally need about 60 to 100 degrees centigrade. If you're dealing with something like pallets, for example, you generally have to heat those up to something like 300 to 400 degrees centigrade.

DR. WALLIS: It doesn't make a difference how it's disbursed if it's just in a pile like that. Presumably it eats up all of the oxygen in the pile. It only burns on the surface, but if you disburse it, fluff it up and puff it up into a cloud --

MR. MURRAY: Yes.

DR. WALLIS: -- it's going to react more quickly.

MR. MURRAY: That is correct. It's a little bit like a dust cloud.

DR. WALLIS: Yes.

MR. SIEBER: Yes, or coal dust.

MR. MURRAY: Yes, like a dust cloud, yes, exactly.

MR. SIEBER: But you don't need an ignition source.

MR. MURRAY: If the material is fine

enough, a small enough diameter, that's correct. You don't need in your resource. It purely is mass transfer limited.

And I just included standard pictures of uranium dioxide and plutonium dioxide.

Now, the applicant has proposed a safety approach to address this event, and this involves a preventative strategy to remove fine depleted uranium oxide particles before they can impact the HEPA filters, and if these fine particles are removed before they impact the HEPA filters, this allows the HEPA filters to continue to perform their safety functions, which is essentially a confinement barrier.

And the safety controls I just want to point out in the original application, the applicant did not have any safety controls identified in the revised CAR, revised construction authorization request, which was received this past summer. They included PSSCs to address this event, and these are two high strength metal pre-filters.

And here's the description of the applicant's safety controls, two high strength stainless steel mesh pre-filters. They sometimes use the term "spark arresters" in the application. They also have two after the air stream has passed through these metal pre-filters. They also have two HEPA filter elements, all within the same housing.

In addition, you have the standard redundancy of an air handling system.

DR. WALLIS: I don't understand this at all. You've got a filter which collects the particles of uranium oxide?

MR. MURRAY: Right.

DR. WALLIS: And the air is blowing through it. So why doesn't it react and blow it on the filter?

MR. MURRAY: Well, it can react on the metal pre-filter.

DR. WALLIS: So you make yellow cake on the filter.

MR. MURRAY: Right. The safety strategy is to prevent the uranium dioxide particles from, if you will, reaching the HEPA filter elements.

DR. WALLIS: You don't care if they burn then.

CHAIRMAN POWERS: That would not be yellow cake. It's uraninite.

MR. MURRAY: Huh?

CHAIRMAN POWERS: You would not make yellow cake.

MR. MURRAY: No.

CHAIRMAN POWERS: You would make uraninite.

MR. MURRAY: Yes, that's correct.

DR. WALLIS: Why is that high strength?

MR. MURRAY: To take potential temperature extremes and even pressure delta pet peak considerations across the metal pre-filters because burnback reactions in past instances have achieved temperatures as high as 600 or so degrees Centigrade. You know, if you have it out of stainless steel, that's a completely different matter as having it in a HEPA filter.

Again, the key thing is prevent the material from reaching the HEPA filter.

MR. SIEBER: That's all you protect though because uranium dioxide lines are going to be everyplace in the system where there's any kind of a leak. So the potential of rapid oxidation is always going to be where the material will collect.

MR. MURRAY: That's right. That is correct.

MR. SIEBER: So you don't worry about that so much as the boundary, which is the filter.

MR. MURRAY: Exactly, exactly. The

concern is maintaining the confinement boundary is the HEPA filter.

MR. ROSEN: So the idea is to burn right there in those stainless steel pre-filters, right?

MR. MURRAY: Potentially, yes.

MR. ROSEN: I mean, the idea is to burn it up before it has to get to the HEPA.

MR. MURRAY: That's correct, yes. Before it can, if you will, impact and damage the HEPA filters.

MR. ROSEN: So you expect this to happen once in a while, to have some burnback in those filters.

MR. MURRAY: Yes, conceivably.

Now, I will add -- and we'll get to this a little more in a moment -- in the process, in the applicant's proposed design, where powders are handled, they're under nitrogen. Okay? They have not identified nitrogen as, if you will, or the supply of nitrogen as being a safety control.

As a matter of fact, as the air streams come together from the different powder process gloveboxes, some of the other gloveboxes are normal atmosphere. So by the time the mixture reaches the final plenums where the C4 HEPA filters are, you actually have, if you will, an air stream or close to an air stream.

Okay, and on this slide I've used some other design basis information for the HEPA filters and the ventilation system. The pressure drop design for ten inches of water pressure or less, the fire barriers between areas and also the applicant has also identified administrative controls for inspection and maintenance of the HEPA filters.

Okay. Here I'm just giving some specifics on the two pre-filters, and as you can see, they have a design basis of removing 90 percent of the particles greater than one micro in size, and again, the safety function is a protection of the HEPAs.

Do you have a question, Dana?

CHAIRMAN POWERS: Not on this in particular, but in the SER you go on -- in fact, you don't go on, but who ever wrote this thing goes on and then discusses the potential for burnback and substoichiometric plutonium dioxide, and it's presented more as a plausibility argument than the basis of any experience, and I certainly don't know a burnback in substoichiometric plutonium dioxide, and I wondered. I mean, the reason you get burnback here is a peculiarity of the partial molar free energy of oxygen going into uranium dioxide.

MR. MURRAY: Yes, yes.

CHAIRMAN POWERS: I mean taking it over to first U_4O_9 and then on to U_3O_8.

In the substoichiometric plutonium dioxide, you've got a different situation. Unless you're wildly substoichiometric -- and I don't know of anybody that's producing wildly substoichiometric plutonium dioxide -- you're going to go from a little bit below stoichiometry to a little less below stoichiometry.

I mean, it's not the same magnitude of thermal effect. Did somebody do any sort of calculations to suggest there could actually be a burnback effect in substoichiometric or is it just a plausibility argument? It's presented more like a plausibility argument.

MR. MURRAY: Yes. On the south tract (phonetic) of the plutonium dioxide or substoichiometric plutonium dioxide, that is from information supplied by Los Alamos.

CHAIRMAN POWERS: Okay.

MR. MURRAY: And it primarily relates to the sesquioxide PU_2O_3 up to PUO_2, perhaps PUO_2 plus .05 or 2.05, 2.1, and from the information we found, the enthalpy effect is far less. That's why they're sort of handled separately in the revised -- I should say in the FSER.

CHAIRMAN POWERS: Yeah, it's kind of a confused argument because it does talk about the superstoichiometric material or oxygen or water absorption of plutonium dioxide, but I don't know of anybody that has actually produced superstoichiometric plutonium dioxide. Dave Hanshe (phonetic) gets some stuff that has water absorption on it, but I mean, that's not really superstoichiometric.

MR. MURRAY: Most of the information which we found was related to other volatile species, but the substoichiometric to slightly superstoichiometric PUO_2 concern arose from one of the researchers at Los Alamos.

CHAIRMAN POWERS: Okay.

MR. MURRAY: And the applicant has an approach for addressing those type of concerns in addition to the volatile concerns, and that's discussed in the FSER.

CHAIRMAN POWERS: Yeah. I mean, it's a little different than this. You've actually -- this has actually occurred in a couple of the fuel plants.

MR. MURRAY: Events have occurred. Plus

the fuel cycle licensees which manufacture UO_2 fuel, the way they process the fuel, their comment is it's a process argument. They usually do a number of steps which limit the reactivity of the UO_2 powders.

CHAIRMAN POWERS: Yeah. In fact, if you processed all of your powders in air, you would never get a burnback.

MR. MURRAY: That's right because it would oxidize.

CHAIRMAN POWERS: Because you're doing it in the inert atmosphere --

MR. MURRAY: Right.

CHAIRMAN POWERS: -- that you even have the potential of getting burnback.

MR. MURRAY: That's right. That's right. And they usually do something to control the amount of oxidation so that it just occurs at the surface as it is loaded into a container, for example.

CHAIRMAN POWERS: Okay. Any other questions about the fascinating world of burnback?

It's fun.

MR. MURRAY: Yeah.

CHAIRMAN POWERS: I mean, Alex did not go into decrepitation and the fact that it takes these ten micron particles and converts them into submicron particles.

MR. ROSEN: It's own fuel.

CHAIRMAN POWERS: It kind of decrepitates. I mean, there's all kinds of excitement. Plus things on surfaces bounce along the surfaces and things like that.

MR. MURRAY: Yes, an example of unique phenomena which occur.

I just wanted to also mention that the applicant has identified what they call APFs or additional protective features, and for uranium burnback, I have listed them here.

CHAIRMAN POWERS: Delivered to the site in sealed drums. That's why you have the problem.

(Laughter.)

CHAIRMAN POWERS: You wouldn't have the problem if they didn't do that.

MR. MURRAY: That's correct.

MR. ROSEN: You'd have the burnback someplace else.

CHAIRMAN POWERS: Yeah, when you filled the drum.

MR. MURRAY: Yes, sir. Again, about the burnback phenomena, it's a question of where it occurs and to what extent, and if it's in an area where you can handle it and where confinement boundaries and HEPA filters are not challenged, in effect, you've prevented the event from impacting those confinement barriers.

CHAIRMAN POWERS: The biggest change I think they made is in their choice of materials for their HEPAs. I mean, they are relatively immune to --

MR. MURRAY: Yeah, they're much more robust.

CHAIRMAN POWERS: Yeah. I mean, other places where we had the old paper HEPAs, it just really couldn't survive this kind of thing at all.

MR. MURRAY: Right, right.

CHAIRMAN POWERS: And they couldn't take any loading. That was the big problem, was they couldn't take any heavy particulate loading so that they blow out and you'd get the entire inventory of the filter.

MR. MURRAY: Yes, yes, that's correct.

I just want to summarize the staff evaluation. We postulated that there could be a glovebox spill or fire that could disburse these fine UO_2 particles into the ventilation system, and the C4 ventilation system is the glovebox ventilation system. Okay?

And from an analysis, we looked at ball-milled material, which would be the finest material in the facility, and we found that the amount which could end up being deposited on the HEPAs after going through the system, going through the stainless steel mesh pre-filters would be something around ten to 25 percent of that needed to cause temperature damage.

And we concluded that this was an adequate safety strategy. The HEPAs could survive a burnback reaction, and they could continue to perform the safety function.

Any questions?

CHAIRMAN POWERS: Any other questions?

(No response.)

CHAIRMAN POWERS: Well, you guys don't like -- either ate too much lunch or just don't like burnback.

(Laughter.)

CHAIRMAN POWERS: Let's go talk about TEELS.

MR. MURRAY: Okay. The next subject area we're going to look at is what are called TEELS, and I'll also use the term "chemical limits," "chemical consequence limits."

And for the revised Part 70, as was

discussed this morning, both high and intermediate consequence chemical events are identified as needing to be addressed in the application.

In order to define what are high and intermediate consequence events, you have to have chemical levels or criteria, and these limits are shown as parts of the regulation where they are important and cited. These limits should address, if you will, or should be, I should say, quantitative standards that relate to acute chemical exposure levels.

Okay. These are not long term exposure levels, not, if you will, occupancy type levels. These are levels which are appropriate for potential events and accidents.

Let me just mention what the safety issue is. These chemical limits essentially are used to determine what the safety controls and the design bases are. No, in the standard review plan for MOX, several are mentioned, AEGLs, A-E-G-Ls, which are from the EPA and National Academy of Science, and there's a number of people involved with that.

There are also ERPGs, which are emergency response planning guidelines which come from an industry group, and the SRP also mentions limits from

OSHA and NIOSH. PELs are permissible exposure levels, a little more like occupancy levels. STs are short-term exposure limits. Cs refers to ceiling limits.

Okay, and of course, the standard review plan says that the applicant may use an alternative, provided that they adequately justify it.

Now, as part of our review of the CAR application and related information, we found that there can be significant variations between all of these limits, and that can affect the selection of safety controls.

DR. FORD: So which one do you choose?

MR. MURRAY: He's a good straight man.

(Laughter.)

MR. MURRAY: We're getting there, and that's where we're going to.

Now, in the initial application, the applicant did not have any chemical limits identified. Okay? In the revised application, including the application which came in in June 2004, they have values in Table 8-5 of the application which are based on a combination of TEELS, which are temporary emergency exposure limits, and ERPGs. Okay?

So the staff went and looked at these revised application values and went from there.

Now, when you have these different limits, generally they have three levels. You have a Level III, which as AEGL-3, ERPG-3, TEEL-3, and these can correspond, if you will, to a high consequence type event.

You can have Level IIs, which usually correspond to a more intermediate event. I should say a high consequence event is usually life threatening or with part of the definition includes life threatening effects. An intermediate effect can be a significant injury, but the person is still able to escape from the area.

And then, of course, there's the low effect where it is more just an offensible (phonetic) odor or stinging of the eye and so forth.

This is how, this table which I'm showing here, is how the applicant has decided to, if you will, determine what are high, intermediate, and low consequence events, and they have identified them for both the worker receptor and also the IOC/public receptor. And the only difference between those two is the distance to where the receptor is assumed to be.

CHAIRMAN POWERS: Sixty meters was a difference now. There's no difference at all.

MR. MURRAY: Yes, there's only a small difference now. It used to be 100 meters versus four and a half miles. Now it's 100 meters.

MR. ROSEN: For example, how long is the longest dimension of a building?

MR. MURRAY: Hold on a second. I want to say it's about 170 meters. Do you know, Dave, offhand?

MR. BROWN: I don't know. I think it's a little larger than that.

MR. ROSEN: One hundred and 70 meters. So it's --

MR. BROWN: Or round about.

MR. MURRAY: Yeah, somewhere on that order.

MR. ROSEN: So if you release something at one end of the building, somebody at the other end of the building --

CHAIRMAN POWERS: Is safer than somebody at the site boundary.

MR. ROSEN: Right. Further away from the source.

MR. MURRAY: Yes. Significantly, in this case, the applicant has made commitments that while they define high, intermediate, and low consequence events by the preceding table, in actuality they are going to not exceed, if you will, the Level II values, TEEL-2s, ERPG-2 values for the worker receptors, and not exceeding the Level I values for the public receptors at 160 meters.

And if you can compare the two tables, you notice that these are essentially one step lower.

Now, the staff looked at this, and again, we noted and it's all discussed in the FSER that there are multiple limits which are available, and one of the concerns that we had was that the Level III values, which the applicant had proposed, trend toward the high ranges of all the limits which are out there in the world.

Now, when you look at the Level II limits, TEEL-2, ERPG-2, you find that these are significantly lower than these Level III limits. They all are below what are called IDLH values, immediately dangerous to life and health, and there's more consistency between the different limits.

And I point out again here the applicant's commitment to workers and not exceeding a Level II level and the public not being exposed to anything greater than the Level I.

The staff review also found out that Level

I values tend to approximate what we call habitability limits which are put out by OSHA and NIOSH. Okay? And in the end we've summed this all up in several tables in the FSER. We find that their approach on the limits is acceptable for the construction stage.

MR. ROSEN: Is the habitability limit something that if you were at that limit, you could live there essentially forever?

MR. MURRAY: Essentially indefinitely. Okay. If you look at the definitions, most of the Level I values, be they ERPGs, TEELs, AEGLs, they all are generally identified as being, oh, there's noticeable odor. There might be some discomfort, but there is essentially no significant effect.

CHAIRMAN POWERS: I thought they were for an eight-hour working day.

MR. MURRAY: The Level I values?

CHAIRMAN POWERS: The habitability limits.

MR. MURRAY: Habitability limits --

CHAIRMAN POWERS: I don't think you do infinite amount of time. I mean if there's any order at all, you can't be there for an infinite amount of time.

MR. MURRAY: I have to check on that, Dana.

CHAIRMAN POWERS: I think they're for, you know -- I mean, I think the idea was taking advantage of basic workers are relatively healthy people and have good recovery systems, all operational, and so that it was for a finite period of time, but I could be wrong. It has been a long time since I looked at them.

MR. MURRAY: I have to check. I know there are habitability limits out there which tend to be long term, in essence, and also there are similar limits out there which are work day limits, which are eight-hour limits.

CHAIRMAN POWERS: Yeah, I just can't remember which one's which.

MR. MURRAY: Yeah, I'd have to check for you, Dana.

Okay, and any other questions on TEELS?

CHAIRMAN POWERS: The bottom line is they've straightened this out and gotten it organized so that it's a fairly coherent --

MR. MURRAY: Yes.

CHAIRMAN POWERS: -- and meaningful set now instead of that hodgepodge that came in originally.

MR. MURRAY: Right, right. It seems that

the approach is now better thought out, more consistent, and the focus on, if you will, essentially using lower values, a commitment to lower values is, we think, a very positive step.

CHAIRMAN POWERS: Everybody wants lower values on these things.

MR. MURRAY: Yes, yes, yes.

CHAIRMAN POWERS: The NRC and its reactor domain has what, four years ago, I guess? Went through this for the control rooms of the reactors and looked at them.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Did you do a cross-comparison between the two?

MR. MURRAY: Yes, we did, okay, and we found that sometimes the Level III limits will, if you will, exceed those limits in Reg. Guide 1.78 on control room habitability, and sometimes they'd be a little bit below.

CHAIRMAN POWERS: I mean, the whole situation on limits and chemicals is just a mess in this country.

MR. MURRAY: Yes.

CHAIRMAN POWERS: And unfortunately NRC is too small of a fish to put pressure on them to fix it.

MR. MURRAY: We're just a little guppy in the big ocean.

CHAIRMAN POWERS: Yeah. And nobody wants to fix it because they've got the set that they want to live with, and they don't want anybody to change it, and so it's a hodgepodge.

MR. MURRAY: And there's limited data for making changes.

CHAIRMAN POWERS: That's also the problem.

MR. MURRAY: Yes. Okay. Any other questions?

We'll discuss control room habitability a little later on.

CHAIRMAN POWERS: Good. Any other questions about -- I mean, it's an extremely frustrating area because, I mean, we don't have expertise in this area. You'd like to have somebody, you know, like ICRP come in and lay down the law on this, but as we said, there's nobody in a position to do it, and NRC is just not capable of putting the torque on the necessary legislators to do it, and people have their own limits for their processes, and they just don't want anybody to change it.

MR. MURRAY: Yeah.

CHAIRMAN POWERS: And the other problem is there are more chemicals than there are limits. So you end up doing strange things that you know are unjustifiable because we wouldn't call them different chemicals if they had all the same properties.

MR. MURRAY: That's right. That's right.

CHAIRMAN POWERS: So it's extremely frustrating. But having something that hangs together and makes sense is about the best you can hope for.

MR. MURRAY: Yes, and that's the approach we've taken.

And, well, since we've discussed the control room, here we are, discussing control room habitability. And I just want to just again do a quick introduction about habitability.

The proposed MOX facility will have multiple control rooms and areas. Okay? Now, in addition, the applicant has stated they will have two emergency control rooms or ECRs. And I've listed the two functions of those ECRs.

The first is to maintain a habitable environment for operators, and the second is to provide cooling to emergency electrical rooms.

MR. ROSEN: Are these emergency control rooms the ones that are continuously manned or is there nothing analogous to a power plant control room in this facility, that is, one place that is continuously manned, where individuals who are competent in the whole process, keep an eye on the whole everything that's going on, or is it much more disbursed than that, nothing like that?

MR. MURRAY: Our impression, myself, other reviewers, of the proposed facility is that there will be more of what we call a distributed control strategy, whether it be, in essence, separate control rooms for specific areas of the plant, and this is what the applicant has identified in their application.

As it goes forward into final design and we receive a license application, we anticipate one or more of those areas or the emergency control rooms may be identified as continuously manned, but at the present time, if an event were to occur, the appropriate operators would go to the ECRs and perform their safety functions, which is monitoring a safe shutdown.

MR. ROSEN: Well, it gives me a little bit of concern, the idea that there's no one place where someone or other has overall integrated responsibility for the facility on a 24-7 basis. They may not be doing anything in particular in terms of process-wise, but they're just watching. They know what's going on. This is they're operating. They're operating here. They're operating on Level II, then this and that.

And so they know how many people roughly there are in the facility and where they are and who they may be. So, you know, if there's an emergency they can do an accountability, get people out, know who's supposed to be there, who they've gotten out, who's missing and that kind of thing.

Any thoughts along those lines?

MR. MURRAY: From the staff's review of the application, revised application, plus also other documentation and discussions with the applicant, our impression is the ECRs may end up meeting that requirement.

But at the present time we're looking at design bases. We don't have explicit information on --

MR. SIEBER: It doesn't say that.

MR. MURRAY: Exactly, exactly.

MR. ROSEN: And you have no criteria for that kind of function.

MR. MURRAY: If you're talking about an accountability function, no. If you're talking about maintaining habitability in the emergency control room, we have --

MR. ROSEN: I'm talking about accountability function, overall process control over the whole facility.

MR. MURRAY: We would expect the details of that to be in the license application. We do have in the instrument area and some of the human factors areas, if you will, design bases which have been identified by the applicant and reviewed by the staff, which, again, top level sort of approach would address those sorts of questions.

CHAIRMAN POWERS: Well, I guess the question that comes to mind is suppose you have an event that exceeds your expectations. Well, maybe it doesn't exceed your expectations, but it hits your low probability events. Low probability events do occur.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Who makes the declaration of a general site emergency?

MR. MURRAY: That would be in a procedure, and procedures will be reviewed in the license application.

CHAIRMAN POWERS: Yeah, but who does it? I mean, who's going to read this procedure and follow it?

MR. MURRAY: I would have to look at the management structure, which is discussed and evaluated up front in the document. Right now I don't have an answer.

CHAIRMAN POWERS: Yeah, but the trouble is I don't think I have an answer either, and I think I looked at that. I mean, I think I don't understand what I read.

MR. MURRAY: Yeah, do you recall, Dave?

MR. BROWN: No, I don't recall the specific title of the individual who's responsible for managing emergency response at the plant in the event of such an emergency.

They have described specific features of the plant, you know, such as the safe havens. There are five safe havens.

CHAIRMAN POWERS: Yeah, I've got all of that sort of stuff.

MR. BROWN: Nonessential personnel will escape to those areas, that sort of thing.

CHAIRMAN POWERS: They've got lots of individual things, but who makes the decision that I have a general site emergency? Who makes the phone call to the NRC that says, "I've got a problem here"?

MR. BROWN: This is something --

CHAIRMAN POWERS: Who calls Savannah River that "look out, F. Canyon. Here I come"?

MR. BROWN: The current plan, and as you may have seen in the CAR in Chapter 14, is that this facility will be integrated with the existing Savannah River site facilities. The plan is that this will be an annex to the site-wide emergency plan. So the call would be to the Savannah River site in the operations center.

CHAIRMAN POWERS: I know where it's going to go.

MR. BROWN: But who, right? I understand.

CHAIRMAN POWERS: And the other thing is I'm quite certain this facility will follow the well established rule known since TMI, Chernobyl, et cetera, that all major events occur after one o'clock on Tuesday morning, call on the back shift.

So the question really boils down to: who is this guy?

MR. ROSEN: Where does he sit?

CHAIRMAN POWERS: And how does he know that he's got a general site emergency if he's in Control Room 2 and Control Room 1 is where the event is taking place?

MR. BROWN: Well, the control rooms, as

Alex suggested, are distributed so that there's a control room for the aqueous polishing side of the plant, a control room for the MOX fabrication side of the plant. So there are not two trains of the normal controls.

CHAIRMAN POWERS: No, no, no. That's not what I'm implying. I'm implying that the guy that's familiar with aqueous polishing knows when he's getting into trouble.

MR. BROWN: That shift supervisor, right?

CHAIRMAN POWERS: He may not understand when he's getting in trouble when he has a metal fire going on over in the fuel fab site.

MR. BROWN: Oh, okay.

CHAIRMAN POWERS: And vice versa, and so the guy in the aqueous polishing may not be the guy that is the right guy to make the call about a general site emergency because you're burning fuel. I mean, I don't know. Maybe he is. Maybe this is Mr. Wonderful here, but aqueous chemists tend not to be terribly familiar with condensed phased reactions and vice versa.

MR. BROWN: Right.

MR. MURRAY: Unless you've been burned by both.

CHAIRMAN POWERS: Unless you've been burned by both, exactly.

MR. ROSEN: So in which case you're promoted to being the guy who we look to.

CHAIRMAN POWERS: You're the guy that we're looking for, is the guy that has holes in both sides of his jeans.

MR. MURRAY: Yes, I don't think from our review of the application we have a specific, if you will, title or position identified.

MR. ROSEN: You understand, Alex, that in reactor operations, just by comparison, you've got one, two, three, probably four levels of control that are established, and the transfer of control from the main control room during operation through these other levels of control is a very choreographed protocol operation.

MR. MURRAY: Yes, yes.

MR. ROSEN: And there's a great deal of detail, and what we find here is we don't even know where the control room is. I find that rather astonishing.

MR. MURRAY: Well, I think what we have run into is one of the artifacts of the two-step licensing. You know, top level design basis information now, detailed procedures, identification of positions for calling or starting these emergency actions would be defined in the license application, but we can go back and take a look.

MR. BROWN: That's exactly right. The focus now is on system structures and components to make sure that the systems that would alert operators of that condition are there, but we don't have detailed information on the plant procedures, including emergency procedures.

CHAIRMAN POWERS: You know, you can make this two-step system the last refuge of the scoundrel here. I mean this sounds like it's fairly fundament to me.

MR. BROWN: To the structures? I don't think so.

CHAIRMAN POWERS: I mean, to the overall design is understanding who's in charge when.

DR. WEINER: Well, shouldn't there be one focal point where there is someone, some personnel that have an overview of the entire process? This is a flow. This is a chemical flow process, and to have separate control rooms with no centralized at least overview, from my naive point of view, that's a structural problem, isn't it?

I mean, there has to be some design that looks at all of the control systems.

MR. BROWN: The two parts of the plant are essentially separate, and they run in a batch mode. So there's not really as much interaction there, I think, as the question suggests. The one person is concerned with plutonium purification in the aqueous polishing step who provides canisters that go into storage, and when those canisters are required to produce MOX fuel, they are pulled out of storage for that purpose.

So there's a clear break in the operational process there, and there really are almost distinct structures of the same building.

MR. SIEBER: It seemed to me that the whole process was a batch kind of process with a lot of little work stations and gloveboxes, not connected together except through the ventilation system, you know, and so each one of these would operate independent of all the --

CHAIRMAN POWERS: That's a non-trivial connection.

DR. WEINER: Yes.

MR. SIEBER: Yeah. Well, it serves a single function. Okay? So an accident in one portion of the plant affects all other portions because it's connected to the same internal environment.

On the other hand, this piece of equipment is not necessarily dependent on the operation of another process piece of equipment. It is not a process industry. It's all batches.

MR. MURRAY: Yes. The process is what we call essentially a semi-batch process, and we do have a lot of intermediate storage locations both in the aqueous polishing side and in the mixed oxide powder side.

Now, I think we'd have to go and take a look at Chapter 1 of the draft FSER to check out to see where the administrative structure would fit in here, and offhand I don't recall, to be quite honest.

CHAIRMAN POWERS: Yeah, we could get there, but I just don't understand what I'm reading, I guess.

MR. MURRAY: We can get back to you on that one.

MR. ROSEN: Well, I think we're making a list of things we kind of want to know more about, and it might be some of these things will make it into a letter so that you'll have something that reminds you.

MR. MURRAY: Okay.

MR. SIEBER: It seems to me there was no -- there's a fair amount of description of the organization when they're building the plant, the design part and the construction part, but there's not a lot of description about the operating part of it.

CHAIRMAN POWERS: That's not terribly surprising.

MR. MURRAY: Again, that's because of the two-step licensing process.

MR. SIEBER: Right. So I think if you hunt through what we already have, you're going to spend a lot of time and not find any.

MR. ROSEN: The question remember came up because we're talking about two emergency control rooms. We're talking about functions in spaces, and I think I know of a function, but I don't know which space it goes into.

MR. MURRAY: Okay. We'll have to check and get back to you.

Let me continue on here. Okay. I'm just going to briefly discuss the emergency control room ventilation system or just simply ECR HVAC, and I've noted here some of the parameters. Each system consists of two 100 percent capacity filter trains, one per ECR. Each train has one intake, and in that train a filtration unit and a booster fan.

In addition, the filter unit includes, in addition to HEPAs, a Haslet (phonetic) gas removal cartridge and/or a cartridge for removing volatile organics.

Now, here is the safety issue. From the staff's review, we noted that several chemicals on site could affect habitability, and some are present as liquids and some are essentially a liquid-gas mixture.

And releases of these chemicals could prevent the ECR operators from performing their safety functions.

Now, the applicant has realized this, and they have a safety approach. I've identified it here. They have decided that there will be, if you will, an ECR HVAC system, and as I've shown here in the initial application, we have the PSSC, but not a design basis, and in the FSER we have imposed a proposed permit condition which requires a habitable design basis.

Now, these are the actual controls that the applicant has proposed. The ventilation system for each ECR is identified as a PSSC. Elicit that safety function, which is to maintain habitability, and the design bases, which are used and are listed in the table and the FSER. IDLHs from Reg. Guide 1.78 and OSHA. Level II values, which are from Table 8-5 of the CAR, and Level III values if they are less than the IDLH. This is what the applicant has proposed.

And I've also listed some other aspects of the applicant's approach here, and again, it seems to be a thought through from a functional perspective. You know, if you detect a hazardous chemical above allowable limits, that intake is isolated and switched to recirc. mode. If it has these chemicals at both intakes to the two -- there's one intake per ECR -- then the alarm sounds, and both ECRs go into recirc mode, and the operators are to don scubas.

And I just listed something a little bit more about the monitoring and the applicant has stated they will have a monitoring system for those chemicals which they think in a release could result in exceeding control room limits.

CHAIRMAN POWERS: Will they monitor oxygen?

MR. MURRAY: There is a separate slide that I'll get to in a moment about potential asphyxiation. Okay? They have stated as a design basis, which applies to oxygen content, and they will do detailed analyses in the license application to address that, but that's about two slides further on. These emergency actions, i.e., going into recirc mode as an example, will be initiated when the chemical concentrations are at or below the TEEL-3 limit in essence, and any specific set points would be determined in the license application.

And this, I guess, was the next slide, not two slides down. This is the design approach that the applicant intends to use to address potential asphyxiation concerns. Again, they will do analyses of individual rooms, and if that analysis shows that they need to have oxygen monitors or some form of habitable air monitors in that area, they will put those in as required.

And for high asphyxiating or to avoid asphyxiating atmospheres, they expect the high ventilation rates will preclude the formation of, if you will, an asphyxiating atmosphere.

And they do list this publication from the CGA, which has to do with oxygen/air quality.

Does that address your question?

CHAIRMAN POWERS: Yeah. I mean that's explicitly exactly what they should be doing. I mean, with all of that nitrogen that you're using and the system asphyxiation --

MR. MURRAY: Is a concern, yes, yes.

MR. ROSEN: Well, argon as well.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Argon especially.

MR. ROSEN: Especially.

MR. MURRAY: Yeah, we'll touch on this a little more later on. Okay?

Now, staff has evaluated this, okay, and we noted we have a safety function for the emergency control room operators. They have a safety function to maintain habitability in these emergency control rooms, and we did look at the values which they had proposed, and we noticed that these values are not consistent with habitable conditions. All right?

They tend to be Level III or in some cases IDLH values. So what we concluded was the Level I values, which we were discussing a moment ago, approximate habitable conditions, and because of that the staff is proposing a permanent condition which will state that an additional function of the ECR HVAC system is to maintain chemical concentrations below Level I values for the duration of the event.

Okay? And the staff has concluded as stated in the draft FSER that both the safety approach and the permanent condition should provide adequate assurances of safety.

CHAIRMAN POWERS: Because I don't quite understand. It seems like we're coming back and saying, "Look. Putting IDLH values or even anything that's close to it is not really what I want my design basis for my HVAC system to be."

And so you're saying your design basis should be something like Level I.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Well, that's great. Has the applicant said, "Oh, yeah. Sorry about that. You're right"?

MR. MURRAY: Do you have any feedback, Dave?

MR. BROWN: At this point, we're discussing it. We have not had a meeting to discuss this one.

CHAIRMAN POWERS: So there's a clear difference between your position and the applicant's position here.

MR. BROWN: Yes, there is.

CHAIRMAN POWERS: Why isn't this an open item?

MR. BROWN: At this point, you know, we have several options with this kind of review. We have approved the applicant's proposal. We approve it with conditions or we deny it, and of course, this is an approval with condition.

An open item is something we would carry in, say, a draft SER leading up to a final conclusion, but this is our final conclusion.

CHAIRMAN POWERS: It seems to me there's a compromise position, which is not uncommonly adopted, and that is that your design basis is to assure once concentrations from the available sources exceed the IDLH, you have 30 minutes within the control room in order to take some action, which often involves donning scuba gear and trying to operate the facility, which obviously is a plan designed by someone who never tried to operate a facility in scuba gear. But, I mean, it's not uncommon to adopt that.

There are compromise positions in here to achieve the same safety function. Can you walk away from this facility?

MR. MURRAY: I'm sorry?

CHAIRMAN POWERS: Can you walk away from this facility if you shut it down? Can you walk away?

MR. BROWN: No, not immediately. What do you mean by that though? I'm interpreting that as having --

CHAIRMAN POWERS: I do a finite number of shutdown stuff. Can I walk away from the facility?

MR. BROWN: Right. The design is intended to be such that it will bring itself to safe shutdown condition automatically.

CHAIRMAN POWERS: And I can just take a hike at that point.

MR. BROWN: Right.

MR. SIEBER: Well, it wouldn't be as leak tight as if the actions like ventilation were functional. But you don't have decay heat or anything like that to attend to.

MR. BROWN: But I did not interpret that question literally, which is that we could walk away and leave the building vacant and shut down.

For example, the ventilation system is designed, especially the C4 confinement system, will be always operable, never shut down.

MR. SIEBER: Right.

CHAIRMAN POWERS: Yeah. I mean, I think what I meant by that was, yeah, the ventilation system is working. It just doesn't need me there, and I can go away for some protracted period of time measured in days but not in weeks and think about it and then come back and handle that, and you're saying, yeah, that would be fine.

MR. BROWN: You could do that.

CHAIRMAN POWERS: That's good. I mean, that's a good way to design these things.

MR. MURRAY: Yeah, an automated system, automated plant.

MR. MAGRUDER: This is Stu Magruder from the staff.

I just want to jump in and try to get to your question about potential compromise on this issue. I guess for various reasons there has not been as much dialogue on this issue as there probably should have been, and now that the applicant has had a chance to look at the SER or the draft SER, we're starting up discussions on this. There's a potential that we could publish the final SER without this condition. I mean it would be our goal actually not to have any conditions in the --

CHAIRMAN POWERS: And you understand my problem, if I take in front of Chairman Wallis a proposed position and he says, "Oh, but the SER doesn't have anything to do with this statement right here," he's not going to be gracious in his comments.

DR. WALLIS: I'm always gracious.

MR. MAGRUDER: I understand.

CHAIRMAN POWERS: I encourage you to go on and discuss these things, but do let us know if anything changes because I like to stay in Mr. Wallis' good graces. He is not kind when he think you've done him wrong.

MR. MAGRUDER: No, we definitely intend to keep you informed. We've discussed --

CHAIRMAN POWERS: He tends to compare you to his sophomores.

DR. WALLIS: Or worse.

MR. MAGRUDER: We will get the errata to the SER staff with exactly what's going on.

CHAIRMAN POWERS: I encourage you to go ahead and discuss this because I think there's lots of room in it, and we had exactly this problem on control room habitability, is the initial proposal was, oh, well, let's just use these IDLHs, and then we regaled the presenter with stories about trying to put on scuba in 500 ppm amonia and ask him if he would like to do that and show us how that worked.

It does not work well.

MR. SIEBER: I'd like to go back to Dr. Powers' question just for a second about walking away from the plant. My impression is that you can't just decide on the spur of the moment that you're going to walk away if you have processes, batches in operation, for example, in order to protect a solvent extraction process. You have to deal with the chemicals that are there so that you don't end up with explosive mixtures and so forth before you decide to take a hike, before you walk away.

So you can't decide on the spur of the moment, you know, we've ha a seismic event or something else happened on the Savannah River site and we want to leave. You just can't leave at that point in time without finishing certain steps that are involved in certain of these batch processes, and then you can walk away.

And I think that is a more complete answer at least in my mind than to say, yes, you can walk away because you can't at any time. You have to, you know, do some things before you leave; is that correct?

MR. MURRAY: I agree with you, and from our review of the revised application and other correspondence on the docket, that it our interpretation of what the applicant is proposing. That's why there are two emergency control rooms. That's why they want to maintain habitability, because they'll be operators in those control rooms performing safety functions, monitoring, slash, shutdown, safe shutdown of the facility.

MR. SIEBER: Yeah, and in the licensee's application, there is a discussion pretty far back in the application of the emergency plan. They do have an emergency plan. So it's there.

Okay. Thank you.

MR. MURRAY: Oh, you're welcome.

Any other questions on control room habitability?

CHAIRMAN POWERS: Have we got control room habitability covered adequately?

(No response.)

CHAIRMAN POWERS: Alex, you've going to get a gold star from us here. You're getting way ahead of time. I mean, I think these guys took -- you must have fed them something for lunch. I don't know.

MR. SIEBER: Or we're groggy.

CHAIRMAN POWERS: Is Rex available to talk to us? I propose that we go right on to his discussion rather than taking a break.

PARTICIPANT: Aw.

CHAIRMAN POWERS: You just got out of lunch, and you ate too damned much there anyway. It's making you sleepy, and you've giving Alex a bye here, and he's going to go home and say how disappointed he was because he didn't get interrogated enough at the ACRS to hardly make it worth his while.

(Laughter.)

CHAIRMAN POWERS: Thank, Alex. That was a good briefing.

MR. SIEBER: Thank you.

MR. MURRAY: Thank you.

MR. WESCOTT: Okay. I guess I'm the slide controller here.

Okay. Good afternoon. My name is Rex Wescott. I'm a senior fire protection engineer and was the ISA coordinator for the MOX CAR review.

I'm here this afternoon to talk about the flammability issue. Basically four open items reflect the need for flammability control. One of the items, open items, was CS-09, which is the design basis of various solvent combinations and process vessels; AP-02, hydrogen generation in the electrolyzers; AP-08, off-gas unit flammable gases; and AP-09, which is the off-gas unit solvent flammability.

Flammable and combustible materials can initiate fires and explosions. They can initiate flash fires, combinations just above the lower flammability limit or at the lower flammability limit.

They can result in deflagrations as the concentrations get somewhat higher, and they can result in denotations in some cases when you start getting near the stoichiometric mixture of flammable gases and air.

CHAIRMAN POWERS: You fire protection guys can't put up a viewgraph without a triangle on it; is that --

(Laughter.)

MR. WESCOTT: Well, I've got something, but I'd rather wait until I get to the end of the presentation because if I start messing with it here, I don't know what's going to happen.

CHAIRMAN POWERS: I've just got to harass the fire protection guys.

MR. WESCOTT: All right.

CHAIRMAN POWERS: Well, fire protection always begins with a triangle. It says you've got to have fuel, heat source, and oxidant.

DR. WALLIS: Is that what it means?

CHAIRMAN POWERS: And so I think they're congenitally required to have triangles on their slides.

MR. WESCOTT: Well, actually it's being taught as a trapezoid now. You have to have that other part, which is basically close enough combination so that you can get a continuous chain reaction with the fuel.

CHAIRMAN POWERS: Oh, you guys, anachronistic. You guys are getting too sophisticated.

MR. WESCOTT: Okay. The applicant proposed a preventive strategy and adopted NFPA-69. This is the design basis, and NFPA-69 is the NFPA code for explosion prevention.

Six areas of applicability were identified where you wanted to apply NPFA-69, and these are the solvent recovery area, the oxalic precipitation and mother liquor units, high temperature acid recovery, that is, high temperature equipment in the acid recovery area, low temperature equipment in the acid recovery, hydrogen from radiolysis, radiolysis like in the waste area, and the electrolyzer units, were the six areas where NFPA-69 criteria was to be proposed.

And also the sintering furnace was another area, but we had already accepted that for maintaining 25 percent -- well, that wasn't one of the open issues that was discussed last time.

CHAIRMAN POWERS: Do I understand why 25 percent of LFL? I mean, why not delta below LFL?

MR. WESCOTT: Yeah. Well, actually in

some areas it is even more. I think an underground fuel storage tanks, I think they go down even lower than 25 percent LFL.

I was never on one of the code committees, but what often these are, they're not arbitrary, but what they are is they're numbers that seem to present a safe margin and at the same time are doable. It's kind of reached by consensus.

CHAIRMAN POWERS: I mean, the rational that was adopted for the Hanford tanks, for instance, was how fast could a rise in combustible gas be, and how did that compare to your ability to detect it.

MR. WESCOTT: Right, exactly.

CHAIRMAN POWERS: And you know, after some machinations and whatnot, they said, "Well, if we were at 25 percent of LFL, sure enough, we could probably detect it before we exceeded it," for most of the events that they knew about.

And the one that they couldn't do that on, they remediated the tank. Now, that was a fairly rationale picking of 25 percent of LFL, but other places who adopt this number I never understand because delta before LFL is fine. You aren't going to propagate, and usually those LFLs are for an upward propagating combustion event, not for a downward propagating combustion event.

MR. WESCOTT: I think one thing that has to be said about our review process here is basically because the design wasn't completed, there's a lot of information that still hadn't been developed. We sort of set code compliance as probably one of the major hurdles for the CAR review. Now, when we get into the actual ISA review, I think we're going to start looking at things like generation rates of hydrogen, what actually happens to combustible solvents. Do we really have problem? Is 25 percent safe?

I mean there's different ways of controlling it. We have a rapid generation of gas. Maybe the off-gas system could be designed to continually provide a high flow of air. You know, we didn't want to try to dictate design at this point because we're not at the design --

CHAIRMAN POWERS: So presumably we could find it going both ways, that if you were not getting a great deal of safety benefit from being a 25 percent LFL, but getting a lot of operational headache, you could move it up.

MR. WESCOTT: That's correct.

CHAIRMAN POWERS: And if you found out that your detector response was slow to the generation rate, you might move it down.

MR. WESCOTT: That's correct, or you might worry about the off-gas system as a whole so that the generation in the vessel -- you have a number of options probably to go at.

CHAIRMAN POWERS: Now here you get to my ignorance barrier. I know that when we burn hydrogen at near the LFL in any kind of volume at all that you get the most incomplete burn you ever saw in your life. I mean, you're lucky if you get a third of the hydrogen to combust at those levels.

MR. WESCOTT: Yeah, it depends on how well mixed it is. If it's just --

CHAIRMAN POWERS: You could put a --

MR. WESCOTT: It's very inefficient.

CHAIRMAN POWERS: You can put a whirling dervish in there, and you just can't get a complete combustion, but I don't know that that's the case for some of these organics because I don't know what their LFLs are, to begin with. And I don't know whether they're more complete in their combustion at down near the level.

MR. WESCOTT: Well, you know, I think one rule of thumb is that you get more complete combustion as you get closer to stoichiometric levels because if you're not at the stoichiometric level, of course, you've got a lot of extra gas in there that's not taking part in the combustion, just keeping the molecules away from one another.

So I think, you know, the farther you are away from the stoichiometric mixture I guess the less complete your combustion, but as far as LFLs, there's no real good rule of thumb. I used to think hydrogen had a relatively low LFL, but then you look at something like acetylene, which is even lower. Propane is lower. A number of gases are lower LFLs, you know.

CHAIRMAN POWERS: Acetylene is down like about one percent or something like that. I think one percent, something like that?

MR. WESCOTT: For what gas?

CHAIRMAN POWERS: Acetylene.

MR. WESCOTT: Yeah. I didn't know it was that low, but it's probably close, and of course you could almost have 100 percent atmosphere with acetylene and still get combustion. You know, you don't need much air in there.

CHAIRMAN POWERS: You don't need much air, but in general things are around three or four percent, aren't they, like butane?

MR. WESCOTT: Yeah, I think they probably range from two to five to six, something like that.

MR. MURRAY: So a low of about two, high of about seven of LFL.

MR. WESCOTT: Yeah, yeah. Okay. Oh, yeah. Moving on past 16, we also reviewed some other guidance we looked at, too. We looked at NFPA-30, which is combustible liquids codes because solvents really kind of come under combustible liquids as opposed to flammable gases.

We looked at our NUREG 1718, our SRP. We looked at the Hanford tanks and what was done there. So we took into account a number of things to come to our conclusions as to what to do and what would be acceptable to us, and we also looked at electrolysis and what were the factors that go into generating hydrogen through electrolysis.

NFPA-69 was the main standard that we looked at. That was, of course, the standard explosion prevention systems. It provides guidance on oxidation reduction and concentration reduction, suppression of deflagrations, for example, containment of deflagrations, and you know, spark detection and extinguishing. It provides a number of ways of preventing controlling explosions.

What we are primarily interested in and also the applicant is primarily interested in was control of the concentration of the combustible or flammable gas. That's probably the most straightforward way of controlling or preventing explosion.

CHAIRMAN POWERS: How big is the gap between the flammability limits and the detonation limits on these organic gases?

MR. WESCOTT: Like I said, it differs. You get a detonation of hydrogen below the stoichiometric limits and detonations require some turbulence. So if you have a turbulent atmosphere, you're more likely to get a detonation than if you have a non-turbulent type of atmosphere that your gas is in.

So I think there's a number of factors that determine whether you're going to get a deflagration versus a detonation, but probably one of the biggest factors is concentration. You're not going to get a detonation, say, at LFL or just, you know, slightly above.

CHAIRMAN POWERS: Hydrogen I'm acutely familiar with, but I don't have any familiarity with things like butane and butanol and things like that about, you know, where the relative displacement between flammability and detonation limits are.

MR. WESCOTT: Yeah. To be honest with you, the only time I've basically worked with those is looking at favor cloud explosions, and you always assume a detonation because that's the worst case.

Now, I know that, you know, some cases, some areas are more prone to detonation than others, but as far as being very aware of experiments where they've actually tried to look at all of the different parameters, I'm just not aware of that.

Some of the basic considerations if you're going to get into the concentration reduction that you have to look at is first to determine how much you want to reduce your concentration, whether you're going to shoot for 60 percent or 25 percent or 50 percent. You've got to look at variations in process, temperature, pressure, and materials, all of which can affect the generation rate of hydrogen.

Your operating controls, and you have to have a maintenance inspection and testing program if the kind of controls you're going to put on the system are going to be reliable and maintainable.

Okay. Now, the MOX standard review plan also has guidance in regard to explosion control.

Chapter 7, which deals with fire, mentions a number of codes and standards to use, such as NFPA-70, which is the national electric code; NFPA-69 and NFPA-30; a number of codes that I haven't listed dealing with oxygen systems and hydrogen tanks and systems and so on, but there's a number of codes which all should be looked at to have a good explosion prevention program at your plant.

Chapter 8 also mentions specific interactions which can cause problems like radiolysis and degradation of organics in high radiation fields, and also requires you to analyze --

CHAIRMAN POWERS: What kind of dose rates are we going to get?

MR. WESCOTT: Well, if you're talking about americium, which is primarily an alpha producer, you're not going to get any dose outside of the vessel, but you are going to get all of the energy contained inside the vessel. I guess you have a high G factor for generating hydrogen, and you're going to get relatively efficient generation of hydrogen, but I wouldn't expect any dose outside the --

CHAIRMAN POWERS: So the G factor for hydrogen production in water is what, .45?

MR. WESCOTT: I'll turn to Alex for that.

MR. MURRAY: It depends on the source and the chemical environment. I think there have been some values which have been -- let me speak into the microphone.

It depends on the environment, what's in solution, and nitrates do tend to suppress hydrogen evolution a bit. I keep wanting to say though some values which can be higher than that, but I'd have to go back and check.

CHAIRMAN POWERS: And then how does it go with kerosene?

MR. MURRAY: I'm sorry?

CHAIRMAN POWERS: What's the G value for hydrogen production in kerosene?

MR. MURRAY: I don't think we have a clear G value for that. There has been some very good work on G values done and reported in the past year or 18 months, and basically they were coming up with lower G values than have been historically applied.

CHAIRMAN POWERS: My impression is the G value for hydrogen in organic liquids is low, relative to water, but if you asked me to prove that with numbers, I'd be hard pressed.

MR. MURRAY: I'd have to go and look at the specific data, and I don't have it on the tip of my hand right now.

MR. WESCOTT: Okay. These are recommendations on hydrogen supply. They come out of the NRC SRP guidance.

CHAIRMAN POWERS: Hydrogen has to be supplied?

MR. WESCOTT: For the sintering furnace, for example.

CHAIRMAN POWERS: Yeah, but I mean, they come in and they mix it with argon and they're not just giving the hydrogen argon?

MR. WESCOTT: That's correct. It's 95 percent argon, five percent hydrogen or -- yeah, five percent hydrogen.

CHAIRMAN POWERS: But, I mean, they're going to do the mixing on site. They're not going to -- just by the mixture.

MR. WESCOTT: That's my understanding. Alex, do you know any more about that, that it would be mixed down?

MR. MURRAY: For the most part, they will be mixing the gases in what they call the gas storage area of the proposed facility. All right? They have a back-up supply of a cylinder mixture of hydrogen and argon that's essentially ready mix, and they also have a back-up supply of argon.

Okay. The hydrogen itself comes from cylinders, I guess, truck mounted cylinders. The argon comes from cryogenic storage.

And the concept, approach, if you will, of the applicant is if they go outside the ranges of the hydrogen limit from the pre-mixing operations, they will switch to the cylinder storage. If for any reason that isn't working or they have a flammability concern, they will switch over to pure argon going to the sintering fences.

CHAIRMAN POWERS: It would be interesting to see the trade studies because in every case that I have encountered on this, it was way easier and cheaper just to go ahead and buy the gas mixture, the argon-hydrogen mixture that was below the LFL than it was to go through the agony of showing that you never got above the LFL and/or your mixing and manipulations and things like that. I mean it wasn't even close because when your source gas is below the LFL, there's not too many ways to ever get yourself above the LFL.

It would be an interesting trade study to look at on this one, not that it's pertinent to our business.

MR. MURRAY: It's interesting.

CHAIRMAN POWERS: It's interesting, yeah.

MR. WESCOTT: If you don't mind I'd like to skip to the last point on the next slide, which basically just shows that the SRP really recommends maintaining hydrogen below 25 percent LFL and all, basically whenever possible. That was one of our recommendations.

DR. WALLIS: Could you review what you've been doing here for me? Have you been looking at normal operation and concentrations of things in various reactors or something or are you looking at accidents? I don't see any mention of any inadvertent mixing of flammable things with oxidants or anything.

What is this guidance applied to?

MR. WESCOTT: Well, I think our primary concern about where we might get combustion is in the off-gas system, when actually this gas is coming out of the process vessels.

DR. WALLIS: So you are mixing it.

MR. WESCOTT: Mixed with air, and there conceivably could be an ignition source, although certainly everything will be done to prevent --

DR. WALLIS: Is that just a flare? It just goes up in the air?

MR. WESCOTT: Well, it depends on, of

course, where the combustion takes place, and I think probably your worst case is probably a flash fire inside the system.

DR. WALLIS: Have you been look at off-design conditions or something?

MR. WESCOTT: Well, I think we're going to expect that to be done in the ISA stage.

DR. WALLIS: So some other stage. Everything is always at some other stage.

MR. WESCOTT: Well, this, of course, is kind of a conceptual design at this place, and we're actually more interested in strategies and the design bases for these strategies as opposed to actual, you know, final design parameters.

DR. WALLIS: There must be monitoring throughout the whole facility that you haven't got leaks of combustibles and all of that. That's not part of this at this stage?

MR. WESCOTT: Well, you know, one of the things I should have said on the first slide is we very carefully said flammable gases and combustible liquids. To our knowledge, there are no flammable liquids actually in the processes, you might have some in the laboratory, you know, things like alcohol and acetone and things like that, but your primarily process liquids are combustible. They're not flammable, and by that I mean that you don't have a flammable vapor generation until you get up over 100 degrees Fahrenheit.

So leaks of the liquids themselves at non-elevated temperatures really don't present a fire hazard as such. So I think that's a point that needs to be made because that's a good question. If we're dealing with flammable liquids, we would have concerns about leaks and things outside of these particular areas.

CHAIRMAN POWERS: I'm struggling a little bit on that.

MR. WESCOTT: Sure.

CHAIRMAN POWERS: I mean, I understand what you're arguing with. You're arguing that dodecane just doesn't produce enough vapor to amount to anything at modest temperatures.

MR. WESCOTT: Right.

CHAIRMAN POWERS: But what you've got is dodecane with tributyl phosphate in it, which is rapidly becoming dibutyl phosphate and putting a little butanol into the system.

Now, butanol does have vapor pressure.

MR. WESCOTT: I'm not sure of the

chemistry. Alex, do you know the flash points of change with the combinations?

MR. MURRAY: The applicant has identified flash points for the diluent, the TBP, and the mixture of the diluent and TBP. Okay? For the diluent itself, it's approximately 55 or so degrees centigrade. For the mixture it's approximately 57 degrees centigrade, and for tributyl phosphate, it was quite a bit higher. I forget the exact value.

CHAIRMAN POWERS: Yeah, but if I take this stuff and I bang it around, heat it, throw a few alpha particles through it, now I've got a much more complicated mixture.

MR. MURRAY: That's right.

CHAIRMAN POWERS: And in particular, it has butanol in it, unavoidably has butanol in it.

MR. MURRAY: Right, right.

CHAIRMAN POWERS: It may have some other various zoology of organics of small chain link in it. Now it has vapor pressure, significant vapor pressure at room temperature. You can smell it.

MR. WESCOTT: Yes, I agree.

CHAIRMAN POWERS: Now what's the flash point?

MR. WESCOTT: Well, that's why we're

looking at design bases. Are the design bases appropriate? NFPA-69 does give you some top level, if you will, design basis type guidance as to what would be reasonable, what would be general practice, if you will.

Maintaining vapor concentrations below 25 percent of their respective LFL is a design basis. Now, depending on what the mixture is at the plant, at the license application stage, the applicant will have to demonstrate that under all circumstances they meet the NFPA-69, which they've used as the design basis.

CHAIRMAN POWERS: But what I'm struggling with is if you tell me to keep the vapor concentration of dodecane below 25 percent of its LFL, I'm a real happy camper because it's going to be damned difficult for me to get it up to the LFL.

Okay. If you tell me to do the same thing with butanol, I have got a problem.

MR. WESCOTT: Yeah, one of the things that that NFPA-69 requires that you have to do is that you really -- and this is another reason why I think we want to wait until the design stage. You really have to know the partial pressures of all your different gases and your environment, and once you know the partial pressures, you can take a ratio of the partial pressure to the LFL for all of these gases and add them up and they become the divider to the total pressure that you have. It's a Le Chatlier's Law.

And that's how you determine the LFL of your mixture, but until you know these partial pressures, there's really no way to calculate it.

CHAIRMAN POWERS: Yeah, I don't know about hydrogenated propylene tetramer, but I do know about dodecane butanol mixtures have been investigated for their non-ideality because it was one of the many pains in the neck that occurred up at the Hanford tanks, and so somebody had to go off and do it.

So I don't know if we can routinely do the partial pressure calculation here or not.

MR. WESCOTT: You know, from most of my experience, and that's with hydrogen, and that also involves reactors, we generally approach the problem through dilution, and instead of worrying about just exactly where the LFL is, we provide enough dilution, and the same with the Hanford tanks. You provide enough dilution so that you're nowhere near the LFL.

And I think with some of these situations maybe that's going to have to be the solution, and your main alarm is not if you've approached LFL, but if you've lost air flow. You know, and then you --

CHAIRMAN POWERS: Well, I just want to ask you. When you take 25 percent of LFL as a design basis for 60 percent with automatic tracking, which I think is what you actually say, it's 25 percent of what.

Like I say, if it's 25 percent of the LFL for dodecane, I mean, I've got some design flexibility, shall we say? But if it's 25 percent of the actual combustibility of the liquid you would really have there, which it should be, then you've got a much more challenging thing.

MR. WESCOTT: Well, yes, you do. I mean, if you've got other gases that have low flammability levels coming off in significant quantities at the temperature, you've got to calculate what your LFL really is for the mixture. There's no way around it.

CHAIRMAN POWERS: So I guess what I'm asking you is it's 25 percent of LFL what. Of liquid?

MR. WESCOTT: Of what they actually do.

MR. MURRAY: What they actually have, yes.

MR. WESCOTT: Yeah, that's right.

MR. MURRAY: Now, if they have proposed a methodology for determining LFL and LFLs of mixtures and we've looked at that. it is based on the standard Le Chatlier's principle. Again, that is something that is usually used in plants, process, industry plants, and you know, we have concluded that what they proposed is reasonable for mixtures.

Now, I'll also add there's a question about measuring hydrogen. The applicant has identified industry code standard, I guess I should say, for both the type of hydrogen/flammable gas censor and also its spacing. Okay? So that design basis is in there, and I believe it's for areas where either the hydrogen line runs through or a hydrogen type generation can occur.

MR. WESCOTT: Okay, and this is the hanford tank experience that we were talking about and you had mentioned that hydrogen is not to exceed 25 percent of the LFL, and this was based on, you know, the actual physics, the overturning type of thing, the rapid increase in hydrogen concentration and their interpretation of NFPA-69.

This is electrolytic hydrogen. It's hydrogen formed from electrolysis, and this shows how the concentration of nitric acid in the solution can control the hydrogen generation. As your molar concentration of acid increases, your ability to generate hydrogen basically decreases, and so that becomes the control on electrolytic production of hydrogen, is maintaining the --

DR. WALLIS: Circles don't do a very good job of going through any of them relating to the curves.

MR. WESCOTT: Well, --

CHAIRMAN POWERS: Actually my reaction to that was totally different, Graham. I said for electrochemical data, that's fantastic.

(Laughter.)

MR. MURRAY: That was my reaction as well.

MR. ROSEN: Peter, can't you get your electro materials to behave better than that?

CHAIRMAN POWERS: It's especially bad with stainless steel. You should have spent more of your career working in plastics, Peter.

DR. WALLIS: Well, that's what we did finally.

MR. MURRAY: I just want to mention this curve is in the open literature. It comes from some of the experimental work performed at Pacific Northwest Lab, and the important parameter here is if you notice this is a hydrogen concentration in the involved gases, and one percent is nominally 25 percent of the LFL. Okay. LFL and hydrogen under normal conditions is about four percent, right?

And you can see if you're above about a two normality, two normal nitric acid solution, that both of these curves are clearly below the 25 percent of the LFL.

DR. WALLIS: But all of the data are, too.

MR. MURRAY: Yes, yes, yes. Now, again, we're doing the construction application review. All right? And we're looking at the fluidability of the proposed control, which is to control the nitric acid concentration, which is a catholyte, by the way; it's nitric acid.

All right. It's very clear that, hey, if I go to higher acid concentration, I am definitely below the LFL based on this data. Now, for the specific electrode materials, which the applicant decides upon in the final design, we would look for some assurance that, you know, this type of phenomena still applies.

But it's very clear you can control hydrogen generation under normal conditions by nitric acid concentration.

DR. RANSOM: In any of these applications do they consider recombiners?

MR. MURRAY: There's no proposed recombiner in the current MOX design.

MR. WESCOTT: One thing I might add is we're talking about concentrations basically inside process vessels. We don't have any situations where we've got, say, concentration inside a containment structure or anything this large.

DR. WALLIS: Well, this figure here, this is mole concentration in what?

MR. MURRAY: Oh, this is in the gaseous base or gaseous.

DR. WALLIS: So what's the other phase?

MR. MURRAY: This is the liquid phase, catholyte.

DR. WALLIS: What's the other gas?

MR. MURRAY: I'm sorry?

DR. WALLIS: What is the other gas?

MR. MURRAY: Some of the other gases they get here are NOX, N_2O, NO_2. I'm sorry?

DR. WALLIS: There's air presumably if that's what you're worried about?

MR. MURRAY: They do get some nitrogen, okay, but understand this Y axis here refers only to the gases which are evolved. It doesn't refer to any cover gas. All right?

DR. WALLIS: So you're evolving something else.

MR. MURRAY: Yes, nitrogen oxides and nitrogen. Again, it's an artifact of using nitric acid as the catholyte. If you're putting electrical current across nitric acid, you do get some reduction at the cathode, and some of the reactions are mentioned in the FSER. All right?

DR. WALLIS: And this is the hydrogen concentration in NOX to prevent a NOX-hydrogen reaction. Is that what you're talking about?

MR. MURRAY: I'm sorry?

DR. WALLIS: Are you talking about a NOX hydrogen reaction or an air hydrogen reaction?

MR. MURRAY: Because the ullage space above the electrolyzer in the proposed plant would be an airspace, okay, our concern would be for it in an airspace. However, what this says here --

DR. WALLIS: Hydrogen will react with NOX, won't it?

MR. MURRAY: It depends on time, concentration, and temperature.

DR. WALLIS: Right, on concentration.

MR. MURRAY: Yes, under certain circumstances it can react with NOX.

CHAIRMAN POWERS: Yeah, but did Joe Shepherd look at the combustion limits on there and find out that they're actually not as bad as air?

MR. MURRAY: I think he did, but I'd have to --

CHAIRMAN POWERS: It takes more effort to react with NOX.

MR. MURRAY: Yeah. In the case of NOX-hydrogen reactions, they tend to require a much higher initiating energy, if you will, to get ignition. In addition, the ranges, flammability ranges are much higher.

CHAIRMAN POWERS: The lower flammability limits like five or six percent or something like that.

MR. MURRAY: Yeah, yeah, yeah.

CHAIRMAN POWERS: So, I mean, the answer is yes, but if you can meet the air criterion, you're okay in N_2O.

MR. MURRAY: Yes. Any other questions on this Figure 4 from the electrolyzer?

(No response.)

MR. MURRAY: Okay.

MR. WESCOTT: And here's the last figure, our conclusions, and basically the staff accepts the preventive strategy that was proposed by the applicant. Staff accepts the general use of NFPA-69 as a design basis. Staff will review implementation to check to make the proposed interlocks where they're proposing a 60 percent level, for example, or 50 percent, can perform their safety functions adequately to prevent an explosion or a fire.

The applicant has different strategies to pursue, a number of ways of arriving at the desired result. Clear calculation on an experimental basis will be needed. For example, what actually is the behavior in terms of vapor pressures and LFL? So the actual solution that's in there.

DR. WALLIS: Those are the things we see later?

MR. WESCOTT: Those are the things, right, that we will be looking at during our review.

You know, a review, of course, is an audit. I mean, we'll look at where we think the problems are, but we'll probably be looking at this in some detail, and we consider it acceptable for construction under the proposed strategies.

DR. FORD: Would you mind just going back to the previous diagram?

MR. WESCOTT: Sure. Oh, boy.

(Laughter.)

CHAIRMAN POWERS: You wouldn't mind, but

the computer would.

MR. WESCOTT: Let's see. There we go. Wow, I got over this one.

MR. MURRAY: Science is wonderful.

DR. FORD: In order to get a reasonable efficiency in terms of the reaction you're trying to do, you've got to have a certain nitric acid concentration, don't you?

MR. WESCOTT: Yes.

DR. FORD: So what is that value? I think I saw six molar nitric acid mentioned somewhere, I think. Is that right?

MR. WESCOTT: I believe that's in the SER.

DR. FORD: So you're stuck at six molar; is that right?

MR. WESCOTT: Could you explain what you mean by "stuck at six normal"?

DR. FORD: In order to have an efficiency in the process you're trying to do, you presumably want to have as high a nitric acid concentration as possible; is that right? No?

MR. WESCOTT: Well, you're talking efficiency now. So that's sort of outside the range of a safety review, but let me just comment.

DR. FORD: Yeah, okay.

MR. WESCOTT: Let me just quickly comment on that. Because of the type of reactions that are going on and design of typical cells like this, your electrodeficiencies may be quite low, 50 percent tops, something like that.

A lot of the electrical energy ends up in either heat or other auxiliary reactions occurring at the electrodes. Okay? And one of them --

DR. FORD: I was just trying to work out what the message from this diagram was in terms of managing your flammability aspect. Obviously you want to have as high a concentration as possible.

MR. WESCOTT: Exactly. If you increase your asset concentration, okay, and again, this is around the cathode, all right? This diagram shows that you can control the evolution of hydrogen, i.e., you can keep it below the 25 percent of LFL limit. If you had no air sweep or no ventilation on this system, this would be the hydrogen concentration evolved in to the ullage space.

MR. BROWN: Alex, if I may interrupt.

MR. MURRAY: Sure.

MR. BROWN: This data is for an electrolyzer of some design, not necessarily of the plant we're looking at. This curve would essentially have to be reestablished for the final design.

DR. WALLIS: Yeah, i was going to ask: aren't there some other variables to determine this?

MR. BROWN: Right. The size and shape of the electrolyzer, I'm sure, the current densities, and that sort of thing.

MR. ROSEN: What we heard earlier would be tantalum and it won't even be platinum. Maybe it might be --

MR. BROWN: I believe the material platinum cathode is right, as shown here. What's intended by this figure is the concept of generation control with nitric acid concentrations. The data will be different.

DR. FORD: It's also telling you that if the licensee wanted to use platinum, that would increased the efficiency of his process. You'd say, "Hold on a bit. You can't go too far in that direction because you're going to increase my flammability aspect."

CHAIRMAN POWERS: No, I wouldn't say that at all. I would say, "Look. It doesn't matter whether I use stainless steel or platinum." I mean, these are --

DR. FORD: As long as you blow --

CHAIRMAN POWERS: As long as I'm below, I'm below. I mean, it doesn't matter. You can never get this gas to be combustible, unless I run it into something that's going to freeze out whatever the diluent gas is. I mean, I'm fat here. This is great because he's going to have to stay above three molar to keep from precipitating out the plutonium dioxide to begin with.

Now, I can imagine current density makes a difference and material makes a difference, but I can't imagine geometry really making much of a difference here, can you? I mean, it doesn't seem like it because it all depends on what the over voltage of hydrogen is, the over potential on hydrogen production at the electrode is.

MR. MURRAY: That's correct.

DR. FORD: Your stir rate is going to affect it. The hydrogen evolution is going to be diffusion control to a large extent. The reason for my question was --

CHAIRMAN POWERS: The total amount of hydrogen I produce, but not the gas production here. I mean, as a fraction of the gas production rate why would it affect that? I'd have to think about that a little bit.

DR. FORD: Well, the reason for my question was flammability, managing the flammability aspect, you would use such data to essentially reassure yourselves that even using different materials, which you might use for various business reasons, you're still well within your flammability limit. That's essentially the message from this diagram; is that right?

MR. MURRAY: Partially right. The main message from this diagram is, yes, you can control hydrogen evolution and keep it below the LFL by controlling the nitric acid concentration. That's the main message.

So there will be some bumps on these curves for different electrodes. Okay? I haven't seen any information on, say, tantalum. Is it in the middle if it's a palladium coated? Is it above platinum?

But the basic concept that this control philosophy of using nitric acid to control hydrogen generation is a reasonable approach.

DR. DENNING: Could you take me back to -- I'm trying to read the slide up here -- 66, I guess?

CHAIRMAN POWERS: What, are you testing? It takes him quite a while. You're a little bit slow on the uptake here, aren't you, Rich?

DR. DENNING: Okay. These are the six areas of applicability that you were considering. Could you then interpret for us again your bottom line conclusion?

I have the feeling that what you've done here is rather than looking at these areas in detail and seeing how the applicant is going to demonstrate satisfaction, that what you've really developed is more criteria that they have to satisfy. You don't know exactly how they're going to do it at the moment. You just have developed criteria. Is that a fair comment?

MR. WESCOTT: I think that's a fair statement. Now, they have made proposals as to how they intend to do it, and I think in many of these ways they're going to be -- some of them are going to be looking at temperature control. Of course, in the electrolysis area they're looking at nitric acid control. I think there may be a few --

DR. DENNING: Is that the way I interpret like in number three? The PSSC is high temperature control in acid recovery. Is that what you're implying here or am I not -- or is it that's the concern?

MR. BROWN: That's the concern.

MR. WESCOTT: Yeah.

MR. MURRAY: This is merely a title for the area of applicability.

DR. DENNING: Area of applicability. So as far as the risk that they can't satisfy these, I mean, obviously DOE is the one who really has a risk, and they're going to go ahead and they're going to construct under the assumption that they can satisfy the criteria that you've established, and then if they can't satisfy those criteria, then they may be forced to go back in and do some system redesign to be able to do that. Is that --

MR. WESCOTT: That's always possible. I mean, if they can't satisfy it with temperature, they may have to look at redesigning their off-gas system to get possibly more dilution or something like that. I mean that's certainly possible..

DR. DENNING: It just isn't exactly clear to me how far you have to go in deciding they're ready to go ahead and construct, you know, since I don't think -- but I may be wrong -- that you've looked at this in real detail because all you've done is really kind of established the criteria rather than really looking and saying, yeah, I'm fairly confident that the PSSC that they have established is going to be satisfactory and meet that criteria.

MR. WESCOTT: That's exactly right. That's the kind of conclusion we're coming to from a safety assessment standpoint that we expect that they will be able to satisfy the performance requirements of the regulation, but we will verify that when we see the final design.

MR. MAGRUDER: Let me just clarify a little bit. We have also to reach the conclusion that we have reasonable assurance that they can meet the criteria. I mean, it's not just, yes, that this is the right standard to apply, but we also have to have some confidence that what they're proposing or that there is a feasible approach to meet the requirement.

MR. WESCOTT: Right. We don't see any of these problems are requiring a total redesign of their process, you know.

MR. ROSEN: On the other hand, DOE can take no comfort from this approval of construction. The burden is still really on them to come up with designs that through the ISA process you can agree meet these criteria.

MR. WESCOTT: Yeah. I mean, really when you look at the regulation, most of the emphasis on

CAR review is, of course, on structural design and seismic. I mean, we're trying to avoid situations that can't be undone, you know, which I think is the main emphasis where process design is probably where we don't want to force them to redesign their whole process either.

But I think we tend to feel that the designs to meet the performance requirements that we have approved will be relatively minor differences.

MR. MAGRUDER: I will add that in some areas we've pressed them pretty hard to make sure that we were satisfied that there is a feasible approach out there, but the question is, you know, the million dollar question is: how far do you have to go to satisfy yourself that the construction is okay, as opposed to waiting for the detailed design.

MR. MURRAY: You know, just to clarify this a little bit more, the applicant has committed to an NFPA-69, a code, if you will. That code outlines a number of approaches, activities with different limits which would, if you will, prevent a flammable event from occurring. All right?

There is a general limit identified, which is 25 percent of the LFL. In addition, there's also an exception which can be up to 60 percent of the LFL if automatic interlocks are available and reliable. All right?

In the revised construction authorization request, the applicant for two of those areas of applicability wanted to propose and did propose interlocks. All right? The staff looked at what the applicant had proposed, and we had no clear calculational or other basis at this time to say that, yes, these PSSCs, these interlocks, if you will, could function the way NFPA-69 anticipates.

All right. So the staff took a step back and said, "Okay. We understand you want to follow NFPA-69. We know NFPA-69 has been applied to situations like this. We think we can accept it as a design basis, and we put the onus on the applicant that in the license application if they wish to pursue, if you will, interlocks, then they're going to have to get a very clear, calculational basis as to why those interlocks should function and, if you will, maintain safety, perform the safety function, I should say.

Does that help or did I confuse the situation more? Dana is smiling. That's a good sign.

MR. ROSEN: Well, I'm smiling because I'm thinking about the 2,700 pages we've looked at supposedly, and the promises you've made about the rather lengthy detail that will be included in the ISA compared to what we now have. The estimate to the Chairman was 27,000 pages, but maybe I'm off by a factor of two.

MR. MURRAY: You're probably in the ballpark. It will be several thousand pages in the ISA at least.

CHAIRMAN POWERS: Yeah.

MR. ROSEN: Well, I'm thinking about the final. Is there another document from applicant that --

CHAIRMAN POWERS: Yeah, that's the ISA.

MR. ROSEN: -- upon which -- yeah, the ISA itself, 10,000 pages; your analysis of the ISA, 5,000 pages.

CHAIRMAN POWERS: No, they're just saying it looks good to us.

MR. SIEBER: You mean the operating license application.

MR. BROWN: Just to clarify --

MR. ROSEN: Put it on a scale of three significant digits.

MR. BROWN: There is a bit of a nuance. Since the applicant is required is required to complete an ISA and submit an ISA summary, so there is a much more substantial ISA available for staff review that's not provided on the docket.

CHAIRMAN POWERS: I mean, it's also available to us to review as well, but at his facilities.

MR. BROWN: Correct.

CHAIRMAN POWERS: And as you may have detected in some of the questions, I think it's unavailable to actually go down and spend some while looking at that to at least spot check it.

MR. ROSEN: Where is that?

CHAIRMAN POWERS: It doesn't exist now.

MR. ROSEN: No, but where would be go?

CHAIRMAN POWERS: Savannah River.

DR. WALLIS: Can't these 10,000 pages be boiled down to something we can digest.

MR. SIEBER: Yeah, two slides.

DR. WALLIS: In particular, five key things like red oil runaway reactions and hydrogen flammability and so on, why can't that be put into a small volume in which the essence of what we need to know is contained instead of us having to dig through this mountain of stuff? Trying to get somehow on a computer that diagrams so that we can see them and not spread over several pages, isn't there some way someone can concentrate it for us so we can look at what we need to see and not everything else?

CHAIRMAN POWERS: My experience has been that, yes, no trouble at all. I could get it down into the five things that you are interested in. Unfortunately, the five things you're interested in are not the same as the five things that Peter is interested in, which are totally orthogonal to the five things that Jack is interested in.

DR. WALLIS: But I mean things for the decision making, that's all I care about. I will be interested in them if they matter. It's not a question of --

CHAIRMAN POWERS: Well, I mean, the things that are put into this document, I mean, it seems to me that one can make an argument that they all matter.

DR. WALLIS: Well, let's see. Which things can the ACRS have any influence on that's been on -- where can we add value. We're not going to add value on 10,000 pages.

CHAIRMAN POWERS: Well, right now we don't have to deal with the 10,000 pages. Let's deal with our 2,700 right now.

Anything else on the flammable gas issues?

MR. WESCOTT: I had one slide, but I'm afraid to go after it because I don't know what --

DR. WALLIS: You have a flammable slide?

(Laughter.)

DR. BONACA: I would like to just ask one more question regarding this issue. I think from this conversation that we're having now, it seems as if we're talking about purely conceptual design here with no reference of experience or anything out there about how possibly successful these measures can be.

But my understanding -- and, you know, I'm not an expert in this area -- but my understanding is there are facilities using very much these kind of processes.

We also visited a facility in Avignon which I thought --

MR. WESCOTT: Absolutely.

DR. BONACA: So I mean, there is more than just a sense that probably --

CHAIRMAN POWERS: I mean, I thought that that was Alex's point. A standard exists. We know the standard has been applied to similar facilities. Therefore, it's plausible that -- I mean, I think that's what he said.

DR. BONACA: Yes, but I think you know,

one of the reasons that I have been curious about this as it evolved is that for normal reactor facilities, we don't go through a conceptual design approval phase. I don't think there is a separate phase in the licensing process.

MR. ROSEN: There used to be a PDAR and the FSAR. Now we have one COL.

DR. BONACA: Yeah, yeah.

MR. ROSEN: It's very analogous to what we used to have.

DR. BONACA: It's very analogous probably. Well, it is.

CHAIRMAN POWERS: I mean, it seems to me that this has some advantages in that it was clear, for instance, that in the original application the applicant did not consider titanium fires to be a hazard. And so the NRC was able to say at that stage, yeah, you need to think about this. Put in some PSSCs here, rather than hitting them after he had essentially completed the design.

MR. ROSEN: Poured the concrete.

CHAIRMAN POWERS: And so I mean, it makes sense. It's a little bit frustrating for the staff, a little bit frustrating for us because every time we ask you, okay, what was the tradeoff study on the particular width and dimension of the electrolyzer or something, well, nobody has that information right now. We'll get over it.

DR. BONACA: One of the encouraging things I seem to have heard through these meeting is that there is an expectation that the level of safety for this facility seems to be much more automated. It would be higher than existing facilities in the U.S. now, and that's what I believe yours is probably, I mean, from what I got from your comments.

MR. SIEBER: I'm not sure that gives us comfort, if you know what I mean. One of the interesting things that I think sort of sums up the attitude of the applicant is that they write in their Chapter 15 of the application, which is entitled "Emergency Planning," that because of the controls that are established in the construction of the plant that the applicant intends to prove they don't need to have emergency planning, even with the shrunken uncontrolled area that they have, which I guess I keep pondering that statement over and over again to make sure in my mind. You know, that's a pretty high hurdle to put out there and prove that you don't need any kind of emergency planning.

CHAIRMAN POWERS: I can't imagine the site letting them do that.

MR. SIEBER: I think that they intend to participate in the site's emergency plan, but it seemed to me that from the standpoint of the hazard from this facility it doesn't extend beyond the owner controlled boundaries, but obviously there are other things at the Savannah River plant, too.

CHAIRMAN POWERS: Yeah, there are a lot of things going on at Savannah River.

MR. SIEBER: There's more than this going on there. At least there was the last time I was there.

DR. WALLIS: There's no emergency plan for this plant?

MR. SIEBER: Well, Chapter 15 says the applicant establish emergency planning isn't needed.

DR. WALLIS: Because events are so unlikely?

MR. SIEBER: It doesn't say "because." It just says they intend to show that it is not needed.

MR. ROSEN: Basically they have prevented all of the events is why, is what they've said.

MR. SIEBER: Well, to me that shows a measure of confidence that I think --

MR. ROSEN: One hundred percent of the

time.

MR. SIEBER: -- poses a challenge to me, anyway.

DR. WALLIS: Well, the introduction talks about things like aircraft and so on, and we don't believe that would require an emergency plan.

CHAIRMAN POWERS: I believe actually those things were screened out.

DR. WEINER: Yeah, they were screened out.

DR. WALLIS: We just don't want to consider them?

DR. WEINER: There is a site emergency plan for Savannah River, and they could at least have said --

DR. WALLIS: Well, they said that. They recognized the site has an emergency plan.

CHAIRMAN POWERS: Let's let Rex get through this. Are you done, Rex?

MR. WESCOTT: Yes, sir.

CHAIRMAN POWERS: Okay. What I propose, that we go ahead and take a --

MR. MURRAY: Dana, we just have like three more slides to finish off.

CHAIRMAN POWERS: I know. I want to go ahead and take a break.

MR. MURRAY: Okay.

CHAIRMAN POWERS: And come back and that will give us -- there's a method to my madness here. I'll let you go through your three sides, but I think we wanted to go through a little more discussion before we move on to the next issues.

MR. MURRAY: Okay.

CHAIRMAN POWERS: And we've got a little time here. I think we're still struggling a little bit philosophically here. Maybe give us a few minutes just to discuss things a little bit because we have really two chores here. One of them, which is directly pertinent to you, is to say out of all this material you've put together, plus a huge amount of introductory material that probably is necessary for the full committee, that, you know, what fraction of that should you really want to present, and I invite you to participate in that discussion.

We need to give you some sort of marching orders or guidance on that because you will have at most a two-hour period, and they will not want you to talk for more than an hour. That means a considerable condensation of this, but you're going to have to do more background material because you've got to tell people better what the facility is, even if people on the committee know. You may have people from the public in the audience that are not going to have a clue what you're talking about, and so we need to mutually decide what that is, and then you need to make sure that we're as close to on board to your thinking and philosophy here as is feasible to get because we're going to end up drafting a letter that's going to go in front of the committee, and they're going to massage that. I doubt that the full ACRS is going to dream up a wholly orthogonal letter all by itself.

And so we want to make sure that we're in line with all of your thinking. One of the areas that I've got to know more about is we have identified at least one case where we've come in and said, "Okay. Here's our position and here's the staff's position. They're not the same," but that's not labeled an open item.

I noticed a couple of other areas where you discussed with the applicant, and you said, yeah, this was a hazardous area. You didn't mention it in your original application, but they said, "Yeah, we agree," and we'll handle it with administrative controls," even though DOE has standards.

And you point out, well, they didn't cite a standard here and we think we ought to. Okay. I would really prefer not to try to go find all of those things. If we could talk about that just a little bit and give me some guidance on where to look for a summary on those because we're going to have to understand those pretty well.

So the method to my madness was it seemed to me that followed better from your summary than to do the summary and then come back.

MR. MURRAY: Okay, that's fine.

CHAIRMAN POWERS: So I thought we'd take a break until 20 after, come back and do that, with the idea of bringing that discussion which could just go on forever to an end at four o'clock, and then move on to the next item on the agenda.

Does that sound like a strategy? Good enough.

And, by the way, I iterate these subcommittee meetings are kind of times for discussions and whatnot, and the presentations have been just right on the mark as far as technical detail and topics and the presentations have been excellent. So you're doing exactly what we need to hear.

MR. MURRAY: Thank you.

CHAIRMAN POWERS: So 20 after.

(Whereupon, the foregoing matter went off the record at 3:05 p.m. and went back on the record at 3:25 p.m.)

CHAIRMAN POWERS: Let's come back into session.

Okay. In this session what I wanted to do was to allow the staff to go through their summary slides where they think they stand, and then I'd like to chat just a little bit about various topics that people have on their mind, but mostly work to help try to define what we think ought to come forward to the full committee meeting, and I'll talk about what my view on that is, but I'll actually ask everybody around the table what items they think should come forward.

Mr. Rosen, you had a question?

MR. ROSEN: Yeah, just a question. Have you been sort of collecting the key points that have been made around the table so you can kind of spew them back to us at least?

CHAIRMAN POWERS: Well, what I plan to do actually is tomorrow after we have a presentation on criticality, we're going to go back to our technical points on that. That's in our function of developing an outline for a draft position for the committee to look at.

MR. ROSEN: That will be tomorrow.

CHAIRMAN POWERS: Yeah, I want to do that tomorrow. I want to spend a little while discussing philosophical aspects of this, as well as technical details because, I mean, what we've done here is go through really what the outstanding issues were from our previous meeting on this subject, but there are, in fact, 15 chapters in this that we need to think about, whatnot, and we need to give the staff some help because they're going to at best, I suspect get about a two-hour period. Well, we only let them talk for an hour, and I don't think they can come in with a presentation with this excerpt out of the whole thing. So I think we need to discuss that.

Dave, you want to go ahead and wrap up what you presented?

MR. BROWN: Yes. Let me just finish up for Alex, and this is his summary conclusion, which is that now all of the open items are closed in chemical process safety, and that the applicant has provided reasonable assurance of protection against natural phenomena hazards and accidents.

In addition to the previous conclusion with regard to 7023(b), we have concluded that the applicant has met the baseline design criteria, which is also a new feature of the revised Part 70 when it was revised to be a little more risk informed.

I think just overall I think some highlights of the last four years is that the regulation was revised in September of 2000. We received the application just a few months after that. So this was one of the first applications to go through the new risk informed Part 70 regulation.

On top of that was the special circumstances surrounding a plutonium facility, which is a two-step licensing process.

But despite this being kind of a first time exercise, I think that we've done a good job, that the staff working together with the applicant has improved safety, and that there are some changes that we've asked the applicant to make to adjust some of the hazards that we've talked about here today, and that overall we've added value to that process, which I think goes strongly against any sentiment that NRC rubber stamps anything.

So with that statement I'll conclude and be willing to answer any questions first, I guess.

CHAIRMAN POWERS: I guess the first response I have is on your slide 70, "have satisfactorily addressed by additional controls and safety strategies," and I come back to the Level I/Level III chemical concentration controls where you said, yeah, we're going to accept this with a codicil, and I'm not sure that the applicant is 100 percent aware that that's what you're doing.

I mean, there's not an agreement from them. How many other things do we have of that nature?

MR. BROWN: Of that nature? That is something that we will continue to talk to the applicant about, and we certainly will keep you apprised of any changes that do result from that.

I am not really -- and I'm earnestly, sincerely thinking back through -- there should be nothing else of that nature in the --

CHAIRMAN POWERS: Well, I know there's one in which you identify a hazard. I can't remember what the hazard is unfortunately right now, and point out that DOE, too, thinks it's a hazard, has a standard. The licensee agrees that it's a hazard, but proposes administrative controls and doesn't cite the standard, and apparently you don't like that very much. I have to look.

MR. BROWN: I'm not sure I understand what you mean. What event was that that we're talking about?

CHAIRMAN POWERS: I'll have to look through my notes to find it for you, but I will.

MR. BROWN: Okay.

CHAIRMAN POWERS: And so I'm just wondering. I mean, do I have to go through and look and find these not quite full agreement sort of things?

MR. BROWN: No. The other area where we did not accept the design bases that were offered was actually something Chris Tripp will talk about tomorrow, was the criticality safety where for MOX powders we did not feel that there was sufficient benchmark experiments to support the subcritical margin that was proposed.

So we added an additional one percent non-parametric margin. That was made clear to DCS, and it has been communicated to them by letter I think about April last year or April of this year I should say, 2004, and DCS has not approached us to have additional conversations about that and seek any relief from that condition.

MR. ROSEN: So they're just going to leave it in the license application the way it is and have you grant a license condition?

MR. BROWN: This is --

MR. ROSEN: It sounds like just holding your breath until you turn bright red and die.

MR. BROWN: Well, no. The nuance here is that these subcritical margins are not actually in the construction authorization request. They're in a related document called the criticality validation report, provided on the docket, but not actually part of the CAR. This condition is necessary, you know, to establish that this is the limit, notwithstanding what else is in your criticality validation report. We would only accept this margin for MOX powders.

MR. ROSEN: So it's not like they're standing on principle. It's just they don't know what to change. You're going to require --

MR. BROWN: They wouldn't have, yeah, a change to make.

MR. ROSEN: They're probably going to license the change, the CAR for them to change.

MR. BROWN: Right. I think it's fairly stated that DCS and DOE do not agree with NRC on this matter, and so, you know, where NRC and an applicant have reached an impasse, a condition is the appropriate tool

MR. ROSEN: Yes, yes. You grant the license.

MR. BROWN: Grant the license with the condition required to protect safety.

CHAIRMAN POWERS: Okay. What I propose to do is let's just walk around and address two things: general comments you care to make and any guidance you'd like to give the staff on what they ought to bring forward to the full committee.

And after I've walked around the table, I'm going to come right back to you, Dave, and your team and ask you the same question, what you think should be discussed in the letter and what you think you ought to present to the full committee. So it will give you a chance to think about those.

Ruth, why don't you lead us out here?

DR. WEINER: Okay. I'm going to defer our general ACNW comment to my chairman, when you get to him. I'd just like to make a personal comment about the safety margins for chemical reactions in closed systems. They make a number of assumptions that I think are optimistic about the way thing really work.

In a mixture, the temperature is not uniform, and I think very close attention should be paid, in particular, to any closed system that they have to what kind of safety margins are being left for reactions, but I will defer comment on waste to Dr. Ryan.

CHAIRMAN POWERS: Well, why don't we just jump right straight to Dr. Ryan in that case?

DR. RYAN: Thank you very much.

First of all, I think we all three appreciate the fact that you're at a conceptual design stage and the details are coming, as we heard on many of the issues that you addressed today, and I thank you for that.

One of the issues that I think we all think about focusing on waste is -- and I'll just read this to you -- how has the waste management hand-off to DOE/SRS been analyzed to assure that waste management processes and systems don't create any MOX plant safety challenges?

In other words, if there was a phone call that said a waste pipe is closed, what does that mean to you in terms of safety challenges?

And, again, I recognize that in an early design stage that's kind of a very open ended question, but it's something to think about as you go from this stage on into the more detailed design step.

And would a interruption of waste

management services from the SRS/DOE site be factored into the design and would immediate shutdown be required? Could you shut down carefully over time? You know, what kind of safety questions would you face if you were told that that outlet can happen?

And you mentioned, I think, Allen comments that you have acids and bases, and you know, would you have to mix them? Would you have to dump them to some kind of collection tank? You know, are there any special issues that would result from that sort of a force majeure or other imposed condition on you?

You don't control that aspect of it. So that's something to think about, and again, we defer to our colleagues here on the details of design. Obviously they're the experts, but that's one that kind of struck all of us as you talk through it today.

CHAIRMAN POWERS: Any comment on this question?

MR. MAGRUDER: We agree that we ought to pursue it, you know.

(Laughter.)

MR. MAGRUDER: I'm not sure what else to say.

CHAIRMAN POWERS: Okay. That may be enough.

MR. MAGRUDER: We agree. Do you want to add anything?

MR. BROWN: Well, I'll just add and perhaps repeat that, you know, we did consider the safety implications of the waste that is stored inside the MOX plant, and I think it has been our underlying assumption that if those tanks were filled to capacity they'd be forced to shut down.

DR. RYAN: That's not what we're saying though. What we're saying is if your waste outlet says you can't send this waste anymore, we've got a problem. What does that do to you?

That happens to day. If your waste tanks are near capacity and you've got a lot in process, what's your excess --

CHAIRMAN POWERS: Well, I don't know if it even matters that they're near capacity. It is merely that they have to stop.

DR. RYAN: Yes, or have you evaluated that kind of scenario that would causae you to rethink do we keep going or not, under whatever set of conditions you had?

So that's a different question than what you just offered as an observation.

CHAIRMAN POWERS: In fact, it brings up

the point of your waste collection tank. You have this waste collection tank at the facility that receives all kinds of stuff. I mean, they go to some lengths to describe all of the feeds that are coming into it and their diversity.

I mean, how do you assess the safety of that in light of the fact that that's exactly the sort of tank that has created so many headaches for the Department of Energy, one that's receiving lots and lots of diverse waste streams.

DR. WEINER: That raised a question which is really not part of NRC's purview, but is just something generally to think about, and that is the extent to which a facility like this will contribute to legacy wastes that we're now dealing with.

CHAIRMAN POWERS: Otherwise known as employment for waste.

DR. WEINER: Keep those people at Savannah River going.

CHAIRMAN POWERS: Keep Yucca Mountain green.

Professor Denning.

DR. DENNING: I'm not going to address any of the real technical issues here, but I am struck by the difference that I see between what we normally do in approving something versus what I think our charter is here, and I think that our charter here is substantially less than it normally is.

I think normally we're really being asked is something safe enough, and I think that in this case -- and at some point I think we will address that question -- but because of this two-step process, it seems to me that the kind of three questions that I see, and perhaps we can discuss these more when we get to what our letter would actually say, but I think it does have relevance to what they should be presenting to us at the full committee meeting.

The first is: has the staff performed a comprehensive review of the hazards represented by the facility and the design bases and PSSCs proposed by the applicant?

Has the staff developed appropriate safety acceptance criteria?

And I think that the principal question that we have to then address based upon that is: is there reasonable assurance that the applicant will be able to satisfy the safety criteria based on the conceptual design?

CHAIRMAN POWERS: I mean, I'll look to Dave, but it sounds very familiar to the language we've been using.

MR. BROWN: Yeah, I don't have any comment.

CHAIRMAN POWERS: I mean, it sounds like we're aligned there in our thinking on what they're trying to accomplish here,a nd I think it would be useful to articulate those. I mean, we're going to serve something of an educational function to the Commission in our advice on this, too, and we're going to have to lay this out.

And I think we will probably interact with you guys on that aspect of the letter in draft form. I mean, we're going to spend some time to make sure we craft those words very carefully. So when it gets time for that, please help us get the words in precision there, and to articulate it out into three questions like that might be very useful.

Vic, or Professor Ransom I should say.

DR. RANSOM: I don't have much to add. I think I agree that from what I've seen, we're used to looking at the details of a process and trying to evaluate whether or not there are safety concerns.

I assume in this case, too, that the consequences can be made small, and that the facility reviewed in France at least, you have kind of like a pilot plant line which --

CHAIRMAN POWERS: Well, it's an interesting pilot plant in that it's bigger than the one we're talking about.

DR. RANSOM: Really?

CHAIRMAN POWERS: Oh, yeah. The throughput in France must be what, ten times this or something like that?

MR. BROWN: With the MOX plant at least, I think it has the capacity in France of 200 metric tons per year. this is a 70 metric ton per year plant in the U.S.

DR. RANSOM: I'm having a little bit of a hard time getting my hands on what are the risks, you know, involved in this kind of facility.

No other comments I don't think.

CHAIRMAN POWERS: Dr. Bonaca.

DR. BONACA: Well, referring to what should be presented in February to the whole committee, I think that's an interest you had. I would echo somewhat what Dr. Denning pointed out. It seems to me we have to go and talk about, you know, the general safety assessment of the design basis.

You have a full chapter there in the SER, Chapter 5, and you don't have to go in fanatically, as

I see the issue, but certainly talk about the issues to do with nuclear safety and chemical safety. How you have established those criteria in terms of the point we were making there.

Particularly we saw today that table of doses versus likelihood, and you referred to a NUREG that contained those as some quantitative indication. I think it would be valuable for us to have an understanding of that.

Also you referred to the fact that we are using chemical releases to determine risk also. So also that kind of information, and I would keep the presentation at the kind of high level to give a sense of how you do have envelope to issue the conceptual basis, and then at that point I don't think you have to go into much detail, but you have to give some basic understanding of why you believe that this approach, this criteria can be met. And I would keep it at a high level because I don't think we have that much time. I think probably a couple of hours.

CHAIRMAN POWERS: Well, I mean we may make an argument for it, but I think as a planning basis, we plan on a couple of hours.

DR. BONACA: We're not doing anymore than that.

CHAIRMAN POWERS: And I'm just guessing. I mean, the problem is this. The facility encompasses enormous numbers of technical fields, enormous numbers of technical questions. There is no way to anticipate the particular question that's going to excite somebody. I mean, even the people that have been sitting here, they're going to continue to review the material, and you cannot prepare for everything.

So it's better to prepare for being surprised or maybe not surprised, but prepare for unanticipated questions. Make the presentation, as Dr. Bonaca said, at a fairly high level. You can list some of the particular issues as illustrations of your approach, but it's really getting across your approach, you know, not red oil is an issue.

DR. BONACA: That's right.

CHAIRMAN POWERS: But rather, here's what we did.

DR. BONACA: One last comment I wanted to make was regarding this issue of preventing versus mitigating. I haven't heard a single word in the presentation in regards to mitigation, and yet you do have mitigating features, and it seems to me that you call them preventative because anything that prevents a dose you call it preventing, but that is like saying in a reactor ECCS is a preventive. It's equipment because it prevents doses from being released.

The reality, we consider it a mitigating system, and I think you're doing a disservice a little bit to what has been done and proposed by ignoring that there are some theoretical issues there that you include in your design.

CHAIRMAN POWERS: Yeah, I agree with you that there's a definition of terms here, and I particularly liked the way Dr. Bonaca characterized it, and so you might want to in your introduction acknowledge that there's a challenge in terminology throughout this Part 70 versus Part 50, and use that as an illustration of, you know, when you guys are looking for a balance between mitigation and prevention. We've got that, but the way we label things it's a little different. So it might seem like we don't.

And just acknowledge there's a difference in terminology and hope that the members that are maybe insensitive to that, the people here can help them understand that better.

DR. BONACA: Those are my comments.

CHAIRMAN POWERS: Very good. Mr. Rosen.

MR. ROSEN: Yeah, I'd like to echo what

Mario just said about the differences in the regulatory framework. I mean, I think that the other members who haven't been involved won't really understand, won't really have in their heads the idea that this is really governed by Part 70, 7061, in particular the performance requirements.

And it might be a little tutorial on that up front may be very helpful.

The other thing I think that's of major importance, and I'm not sure whether this falls across the line into a technical question, but I'll talk about it anyway, and that is the need, I think, for a process overview in the facility, that is, -- and these issues all tie together -- a control room where the overall process is overviewed. The very existence of such a space and the function itself, and the need for someone to initiate an emergency plan which would likely come out of that space to me is either a glaring omission or either I don't understand it or maybe there isn't a need for it, but it's so different than what we're used to in the reactor world that I think it bears some exposition, either explanatory of why it's the way it is or maybe to say, well, we didn't really give the subcommittee all of the answers that maybe we could have or should have, and here are some answers around the question of (a) a central control room if it's needed and (b) how one initiates an emergency plan, although the point is that the applicant is saying they don't need one.

And then that's a very big issue, and I don't see how we could reasonably go to the full committee or even mention it to the Commission without having addressed that issue. After all, the Commission has just, I think, said in the area of future reactors that emergency plans will be required even for future reactors. Here's a current system that's not a reactor, granted, but where the idea is there isn't going to be one. I think it's a big issue.

And I wanted to talk about this question of the third issue that I think is a technical issue. It's the issue of when you have an area where you need to have moderation control, need to make sure the water doesn't get into that area, that you're really basically making a choice or making, let's say, optimizing the choice, making a trade perhaps is a better way to say it, between five protection as you would normally design it in order to protect, I think, the public's health and safety versus nuclear criticality safety in the facility which is a protection for the workers.

And you're making some sort of trade, and the dimension of that trade are not exactly explicit to me. Now, is that a technical issue? I don't know, Dana.

CHAIRMAN POWERS: But I think it's a good issue, and we need to explore that further. You and I need to chat because we've got to understand this a little better.

We're going to get a report from one of our consultants on the nuclear criticality stuff. Maybe at that --

MR. ROSEN: We can look tomorrow.

CHAIRMAN POWERS: Well, we'll hear more about the criticality tomorrow. We're going to get a report on that material from a consultant. Once we have that in hand, then we need to explore it a little more, and it may be necessary for us to sit down with the staff and understand this a little better.

MR. ROSEN: Yeah. Well, I'm not sure that's something that we would want to put in the full committee discussion, but there it is. It's a big issue.

CHAIRMAN POWERS: It is, I think, a useful issue to pursue because this tradeoff is always a challenge here, especially with the closer site boundaries. We just need to understand the issue a little better.

MR. ROSEN: That's all I have.

MR. MAGRUDER: I think, Dr. Powers, I think that tomorrow morning when we talk about safety issues we can get into this again. I think we have a better story than we presented.

CHAIRMAN POWERS: Sure.

MR. MAGRUDER: I mean, this is definitely something we should talk about, but I think that for this particular design it may be less of an issue than we think it is.

CHAIRMAN POWERS: So why don't we just count on that, and we'll explore it a little further. I understand it may take us a little while to get up to speed here because we're still collecting our information on this.

MR. MAGRUDER: Right, right.

CHAIRMAN POWERS: And if its necessary for us to get together again and chat, I mean, we can arrange that.

MR. MAGRUDER: Absolutely.

CHAIRMAN POWERS: This should not be an onerous thing to do.

Professor Wallis.

DR. WALLIS: Well, what we heard today I found to be at a very high level, which is where you are so far, toward about approaches and principles and in general terms the methods that were to be used to control these various reactions and so on. But it was very hard for me to tell which of these might turn out to be a technical issue because I couldn't see enough detail, and I don't yet know whether the design will actually be adequate. So there's obviously a long way to go.

I was helped by the discussions today of a phenomena, such as red oil and HAN and all of this kind of thing. It really helped me as opposed to trying to just read the documentation. I found what you presented today helped me there.

In terms of presenting to the full committee, I'm not quite sure. Are you presenting the whole draft SER on the entire CAR, in which case you're going to talk about a lot of things besides these open issues, or are you just going to talk about the open issue resolution to the full committee?

MR. BROWN: No, I think we will have to go to an even higher level for the full committee.

DR. WALLIS: Because if you talked about

just what you did today, I would suggest you use your last three slides, that you give something like three or four on the overview of your approach to things and the design approach for this facility.

And then I found that these were illustrated well by the individual topics. So I'd have another three slides on things like red oil, electrolyzer, HAN/hydrazine, control room habitation, and fires, and seven times three is 21, which is about what you need for an hour long presentation.

But I think it was useful to go into some of the specifics of these individual phenomena as they illustrated the approaches being used.

CHAIRMAN POWERS: Dr. Ford.

DR. FORD: I agree with Graham as far as the recommendations for what to be given to the full committee. However, I think I'd disagree with the majority of this on the specifics. As I understand it, we're being asked to endorse the case being made for a construction permit, which includes the validity of specific values -- and I'm quoting from here -- the specific values and ranges chosen for the controlling permitters in the design basis, and in order to endorse those, you have to get into specifics.

For instance, on the red oil issue,

there's a set point of 125 --this is Slide 16 -- of 125 degrees Centigrade. For a runaway process it is 135. I'm unsure where the data associated with that is, and what is the real margin between the data and the runaway temperature? And what is the response time for the system for a runaway process?

With regards to the HAN, Slide 23 and 25, we have a temperature instability which is some function of the nitric acid, et cetera, and hydrazine. That's a mathematical value that is being given. I do not know what the correlation between the data and that mathematically derived set point is, and are there any data -- question: are there any data showing that you could have unstable performance below the set point of the design basis value of 50 degrees Centigrade?

It seems to me a lot of detail is being left until you get to the ISA aspect. So generic questions: what happens when you get all of this data and you find those design basis values were inappropriate and you change it?

As regards the full committee meeting and things that Graham mentioned, I suspect that you might get questions relating to quantification of the frequency consequence diagram on Slide 11 in the opening talk. It is entitled risk informing, 10 CFR, Part 70, and I suspect you might well have questions asked about the lack of use of PRA.

That's it. Thank you.

DR. DENNING: Dana, could we have just a little discussion? Because I think that Peter's view really is critical as to whether the ACRS can really even support the approval for a construction permit because if we have to do it at the level that you talked about, if we really have to know whether the 125 degrees is correct today, you know, I don't think we can do that, although perhaps we could, but we certainly didn't look into it enough.

So I think the question is: exactly what is the charter that we have? What is the ACRS really going to approve? How far do we have to go? And, of course, there's going to be judgment in that, but if we really had to go as far as you said, if they had to provide enough evidence to take us to that level, I don't think they have done that, nor do I think they can do it, and I think that this two-step process is one where we have to accept the compromise that we really aren't going to know, and there's going to be a risk that the plant is going to get built, and it's not going to satisfy the criteria.

So I think the focus has to be on the criteria that is established. By that I don't mean 125, but just the general concept of the maximum temperature.

DR. FORD: I agree with you entirely, but I was taking my comments, taking verbatim from the slides. It says what the purpose of the meeting was, and it's to endorse this CAR for the facility, and then it goes on to say which involves the design basis, definition of the design bases, which on Slide 10 goes specifically into specific values and ranges of values for controlling parameters.

So that's why I suggest that logical step. Maybe I'm reading the criterion wrong, but taking it from --

CHAIRMAN POWERS: I mean, I think you do it within context here. You say the staff is really asking is there anything wrong with our methodology to evaluate these criteria, and in general most of the criteria have been advanced by the applicant and the staff is simply reviewing them in the face of some uncertainty, okay, and the staff is asking us where we've asked the applicant to do research to support those numbers, was that the right decision, and when we have not, was that a correct decision?

I don't think you're being asked to take the way out of saying in the absence of perfect information, I approve nothing. I mean, I think you're being asked given the information that's available, has staff taken a prudent course here, and understand that one of the advantages of this facility is that, of course, there is this plant that Vic talks about that has operated for some number of years. Some of these processes, for instance, the evaporators of Hanford have operated for now 15 years using less restrictive criteria than the staff has adopted.

So I see that as our charter, and not saying, "Okay. Well, I have to have perfect information."

DR. BONACA: I can give you an example of why throwing the early design of the plants. I remember commitment in the PSARs that you would have a protection system that would give you protection from over pressure transience so that you will never reach in a PWR 2750 psi, and you have certain assumptions about the functions you will use for that.

Therefore, I remember at Babcock & Wilcox the function relied on was high flux and high pressure, and then once you have begun to develop the plant we found that you had a range of reactivity insertion rates for which you had no protection. So you had to implement a new function that you finally found. I mean, it was in a flux as the core; you implement some new element.

So there is no doubt in my mind that in this process there may be some features that the implementation process may require some modification of that kind, but it seems to me it's more of a refinement at that point than a general assessment that says, yes, a protection system that will meet certain requirements can be, in fact, implemented and is acceptable in concert.

And I view this as a conceptual design that says the approach is feasible.

DR. FORD: Well, I'm certainly not saying that they have not identified the issues. I think they have. All I'm responding to is what's on this, what they're asking us to do, and if it's not what they're asking us to do, fine.

But they do ask us to comment on the specific values of the design basis parameters, and even admittedly in the face of uncertainty. And you take that into account in terms of adequate margins, and so now I'm asking, well, how adequate is the margin, and that's where I'm coming from.

Maybe I'm being too copious on what they say they want us to do.

CHAIRMAN POWERS: Well, I mean, on the specific issue, again, I caution that if they had put up a slide that says, "Okay. Here's what the computer code calculates and here are all of the data that we've collected from a bunch of laboratory tests," it wouldn't help me a bit because I know that it's almost impossible to reproduce in the laboratory the conditions that take place in the actual evaporator.

DR. FORD: So then you'd be more conservative presumably.

MR. SIEBER: Not necessarily.

CHAIRMAN POWERS: I would tend to go back to the empirical data that says, okay, where have the evaporators been operating for 25 years successfully. Okay. Well, sit in that range because, you know, they work fine. I mean, that's my natural tendency, is to do that.

I mean, I have not done this laboratory research myself. I've held the hand of he who is doing the laboratory research, and you can never convince yourself that you were actually reproducing the conditions in the --

DR. FORD: I drew up here a graph. This

is for the HAN process. These values here, 65 and 50, are calculated. The points that are supposed to be the experimental data points, all I'm asking is are there red spots, i.e., denoting unstable behavior, below that 50 degrees line which they say is an adequate margin. That's all I'm asking.

CHAIRMAN POWERS: Well,w hat I will tell you --

DR. FORD: And if there are, then it's no longer a margin.

CHAIRMAN POWERS: I don't know the database for HAN. I know more the red oil, but on the specific limits there, there are none below what's set as the DOE --

DR. FORD: Well, that's fine.

CHAIRMAN POWERS: There are absolutely none. Never make it go there.

DR. FORD: Good for the rationalists or are we structuralists? I'd love to see that graph. Data compared with a mathematical derived model.

DR. WALLIS: Well, in the absence of that, I'd like to know that the designers of the plant have some other way of doing it. Maybe it's not this graph but some other way that assures adequate safety, and we never heard anything from the designers of the plant.

I mean, that's a problem I have with the documentation. I read your documentation and on the red oil I was told that by controlling the temperature of the residents with the organics, the off-gas system and so on, you could get the red oil to be stable.

But I said, okay, the details must be in the applicant's paper. So I go to the applicant's paper, and the applicant says exactly the same thing. There's no detail there. So in the absence of having the designer up there confronting him with "what do you mean by you can control the temperature. Show me," there's no way I can get that reassurance.

Presumably you aren't the designer. So who is it who knows the technology well enough to do it right?

DR. RANSOM: Well, along those lines in the red oil argument, they want to control temperature, but actually temperature and pressure are coupled, and they talk about open and closed systems, and so your ability to vent this thing and regulate the pressure is really coupled with the ability to regulate the temperature, and there's no detail. I don't know whether they can do it or not.

MR. SIEBER: When you vent, you remove

heat, and that's the strategy.

DR. RANSOM: Well, they actually argue you're cooling by evaporative cooling, which means you're boiling the liquid mixture, and if you increase the pressure, you increase the vapor pressure of that fluid, and so the boiling temperature goes up. So they're all coupled together.

CHAIRMAN POWERS: And heat removal goes down unfortunately.

Mr. Croff.

DR. CROFF: Mike covered it.

CHAIRMAN POWERS: Boy, you're efficient.

Jack.

MR. SIEBER: They have but one leader.

DR. WEINER: That's just our public persona.

MR. ROSEN: It would be to follow their example.

MR. SIEBER: I guess in my comments I would agree with everybody, but as we went through today, I kept thinking about how could you restructure what you've said today in a way that I could better understand it. Okay? And so I've been, as we've been going on, writing down the elements of what I think a person with the mental capacity to understand what's going on here, but not an intimate familiarity with the plant or the process or the licensing might have prior to any discourse with the staff on the subject.

And it seems to me I think that there are some areas of confusion. At least the ACRS deals 95 to 99 percent of its time with power reactors. It's licensed under a different set of rules. The processes that occur in power reactors are quite different than they are in chemical plants or in processing fuel or what have you. So I think that the stage has to be set by, first, spending a couple of minutes on the Part 70 two-stage licensing process.

Next, I think that one needs to explain the overall process for the facility, you know, from the time that it leaves the DOE part until it comes out as pellets ready to go into a fuel assembly.

Okay, and in the process of doing that, I think that it's important to describe what's a batch process and what's a continuous process because it makes a difference as to how the controls are established, and the limits and the set points and the degree of the hazard present when you know these kinds of things. And a good part of this plant is a batch process plant.

Then I would -- and I agree with Dr. Ford in this area -- I would look at the various kinds of issues of concern from a safety standpoint. Number one, chemical safety, and I mean by that toxicity. You know, if you go to a chemical supplier and you buy a drum full of something, you get an MSDS with it, but if you are the chemical processor, there's no MSDS, and you have a lot of intermediate products in your own process that have certain hazards to workers, off-site people, and so forth.

I think those things need to be -- the important ones need to be described in how they're controlled, and you've talked about that today.

The second thing is process safety, which is the red oil kinds of issues, and whether they're mitigated against or prevented.

Third would be criticality safety, which we haven't heard about yet, but I think I have some concerns about it at this point, and we'll find out tomorrow when we ask questions.

Fourth was radiation safety both for normal operations, the workers inside the facility and under accident conditions.

And lastly, but not least, fire protection. It seems to me with all of these chemical in there, this place is just aching to burn, so to speak, and so fire protection becomes an important issue.

And in dealing with each of these, I think it's important to describe whether the strategy is prevention or mitigation or both, and what controls are established on each of these processes, each of these areas that's built into the design that says I'm going to avoid this by preventing it or I'm going to have prevention, but in case I really don't prevent it, here's some mitigation strategies, for example, your ventilation system. So your ventilation is a strategy for mitigation to me.

I think that you need in accordance with Dr. Ford's explanation the data that says, for example, in process safety: here's the stable region. Here's the unstable region. And then you have to go beyond that. How well do I know it? What's the uncertainty?

Secondly, where am I going to establish my process limit?

And lastly, how much margin is there and does it encompass the uncertainty that I have in my test data and in my ability to measure what's going on in the process?

To me that would much more firmly

establish whether this plant is operated within the safety parameters that the application bounds and that the staff would like to assure. I think without that, then we don't have all the technical pieces that it takes to say, yes, this facility will meet expectations with regard to safety impacts or, no, it won't and these things need to be changed. You don't have enough margin here. You need to lower this process control variable, and so forth.

And I think if you set things up like that and then establish really what integrated safety analysis is as compared to what we all know as PRAs and why it's good enough and in some cases for these kinds of facilities, it's better than a PRA, and what one hopes to establish by reviewing the ISA.

And I think that when you do that, that sort of ties together all of the parameters and control variables that you need to discuss to establish a reasonable probability the facility can be operated safely.

I don't know if you can fit all of that into two hours, but that's what I'd try to do. You have to talk fast. I mean, you've got to keep right on going.

(Laughter.)

MR. SIEBER: But in any event, to me --

CHAIRMAN POWERS: You mean that they're to ignore any interruptions from Professor Apostolakis?

MR. SIEBER: Right.

CHAIRMAN POWERS: Just tell him to shut up?

MR. SIEBER: And my wife always gets annoyed when I turn my hearing aid off. Perhaps that would work for you.

(Laughter.)

MR. SIEBER: It does work for me.

In any event, to me that's what ties this up in a package, and the presentations I think today were good. A lot of effort went into them, but not all of the elements were there that I felt I needed to know to be able to say that this facility is a good facility, it would be operated properly, and it doesn't represent an undue hazard.

And I guess that's sort of the way I feel about it, and you know, the application is very long and the SER is a third the size or a fourth the size, but it's also very long and neither say as much as I would have liked them to say, and I guess you almost have to wait for the sequel, which is the operating license application, in order to find out --

MR. ROSEN: How does the story end.

MR. SIEBER: Yeah. No, what is the background? What are all of the little parts. You know, you make glorious statements. You know, we aren't going to do this and we aren't going to do that, and here's our limits, but you don't say how you're going to do it, and until all of these design details are there and a description of how you're going to operate the facility, until that's there you won't have every piece of the story that's necessary. You can just say, "Okay. Here's some weapons grade material. Let's make fuel out of it."

So anyway, that's sort of the way I feel about it, and I think the elements are there. I think the staff has done a really good job, and I'm impressed with the effort that the staff has put forward on this project, and I think that the applicant has done a good job, too.

On the other hand, I think that we could package it better, and for those unfortunate enough not to be on the fuels subcommittee.

I don't know if the staff has any comments or if I make any sense, but that's sort of the way I feel about it.

CHAIRMAN POWERS: Dr. Weiner.

DR. WEINER: I just had one brief comment. The slide that you have that showed that hazard matrix highly unlikely and so on, first of all, that is an area where you are showing that your analysis is risk informed because that's exactly what that does.

I'd certainly make it clear what you mean by highly unlikely, and so on, and I would add to it the chemical hazard matrix. It's just a suggestion.

I think especially if you have members of the public, less involved people present at the hearing, that will mean something.

CHAIRMAN POWERS: Okay. Dave, you're up. What do you think you ought to present?

MR. BROWN: Well, I wanted to also mention the content of the letter.

CHAIRMAN POWERS: Yes.

MR. BROWN: You know, as pointed out, we can fit all of that even into two hours. We'll have to see, but you know, I think it's probably useful if this is -- if you don't object, to put some historical context in on this section of that regulation, the 7023(b). Where did it come from? How did it come to be there?

It turns out that that section was added in the early '70s with the specific intent in mind that no one would build a plutonium processing facility that could not be run. For example, you wouldn't build a plutonium processing facility out of concrete block with glass windows. That clearly would not meet any strenuous seismic design criteria. You'd end up having to tear the building down because you couldn't get a license.

That was kind of the intent, and as you said earlier, Dana, the struggle that the staff is having with that regulation is, you know, have we gotten adequate assurances that this plant if it's built according to these design bases could be operated safely, and we have made appropriate judgments that some details can be deferred later until the final design is completed; that in no case would this plant have to be torn down to the ground and rebuilt in order to get a license.

I think that's kind of, I think, a message that I'd like to across.

CHAIRMAN POWERS: Yes, I think that's very useful.

MR. BROWN: Okay. That's my boiling it down to one point.

CHAIRMAN POWERS: Now, here's a man that knows how to hone things down.

MS. WESTON: Dana, I'd like to weigh in on this.

CHAIRMAN POWERS: God is speaking to me.

(Laughter.)

MS. WESTON: I'd like to weigh in on this also. I think that it must be clearly articulated that this is the design basis phase, and they need to make clear to the committee what that means and what the obligation is of the licensee with regards to that.

I think that has led to a lot of confusion about what is expected of the licensee. So I think that really, truly has to be clearly articulated at the full committee so that everybody understands what the playing field is and what the licensee is obligated to provide at this point based on the regulations, which we can't change at this point. Okay?

CHAIRMAN POWERS: Good point.

DR. RYAN: Let me pick up on that comment. You know, as I walked in today, I'm thinking about where are we in terms of percent complete. You know, there's preliminary design, trial design, pre-construction, and all of that, and it might help you to lay out that time line, you know, in some way and say, you know, we're here; we're not over here, and just kind of get everybody oriented to what's going on at this.

CHAIRMAN POWERS: Okay. That's very good.

DR. RYAN: That might be helpful.

CHAIRMAN POWERS: You're quite right. And one of those standard diagrams that DOE uses in its system engineering would really clarify things very much.

Joe.

MR. GIITTER: I think something that would be helpful, Dr. Powers, is if you started off the presentation to the full committee by summarizing the collective view of the subcommittee, you know, based on what you're going to talk about subsequent to this meeting, what you've talked about today, and I think that will set a tone for us to step in.

And I agree with Mag's comments. I think we do need to redouble our efforts to make it clear that this isn't a reactor. This is a fuel cycle facility being licensed under what was intended to be a one-step process, a risk informed, performance based process, and what we're doing here is something different and unique, and that we're actually taking this through two steps: a construction authorization and then a possession in use license.

CHAIRMAN POWERS: I think that's a good comment, Joe, and our ground rules even actually prescribe that the subcommittee chairman is supposed to give the full committee an appropriate background for this.

And so I will suggest that Mag and your staff work together to kind of create an outline of what those comments should be, to put a context, and I may carry a little water for you. I might use that percent completion slide that Dave used just to illustrate things.

I certainly would use the point that this is the first application of the regulation and whatnot, and maybe we can work together and come up to a background that sets the stage appropriately for you. That would fit well with the prescriptions that are given to the subcommittee chairman for full committee meetings, and I might use language that the committee kind of expects to hear and avoid new terminology for them just because it's familiar to them.

So that's a good point.

Stuart, do you have any comments?

MR. MAGRUDER: Nothing.

CHAIRMAN POWERS: I can't believe it.

MR. MAGRUDER: It has all been said.

CHAIRMAN POWERS: Somebody has got a gun to your head. I know this.

DR. WALLIS: Dana, could we go back to this risk informed, performance based remark here? In terms of the red oil, I think if this were risk informed decision making we would want to say what is the probability of a runaway reaction which led to a breach of the vessel, and we would have to look at the uncertainties in the measurement of the temperatures, the chemical reaction rates, the stability criteria, all based on some sort of rationale, and we'd have to say now with this choice of 125 degrees and these controls, what is our best estimate of the probability of failure.

And without that, I feel I'm dealing with something I can't get hold of. Now are you going to get to that state some time?

MR. MAGRUDER: Yes. That hopefully is what will be in the ISA.

DR. WALLIS: That sort of thing will be in the ISA.

MR. MAGRUDER: Yes, absolutely.

DR. WALLIS: And they may say we were

wrong about 125 degrees. We should have picked 122 because that puts us within our criteria or something, and we realize we are uncertain enough about the reaction rates that we have to add some factor of safety or margin or something. That will all be there?

MR. MAGRUDER: Yes, it will. Well, where they can quantify things it will be there.

DR. WALLIS: If it's as vague as it is today, I'm not going to feel very secure.

MR. MAGRUDER: Hopefully you'll feel more secure after you've seen the ISA.

CHAIRMAN POWERS: Yeah, I guess I am less confident that a mechanistic understanding would come about. I think if I had a vigorous interrogator demanding quantitative information I would go experiential.

I mean, I keep coming back to this all the time. The system seems to be chemically complex. More importantly, it seems to involve some cooperation between radiolytic and thermal processes, which are -- I mean, we're still sorting out the radiolysis of water. We are not going to solve the issues of radiolysis of complex compounds promptly, and I have to admit that I'm must more comfortable with experiential bases than maybe someone who has a strong bent toward mechanistic understandings.

DR. WALLIS: Well, that's fine, but what's the bottom line? What do you use to conclude as a criterion of acceptability?

CHAIRMAN POWERS: Well, I mean, the thrust has always been, I mean, in many of these, many, many processes, if I do it this way I'm okay.

DR. WALLIS: It has never failed before. Therefore it will be all right. Maybe it's not a very broad experience?

DR. BONACA: I think they provided the criteria, however, for the example you're making. They're saying process safety control subsystems. So control reactivity enthalpy by limiting steam temperature. Okay?

Now, when they would come up with detailed design after construction, they would have to explain how, in fact, they're achieving this.

And the next one is limit organic compound residence time to oxidize radiation. That's the criterion that they'll have to demonstrate physically. I mean, what have you done to deliver on that issue?

I believe that you would use this as criteria to compare to, right? To make the judgment whether or not this is reasonable residence time.

MR. BROWN: That's right.

DR. BONACA: What happens if, in fact, you cannot limit? Do you know enough about what does it mean "limit residence time"? What's your expectation on a jargon of that nature?

MR. BROWN: Using that as an example, we know enough that the hydrolysis rates and radiolytic decomposition rates are such, especially for weapon grade plutonium with not a lot of fission products present, are slow, and so that the order of magnitude of the time involved here is months.

DR. BONACA: Okay.

MR. BROWN: And the solvent undergoes regular washing at the end of the cycle. So that's why we can say without specific information on those rates it's reasonable that they can obtain clean solvent using the sodium carbonate solvent washington system.

CHAIRMAN POWERS: It may be that this system is not even susceptible to red oil phenomenon because it only has alpha emitters and there's no strong gamma component to this. You don't have a lot of cesium in this.

MR. BROWN: Yeah, we think it is

susceptible to red oil phenomenon in the hydrolysis rates alone,b ut I understand your point.

CHAIRMAN POWERS: It could be. It could be.

DR. BONACA: No, no. I agree that only the most recent steps have been accomplished, but I thought that the criteria have been put in place to make a judgment once the facilities are constructed. Now, it may very well be that what is being delivered is not adequate, and that may be a judgment we pass at that time.

DR. WALLIS: There seems to be an assumption that if you control the steam temperature, you can control sort of heat input. Well, I'd have to see how that works. We have to know something about how this head exchanger works and now it's controlled and what the flow rates are and all kinds of stuff to find out if it was really controllable that way.

And this idea of adding water and letting it evaporate, again, you've got to calculate all of that.

DR. BONACA: Yeah, it is, yeah.

DR. WALLIS: So there's a huge step of faith that these methods will actually work.

CHAIRMAN POWERS: Okay. Well, I think

you've gotten the guidance repeatedly now that in your presentation that some sort of overall setting the stage, some discussion of the two-step licensing period as a background, some description of the facility itself, and then I would encourage you to use the slide to illustrate the magnitude of your review. I think there's a consensus there's a fairly comprehensive review you've done.

Then a variety of technical issues come up, and I would encourage you, again, to use these as illustration of your approach, avoiding plunging into too much details, but focus on how you went about doing things and whatnot.

And, of course, you're stuck with roughly an hour of presentation here. So I mean, I will try to set it up so that you get forgiveness for just listing some of the issues that you've gone into, and then pluck a few out that you think you can make your case clearly on that.

DR. DENNING: Dana, an hour's presentation really seems totally inadequate to me. Is that cast in stone? Should we be considering changing that?

CHAIRMAN POWERS: The ground rules, well, we're certainly trying to get a three-hour block for them, but in general, the planning and procedures committee says that if you have to go much longer than that, then you're really talking about a subcommittee meeting and get your act together.

Okay. Now, we have an advantage there. There are eight members here, plus we have the advice and help from the ACNW. So, quite frankly, I am sympathetic to the full committee's planning and procedures committee that this thing ought to be sorted out such that a presentation can be made that they can evaluate a draft position that we bring forward to them.

I mean, I think we ought to be able to do that, and I will certainly be holding the time schedule fairly rigorously on this. Now, if we get an extra half hour, we get an extra half hour,b ut --

DR. WALLIS: And I think it would help, from my experience of these planning procedures committee, if we actually had something from the subcommittee chair indicating how much time was needed. Otherwise it just seems that we go with the old formula and give everybody an hour and a half or something.

It's quite clear that some issues take longer than others when you're bringing the whole committee up to speed or if there's much more material or something. So maybe you could help guide the planning --

CHAIRMAN POWERS: Well, let me remind you that this will be the third time that the full committee has been exposed to this material. I mean, they're not virgins on this subject, and in fact, even asking to go through the general purpose of the facility is a little bit repetitious to the committee. They've seen it before.

DR. BONACA: Well, I propose it only because this has taken so long.

CHAIRMAN POWERS: Yeah, I mean, it's just a reminder and things like that, and it's unusual. It is an experiment, and it's a heroic amount of effort on the part of the staff.

MR. ROSEN: And some important things have changed.

CHAIRMAN POWERS: And some important things have changed.

MS. WESTON: I have already requested additional time.

MR. SIEBER: You need to use the microphone.

MS. WESTON: Oh, I'm sorry.

CHAIRMAN POWERS: And identify yourself.

DR. RANSOM: Speak with sufficient clarity and volume.

MS. WESTON: I said I've already requested additional time. We'll see whether or not we get it. John understands that we need more time than the usual.

DR. WALLIS: It also depends on how much the ACRS can influence the course of events or add value to this whole process. From what I've seen here, I'm not sure that we have --

CHAIRMAN POWERS: I can assure you that we'll have a substantial influence on the commission's vote.

DR. WALLIS: No, but I think that we're likely to give them a blessing to go ahead and we're going to say we're going to look at things later on when we've got more detail. It isn't as if there are some issues we want to weigh in on at the moment.

CHAIRMAN POWERS: No, I think I have three of them, yeah.

DR. WALLIS: Well, if the committee has got to weigh in on issues, then we need time to get enough information.

CHAIRMAN POWERS: I think there are three of them that we will certainly be exploring further.

Okay. I'd like to try to keep to the schedule and move on to the DPO process. I again can't say enough about the quality of the presentations and the delivery today from those specific topics you brought up, and I will comment on reviewing the SER.

There are, of course, a number of things I think you need to correct in there. It does bear the nature of a draft. I will compliment you on it. Much of the SER reverts to the familiar staff jargon that says, "Gee, maybe we looked at this and it sounds okay," and it didn't tell us how you looked at it, but there are occasions in which you have done a good job in explaining why you came to the conclusion, and I thank you for every one of those, and don't take it too hard for the numerous times you revert back to the familiar jargon of "it looks okay to us."

And we'll be in communication as we try to put this thing together, but I alert you that as the members of the subcommittee get through more and more of this material, it is entirely possible we may have to get together again to chat about specific issues when we don't understand them, and we do have two or three here that we're going to go through, and we'll talk about those a little bit tomorrow.

Otherwise I'd like to move on to the next topic.

MR. BROWN: Thank you. Thank you for your time.

CHAIRMAN POWERS: Thanks, Dave.

MR. MURRAY: If I could just have a minute just to see if the copies have been finished, please.

(Whereupon, the foregoing matter went off the record at 4:36 p.m. and went back on the record at 4:38 p.m.)

CHAIRMAN POWERS: Okay. We're back with Alex Murray.

MR. ROSEN: This will be interesting.

DR. WALLIS: Are you wearing a different hat now, Alex, or is it the same hat?

MR. MURRAY: Yes.

MR. ROSEN: Is that crutch loaded?

MR. MURRAY: No. I only have one bit of bad news. My pain medicine is wearing off.

(Laughter.)

MR. MURRAY: Thoughts of me going to a higher quantum state. I apologize.

Well, let me begin. My name is Alex Murray. I am the lead chemical safety reviewer for the MOX construction authorization request. As I'm sure everyone is aware of, I have expressed concerns about potential safety issues at this facility numerous times.

In November of 2003, I actually had, if you will, a dissenting view which I presented before the subcommittee, I believe it was, and now that we've gone a little over another year and a review of some new, additional information has been provided and so forth, I wanted to give you an update on what my thoughts are about where some of these safety issues stand, and I want to emphasize that it is possible that I may decide to pursue some of these safety issues through basically the differing professional opinion process, but I have not finalized any decisions yet.

Now, I want to give you feedback in three general areas. One is some comments on the safety review process, some observations which I think you'll find have been similar to some of the comments and statements that the subcommittee members have mentioned earlier today. I want to just comment on some of the previously open items which were presented today and then give a quick overview about DPVs and DPOs.

Now, this is a two-step licensing process.

We've heard that numerous times. Step one is a construction permit. Step 2 is a license application.

I do have a concern about the balance between the two. How much can we defer to the license application? How much should we look at and have now?

In some places I think we really need some more information now, particularly when we're dealing with commitments. All right. In a number of places for the construction permit we, the staff, are supposed to review the application for the appropriateness of PSSCs and design bases. Okay?

In some places the commitments are that, oh, well, we'll determine these, which seems to be putting the cart before the horse, and I elaborate upon that a little more in a moment.

I went through the regulations as regards to commitments, and there was no clear statement which even mentions commitments.

If I look at the safety guidance which is primarily in the standard review plan, I note that there's a comment that commitments may be acceptable. A concern which I have with MOX is that in general, you know, we have accepted PSSCs and design basis that the SRP primary source of guidance would say we would need more information on, and I have heard that sentiment about the need for more information on PSSCs and design basis mentioned by members of the subcommittee here.

We also have accepted a number of items which are not what we called RAGAGEP or good practice, reasonably and generally accepted good engineering practices, and I'm concerned that with some of those we do not have an adequate basis for accepting them.

Okay. In particular, I note here about relying on future efforts and experiments to define, if you will, current PSSCs and design bases or better define these PSSCs and design bases. In particular, for red oil and HAN we have a commitment to future experiments to basically fill in the blanks, and that concerns me, concerns me greatly.

Now, I just want to mention very quickly a couple of comments about diverse viewpoints. As a member --

DR. WALLIS: Are you going to tell us what some of the blanks are?

MR. MURRAY: Yes, in about five minutes. Okay?

I just wanted to mention a little bit about diverse viewpoints. This is what the staff haws available as, if you will, processes for expressing diverse viewpoints, and I just want to give, you know, some observations.

For the most part I have found in raising safety issues, safety concerns, trying to get some resolution of safety issues and safety concerns, I find that I either deal with it locally or it has to go all the way to DPV/DPO. There's nothing in between, and that's a concern.

Okay. Now, on the positive side, I do want to mention that there are going to be a number of internal staff workshops to try and address a number of these concerns, particularly on the consensus process. So all may not be lost, but again, you know, these are some observations I have.

Now, we at the NRC, we are basically stewards for the public, and I remember from one of the public meetings that this statement was set, and it struck a cord with me, and a couple of other reviewers have picked up on it as well, namely, that the NRC needs to act as a regulator and conduct thorough safety reviews of the proposed MOX facilities.

Now, I'm going to go in and just give some feedback and comments on the previous open items. We discussed these earlier on today, and also just to remind you, these were items that I had a dissenting viewpoint on at the November 2003 subcommittee meeting, and you can, of course, read the titles of all the issues there.

Now, red oil. Okay. We have discussed this at length. As you know -- I'll show a picture in a second -- there's a potential for significant damage and release of radiochemical materials. This event has happened.

Now, when we look at open systems, okay, we have limited information provided by the applicant. The staff went out, did a lot of digging, looked through the literature, talked to people, did a lot of reviews, and we came to the conclusion that this was clearly acceptable because it is based on test data, empirical data, but data nonetheless, and there was a nice safety margin.

However, for closed system, we really had no additional information from the applicant on the docket. We found that this clearly contradicts some of the Department of Energy and Defense Nuclear Facilities Safety Board reasonably and generally accepted good engineering practices.

And another concern is it is clearly in a range which the department of energy has identified as potentially unsafe.

I just want to point out why are we concerned. This is in the public literature. This is a picture of the Tomsk facility in Russia which underwent a red oil event that involved potentially less than 100 gallons of red oil, okay, organic material. What is even more amazing is that the event occurred in a shielded canyon below grade.

MR. ROSEN: And that wall blew out obviously with -- what was it made of?

MR. MURRAY: This wall above grade is simply a thin masonry with some reinforced concrete to it. The canyon below it had a four foot thick shield plug blown out.

MR. ROSEN: And it pressurized the space behind that wall which blew out --

MR. MURRAY: Yes.

MR. ROSEN: -- towards the plane --

MR. MURRAY: That is correct.

MR. ROSEN: -- which was masonry and maybe some reinforced concrete.

MR. MURRAY: Some four inch reinforced concrete wall, but you get some idea. This was, again, comparable quantities of organic materials participated in this reaction, and comparable quantities to what would be available at the proposed MOX facility.

DR. WALLIS: This was since their runaway reaction?

MR. MURRAY: Yes.

DR. WEINER: Is it thoroughly documented with access to the documentation, whatever they could figure out? Was it thoroughly documented, whatever they could figure out of the parameters of the runaway reactor?

MR. MURRAY: There are several reports and documents on this. There is some interpretation.

MR. ROSEN: Can you make a guess about what year it was?

MR. MURRAY: I think it was 1994, I believe. It may be '93.

MR. SIEBER: Yeah, it wasn't too long ago.

CHAIRMAN POWERS: The Department of Energy sent a relatively large review team out. They had access to everything you have. It's like all events of this type. You've got a bunch of junk. It was a less than well instrumented test.

MR. MURRAY: Yes. Now, I just wanted to point out you've seen this slide on the pressure vent relationship before. Okay? I'll just point out the open system is here: clear safety margin based on capacity to the empirical test.

For the closed system, it's over here. I have concerns about that. Okay? It concerns me that the approach for closed systems I have to conclude does not provide adequate assurances of safety at this time. I have listed some of my concerns here. In essence, it's a control of a single parameter, temperature. The potential for common mode failure effects, particularly with heat transfer and the vent. I've heard a couple of the ACRS subcommittee members mention something to that effect.

I'm very concerned about margin or adequate margin. We have in a closed system a situation, a chemical reaction situation where there is less capability for venting and yet we, the NRC, are willing to accept a higher temperature for the reactions. It seems as if we're going the wrong way.

And I've also noted what's been discussed here several times about uncertainties. Okay? There's very little information on uncertainties. We have little -- well, we have no calculational basis.

DR. WALLIS: How can we tell who's right?

MR. MURRAY: That is a good question.

DR. WALLIS: Because we have assurances

from one side and you've got questions from the other, but without some technical data, we have no basis for a decision.

MR. MURRAY: That is correct. As I state here, I have no assurance that the quench system and the 125 degree Centigrade limit has the ability to prevent red oil reactions.

MR. ROSEN: Well, I think, Alex, you stole my point. I think --

MR. MURRAY: Oh, I'm sorry. I'll give it back to you.

MR. ROSEN: I pointed out on the slide that there were no uncertainties. Uncertainties weren't addressed on this 32 kilograms per square centimeter number. Now, the way you deal with uncertainties traditionally is margin.

MR. MURRAY: Yes.

MR. ROSEN: We establish lots of margin.

MR. MURRAY: Yes.

MR. ROSEN: So it's not like you can't deal with it. It's just a question of --

MR. SIEBER: You have to define both the uncertainty and --

DR. RANSOM: He's just pointing out the vent area where the vent is not sufficient to bring it back to the --

MR. ROSEN: But that's why I wanted to ask you about your red dot way over there in the corner.

MR. MURRAY: Yes.

MR. ROSEN: Now, that's your view of how much margin we need?

PARTICIPANTS: No, no, no.

MR. MURRAY: That is where the applicant's proposed closed system resides on the vent diagram.

DR. WALLIS: It's a very small vent.

MR. MURRAY: It has a relatively small vent. It is not capable of venting the reaction.

MR. ROSEN: But the number goes out to the hundreds perhaps.

MR. MURRAY: I think it's around 200.

DR. BONACA: Could you explain to me the difference of this approach to the DOE? Well, they're talking about what you recommend. This seems to be an approach which you suggest.

MR. MURRAY: Well, my suggested approach, my recommendation is the Department of Energy runs evaporators right now which has controls for addressing red oil concerns. Their controls basically focus on four parameters. So they have control of multiple parameters. They generally have a good branched control strategy on controlling temperature, on controlling organic carryover, on controlling concentration of the nitric acid, and I am controlling the concentration of the organic material.

All right. So there are multiple approaches to it.

DR. BONACA: So it is not that the approach with DOE is to have larger vent. It's --

MR. MURRAY: One other control is the Department of Energy uses that vent relationship just to --

DR. BONACA: Does it move? Doe she move it?

MR. MURRAY: On the same slide, the Department of Energy uses vent relationships approximately in this range.

DR. BONACA: Also for closed systems.

MR. MURRAY: They do not try and make a -- they do not try to distinguish between open and closed systems.

DR. BONACA: But you are not aware of closed systems used by DOE that have must vent area beyond that point?

MR. MURRAY: No, I'm not aware of any such situations, and that is the concern I have. I think it's very appropriate that the applicant would put forth what is, in essence, a new safety approach. However, my recommendation, since we have no details on this approach, we have no follow-up test data which has been provided on this approach or calculations, my approach would be, gee, you know, why don't we have a permit condition which imposes the DOE/DNFSV good practices, if you will, which are summarized in a report which they put out last summer, and then at the license application stage, the applicant can come forth and prove their case for something different when they have data.

DR. BONACA: Moving to this kind of recommendation, would it have significant implication to the physical construction of the equipment? Because you refer to a number of process issues. I'm asking now regarding physical characteristic of a system.

MR. MURRAY: I would think, yes, event size would be larger. There would have to be more safety controls identified, yes.

DR. RANSOM: Is the differentiation between an open system and a closed system just the size of the vent?

MR. MURRAY: The differentiation between

the two systems is basically identified by the size of the event, yes, okay, and an open system as defined by the applicant is in accord with that venting relationship. Okay. It can vent the full red oil reaction if it were to occur.

DR. WALLIS: It would still be pressurized. It's just that when it needs to vent, it has a big hole open --

MR. MURRAY: But basically --

DR. WALLIS: -- open to the sky.

MR. MURRAY: Right. Basically it has a big enough hole through the venting system, I guess in this case an evaporator be the off-gas treatment system, yes.

DR. RANSOM: Well, is it run at one atmosphere then pressure?

MR. MURRAY: From the construction application, the revised construction application, I believe two of the evaporators are nominally atmospheric pressure, and one is slightly under vacuum. Oh, I just should say vacuum evaporator.

MR. SIEBER: But the venting occurs to the environment, to the atmosphere?

MR. MURRAY: Through an off-gas treatment system, ultimately through fans, and then ultimately to the environment, yes.

MR. SIEBER: Right, not into a tank.

MR. MURRAY: No.

DR. BONACA: Why do you feel that this approach of DOE would prevent the Tomsk red oil explosion? I mean you present it as the picture of the explosion right after the design presented here. You just did it to indicate concerns with red oil explosion, not necessarily because you think -- well, also because you think that system is vulnerable to that kind of --

MR. MURRAY: I think the Department of Energy has gone through all of the information it has from both its own tests, plus analyses of events like Tomsk, and has come to a conclusion that if you introduce these four types of controls and, if you will, their design basis values, that the event is rendered to be, using DOE terms, incredible, less than ten to the minus six.

DR. BONACA: Okay.

DR. RANSOM: Why is that? Was the Tomsk situation, for example, a closed system or inadequately vented?

MR. MURRAY: Just very quickly, in the case of Tomsk there were two vents. Okay? They both were nominally one inch diameter. What happens, and this happens at any vessel, because of the degree of gas evolution, you essentially experience choked flow as the gases try to get through the vent.

DR. RANSOM: So that basically it would not be called an open system, I guess, then.

MR. MURRAY: That's correct.

DR. RANSOM: Okay.

MR. MURRAY: Okay. It could not relieve the full red oil reaction, the gas evolution from the full red oil reaction.

CHAIRMAN POWERS: But, Alex --

MR. MURRAY: Yes.

CHAIRMAN POWERS: -- the contention that DOE makes that it has rendered the red oil phenomena incredible is not the product of detailed kinetic analysis and whatnot. I mean, it's mostly what you would characterize perhaps as a plausibility argument?

MR. MURRAY: I would say it's an argument based upon empirical data.

CHAIRMAN POWERS: Experiential data.

MR. MURRAY: Experiential data, exactly, and thank you for using the word "experiential."

Yes?

DR. WALLIS: So it wasn't an incredible

response.

CHAIRMAN POWERS: Well, I understand Tomsk involved a variety of situations that are not typically encountered.

MR. MURRAY: There are a number of controls which basically weren't followed at Tomsk. They had them there. Some were influenced by administrative procedures. There was a shift turnover at the time, things like that.

Okay. Let me move on and --

DR. BONACA: But I guess the sense you have is that, in fact, controls and procedures which also the applicant is proposing can, in fact, fail, and you need a mitigating feature, such as a large event. Is it your fundamental point?

MR. MURRAY: These are my concerns.

DR. BONACA: Because, you know, when you look at -- okay. No, you go ahead.

MR. MURRAY: These are my concerns, and they include a concern about the adequacy of the vent. In particular, this common mode failure and what happens in the real world when you have vessels and evaporators like this, you essentially hit a limit of about 200 feet per minute with the vapors flowing out where you have choked flow. It's a practical choke flow limit, and you cannot get more material, more gases through that vent until your pressure rises.

As your pressure rises, the normal boiling point increases. As the normal boiling point increases, the reaction rate increases. You get more gas involved, and it starts running away.

DR. WALLIS: In feet per second or --

MR. MURRAY: I'm sorry?

DR. WALLIS: From 200 feet per minute is not very rapid.

MR. MURRAY: But that's been if you're going to look at evaporator design, for example --

DR. WALLIS: That would be in a two-phase mixture that you can get that, but in a gas it's very unlikely.

MR. MURRAY: Two-phased mixture is another concern, yes.

Let me move on very quickly to HAN/hydrazine, and as we discussed earlier today, there are two cases, and one of the cases has been modeled as a system of partial differential equations. I just wanted to quickly show pictures of how powerful this type of event can be.

This is from the Hanford event in 1997. This was before the accident. This was afterwards.

Okay? About 25, 30 gallons of HAN were involved in this event. Fortunately the people, personnel who were in the area has left for lunch. Otherwise there could have been serious injuries and/or deaths.

Now, I just want to quickly go over my conclusions on these. I think the system of partial differential equations' mathematical model is fantastic. I love models; I love math. It's an engineer problem I have. My family thinks I'm nuts.

Having said that, all we, the staff, have done is we have checked the mathematics. That concerns me. You know, we have relatively little comparisons to actual data, and you know, if you start looking at some of these software guidance that we, the agency, have, we haven't followed it, and that bothers me. How do we know we're getting two reasonably good predictions from the system of equations for, if you will, making a safety decision.

I also want to add that there is a contradictory design basis with hydrazoic acid. Now, you know, I think it's something that can be worked out. I have a recommendation coming up in a moment, but I'm concerned there.

Now, Case 2 actually concerns me more than Case 1. Case 1 is where you're trying to prevent decomposition. Case 2 is where you're trying to make it happen. So you are going to have gas evolution in I guess it was the October 2002 revision of the application, the applicant had proposed a flow control, active engineer control for the situation.

DR. WALLIS: What flow was being controlled here?

MR. MURRAY: Basically the flow of the reagents, the nitric acid, hydrazine.

DR. WALLIS: So it's flow control of every reagent.

MR. MURRAY: Yes, or it can be a general control on the total flow, essentially controlling how much energy goes into that system.

Subsequently, in the revised safety strategy which they submitted last October, I believe it was -- I'm not sure of the exact date right now -- the applicant decided to remove that flow control or that active engineered control, and they instead cited standards which accommodate flow design, but not active flow control.

And I'm concerned that, you know, we essentially have a situation where we're missing a control link.

And here I list my recommendations for

controlling HAN/hydrazine, and for Case 1 it needs to be addressed soon. I think it could be addressed before significant construction gets underway, perhaps deliver the schedule.

On Case 2, I think the applicant and/or the staff should consider putting that active engineered flow control back in.

Let me move on. Electrolyzer. Now, this is a good one. I had a lot of concerns about this area, and I presented a dissenting viewpoint at the November 2003 meeting, and I'll just mention here that the applicant has proposed now what I would call a much more robust safety strategy, and it incorporates both active and passive engineered controls.

Also, the active controls turn off the power. If you don't have electricity, you can't have the initiator for the event, and my conclusion is they've done a smart job there, and that has the ability to meet the Part 70 requirements for construction.

I just want to just very quickly mention this just shows rough calculations by the staff and the various scenarios, and you can see there's potential for very rapid increases in the temperature of the titanium given short in currents. That cannot happen now with their proposed safety strategy.

Yes?

DR. WALLIS: Because it switches off quickly enough?

MR. MURRAY: Yes, yes, exactly.

Just a quick comment about uranium dioxide. Burnback, this is one of those strange phenomena. It happens when you lease expect it and when you don't want it to happen, and as you can see here, the concern I have is if you use some of the values that the applicant has stated can be involved, you come I would say very close to the threshold for damaging the filters, the HEPA filters, with the material that has potentially passed through the stainless steel pre-filters.

I think this is an easy one to fix.

DR. WALLIS: I was a bit curious about how you filter such small particles using stainless steel filters.

MR. MURRAY: Yes.

DR. WALLIS: What kind of a filter is it that's stainless steel that can filter such small particles?

MR. MURRAY: At one of the public meetings, I believe it was the January 2003 one, the applicant graciously brought in a sample of what they were proposing, and I will say, you know, stainless steel mesh type filters are quite difficult to make in this range, but you know, there are some very capable filter manufacturers out there. So, again, using the criteria, I would say, yes, there's ability to fabricate such filters.

And I think to adequately address this concern, the applicant has stated there would be intermediate HEPA filters. Right now none of those are identified as safety controls. Elevating one of those intermediate filters would address the concern.

Chemical limits, as I said, there are four issues here. One I'll discuss in a moment as a DPV/DPO; also, one related to dispersion modeling, which I'll discuss as a DPV/DPO; and also phenomenological modeling, and that is discussed and addressed in the final safety evaluation report.

This discussion I'm just going to quickly comment about the limits. I have three basic concerns or areas of concerns. One is the staff's previous findings have not been addressed. I've listed them here.

Also, I have some concerns about procedural issues. Okay? Unqualified staff made this decision. You know, what are appropriate chemical levels that do not involve people who have a background in toxicology or in chemistry or biological effects on chemicals? I have a concern about that. You know, what credibility do we have as an agency?

And third --

DR. WALLIS: Were these management type decisions or were they some something delegated to unqualified staff members? How did it happen?

MR. MURRAY: A friend of mine, who is a very good health physicist, was asked by management to do a review and to make a recommendation. And as I stated here, these values -- and we discussed these earlier in the day -- they do tend to fluctuate a lot.

DR. WALLIS: I hope you don't examine all of the qualifications of the ACRS.

(Laughter.)

MR. MURRAY: You guys have perfect qualifications. Don't you know that?

Anyway, since time is short, let me keep moving along.

CHAIRMAN POWERS: Could you go back to the variations in TEELs? You have a line there that says certain TEEL values have increased substantially.

MR. MURRAY: Yeah, yes.

CHAIRMAN POWERS: Would you tell me what you mean?

MR. MURRAY: Over the four-year course of the staff's review of the application, several of the TEEL values for chemicals of concern have increased by factors ranging from about five to about 20, if my memory is correct.

CHAIRMAN POWERS: And could you maybe have on the top of your head a couple of those that have gone up?

MR. MURRAY: One that comes to mind is the one for nitric acid. It approximately tripled from about 25 parts per million up to about 68. These are what I would call Level III values.

The values for hydrazine have also changed. I think they have changed by more like a factor of ten. It's detailed in the revised draft safety evaluation report.

CHAIRMAN POWERS: My recollection, I could be wrong, but I thought the TEEL for nitric acid was originally based on the one for hydrochloric acid.

MR. MURRAY: I don't think so. I think it was based on some actual animal data.

CHAIRMAN POWERS: Data.

MR. MURRAY: Okay? Okay. Just a quick

comment about habitability, and that was where I had a dissenting opinion last November, and I will just say that I think the proposed permit condition addresses those concerns that I have.

Flammability issues. Okay. In this case you heard a very good discussion that we have had, and the staff had some concerns that the PSSCs, which the applicant has proposed, might not function as intended as interlocks. And we had a brief discussion on that this afternoon, and the staff, we have basically accepted the NFPA-69 as, if you will, the design basis commitment, and if the applicant wants to pursue interlocks, they need to provide the details in the license application as to how they can perform the safety functions. And I think that's a reasonable approach.

Okay. Let me just quickly summarize differing professional viewpoints and differing professional opinions. Five DPVs have been filed so far on this. There was a change in the DPV/DPO process. If you have any questions, Rene Pedersen from the Office of Enforcement is here, and after I'm done, you may address any concerns on that process to her.

I should add that two of the DPVs have

gone through the full process, and two panels appointed by management essentially agreed with the DPVs 100 percent. Okay. That's like hitting six grand slam home runs in a baseball game, to use a sports metaphor.

The concern I have was that the actions and responses did not address these safety issues. So I pursued both as DPOs.

This is just an observation on some of the changes in the DPV/DPO process. Now, this is the DPV/DPO on chemical consequences, and in it, I expressed concerns about chemical releases which are regulated by the Nuclear Regulatory Commission.

The applicant has stated that the likelihood of this event is not unlikely. The applicant has also stated that radiation doses are received. However, the applicant has also stated that these releases are not regulated by the NRC because they are below 7061 performance requirements.

Now, I want to point out that these types of events, or at least one of them, has the potential for multiple fatalities for operators outside the emergency control rooms.

Now, I am not alone. I work on a team, and I try and help people out as much as I can and so forth. I want to point out that other members of the staff have done assessments and have found that in the case of one of the chemicals, nitrogen tetraoxide, you can have very high concentrations at 100 meters. At 1,500 milligrams per cubic meter, that is almost like a red fog, all right, no visibility.

Other members of the staff have concluded that that would be immediately incapacitating and fatal. All right? My assessment is, yeah, I tend to agree with that. The estimated concentration could be higher because we have a nuclear facility with a lot of shielding, controlled access, security requirements. That facility design will exacerbates the hazard, and even though there are safe havens at the proposed facility, they are not identified as PSSCs to protect people, and given the magnitude of this event, it is unlikely that they could reach those safe havens or exits. They're trapped. As they're trying to get out, the release would be sucked in.

Now, I show this as an example of a chemical release of nitrogen tetraoxide. Okay. This is from one of the Titan II silos. I believe it was in the early 1970s.

The key point about this: the evaporating surface area in this silo is about comparable to the evaporating surface area from a spill, a potential spill of N_2O_4 at the proposed facility.

Also, this is being released 126 feet below ground. Also, the fluid was chilled. It also required evacuation of a town two and a half miles away. Two people were killed in this event from the chemical release even though they had full suits.

At the proposed facility at the present time, there is no safety requirement for protection for any members of the facility against this type of hazard.

MR. ROSEN: The two people who were killed were members of the crew of that silo?

MR. MURRAY: That is correct. They had what they called rocket handling protection suit.

DR. RANSOM: Were the amount of N_2O_4 comparable?

MR. MURRAY: The amounts of N_2O_4 present at that facility were greater. The evaporating surface area was about the same. The evaporating surface area is key part to the release, if you will, the source term, I should say.

CHAIRMAN POWERS: You mentioned the N_2O_4 was chilled, and I'm wondering does that -- I mean, the fact that it's chilled, does that enhance its off-site consequences or reduce them?

MR. MURRAY: It would depress them, okay, lower vapor pressure, less of a release.

CHAIRMAN POWERS: Well, what I'm thinking is the dispersal is less as well. Okay? I mean, if it's hot, you get a buoyancy effect.

MR. MURRAY: Un-huh. I know what you're talking about.

CHAIRMAN POWERS: And whereas if it's chilled, it tends to hug the ground. I mean, the molecular weight is higher than that of air.

MR. MURRAY: Right, right.

CHAIRMAN POWERS: It ends to remain concentrated. You just don't have the buoyancy effect.

MR. MURRAY: Right, right. It can travel, be dispersed like a heavy fog.

DR. WALLIS: Why does it seem to be a plume in this picture if it was chilled? This picture of yours --

MR. MURRAY: I'm sorry?

DR. WALLIS: -- it seems to be a plume going up, isn't it?

MR. MURRAY: Ultimately it is starting to go up, yes. Now, this was taken at a distance from the facility.

DR. WALLIS: Some source of heat there or something?

MR. MURRAY: What tends to happen with N_2O_4 is it undergoes a dissociation reaction as it heats up, and that gives some more dispersion to it. So it can both hop the ground. It can move over things as it disburses, go back to the ground.

DR. WEINER: We had a very similar incident in Colorado in the very early 1970s. There is an explosives factory near Colorado. It's sort of between Colorado Springs and Denver, and they had a chilled N_2O_4 release that most of it just simply went up the stack and kind of rolled down the side of the stack, but what got up to the top got picked up by the wind. There are down mountain winds there, and you saw a very similar kind of pattern.

CHAIRMAN POWERS: Mike and I think that a lot of the disbursal here may be coming because you're interacting with moisture and water and turning into acid, and that should be an exothermic reaction that's giving you the heat.

MR. MURRAY: Let me just continue here. I just restated what the DPV panel found, and I'm a little bit concerned that some of the actions by the office and division didn't really address the concern, and I ultimately pursue this as a differing professional opinion.

Now, there has been a draft report generated on that, and this report I understand it's supposed to be revised and put out late December, early January. This report stated that no further action is needed.

DR. WALLIS: What's this chilling effect you're referring to on page 34?

MR. MURRAY: I asked staff if they'd be willing to sit on various DPV or DPO panels, if they wanted to be involved in discussing some of the issues, and privately other members of the staff, senior members of the staff, they agreed with me, but they would not want to be involved with, if you will, raising safety issues or being on DPV panels because of concerns about their career. And it was based upon what they saw happen in response to the DPV panel report.

Okay. Now, just to finish off, taking a little more time -- I apologize. I'll be quick -- this report was very interesting in that it did say the safety issue was addressed and no further action was needed, and it stated it that way because the panel concluded the applicant has made blanket commitments without exception to multiple codes and standards which have habitability requirements for occupied structures.

In addition, they looked at the baseline design criteria for chemical safety and that habitability is implied as part of that BDC, and the applicant has stated in their revised application that they intend to follow that baseline design criteria.

So what I would conclude from that is, therefore, the applicant is required to maintain habitability in all structures at the proposed facility. In other words, they have to address the chemical release event.

And I'll just quickly summarize about the DPV/DPO on chemical modeling, and you can read this slide. This is just a quick summary of the situation.

Oh, interesting. These computers never cease to amaze me.

My concern is that, you know, we all love chemical, we all love mathematical and computer models, but no V&V has been done for the use of this model for the specific site of the proposed facility. In other words, the model output has not been compared to, if you will, tracer studies at Savannah River, simple terms.

CHAIRMAN POWERS: I wonder. It seems to me that one of the -- I think the most recent ANS meeting, in fact, there was a comparison of dispersion models applied to the Savannah River site, and for the life of me I cannot remember whether ARCON was part of that comparison, but it might be worthwhile to go look at it.

MR. MURRAY: Would that be in some of the ACRS --

CHAIRMAN POWERS: ANS. If I said ACRS, I misspoke myself.

MR. MURRAY: ANS. I'm sorry.

CHAIRMAN POWERS: The recent meeting at ANS, I'm almost certain there was a paper on comparing several dispersion codes for the Savannah River site, but I can't attest to you whether ARCON was one of them, but my recollection is the paper was quite interesting because the author was very frank in assessing the ease and applicability of the codes.

Okay. If I can find that paper, I'll certainly pass it back to you.

MR. MURRAY: We will be very interested.

CHAIRMAN POWERS: I may be able to find the author easier than the paper.

MR. MURRAY: Okay. That would be fine. My E-mail is axm2@nrc.gov. Call me.

CHAIRMAN POWERS: Yeah, I will look at that, and like I said, he may not have looked at ARC, but he looked at several of them and found -- and he goes through which ones are useful and not.

MR. MURRAY: Yes.

CHAIRMAN POWERS: He was definitely not looking for this facility. He was looking at a tritium release as his base case.

MR. MURRAY: Okay, okay.

MS. WESTON: I might also suggest that you could, depending on the model you use, you can get variations over a factor of ten, and I might also suggest that you try to or have somebody try to solve the equation, apply the Gaussian equation analytically to see what kind of answers you get, look at an elevated release, look at a stat kite (phonetic), and so on, under various conditions.

If you'll give me a call or send me an E-mail, I can give you some guidance on that.

MR. MURRAY: Okay, okay. That would be very good.

And as I said, I did pursue this as a DPO because there are some safety significant impacts from this, and let me just show you some of my concerns here graphically.

At the proposed facility, the applicant is using a wind speed 95 percent meteorology of 2.2 meters per second. So about where these two red hours are.

This is a model data comparison, and as you can see, there's quite a bit of spread there. Which number do you pick?

Right now the applicant's value, if my memory is correct, is approximately around here.

MR. ROSEN: Isn't the most conservative value a lower value?

MR. MURRAY: That is correct. The most conservative value would be somewhere down here. That is correct. What is reasonably conservative -- I don't know -- somewhere around here.

CHAIRMAN POWERS: Well, I mean, I don't know of anybody that really uses Murphy-Campe anymore for chi over Q.

MR. MURRAY: Yeah, that correct.

CHAIRMAN POWERS: I mean, Murphy-Campe is a way of correcting the chi over Q to account for building wake effects, and I don't know of anybody that's using Murphy-Campe anymore.

MS. WESTON: Also, if you do a joint frequency distribution for wind speed, you usually get a speed around four or 4.5 meters per second, which puts you out a little further.

MR. MURRAY: Right, right. And again, you know, we would expect as you get below about four meters per second wind speed that you would have some more variability because of eddies from the phenomena, but I think the question is very valid. Which value do you use for licensing?

And this is another comparison with data. Again you see a fair spread there. Again, which value should we pick as providing adequate assurances of safety?

DR. WALLIS: You've got data here. You didn't show us any data on red oil or how much it scatters.

CHAIRMAN POWERS: No, this is a model-model.

DR. WALLIS: No, I know, but I was going back to another issue there and if there was any data talked about.

MR. MURRAY: Well, when we were discussing red oil, that's my concern.

Okay. Let me continue on here. The DPV

panel, as I stated essentially agreed with it, agreed with the DPV. What I found out was that several of the responses, the actions which were taken to address the DPV panel findings did not seem to be in alignment with the report itself.

Now, let me just mention I did appeal this as a DPO, and again, I have three main points there. The information has not been verified and validated as per, you know, the NRC normal operating approach with software. No adequate quality assurances, and I believe the safety issues still remain.

Now, I did just this week receive a copy of the DPO report, and basically the DPO appeal has been denied, and this implies verification and validation for site specific application of the model is not needed, but I'm still reviewing that report.

DR. RANSOM: Well, this is all an internal NRC procedure; is that right?

MR. MURRAY: For these models, yes.

DR. RANSOM: And the panel is put together. They're all from within the NRC?

MR. MURRAY: All from within the NRC, yes.

DR. RANSOM: And who makes the final decision when you said it was denied?

MR. MURRAY: In the case of the PPO

appeal, it's by the EDO. In this case there was no additional panel formed.

Okay. Let me continue on since time is marching onwards. There has been a DPV, which I submitted on waste management concerns. Now, I've heard several people here express concerns in the area of waste management. I share some of those concerns, and I want to emphasize that my concerns relate to the NRC regulated entity at the facility, and I've listed the concerns here.

Now, I will say this is the DPV that no one seems to want to touch. I don't know why. You know, I know waste is a four-letter word, but still you know, I really don't understand what has happened here.

In the end, after over 12, 13 months, I was told that the DPV was denied because waste is under DOE jurisdiction, even though I am just focusing on the open issues which the staff had in the original draft safety evaluation reports.

CHAIRMAN POWERS: The issue that's been raised here is one that it's waste, to be sure, but it's waste actually on the MOX site.

MR. MURRAY: That is correct.

CHAIRMAN POWERS: I mean it's before it's going to cross the boundary.

MR. MURRAY: That is correct, before it's going to cross the boundary. That is correct, yes.

CHAIRMAN POWERS: That's not under DOE control.

MR. MURRAY: On the other side of the boundary -- well, the waste, before it goes over the boundary, is under NRC jurisdiction. Again, before we can send it over the boundary, it has got to meet something, some requirement for the Savannah River site. Otherwise it doesn't go. It stays in the NRC regulated entity, and that's the concern I have.

DR. WALLIS: And eventually shuts down the plant.

MR. MURRAY: Right. Again, you know, what do you do? Shutdown requirement; well, you know, is that something that we specify now or is that something that is specified later?

I am of the opinion that it's something that we need to have some closure on now.

MR. ROSEN: Well, don't you know the tank sizes for the waste?

MR. MURRAY: Yes.

MR. ROSEN: Well, isn't that the shutdown requirement? I mean, obviously they're not going to overfill the tanks, are they, until the rooms fill up?

CHAIRMAN POWERS: I mean, I think Alex is coming from a different point of view here, is that the NRC has a societal obligation not to let a facility run to fill up some tanks with waste.

MR. MURRAY: Right.

CHAIRMAN POWERS: I mean, that's pretty clear from the Atomic Energy Act that thou shall not do that, but --

MR. ROSEN: Perhaps, but there's a clear limit established. Things will fill up, and that will be the end of it.

CHAIRMAN POWERS: Sometimes establishing these waste acceptance criteria has been extraordinarily slow. Does SRS have a WAC?

MR. MURRAY: At the present time, as I understand it, for the proposed DOE facility which would accept this waste, no WACs have been defined.

CHAIRMAN POWERS: Yeah. I would not be at all surprised.

MR. MURRAY: Yeah. Not even some general type WAC.

CHAIRMAN POWERS: Yeah. Those things are -- I mean it doesn't obviate your point at all, but I was just establishing the ground rules because it takes forever to get these WACs set up.

MR. MURRAY: That is correct. That is correct, and I just want to mention that I have forwarded my concerns to the ACRS/ACNW and asked do you guys want to review this area, and I have not heard anything back.

MR. ROSEN: Just this one, the waste.

MR. MURRAY: That's correct.

CHAIRMAN POWERS: You forwarded it to someone besides me. I know that.

MR. MURRAY: Yes.

CHAIRMAN POWERS: Because I've not seen it.

MR. MURRAY: It's all right. It's all right.

CHAIRMAN POWERS: So I can't respond to you.

MR. MURRAY: Yes, yes. I'm just mentioning that.

CHAIRMAN POWERS: Did that come to you?

DR. BONACA: Came to you later on.

CHAIRMAN POWERS: No, I have not. Nothing has been forwarded to me.

DR. WALLIS: It went into the waste stream.

DR. RYAN: I did see it.

MR. MURRAY: Oh, you have seen it?

DR. RYAN: I did, yes.

DR. RANSOM: All right. That's what it was.

CHAIRMAN POWERS: It's Mike that's slow. You're the bad guy.

MR. MURRAY: You got it. You got it. Okay. Very good. Thank you. So it will not be orphaned forever.

Let's see. DPVs and chemical limits and flammability. I just want to mention these have been delayed for something like ten months, and they're still rattling around in the system, so to speak, and again, one of my union friends went ahead and filed a grievance on this to say this is nuts.

MR. ROSEN: What does this "asked for resubmission" mean?

MR. MURRAY: For one of the DPVs I was asked to resubmit it. I said, well, it's in the system. Why isn't it being reviewed, you see? Anyway, let me just give a very quick summary.

I see that they're both a process, safety review process, as well as specific safety concerns that I have. I'm not quite sure how strongly I feel about some of these. There is a potential for more DPOs. I haven't decided yet, but I say to everybody involved, both members of the staff at the NRC and members of the applicant, some of my colleagues and friends from the Department of Energy, we need to do our job, a good job, and address these safety issues and put a nice, little, holiday Christmas bow on top of it so that it's all addressed, and in that way we'll have discharged our public duty.

Thank you very much. If you have any questions, please let me know.

CHAIRMAN POWERS: Any questions posed?

DR. WEINER: Oh, my question. I just wanted to commend you for a very thorough discussion of this, and it seemed to me that, first of all, the point made about modeling is one that is near and dear to me. Models need to be, when possible, validate against data, not just against another model, and that is used sometimes.

I think that I get he impression tha the applicant would need to amplify the open system description and to thoroughly defend with some detail any use of a closed system. It seems to me you can do that defensibly. Other than that, I made the point about the Gaussian dispersion codes.

And I might also point out Gaussian dispersion codes do not handle the near field well. They blow up close to the source. We're confronting that problem now in a number of instances, and that's one reason I suggested trying an analytical solution, because you can play around with what happens in the near field.

CHAIRMAN POWERS: There's a very nice model, very nice; there's a useful model that LANL has come up with for the near field area.

DR. WEINER: I've seen it.

CHAIRMAN POWERS: Yeah, they developed it actually for the Hanford tanks, and it seems to work reasonably well. I mean, again, the problem with these field dispersions is that you don't have a great deal of data to compare against, but I mean, they did an adequate job with that.

And the nice thing is that it's useful for heavier than air dispersance.

DR. WEINER: We had one called HAZCON that was floating around Sandia a while ago. It's a very complicated model to use, but it does handle heavier than air gases. We used it for chlorine emissions, which is a nice example of heavier than air.

But I think the LANL model may be

available. You may be able to get it through the Web.

MR. MURRAY: Okay.

CHAIRMAN POWERS: Any other questions?

DR. RANSOM: Are we going to hear anything more on these issues from the NRC?

CHAIRMAN POWERS: That really is part of the DPV process, and we're kind of out of that loop until a disposition is made and whatnot.

DR. RANSOM: I get the impression that's --

DR. BONACA: The question that I have is that we are asked to make a determination regarding this SER, and for example, the red oil, I am not -- two sides of a story, and I don't have the judgment on that issue.

CHAIRMAN POWERS: Rene, you wanted to say a word to us?

MS. PEDERSEN: Well, I want to let you know that I'm available if you have specific questions, and I, again, commend Alex for coming forth and letting his safety concerns be heard.

I've just been assigned as the acting differing professional opinions program -- what a mouthful -- program manager since August. Back in June the program was transferred to the Office of

Enforcement. so this is somewhat of a new program to us, and we're trying all that we can do to address some of Alex's specific issues, but more importantly, we're trying to address the issues that individuals have expressed with this program in general.

One of the concerns that we've heard from multiple review panels that have reviewed this program since, you know, many, many years is that people are afraid of using the program for fear of retaliation, and clearly that's not acceptable in this agency.

In our office, we're trying to get the message out that raising safety concerns, raising concerns is not just a right, but it's a responsibility. We want employees to come forward. That doesn't mean that management is going to agree with all of the concerns that you raise, but clearly management has a better ability to make an informed decision when all of the information is brought forward.

What I would like to do is not to go into all of the specifics that Alex has raised on his issues. I just want to clarify a couple of points, if I may. Alex has identified that he's raised five DPVs, and indeed, Alex has raised five DPVs. DPV is not formally accepted into the system until after it has been reviewed by the staff, given a DPV or DPO tracking number, and put into the system.

Of the five issues that Alex has raised, two of the issues have been accepted into the system. Two of the issues have been returned, and in a memorandum to Alex that I had issued back in September, I had encouraged Alex that if he still had concerns with two of these issues, they were returned because they were viewed as premature. In other words, the staff had not established a position at that time.

Coming into the position new, I felt Alex's pain in the delays. There's no doubt that this has not been a timely process thus far, but I encouraged Alex that if he had remaining concerns, to please file a DPO under the new program. We no longer have DPVs. We have DPOs. We have informal discussions, formal submittal of a DPO, and then a DPO appeal process.

So at that point in time I encouraged and I would encourage everybody if they have a safety concern to please file it under the new DPO program, which is on line, and the issue is on Informs. You know, we love our forms in the agency.

The final issue that Alex has raised is he had expressed a concern on waste, and this issue was raised all the way to the level of the EDO. This issue was rejected and basically not included, not adopted as a DPV because it was outside our jurisdiction.

So while Alex has raised these concerns, I want to make sure that it's clear that these issues are not rattling around in the system because they haven't been adopted. Three of the issues have not been adopted into the system.

Who of them very well could be and, again, I would encourage Alex if he has these ongoing concerns to please file them in the new program.

MR. MURRAY: I'll just make a comment on that if I could, please.

I obviously disagree and so does the NTEU, and that's why the three grievances.

Thank you.

CHAIRMAN POWERS: I'll bet they get to revisit the waste issue. Just guessing.

Well, thank you very much, and unless members have any questions.

(No response.)

CHAIRMAN POWERS: Okay. Well, what we're going to do tomorrow is we're going to go into this criticality business, and the only reason it's tomorrow is the speaker is available tomorrow and he was not available today.

And, gain, we will get a report from Dr. Diamond up at BNL on his examination of the criticality materials. I think he has specialized expertise in these areas, and he can help us better understand that.

We will probably include in that discussion of the criticality this interface between fire protection and criticality at least so we can understand how it was handled a little bit because that's one that's been rattling around here a little bit on this, and we need to understand the role of these fire suppressant systems a little better because we have multiple experiences in the reactor community with the Halon and whatnot being great at suppressing fires, but they don't extract heat, and so you just get back into the fire situation every time air becomes available again.

Once those discussions are over, what I really want to do is to spend some time discussing an outline of the letter. I think we are stuck with producing a fairly lengthy letter here, and so I think it's worth our while to spend some time thinking about the outline.

Staff has done a very comprehensive assessment of a complex facility in a new exercise, and it's going to be new to the Commission, and so we've got to, I think, produce an equally extensive letter in order to address this.

Now, that's just my thought. We can debate that issue, and I'll remind you that the committee used to in the early days accept entire reactor systems with a glib phrase, something like, "This facility can be operated without undue risk to the public health and safety," for entire reactor systems.

So it would not be without precedence writing a short letter, but I think we're stuck here, and so I think we need to go through it and identify what points we want to make or we think should be made, and what points we need to at least put on the outline until we've had a chance to review things more thoroughly.

DR. WALLIS: Can't we write a letter that says the staff has done thus-and-so and clearly we're not convinced?

CHAIRMAN POWERS: Sure, absolutely, absolutely.

DR. DENNING: Can we write one that says we're not convinced, but it's -- I'm concerned we haven't heard from the applicant. I mean, you know, it seems to me there are clearly unresolved issues as far as we're concerned. The question is I think that to a large extent the risk here is one of the applicant.

The applicant has to recognize that they could build a facility that might require major renovations, and I could see where the DOE might be under tremendous stress to move forward with this because of international agreements and stuff like that. They may very much want to move forward.

I'm saying too much because I don't know what words they would tell us if they came, but shouldn't we hear from them as to whether they're willing to accept some risk that they may have to modify the facility after it's constructed?

MR. ROSEN: Is that really our job?

DR. DENNING: Well, see, here's the problem that I have, is just how far do we have to go. We're definitely not going to hear enough to say this facility is going to be a safe facility. We know that. So the question is: how far do we have to go?

And we could even have some serious

reservations and still say if the applicant wants to proceed, you know, we're going to examine this thing later and have our comments later.

CHAIRMAN POWERS: Well, right now we really had not -- I mean, the applicant has come in and described its facility, submitted his CAR. We've gone through that. Right now I had not planned to go through more of that material on it. It is not -- I mean, our job is to advise the Commission on what we think about this work and where we have reservations about what has been done and whatnot. I mean, we'll give them our best judgment.

So I don't know that having DOE come in and say what risk they're willing to accept would be anything to change our judgment on it. I mean, we're trying to send some advice to the Commission on this, and it is a technical judgment that we're supposed to offer, and if we have reservations, we need to lay those out in spades and quite clearly.

Yeah, I mean, and this is multi-faceted, and they quite likely will say, "Okay. This part is good and this part we were a little bit concerned about and this is parts that we have great big concerns about." We've got to say that, too.

I certainly have four issues here that I think will show up that will involve technical discussion to establish positions on. I think there's no control. I mean, I don't think there are any surprised people. It's this control and emergency response and planning, fire protection criticality, safety, waste hand-off interruption issue, habitability, and the chemical control limits.

MR. ROSEN: What was the last one, Dana?

CHAIRMAN POWERS: Habitability issues, what issues we send. It seems to me that we spent what seemed like altogether too much of my life looking at the Reg. Guide 1.78 on control room habitability, and the focus of that was precisely on these limits, and I think the committee should have a consistent position on that unless it makes a conscious decision to deviate from that consistent position.

MR. ROSEN: The issue is exactly the same.

CHAIRMAN POWERS: Oh, yeah.

MR. ROSEN: It's protection of human life.

CHAIRMAN POWERS: That's exactly the same position. I mean, there's just no difference here. And it sounds to me like the demands on the operator are almost consistent here.

I mean, it just seems to me we ought to

have a consistent position.

Well, at any rate, so I'll invite you tonight to think seriously about what items. I don't want to write text tomorrow, and the outline is exactly that. It is simply an outline. Things can be added to it; things can be deleted from it. It's just an outline, and you can put things on it that says, "I want to put this point on here, but I want to go back and reread the material and think about it in light of what I have -- and I may adjust what I want to say."

I mean, that's perfectly fair. I would rather have something on the outline than to get surprised later during the debate. It's far easier to delete than it is to add within the committee.

That's not to say that the ACRS doesn't have the right to add things to our outline, but I want to come in with a fairly complete outline, and we will go, for the members that are interested, we will go until about noon, and you're guaranteed it's over by one o'clock because I have a separate meeting at one o'clock on the research program. So we'll definitely come to an end prior to one o'clock.

Any other comments people would like to make?

(No response.)

CHAIRMAN POWERS: Well, in that case, I suggest that we recess for the night and we'll resume tomorrow at 8:30. I thank all speakers and all participants. It was thoroughly enjoyable.

(Whereupon, at 5:54 p.m., the subcommittee meeting was concluded.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards Reactor Fuels Subcommittee

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Rebecca Davis
Official Reporter
Neal R. Gross & Co., Inc.

DB

NRC Review of the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility

David Brown, Project Manager
Mixed Oxide Facility Licensing Section
Division of Fuel Cycle Safety & Safeguards
Office of Nuclear Material Safety & Safeguards

Outline of Introduction

- Purpose of this presentation
- Brief overview of the MOX project
- Regulatory framework for construction authorization
- Overview of project milestones
- Future project schedule

Purpose of this Meeting

- Purpose of this meeting is to seek ACRS endorsement of the staff's evaluation of the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility

MOX Project Overview

- September 2000 – U.S. and Russia agreed to each disposition 34 metric tons of surplus weapon grade plutonium
- The Department of Energy 's National Nuclear Security Administration, Office of Fissile Materials Disposition, is responsible for all activities relating to managing, storing, and disposing of surplus fissile materials.

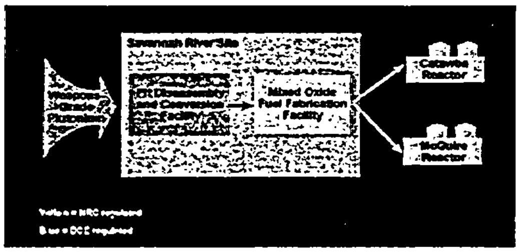
MOX Project Overview

- The National Nuclear Security Administration (NNSA) selected Duke Cogema Stone & Webster to design, build and operate the U.S. Mixed Oxide Fuel Fabrication Facility.
- In April 2002, the NNSA decided to disposition all 34 metric tons of U.S. surplus plutonium by irradiation of mixed oxide fuel in commercial nuclear power reactors.

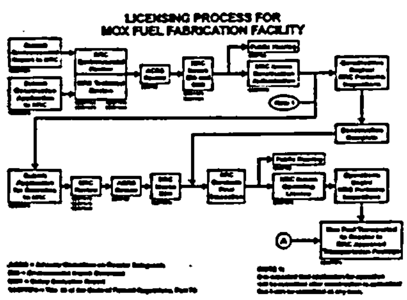
MOX Project Overview

- NNSA will construct two adjacent facilities at the Savannah River Site near Aiken, SC, to support the Surplus Plutonium Disposition Program
  - Pit Disassembly and Conversion Facility
    - Includes the Waste Solidification Building
  - Mixed Oxide Fuel Fabrication Facility

MOX Project Overview



MOX Regulatory Framework



MOX Regulatory Framework

- Two approvals needed for plutonium facilities:
  - Construction Permit
  - License to possess and use licensed material
- Construction Permit - 10 CFR 70.23(b)
  - A safety assessment of the design bases of principal structures, systems, and components (PSSCs)
  - Description of the quality assurance program
  - Environmental impact statement - 10 CFR 70.23(a)(7)

MOX Regulatory Framework

- 10 CFR 50.2 Definition of Design Bases:
  - "Design Bases means that information which identifies the specific functions to be performed by a structure, system, or component of a facility and the specific values or ranges of values chosen for controlling parameters as reference bounds for design..."

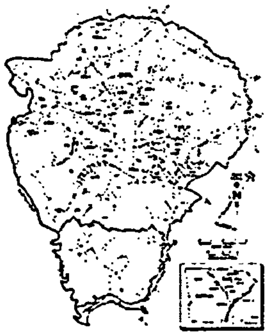
MOX Regulatory Framework: 10 CFR 70 Risk-Informed Regulations

	Highly Unlikely	Unlikely	Not unlikely
High Consequence Publ Dose > 25 rem Worker Dose > 100 rem	Acceptable	[illegible]	[illegible]
Medium Consequence Publ Dose 5 - 25 rem Worker Dose 25 -100 rem Env releases > 5000 Tbl 2	Acceptable	Acceptable	[illegible]
Low Consequence Publ Dose < 5 rem Worker Dose < 25 rem	Acceptable	Acceptable	Acceptable

MOX Project Milestones Construction Authorization

- Construction Authorization Request (CAR), Environmental Report and Quality Assurance Program Plan submitted to NRC by February 2001.
- First draft Safety Evaluation Report (SER) in April 2002 with 56 open items.
- Revised CAR in October 2002, after NNSA decision to cancel Plutonium Immobilization Project.
- Draft EIS issued by NRC in February 2003 – no significant impacts
- Second draft SER in April 2003 with 19 remaining open items
- November 2003 – ACRS meeting with 11 remaining open items; NNSA announcement of new Controlled Area Boundary

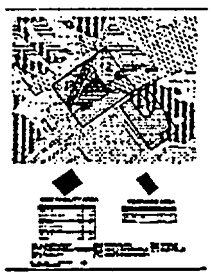
Controlled Area Boundary



- First CAB encompassed almost entire Savannah River Site
- CAB was 800 square kilometers
- CAB would now be < 0.06 square kilometers

New Controlled Area

MOX facility is located adjacent to the proposed Pit Disassembly and Conversion Facility



MOX Project Milestones

- CAR change pages received by NRC in June 2004
- Applicant made few MOX Facility changes resulting from Controlled Area Boundary change
- Safety assessment change attributed to change in CAB
  - Process Cell Exhaust System is included in the set of facility principal structures, systems, and components (PSSCs).

MOX Project Milestones

- Other changes in the June 2004 CAR include:
  - Removed uranium oxide dissolution system – replaced with uranyl nitrate system
  - Added Waste Organic Solvent unit
  - Updated chemical inventory list
  - Revised waste stream volume estimates
  - Other PSSCs added as a result of open item closure
    - Red oil, use of TEELs, and uranium burnback
  - Other editorial changes and corrections.

MOX Project Future

- If the SER is approved and the CAR is granted in February 2005;
  - NRC will start construction inspections and exercise enforcement authority
  - DCS will file a License Application and Integrated Safety Analysis Summary
  - Other license application documents will be filed
    - Facility Security Plan
    - Fundamental Nuclear Materials Control Plan
    - Emergency Plan, if required

Open Item Status

- Presenters:

Alex Murray, Senior Chemical Process Engineer

Bill Troskoski, Senior Chemical Engineer

Rex Wescott, Senior Fire Protection Engineer

Chris Tripp, Senior Nuclear Process Engineer

FSER Open Item Resolution Since November 2003: Chemical Safety Review Area

Alex Murray
Lead Chemical Safety Reviewer
NMSS/FCSS/SPB/MOFLS

Overview

* Discuss closure of open items from staff's RDSER (April 2003) and November 2003 ACRS Meeting

- CS-01: Red Oil
- CS-02: HAN/Hydrazine
- AP-03: Electrolyzer /Titanium Fire
- MP-01: Uranium Burnback
- CS-05b: Chemical Limits/TEELs
- CS-10: Control Room Habitability
- CS-09, AP-02, AP-08, and AP-09: Flammability

* *Provide summary*

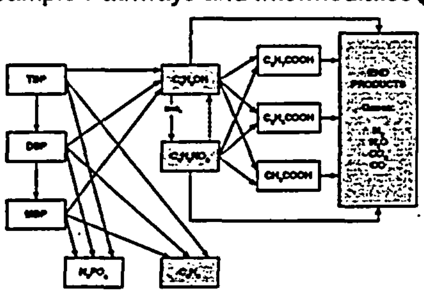
CS-01: Red Oil Introduction

- Aqueous Polishing uses an optimized PUREX solvent extraction process
- Generally two phases:
  - Aqueous: concentrated nitric acid (10-13.6 N)
  - Organic: Tributyl phosphate and branched dodecane mixture
- Nitrated TBP/organic compounds form
- Collectively termed "red oil" for the mixture

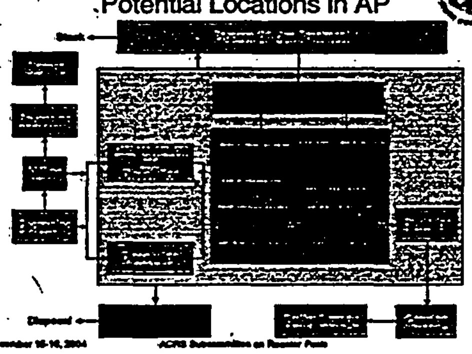
CS-01: Red Oil
Spectrum of "Red Oil"

The solution on the far left is the normal organic phase containing U and TBP. The far right is the material recovered following an overpressurization event. Color is dependent mainly on amount of heating and the type of hydrocarbon diluent employed.

CS-01: Red Oil
Sample Pathways and Intermediates



CS-01: Red Oil
Potential Locations in AP



CS-01: Red Oil

Safety Issue

- Red oil species can undergo exothermic reactions, involving small quantities (< 100 gal)
- Reactions can "runaway" and overpressurize vessels

- Several incidents (e.g., "knocking")
- Several accidents with significant equipment damage and release of radionuclides

CS-01: Red Oil

Applicant's Safety Approach

- Applicant has identified this as a high consequence event
- Selected a preventative strategy to render the event highly unlikely

- Safety controls:
  - Original application: 1 PSSC with 1 safety function
  - RCAR June 2004:
    - 3 PSSCs with 5 safety functions
    - commitment to further research and experiments

CS-01: Red Oil

Applicant Definitions

Two red oil cases:

- **Open Systems:**
  - Vent provided – pressure relief
  - No overpressurization from full runaway reaction
  - Can contain 100% organic compounds
- **Closed Systems:**
  - Vent provided – pathway for evaporative cooling
  - Cannot prevent overpressurization from full runaway reaction
  - Can contain substantial – but not 100% - organic compounds

CS-01: Red Oil

Applicant's Safety Controls (I)

PSSC#1: Offgas Treatment System

- Provide venting/avoid pressurization
- Allow path for evaporative cooling
- Open system: avoid pressurization
  - 0.008 mm^2/g organic (12.5 kg/cm^2)
- Closed System: evaporative cooling
  - 1.2 times [energy input from steam + reaction enthalpy]

CS-01: Red Oil

Applicant's Safety Controls (II)

PSSC#2: Process Safety Control Subsystem

- Control reaction enthalpy by limiting steam temperature (to 133 C)
- Limit organic compound residence time (exposure) to oxidizers and radiation
- For closed systems, use aqueous phase addition to:
  - Limit solution temperature to 125 C
  - Limit maximum heatup rate of 2 C/min

CS-01: Red Oil

Applicant's Safety Controls (III)

PSSC#3: Chemical Safety Controls:

- Ensure no cyclical organic compounds in diluent

CS-01: Red Oil

Applicant Commitment

Further research and experiments to:

- Define reaction kinetics
- Determine effects of impurities
- Establish operational limits and setpoints

CS-01: Red Oil

FSER Evaluation/Conclusions

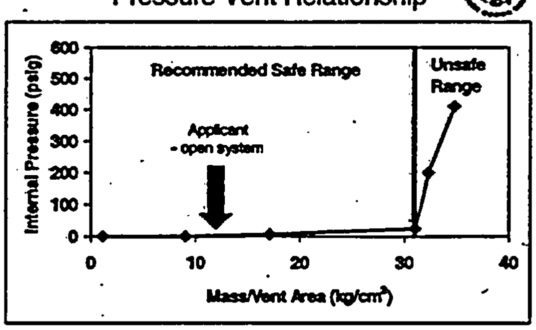
Open Systems:

- Preventative strategy acceptable
- Multiple PSSCs and safety functions
- Offgas (vent) PSSC design basis well within DOE experimental safety range (12.5 versus limit of approx. 32 kg/cm2)
  - System cannot pressurize
  - Physicochemically limited to not exceed NBP of azeotrope (120.4 C)
- Below red oil runaway conditions
- Accepted by staff

NBP = Normal Boiling Point

CS-01: Red Oil

Pressure Vent Relationship



CS-01: Red Oil

FSER Evaluation/Conclusions

Closed systems:

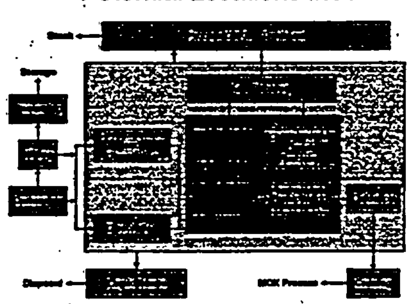
- Solution temperature not to exceed 125 C
  - 5 C margin below DOE safe initiation limit
  - 9-12 C below recent SRS test runaway initiation temperatures
- Organic exposure and diluent selection controls
  - prevent participation of other species (butyl)
  - avoid initiation temperatures below 130 C
- Temperature ramp control limits runaway enthalpy effects
- Aqueous phase addition and vent provide for evaporative cooling (20% margin) that limits temperature
- Applicant commitment to further research and experiments
- Accepted by staff

CS-02: Hydroxylamine Nitrate (HAN)/Hydrazine - Introduction

- Aqueous Polishing uses an optimized PUREX solvent extraction process
- A dilute nitric acid solution containing Hydroxylamine Nitrate (HAN) and hydrazine is used to reduce the extracted Pu(IV) to Pu(III) in the pulsed stripping column.
- This transfers (strips) Pu(III) into the aqueous phase
- A similar nitric acid/HAN/hydrazine solution recovers unstripped Pu in the last stage of the plutonium barrier.
- (Plutonium Barrier is to remove the last traces of Pu in the solvent prior to solvent regeneration).
- Hydrazine both stabilizes the HAN and reduces some Pu(IV).

CS-02: HAN/Hydrazine

Potential Locations in AP



CS-02: HAN/Hydrazine
Safety Issue

- HAN a reactive chemical
  - can undergo rapid autocatalytic decomposition
  - Nitrous acid/nitric acid reactions
  - Large quantities of gas evolved, pressure excursions

- Multiple events and accidents in industry
  - Hanford
  - SRS
- Involved quantities comparable to proposed MOX facility

CS-02: HAN/Hydrazine
Applicant's Safety Approach

- Applicant has identified this as a high consequence event
- Selected a preventative strategy to render the event highly unlikely
- Safety controls:
  - Original Application: partial application of DOE recommendations
  - Revised approach involves multiple parameters and controls

CS-02: HAN/Hydrazine
Applicant Definitions

<u>Safety strategy focuses on prevention for two areas:</u>

- <u>Case 1:</u> Vessels with HAN/hydrazine, no NO_x addition
  - Avoid decomposition reactions
- <u>Case 2:</u> Vessels containing HAN/hydrazine, with NO_x addition
  - Induce decomposition to avoid recycle and accumulation

CS-02: HAN/Hydrazine

Applicant – Case 1 Analyses

- Developed kinetic model based upon multiple reaction mechanisms (5 PDEs)
- Used kinetic parameters from the literature
- Solved model using commercial software
- Predicted regions of stability and safety design basis limits
- Applicant committed to confirmatory testing to substantiate the model

PDE = Partial Differential Equation

CS-02: HAN/Hydrazine

Applicant Controls for Case 1

PSSC	Safety Function	Controlled Parameter	Design Basis
[redacted]			

CS-02: HAN/Hydrazine

Staff Analysis

- Reviewed literature equations
- Developed and exercised similar model
- Found:
  - Regions of stability
  - Regions of instability
  - Margin in proposed design bases

CS-02: HAN/Hydrazine
Staff Analysis of Case 1 DBs

Controlled Parameter	Design Basis	Stable Value	Margin (%)
[redacted]			

CS-02: HAN/Hydrazine
Applicant Controls for Case 2

PSSC	Safety Function	Controlled Parameter	Design Basis
[redacted]			

CS-02: HAN/Hydrazine
Staff Conclusions

Case 1: No NOx
- Model and literature predict stability
- Commitment to confirmatory testing
- Acceptable for construction

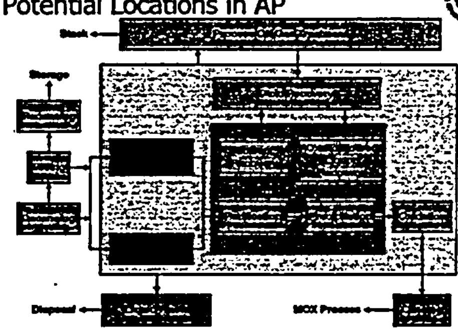
Case 2: With NOx
- Codes/standards consistent with industry, RAGAGEP
- Code methodology leads to DB values/ranges
- Acceptable for construction

RAGAGEP = Reasonably And Generally Accepted Good Engineering Practices

AP-03: Electrolyzer/ Titanium Fire - Introduction

- Purification requires dissolution of PuO_2.
- Dissolution can be difficult for some oxides
- Applicant selected electrolytic process based upon DOE/PNL program and Cogema use
- Electrolysis generates Ag[II], which dissolves PuO_2, circa 30 C, 6 N HNO_3
- Titanium used for corrosion resistance to Ag[II]

AP-03: Electrolyzer/Titanium Fire
Potential Locations in AP



AP-03: Electrolyzer/Titanium Fire
Safety Issue

- Titanium is a reactive metal
- Normal conditions: large currents and presence of oxygen (in HNO_3, oxides)
- Electrical fault could initiate titanium reactions (conditions exceed welding)
  - Planned fire protection may be ineffective, exacerbate situation due to Ti reactivity
  - Ti event would be difficult to predict and mitigate

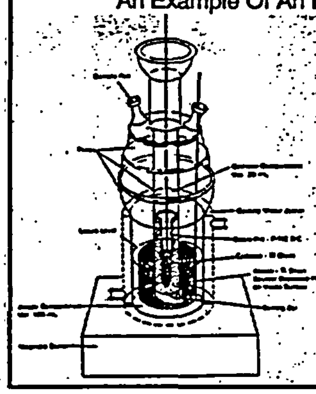
AP-03: ELectrolyzer/Titanium Fire

Applicant's Safety Approach

- Applicant has identified this as a high consequence event
- Selected a preventative strategy to render the event highly unlikely
- Safety controls:
  - Original application: no controls
  - Revised approach involves passive and active engineered controls (PECs/AECs)

AP-03: Electrolyzer/Titanium Fire

An Example Of An Electrolyzer



Key Attributes:

- Cylindrical geometry
- Center cathode and compartment
- Porous frit/barrier
- Annular anode and compartment
- Electrical connections
- Gas ullage and connections
- Insulators
- Means for agitation, cooling
- Silver[II] generated in anolyte

[from DOE/PNL experimental studies]
[Applicant's design would likely have more metallic components]

AP-03: Electrolyzer/Titanium Fire

Applicant's Safety Controls

Controls identified for:

- Maintenance/shutdown
- Seismic Event during operation
- Electrical fault during operation

AP-03: Electrolyzer/Titanium Fire
Controls During Maintenance

- Administrative controls
  - Isolate (terminate) power
  - Other requirements in procedures in License Application (LA)
- Staff Evaluation/conclusion:
  - Administrative controls RAGAGEP (Reasonably And Generally Accepted Good Engineering Practice, e.g., DOE, NFPA)
  - Other details in LA OK
- Acceptable for construction

AP-03: Electrolyzer/Titanium Fire
Controls during Seismic Event

- PSSC#1 is electrolyzer structure
  - Resist seismic events
  - Withstand turbulent flow
  - Not induce vibrations
  - Maintain geometry for criticality purposes
- PSSC#2: seismic trip system (part of PSCS)
  - Isolates power to electrolyzer during seismic event

AP-03: Electrolyzer/Titanium Fire
Staff Review of Seismic Event

Staff notes:
- Two independent controls
- Low frequency of seismic events
- Termination of power prevents Ti event
- Combination should have the ability to render event highly unlikely
- Acceptable for construction

AP-03: Electrolyzer/Titanium Fire
Controls for Electrical Fault

Passive Engineered Controls (PECs):

- PSSC#1: Sintered frit/barrier (Si_3N_4) – separates the anode from cathode in nitric acid
- PSSC#2: PTFE – separate anode from cathode and anode from ground
- PSSC#3: Guide sleeves – separate anode from titanium shell

AP-03: Electrolyzer/Titanium Fire
Controls for Electrical Fault (cont)

Active Engineered Controls (AECs):

- Current leakage detection system – shut down if > 10 mA
- Rectifier Trip Circuit: shut down if > 420 A
- Both part of PSCS (control system)
- No other related information (experience, references, codes etc.) provided

AP-03: Electrolyzer/Titanium Fire
FSER Conclusions

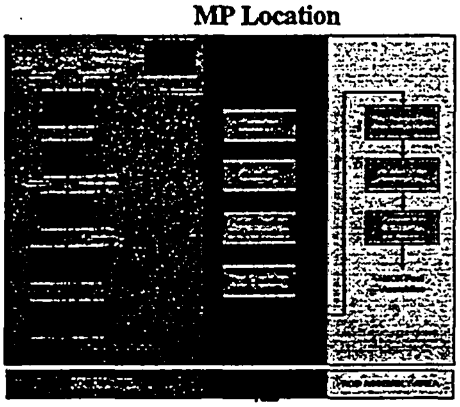
- Analyzed as top-level fault tree
- Used generic information from SRS, INEEL, codes
- Found combination of PECs and AECs capable of achieving highly unlikely
- AECs also RAGAGEP
- Conclude it is acceptable for the construction authorization

MP-01: Uranium Burnback Introduction

- Depleted UO_2 used as the matrix in MOX
- MOX requires blending of fine PuO_2 and (Depleted) DUO_2 powders
- UO_2 thermodynamically unstable under normal conditions
- "Burnback" refers to unexpected oxidation of uranium dioxide powders, e.g., on HEPA filters

MP-01: Uranium Burnback

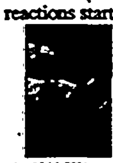
MP Location



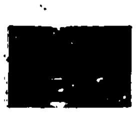
MP-01: Uranium Burnback

Safety Issue

- Burnback reactions can achieve high temperatures quickly
- Burnback can initiate other reactions/fires, disperse radioactivity, breach confinement, and damage HEPA filters
- Main concern is ball-milled DUO_2 powder ready for blending with PuO_2
- Such fine (< 10 micron) powders can burnback in exothermic reactions starting at room temperature



(HEPA = High Efficiency Particulate Air filter)



MP-01: Uranium Burnback
Applicant's Safety Approach

- Applicant has identified final HEPA filters as PSSCs for other safety strategies
- Selected a preventative strategy to remove fine particles and allow HEPA filters to perform their safety functions
- Safety controls:
  - Original application: no controls
  - RCAR strategy (June 2004): 2 high strength metal prefilters identified as PSSCs; also additional protective features (APFs) included

MP-01: Uranium Burnback
Applicant's Safety Controls

- High strength stainless steel mesh prefilters (spark arrestors)
- Protected two-stage final HEPA filters with structural integrity of >10 inches of water
- Multi redundant ventilation fan systems
- Ventilation system design ensures adequate air flow dilution
- Ventilation system design ensures a pressure drop of <10 inches of water across the HEPA filter elements
- Fire areas protected by two-hour minimum rated fire barriers
- Administrative control for inspection/maintenance of HEPAs/filters

MP-01: Uranium Burnback
Prefilters (Spark Arrestors)

- Prefilter 1: stainless steel wire mesh in stainless steel frame
- Prefilter 2: stainless steel and fiberglass mesh
- Safety Function: protect final HEPAs by removing particles from the airstream
- Design Basis: > 90% removal for particles > 1 micron size

Note: applicant states particle size is circa 100 micron upon receipt and circa 2 micron after ball milling

MP-01: Uranium Burnback
Applicant's APFs

- UO_2 delivered to the facility site and stored in sealed, 30 gallon drums.
- UO_2 is double-bagged within the drums, under nitrogen atmosphere.
- UO_2 is maintained in a nitrogen atmosphere throughout the process.
- Fire detection and suppression systems provided for gloveboxes (CO_2 injection) and process rooms (clean agent).
- Use noncombustible or nonflammable materials for process equipment construction and finishing.
- Control of combustible materials

APFs = Additional Protective Features – not PSSCs

MP-01: Uranium Burnback
Staff Evaluation/Conclusions

- Staff postulated a glovebox spill or fire could disperse fine UO_2 into ventilation system (C4)
- Staff analysis:
  - Ball milled material
  - Amount deposited on HEPAs 10-25% of that needed to cause temperature damage
- Staff concluded adequate safety strategy
  - HEPAs would survive burnback
  - HEPAs would continue to perform safety function

CS-05b: Chemical Limits - TEELs
Introduction

- Limits required for assessing consequences from NRC-regulated chemical events
  - 70.61: protect from high and intermediate consequence events involving acute chemical exposures
  - 70.65(b)(7): "description ... quantitative standards ... from acute chemical exposure ..."

CS-05b: Chemical Limits: TEELs

Safety Issue

- Chemical limits used to determine PSSCs and design bases
- SRP – NUREG-1718 examples:
  - AEGLs – Acute Exposure Guideline Levels
  - ERPGs – Emergency Response Planning Guidelines
  - Other cited values, such as OSHA and NIOSH [PELs, STs, Cs etc.]
- Applicant may use an alternative
- Significant variations between different limits
- Variations affect presence or absence of PSSCs

CS-05b: Chemical Limits: TEELs

Applicant's Safety Approach

Chemical Limits:

- Initial Application: none
- Revised Application:
  - Use AEGLs or ERPGs, where available
  - Use TEELs otherwise
  - Several significant variations in values
- Revised Application (June 2004):
  Table 8-5 values – TEELs and ERPGs

TEELs = Temporary Emergency Exposure Limits

CS-05b: Chemical Limits: TEELs

Applicant's Chemical Limits

Consequence Category	Worker (Facility and Site)	IOC/Public
[redacted]		

Site Worker = 100 m receptor

IOC = Individual Outside Controlled Area Boundary = 160 m receptor

CS-05b: Chemical Limits: TEELs

Applicant's Commitments

Consequence Category	Worker (Facility and Site)	IOC/Public
High	<Level 2	<Level 1
Intermediate	<Level 2	<Level 1
Low	<Level 2	<Level 1

CS-05b: Chemical Limits: TEELs

FSER Evaluation/Conclusion

- Multiple limits available
- Level 3 values trend towards high range of all the limits
- Level 2 values:
  - Much lower
  - All below IDLHs
  - More consistency with other limits
- Applicant commitment to < Level 2 (worker) and < Level 1 (IOC/public) addresses concern
- Level 1 approximates habitability limits
- FSER finds Tables 8.5-8.7 approach acceptable for construction

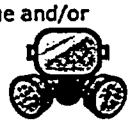
CS-10: Control Room Habitability - Introduction

- The proposed facility has multiple control rooms and control areas
- The applicant has identified two Emergency Control Rooms (ECRs)
- ECRs have two main functions:
  - maintain a habitable environment for operators
  - provide cooling to emergency electrical rooms

CS-10: Control Room Habitability

ECR Ventilation Systems (HVAC)

- System consists of two, 100% capacity air filter trains (1 for each ECR)
- Each ECR train has one intake
- Each ECR train consists of a filtration unit and booster fan for each intake
- Each filter consists of:
  - hazardous gas removal cartridge and/or organic vapor cartridge
  - HEPA filter cartridges



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CS-10: Control Room Habitability

Safety Issue

- Several chemicals onsite could affect habitability
  - Liquids: HNO_3, N_2H_4, solvent
  - Liquid/gas: N_2O_4, chlorine
- Releases of these chemicals could prevent ECR operators from performing safety functions

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CS-10: Control Room Habitability

Applicant's Safety Approach

- Applicant has identified chemical release events as affecting the ability of ECR operators to perform safety functions
- Initial application: PSSC but no DB
- FSER: permit condition requires habitable DB

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CS-10: Control Room Habitability

Applicant's Safety Controls

- ECR ventilation (HVAC) identified as PSSC
- Safety function is to maintain habitability for operators to perform safety functions
- Design bases use (FSER Table 8-12):
  - IDLHs from R.G. 1.78/OSHA
  - Level 2 values (Table 8.5) if no IDLH
  - Level 3 values if < IDLH

CS-10: Control Room Habitability

Other Aspects of Approach (I)

- Each ECR intake is continuously monitored for hazardous chemicals.
- Upon detection of a hazardous chemical above allowable limits, the intake is automatically isolated and switched to the recirculation mode using a filtration unit with HEPA filtration and hazardous gas removal elements.
- An alarm sounds if hazardous chemical levels are detected at both intakes.
- The alarm alerts operators to don emergency self-contained breathing apparatuses (SCBAs).

CS-10: Control Room Habitability

Other Aspects of Approach (II)

- Applicant stated that monitoring would be performed for those chemicals whose unmitigated release could result in control room concentrations exceeding the limits (RCAR Table 8-5a)
  - The emergency actions would be initiated when the chemical concentrations are at or below the TEEL-3 limit
  - Specific setpoints would be determined during the final design

CS-10: Control Room Habitability

Asphyxiation

- Design Approach (LA):
  - During detailed design, individual rooms and areas will be addressed on a case by case basis to establish if air monitors with alarms are required.
  - To avoid asphyxiating atmospheres, high ventilation rates are specified to preclude the creation of an asphyxiating atmosphere.
  - *Publication P-14 of the Compressed Gas Association (CGA), "Accident Prevention in Oxygen Rich and Oxygen-Deficient Atmospheres"*

CS-10: Control Room Habitability

Staff Evaluation

- Applicant has:
  - Identified a safety function for ECR operators
  - Identified a safety function to maintain habitability in ECRs for operators
  - Identified a PSSC of ECR HVAC
- Staff found:
  - Table 8-5a values correspond to short exposures (2 minutes per R.G. 1.78)
  - These are inconsistent with habitable conditions

CS-10: Control Room Habitability

Staff Conclusions

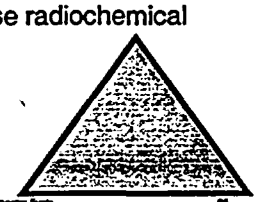
- Habitable conditions approximated by Level 1 values in Table 8-5.
- Proposed Permit Condition:
  - additional safety function of ECR HVAC shall maintain chemical concentrations below Level 1 values for duration of the event
- Staff concludes approach and permit condition provide for adequate assurances of safety

CS-09, AP-02,08,09: Flammability - Introduction

- The proposed facility uses flammable gases and combustible liquids
- Flammability control approach needed:
  - CS-09: Solvent Temperature DB
  - AP-02: Electrolyzer Flammable Gas Generation
  - AP-08: Offgas Unit Flammable Gases
  - AP-09: Offgas Solvent Flammability

CS-09, AP-02,08,09: Flammability Safety Issue

- Flammable and combustible materials can initiate fires and explosions
- Fires and explosions can breach confinement and release radiochemical materials



CS-09, AP-02,08,09: Flammability Applicant's Safety Approach

- Proposed a preventative strategy
- Adopted NFPA 69 as DB
- Identified 6 Areas of Applicability (AOAs) and associated PSSCs:

1: SX, Recovery, Wastes	4: Low T in Acid Recovery
2: Oxalic Precip/Mother Liquor	5: Hydrogen from radiolysis
3: Higher T in Acid Recovery	6: Hydrogen from electrolysis

(Proposed PSSCs and DB (25% of LFL) around Sintering Furnace and LFL methodology already accepted)

CS-09, AP-02,08,09: Flammability

Staff Review

- Reviewed NFPA 69
- Reviewed other guidance
- Reviewed electrolysis

CS-09, AP-02,08,09: Flammability

NFPA 69 (I)

- Standard on Explosion Prevention Systems
- Provides guidance on oxidant/combustible concentration reduction, suppression, containment, and spark extinguishing

- Combustible concentration
  - At or below 25% of LFL
  - Exception: at or below 60% of LFL provided automatic instrumentation with interlocks

CS-09, AP-02,08,09: Flammability

NFPA 69 (II)

Basic Design Considerations (Section 3-2):

- Required concentration reduction
- Variations in process, temperature, pressure, and materials
- Operating controls
- Maintenance, inspection, and testing

CS-09, AP-02,08,09: Flammability

NRC SRP Guidance (I)

MOX Standard Review Plan – NUREG-1718

- Chapter 7 – Fire
  - use and interpretation of codes and standards
  - some specific recommendations
- Chapter 8 – Chemical Safety
  - specific interactions (e.g., radiolysis, degradation)
  - analyze potential accidents

CS-09, AP-02,08,09: Flammability

NRC SRP Guidance (II)

Recommendations on Hydrogen Supply

- Designed to withstand seismic events or no internal leaks or shutoff so that 2% not exceeded
- Bulk storage outside
- Master shutoff valves on hydrogen tanks
- Inerting mentioned - around reducing furnace doors and purging during automatic shutdown

CS-09, AP-02,08,09: Flammability

NRC SRP Guidance (III)

Other Recommendations Involving Hydrogen

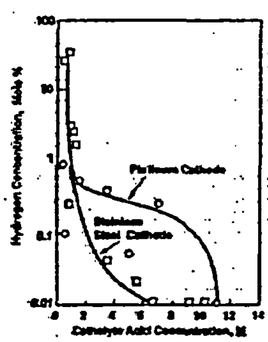
- Inert gas use: oxygen content not to exceed 25% of the level needed for combustion
- Inert gas purge and vent on SNM bearing solution tanks
- If inerting not used, other recommendations, such as ventilation so that hydrogen concentrations maintained below 25% of LFL in tanks, pipes, etc. under all expected process conditions

CS-09, AP-02,08,09: Flammability
Related NRC Guidance & Activities

- Report on Hanford Tank Wastes:
  - NFPA 69 applied inside vessels
  - Hydrogen not to exceed 25% of LFL
  - Based on interpretation of NFPA 69, as applied to the situation

CS-09, AP-02,08,09: Flammability
Electrolytic Hydrogen

- Shows acid Concentration can Control hydrogen



CS-09, AP-02,08,09: Flammability
FSER Conclusions

- Staff accepts preventative strategy
- Staff accepts general use of NFPA 69 as DB
- Staff will review implementation to check that any proposed interlocks can perform safety functions
  - Applicant has different strategies to pursue
  - Clear calculational and experiential basis needed, with setpoint analysis
  - Deferred until ISA in LA
- Acceptable for construction

Summary
70.61: Performance Requirements

- Previously identified open items from:
  - DSER
  - Revised DSER

  have been satisfactorily addressed by additional controls and safety strategies
- Staff concludes, pursuant to 70.23(b), that DBs of PSSCs proposed by the applicant will provide reasonable assurance of protection against NPH and accidents

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Summary
70.64: Baseline Design Criteria (BDC)

- BDC 3 for fires/explosions and 5 for chemical safety
- Applicant:
  - Proposed many strategies, PSSCs, and DBs
  - Used many specific codes and standards
  - Adopted RAGAGEP in many areas
  - Provided information to resolve open items
  - Stated BDCs are incorporated (RCAR 5.5.5.4)
- Staff concludes applicant has met BDC

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Overall Summary

- Unique licensing
  - First significant application of revised Part 70
  - Plutonium facility
  - Two-part licensing
- Many NRC/applicant interactions and working together have resulted in:
  - Improved safety controls
  - Significant improvements in applicant's safety strategies
  - Greater assurances of safety
- The licensing process has added value

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FSER Open Item Resolution Since November 2003: NCS Review Area

Christopher S. Tripp
Criticality Safety Reviewer
NMSS/FCSS/TSG

NCS-04: MOX Validation

- Prior to last ACRS meeting:
- Previously closed for areas of applicability:
  - AOA(1): Pu-nitrate solutions
  - AOA(2): MOX pellets, rods, assemblies
  - AOA(5): Miscellaneous Pu-compounds
- Still open:
  - AOA(3): PuO_2 powders
  - AOA(4): MOX powders

NCS-04: MOX Validation

- Current Status: Closed
  - AOA(3): Approved
  - AOA(4): Approved with permit condition:
    - Additional 1% margin in k_{eff}
    - Reduced parametric range
      - Narrowed range in H/X
      - Narrowed range in EALF
      - Limited to <60cm DU reflector
  - Permit condition required due to reduced number of benchmarks for MOX powders

K_{eff} Margin

- Benchmarks for AOA(4) non-normal
- Committed to follow NUREG/CR-6698
- Nonparametric Method:
  - Uses lowest calculated k_{eff} & nonparametric margin (NPM)
  - NPM depends only on total number of benchmarks
- Method applied to AOA(3) & AOA(4)

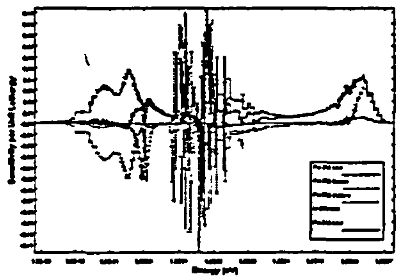
Application of NPM

- AOA(3):
  - 25 PuO_2 & 24 Pu-metal benchmarks
  - PuO_2 benchmarks found acceptable based on:
    - Similar materials, geometry, energy spectra
  - Pu-metal benchmarks found acceptable based on:
    - Differ from oxide only by density & chemical form
    - Staff calculations showed k_{eff} insensitive to density
    - Effect of oxygen on k_{eff} negligible
    - Confirmed by ORNL S/U code (TSUNAMI)
  - 49 applicable benchmarks → 0% NPM

Application of NPM

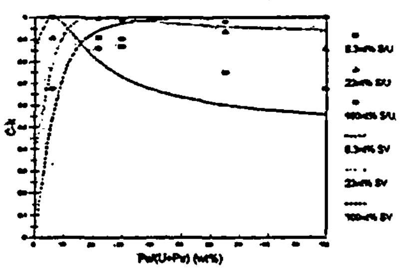
- AOA(4):
  - 42 MOX & 17 PuO_2 benchmarks
  - 38 MOX benchmarks found acceptable
  - 4 MOX benchmarks too high H/X
  - 17 PuO_2 benchmarks not shown applicable
    - Low correlation to 6-22wt% Pu-content MOX
    - Comparison of fission spectra not sufficient
    - Increasing importance of ^{238}U capture at low Pu/(DU+Pu)
  - 38 applicable benchmarks → 1% NPM

Applicability of low-Pu



Applicability of low-Pu

Ck vs. Pu-content: MOX-water spheres



Low-Moderated MOX

- Recognized shortage of low-H/X MOX benchmarks
- OECD/NEA workshop held April 2004 in Paris
  - Share experience with MOX licensing issues
  - Assess need for additional benchmarks
  - Decide among 6 competing proposals
    - Most for reactor-grade (RG)-MOX
    - Most using close-packed fuel rods

Low-Moderated MOX

- NRC position:
  - Weapons-grade (WG)-MOX benchmarks useful to support future flexibility (given restrictions to AOA)
  - Not needed to license MFFF (given additional margin acceptable)
  - MOX powder benchmarks with WG isotopics preferable

Follow-on Actions

- TSUNAMI results part of basis for FSER
- Not available to DCS; not approved code (QAP)
- Part of supporting analysis for design basis not incorporated into DCS documentation
  - 13 follow-on areas for additional demonstration identified
  - FSER states basis will be reviewed by staff in license application
  - DCS has informed us they'll provide substantiation in separate submittal

Additional Slides

- Safety Evaluation Report on the Construction Authorization Request for the Mixed Oxide Fuel Fabrication Facility

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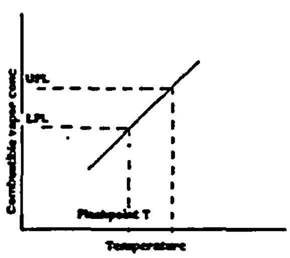
Flammable Vapor Concentration vs. Temperature Curve



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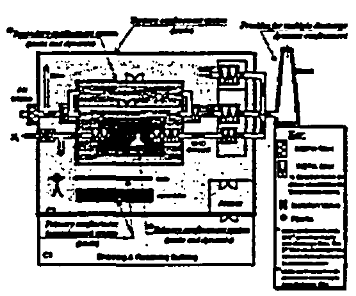
MOX Fuel Fabrication Process (MP) Ventilation Confinement



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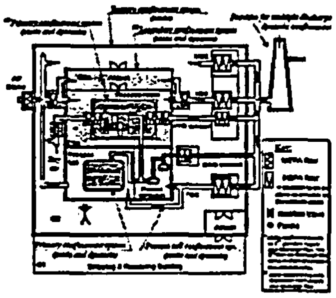
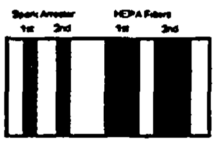
MOX Aqueous Polishing (AP) Ventilation Confinement



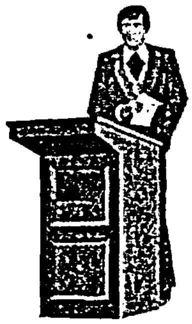
Final HEPA Filtration Units

- 1st stage spark arrester is stainless steel wire mesh
- 2nd stage spark arrestor is stainless steel mesh with interwoven fiberglass to remove particles > 1 micron diameter
- HEPA are glass media with metallic frames, silicone gaskets
- DB temperature: 450 F DB press. = 10 in WG



Safety Concerns and Differing Viewpoints and Opinions on MOX

Alex Murray
Lead Chemical Safety Reviewer
NMSS/FCSS/SPB/MOFLS



Overview

Provide feedback on:

- Safety Review Process
- Previously Open Items
- DPVs/DPOs

Note:

I am impartial – neither for nor against the proposed facility.

I am concerned some safety issues remain and need to be addressed now and not at the License Application stage.

Safety Review Process

Two Step Licensing:

- **Step 1:**
  - Construction Permit
  - Present
- **Step 2:**
  - Licensing – possession and use
  - Future (next year)
- Concern is the balance between the two and how much can be deferred and revisited later in the licensing stage, particularly for commitments

Safety Regulations

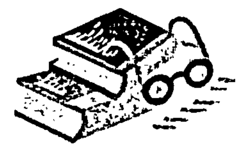
- Part 70.23(b): NRC approved when it has determined the DBs of the PSSCs, and QA plan, provide reasonable assurance of protection

- Part 70.61: Compliance with Performance requirements
- 70.64(a): Address the Baseline Design Criteria

Commitments are not mentioned

Safety Guidance

<u>SRP:</u>
- Chapter 8 for chemical safety
- Arranged for two-part licensing review
- Commitments may be acceptable



<u>On MOX, accepted PSSCs and DBs that:</u>

- In general, have less information than SRP mentions
- Are not RAGAGEP
- Rely on future efforts and experiments to define current PSSCs and DBs

RAGAGEP = Reasonable And Generally Accepted Good Engineering Practice

Diverse Viewpoints

Part of NRC strategic plan – safety and effectiveness goals
- Staff/management discussions
- Nonconcurrences
- Differing Professional Views and Opinions (DPVs and DPOs)

Some Observations

- A voting - not a consensus - process
- Nonconcurrences written – but not accessible by the public
- DPV/DPO only practical route to upper management and public
- Prevailing staff/management and MOX management often involved in DPV/DPO process – objectivity and independence unclear
- Unclear if staff have adequately followed QA and documentation needs
- A number of workshops are being conducted to address some of these issues

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Public Comment

"The NRC needs to act as a regulator and conduct thorough safety reviews [of the MOX facility]"

(public comment during August 2002 public meeting on MOX, North Augusta, South Carolina)

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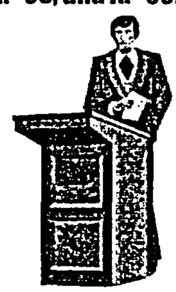
Comments on Previous Open Items

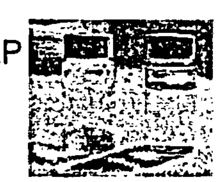
FSER Issues discussed earlier today and at November 2003 ACRS meeting

- CS-01: Red Oil
- CS-02: HAN/Hydrazine
- AP-03: Electrolyzer /Titanium Fire
- MP-01: Uranium Burnback
- CS-05b: Chemical Limits/TEELs
- CS-10: Control Room Habitability
- CS-09, AP-02, AP-08, and AP-09: Flammability

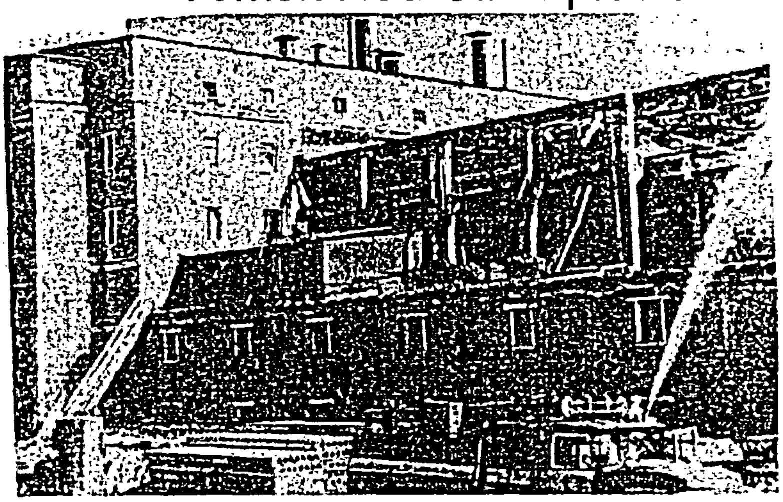


CS-01: Red Oil

- Nitrated TBP/organic compound mixtures
- Potential for significant damage and release of materials
- Open Systems:
  - Limited information provided by applicant
  - Acceptable because clearly based on test data
- Closed Systems:
  - Limited information provided by applicant
  - Clearly contradicts DOE/DNFSB RAGAGEP
  - In range identified as “unsafe”



Why I am concerned - Tomsk Red Oil Explosion



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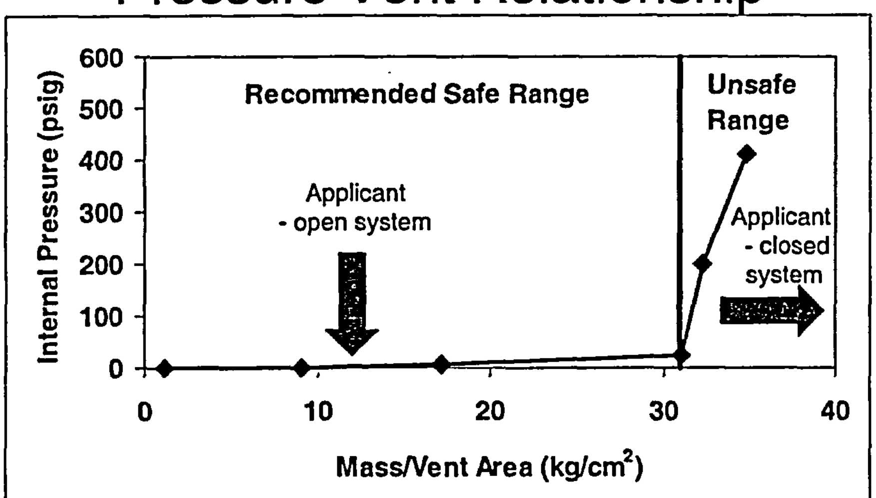
CS-01: Red Oil

Pressure Vent Relationship



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My Conclusions:

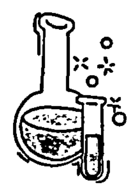
- Approach for closed systems does not provide adequate assurances of safety:
  - Corresponds to 1 control parameter (T)
  - Common mode failure – heat transfer and vent
  - Inadequate margin
  - Uncertainties not adequately considered
  - High aspect ratio design will likely result in higher pressures and temperatures, and phase separation
  - No assurance quench system and 125 C limit will prevent red oil reactions
- No assurance approach can meet Part 70 requirements for a Construction Permit

My Recommendation

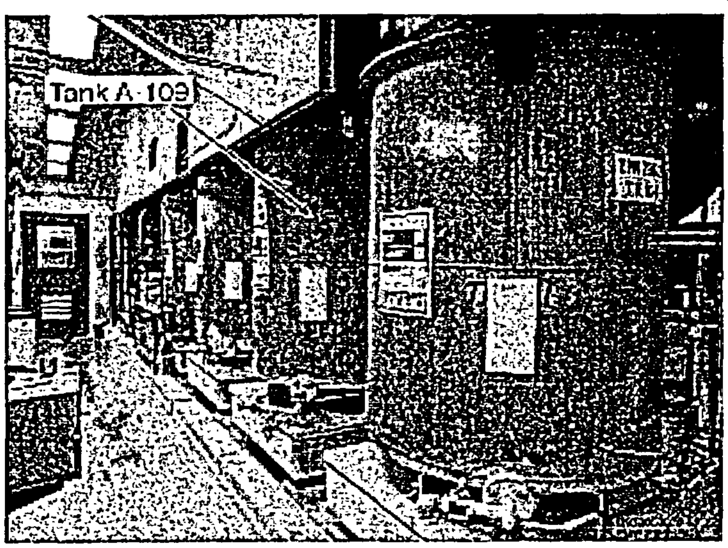
- Impose DOE/DNFSB RAGAGEP as permit condition
- Give applicant the opportunity to provide assurances about their strategy in the license application

CS-02: HAN/Hydrazine

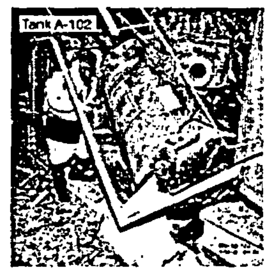
- Potential for rapid pressurization
- Two cases:
  - Case 1 – without NO_X
  - Case 2 – with NO_X addition
- Case 1 modeled as a system of PDEs to identify regions of stability and margin.



PRF Room Prior to Accident



Why I am concerned - PRF Accident Scene



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My Conclusions

- Case 1: no NO_X
  - Have only checked the mathematics
  - NRC model/software guidance for making a safety decision not followed
  - Contradictory design bases with hydrazoic acid
- Case 2: with NO_X
  - Applicant removed flow control
  - Cited standards accommodate flow design not flow control
- No assurance of meeting Part 70 criteria for construction permit

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Recommendation

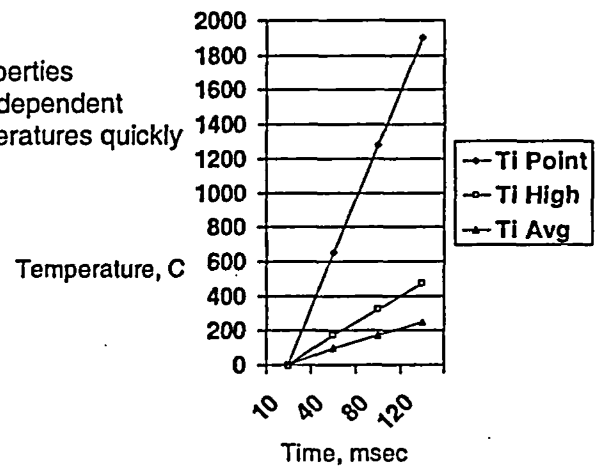
- Case 1: no NO_X
  - Have applicant commit to schedule to resolve DB conflict early after CAR/permit
- Case 2: with NO_X
  - Propose applicant's original flow control as permit condition
  - Give applicant the opportunity to provide assurances about their strategy in the license application

AP-03: Electrolyzer/ Titanium Issues

- Potential for titanium interactions and fires
- Applicant's strategy using RAGAGEPs
- Active and passive engineered controls (AECs and PECs)
- Active control terminates power, which removes the initiator for the event
- Find the approach of AECs and PECs meets Part 70 requirements

AP-03: Electrolyzer/Titanium Issues – Rapid Heating Possible

Assumed constant properties
Geometry and system dependent
Potential for high temperatures quickly



MP-01: UO_2 Burnback

- UO_2 Burnback reactions can damage HEPA filters directly or indirectly (igniting fibers/dust on the filters)
- Strong function of particle size
- Use of applicant UO_2 values produces higher loadings than staff calculations
  - Exceed threshold for one HEPA unit
  - 50-80% of threshold if distributed over C4 HEPAs
  - Contribution from other material on HEPAs not included

Burnback

- One or more features need to be identified as PSSCs and credited for safety
- Recommendation:
  - Propose permit condition that elevates intermediate HEPA filters to PSSCs for this event

CS-05b: Chemical Limits

Four Issues:

- Chemical releases – discussed as DPV/DPO later
- Modeling:
  - Dispersion Modeling – discussed as DPV/DPO
  - Phenomenological Modeling – addressed in FSER
- Chemical Limits – this discussion

Chemical Limit Concerns

- Findings from RDSER not addressed:
  - TEELs not independent, peer/public reviewed
  - TEELs not endorsed by a regulator
  - Certain TEEL values have increased substantially during review of the CAR
- Procedural Issues:
  - Policy decision – qualified staff not involved
  - Prior staff evaluations of limits not considered
  - Public not involved
  - Other regulators not consulted

Chemical Limit Concerns (cont.)

- Safety Issues not addressed:
  - Why are significantly higher values acceptable?
  - Why are values that frequently change acceptable?
  - What is appropriate for determining PSSCs and DBs?
- Recommendation: NRC needs a task force of qualified staff to address chemical limits

CS-10: Habitability

- Safety function of ECR HVAC is to maintain habitability
- Applicant's limits do not correspond to habitability
- Proposed permit condition applies habitability limits

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Flammability Issues

- Applicant proposed NFPA 69 as design basis
- Applicant identified PSSCs for various areas
- Some PSSCs may not function as interlocks for NFPA 69 exception
- Staff has accepted NFPA 69 and expressed need for clear calculational basis for any exception with interlocks, for the license application

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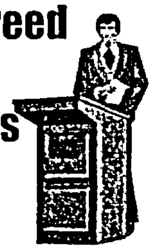
DPVs/DPOs

- 5 DPVs filed
- MD 10.159 DPV/DPO process changed in May 2004
- 2 DPVs went through full process
- 2 Management appointed panels agreed essentially 100% with the DPVs
- Actions and response did not address safety issues
- Both pursued as DPOs



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DPV/DPO Process Changed

- Process has DPO and DPO Appeal, no DPV
- Authority delegated to NMSS for DPOs on MOX
- NMSS has signature authority for MOX
- Consolidation of MOX issues mentioned

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DPV/DPO on Chemical Consequences

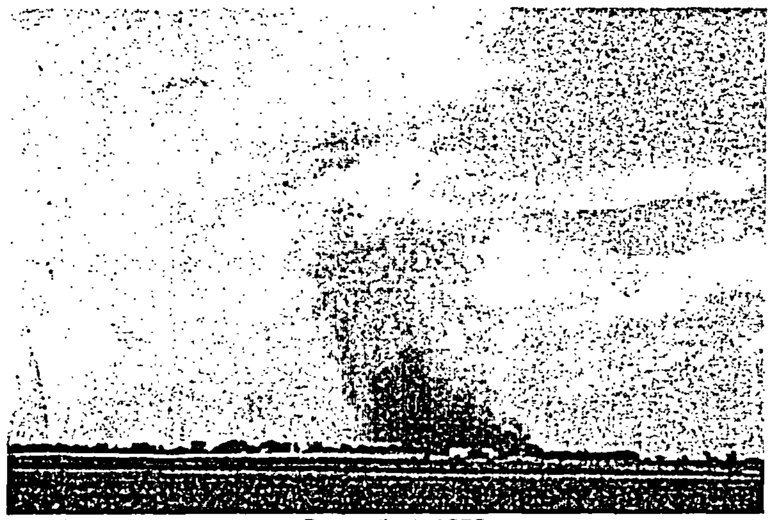
- DPV expressed concerns about chemical releases regulated by NRC
- Applicant has stated:
  - Not unlikely event
  - Radiation dose received (10s of mrem to 5-10 rem)
  - Not regulated because below 70.61
- Event has the potential for multiple fatalities, perhaps all operators outside the ECRs

NRC Assessment

- Management/staff
  - 1,500 mg/m³ at 100 meters for N_2O_4 (in EIS)
  - "Immediately lethal"

- My assessment:
  - Estimated concentrations could be higher
  - Facility design exacerbates hazard
  - Safe havens not PSSCs
  - Unlikely operators could reach safe havens or exits

N_2O_4 Release Example



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DPV Panel Findings

- DPV Panel agreed essentially 100%
  - Recommended the issue be re-opened or a new open issue established
  - Also recommended more guidance and review of safety evaluation process
- NRC Office/Division not in alignment with Panel report and decided:
  - Enough information on the docket, no need for the open item
  - *Some guidance provided*
- Review of safety evaluation process resulted in a chilling effect

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Draft DPO Report

- No further action needed as safety issue is addressed
- Applicant has made blanket commitments without exception to:
  - Codes and standards with habitability requirements
  - 70.64 BDC for chemical safety – habitability implied as part of BDC
- Therefore, applicant is required to maintain habitability in all structures at the proposed facility

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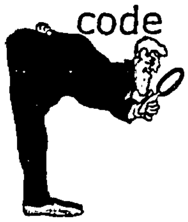
Summary of DPV/DPO on Chemical Modeling (I)

- Multiple codes available for dispersion and consequence estimation
- Applicant initially selected ARCON96, MACCS2, and ALOHA codes
- Applicant subsequently used only ARCON96 code



ARCON96 (coincidentally) produces lowest consequence results

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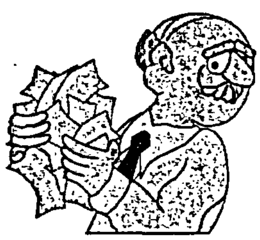
Summary of DPV/DPO on Chemical Modeling (II)

- Applicant provided input meteorology info
- No verification and validation info provided
- No QA/qualification info provided



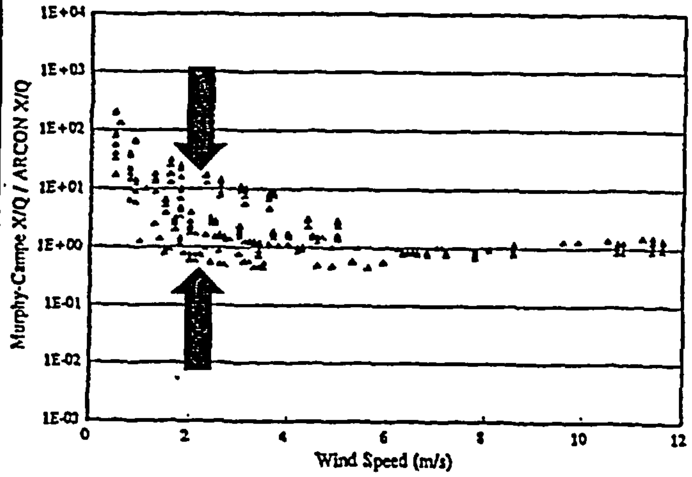
Fundamentally, no data On docket to support Site specific safety code Use at SRS MOX site

Summary of DPV/DPO on Chemical Modeling (III)

Authored DPV/DPO because:

- Matter closed – no reconsideration by local mgmt
- Safety significant:
  - potentially underestimate consequences by 1-2 orders of magnitude
  - Safety controls may be unidentified
- Submitted December 2002

Model/Data Comparisons (I)



- Applicant Using SRS Wind speed Of 2.2 m/sec
- Which value to use?

Figure 27 Murphy-Campe / ARCON concentration ratios by wind speed
(based upon data from 7 reactor sites in NUREG/CR-6331 on ARCON96)

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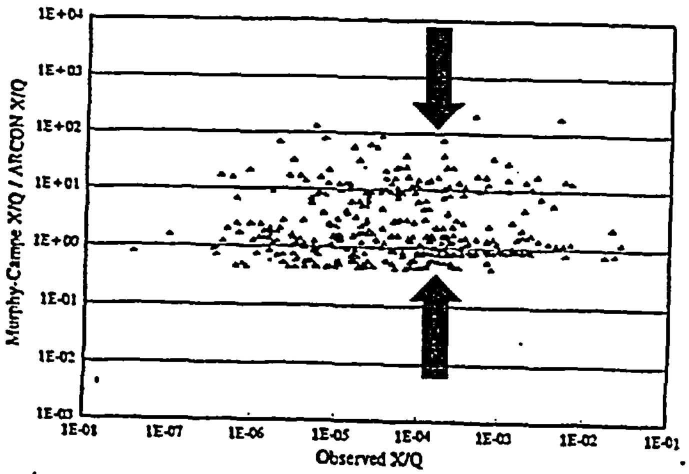
Model/Data Comparisons (II)



Applicant Using Circa 3E-4

Which value to use?

Figure 28 Murphy-Campe / ARCON concentration ratios by observed concentration
(based upon data from 7 reactor sites in NUREG/CR-6331 on ARCON96)

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Subcommitte

DPV Panel Findings

Essentially agreed with DPV:

- Panel noted generic use of ARCON96 OK
  - **but** site specific application for MOX not verified/validated against site test data
- NRC guidance on software not followed
- Staff guidance on code selection and user needs

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Office/Division Responses

On DPV/DPO Appeal, not in alignment with DPV Panel Report:

- Docketed information available
- MDs and NUREG/BR-0167 (Software QA Guidance) not useful
- Sufficient staff guidance available
- RES user-need memo for development/application of scientific codes

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DPO Appeal

Three Main Points:

- Information cited is not V&V
- No adequate QA on applicant's code
- Safety issues remain

Received DPO Report Monday (12/13), from a quick review:

- DPO appeal denied
- Implies V&V for site-specific application not needed

DPV on Waste Management Concerns

- Safety issues refer to premature closure of Open Items AP-05 and AP-06. Applicant should:
  - Confirm MFFF wastes are treated to meet SRS WACs and will be accepted
  - Identify PSSCs and DBs for the waste unit, such as an inventory limit DB and shutdown requirement
- Clearly within NRC regulatory authority

Waste DPV

NRC:

- Delayed the DPV for about a year
- Denied the DPV – waste is under DOE jurisdiction

Subsequently:

- NTEU filed a grievance on the process
- I requested the ACRS/ACNW review the DPV and the safety issues

DPVs on Chemical Limits and Flammability

NRC:

- Delayed the DPV for about 10 months
- Asked for resubmission

Subsequently:

- NTEU filed a grievance on the process

Summary

- Process and specific safety concerns
- Potential for more DPOs
- We – NRC, applicant, and DOE - need to do a good job and address these issues