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

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

MEETING OF THE SITING SUBCOMMITTEE

+ + + + +

OPEN SESSION

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THURSDAY

AUGUST 19, 2010

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ROCKVILLE, MARYLAND

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The Advisory Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:30 a.m., Dana Powers, Chairman, presiding.

SUBCOMMITTEE MEMBERS:

DANA A. POWERS, Chairman

J. SAM ARMIJO

MICHAEL T. RYAN

DESIGNATED FEDERAL OFFICIAL:

NEIL COLEMAN

C-O-N-T-E-N-T-S

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

(8:28 a.m.)

OPENING REMARKS AND OBJECTIVES

CHAIRMAN POWERS: The meeting will now come to order.

This is a meeting of the Advisory Committee on Reactor Safeguard, subcommittee on siting. I'm Dana Powers, chairman of the subcommittee. And we have the A team of members in attendance today: Michael Ryan, Sam Armijo are here; Dennis Bley is scheduled to join us.

The purpose of this meeting is to examine the MOX fuel fabrication license application, and the associated NRC safety evaluation report where what we are actually examining is the safety evaluation report.

The subcommittee will gather information, analyze relevant issues and facts and formulate those positions and actions as appropriate for deliberation by the full committee. Neil Coleman is the designated federal official for the meeting.

Notice in this meeting was previously published in the Federal Register on July 29th, 2010. Please notice that the meeting notice incorrectly stated that the entire meeting will be open to public attendance. The published meeting agenda correctly shows that most of the presentations will be held in closed session. The first half of the day will be held in public session.

A transcript of the meeting is being kept and open portions of the meeting will be made available. It is requested therefore that speakers first identify themselves and speak with sufficient clarify and volume so they can be readily heard.

We have not received any requests from the public to provide comments. At this point I will introduce some of my own comments. I will comment that the ACRS has examined this facility in the first stage of the licensing process, so now we are looking at the construction phase.

In this regard it is regrettably to me that we have been unable to overcome the various legal barriers to prevent Dr. Ed Lyman from offering his perspective on this regard, and I think the committee would have benefited from his particular viewpoint on these matters.

Do any of the other members have comments they would like to make before we begin today?

Again our objective is to formulate some proposed positions to take to the committee, the full

ACRS committee. And right now that is scheduled to occur in the September meeting. That is subject to change with the outcome of this particular subcommittee meeting. But right now our plan is to formulate positions. So I'll be asking the members to provide their input as the meeting goes along and probably toward the end as well.

With that we will proceed. I will call upon Larry Campbell in the Office of Nuclear Material Safety and Safeguards to open the presentation.

OPENING REMARKS - NRC STAFF

MR. CAMPBELL: Good morning, Dr. Ryan and members of the subcommittee.

I guess for formality I am Larry Campbell. I am the branch chief of the Mixed Oxide and Uranium Conversion Branch. I've been in this position since about the end of June.

We are looking forward today to having some very good discussions. Today representatives from MOX Services and staff from the Mixed Oxide and Uranium Deconversion Branch will present discussions on the safety evaluation reports and specific topics that this subcommittee has identified that they would like detailed discussions on.

We look forward to receiving comments from the subcommittee, and look forward to having a good two days' worth of discussions. And as always we value the subcommittee's comments.

Thank you very much.

CHAIRMAN POWERS: Thank you.

I follow my agenda right now. We have a presentation from MOX Services, and I have Kelly Price written down as our speaker.

MR. GWYN: We had a last minute change. Eric Chassard is going to be doing the introduction.

CHAIRMAN POWERS: Okay, I'm sure he will serve well.

MR. CHASSARD: I will do my best.

OVERVIEW OF THE MOX FACILITY

MR. CHASSARD: So good morning. I'm Eric Chassard, and I'm MOX Services executive vice president, and I'm also the deputy general manager for four months now. So you can hear from my accent that I was not born and raised in South Carolina, even if I'm working here. In fact I've been working for AREVA for 14 years, and I spent the beginning of my reactor in the reactors, nuclear power plants. But then I joined what we call the back end of the recycling business of AREVA, and in these two days you are going to hear a lot about La Hague, which is the reference plant for the aqueous polishing part. And Melox which is the reference plant for all the fuel fabrication process.

And I just want to say that AREVA has been operating very successfully these two facilities for the last 30 years. So this process and this technology is a proven technology which has been very successful. And I spent most of my career, so first I studied as a project manager in the Hague, so for the aqueous polishing part, and then in various management positions in Melox as safety, production, maintenance and then quality improvement director.

Before joining the project I was in charge of project engineering for MOX, the world business line for AREVA, so, in charge of all the projects worldwide, so in Japan, in France of course, and also in UK where AREVA is helping to improve the MOX facility.

So MOX Services really appreciate the opportunity to meet with you. We recognize the importance of the work of the ACRS, and the licensing process, and we really welcome the opportunity to discuss with you and to discuss our facility and the different related aspects of the safety analysis over the next couple of days. So just feel free to ask any question you want.

I'd like to introduce the MOX team. So first Bill Hennessey. Bill is our nuclear safety manager. Dr. Sven Bader, so Sven is the lead ISA engineer for aqueous polishing system. Scott Salzman, Scott is our lead ISA engineer for fuel fabrication system. Brian Stone, Brian is ISA technical safety engineer. Brian. Thank you.

Dr. Paul Duval, Paul is an ISA chemical safety lead. Dr. Scott Barney, Scott is an expert consultant, chemical interactions. Dr. Bob Foster, criticality safety lead. Frank Cater, civilian structural manager. Tarun Sau, Tarun is lead NFFF seismic analysis. Rick Imker, human factor lead. And Dealis Gwyn, licensing manager.

So that will be the team for today. And tomorrow, Larry Rosenbloom, fire protection lead, will join us, as well as Gary Bell, software design manager.

So this morning MOX is going to provide another view of the MOX facility, as well as an overview of the ISA process. So first then Sven Bader will be giving another view of the aqueous polishing part of the facility. And Scott Salzman will be giving an overview of the fuel fabrication process.

And Bill Hennessey will provide another view of integrated safety analysis process.

What I propose first is that we are going to start with a very short movie on MOX to give you an overview of the facility. You will see also the reference plants and that will give you a very good idea I think of this facility. And after we will go into the MOX in detail.

(Video presentation.)

"A commitment to a safer, more secure tomorrow: that is the mission of the mixed-oxide fuel fabrication facility, or MOX facility, at the Savannah River site in Aiken, South Carolina.

This facility will be instrumental in permanently removing excess weapons grade plutonium from the United States nuclear stockpile, and as an added benefit this material will be converted into fuel elements to be used in commercial nuclear stations for our home and businesses in the U.S.

The beneficial reuse of these legacy materials for commercial nuclear reactors will mean less dependence on fossil and foreign fuel sources. In the year 2000 the United States and Russia signed a treaty to dispose of 34 metric tons of surplus weapons grade plutonium each. The National Academy of

Sciences was commissioned to study the different management and disposition options for these materials.

It can be recommended that both the United States and Russia pursue a long-term plutonium disposition program that would make the plutonium undesirable by an adversary as well as unusable. To implement this program in the United States MOX technology was selected by the National Nuclear Security Administration, NNSA, an agency of the Department of Energy. This proven technology has been in use in Europe for more than 35 years, and in more than 30 reactors worldwide. The Savannah River site MOX facility is based on AREVA Melox and La Hague facilities in France.

The MOX facility has been designed to meet U.S. codes, standards and regulatory requirements. To supply the MOX facility with plutonium oxide the pit disassembly and conversion facility will take apart plutonium pits which are a key component of nuclear weapons, and then convert the material into plutonium oxide. The waste solidification building currently under construction will process waste streams from both the PDCF and MOX facility for final disposition and disposal.

In 1999 the year we signed a contract with Consortium, now called Shaw AREVA MOX Service, LLC, to design, build, operate and deactivate the mixed oxide facility at SRS. MOX Services is owned by the Shaw Group, one of the largest engineering and construction companies in the world, and AREVA, a global leader in nuclear technology.

Congress mandated that the facility would be licensed and regulated by the U.S. Nuclear Regulatory Commission. The NRC has conducted intense reviews of the MOX design, and in March, 2005 issued their construction authorization. The first such authorization issued by the NRC in over 20 years.

MOX is also regulated by the Occupational Safety and Health Administration to ensure safe and healthful working conditions for every team member on the project.

A closer look at MOX facility operations will demonstrate the safe conversion of plutonium into MOX fuel assemblies. The MOX fuel facility consists of two major processes: aqueous polishing and fuel fabrication.

Aqueous polishing is a five-level chemical process where plutonium powder is converted to a liquid form and then purified to remove byproducts such as gallium, americium and uranium. The purified plutonium liquid is converted back to a powdered oxide form, packaged and canned, and stored until it is needed.

The second process, fuel fabrication, is a three-level mechanical assembly process where fuel is fabricated just like uranium fuel that is used in commercial reactors through the U.S. Because of the plutonium content, MOX fuel fabrication occurs in gloveboxes which allows access to the machinery while protecting the worker.

The plutonium and uranium oxide powder are mixed to the desired blend and pressed into a pellet about the size of a pencil eraser . The MOX facility will provide upwards of 70,000 pellets each day. To strengthen and increase their density the pellets are ground to within a few microns of their required diameter and sorted by means of a fully automated system. Then samples of the pellets are checked and verified - dimension, density, marking and color. The rods are manufactured by arranging the pellets in a long tray and inserting the pellets into a zirconium alloy tube, each rod containing approximately 360 pellets. An end plug is then inserted into the open end and the rod closes shut. The rods are cleaned and decontaminated. And then arranged on trays to be stored.

The rods are assembled in a metallic structure to produce a fuel assembly. A typical fuel assembly contains 264 fuel rods in a 17 X 17 array. It's 13 feet in length, and weighs about 1,500 pounds.

The MOX facility will have the flexibility to produce 17 X 17 fuel arrays, 10 X 10 fuel bundles as well as fuel assemblies for the new generation reactors. One MOX fuel assembly can provide enough energy to power nearly 9,000 homes for an entire year. In 2008 four MOX fuel assemblies successfully completed two fuel cycles in a U.S. commercial nuclear power reactor. The location for the MOX sited SRS was prepared for construction and on the morning on August 1st, 2007, construction of the MOX facility was officially started.

During the first two years of construction, MOX Services has successfully placed over 50,000 cubic yards of reinforced concrete, over 10,000 tons of reinforcing steel, and over 5,100 feet of piping. According to Southeast Construction magazine, MOX was the largest construction project in the Southeastern United States as of 2008.

Currently over 4,500 people work in the

U.S. supporting the MOX project, and when operational the $4.8 billion MOX facility will employ between 800 and 1,000 employees. It's operation is expected to continue well into the 2030s.

The completed MOX facility will bear many impressive statistics. The 500,000 square foot MOX facility will be equal to 10 football fields. Additionally the facility will boast 170,000 cubic yards of concrete; 35,000 tons of reinforcing steel; and over 80 miles of piping. In other words the MOX facility will contain enough concrete to construct four Washington Monuments, and enough reinforcing steel to construct the Eiffel Tower four times. And if the piping were placed end to end it would extent from Aiken to Columbia, the capital of South Carolina.

NNSA continues implementation of its plutonium disposition program. The MOX facility will play a key role in the safety and security of removing excess nuclear material from the national inventories in accordance with the U.S. international agreement for the disposition of excess weapons grade material. The beneficial reuse of these legacy materials in commercial nuclear reactors will mean less dependence on fossil and foreign fuels.

The mixed oxide fuel fabrication facility at the Savannah River site, a leader in America's nuclear nonproliferation program." (End video)

MR. BADER: Good morning. My name is Sven Bader. I'm a senior member of Shaw AREVA MOX Services. I'm an AREVA member. I'm located in Charlotte, North Carolina. I'm here to introduce the aqueous polishing process to you. I've been on the project since 1999. I specialize on the safety of the aqueous polishing process, went through many generations of managers, so I'll give you the ins and outs if you want to hear them.

The focus of this is going to be the aqueous polishing process, which is the little orange shade on there. So it's a very small part of the overall facility. It is five floors. The MOX site that Scott will be discussing is three floors. So we go four down and four up.

The overall process for the NFFF will start with the aqueous polishing process, and we will be doing a dissolving, and I'll be going through these in a little more detail. And we will be going through a purification cycle where we are basically separating the raffinates, the americium and gallium and then separating the uranium as well in that process.

From there we will be moving on to the conversion facility, which is basically converting plutonium from a nitrate oxalate into an oxide.

MEMBER ARMIJO: Before you go ahead, PuO2 comes from this PDA facility onsite or somewhere else?

MR. BADER: You can go to the next slide, good question, set me up. So the two sources of Pu oxide to our facility. There is PDCF facility, not yet built, and then there is an alternate feedstock, which the material is already basically ready made for our facility to process. It has some various additional impurities in the Pu oxide.

CHAIRMAN POWERS: The previous slide only cited removal of americium and gallium. But your ultimate feedstock will have other stuff?

MR. BADER: Yes, and that is part of the raffinates.

CHAIRMAN POWERS: I wonder why it didn't make the slide, because it is such a challenge, isn't it?

MR. BADER: Well, it's part of the challenge. I'll describe a little more the purification process in detail. But yes, essentially the - first we dissolve everything. And in the process of dissolving some of the AFS feedstock, alternate feedstock, is chlorine contaminated. So the first impurity that we remove is actually in the dissolution unit where we are going to first cycle through the process, the electrolyzer to remove the chlorine. It comes out as a gas form, and then we end up treating it and producing sodium chloride waste product at the end.

Then from there we end up going to extraction process where essentially we are only extracting plutonium and uranium. And then we go to the other impurities are going off in the raffinates section.

MEMBER ARMIJO: So you would just run them in totally separate batches. You wouldn't ever mix the alternate feedstock and the other materials?

MR. BADER: Correct.

MEMBER ARMIJO: Because they are really different.

MR. BADER: They are different, and the objective - we have three electrolyzers in our process, two are actually dedicated to chlorine treatment, one is dedicated to nonchlorinated feeds, and we have both nonchlorinated and feeds in this alternate feedstock.

CHAIRMAN POWERS: How do you know that those are the only things that you are going to have in this alternate feedstock?

MR. BADER: There is a pedigree that we are getting from the DOE that they have done studies on these materials that they are sending to us. We also do sampling before we stick it into the batch aqueous polishing process. We have some up front samples taken of the powder that we are getting in in the alternate feedstock to make sure it meets our specifications. We have a very long list of specifications. I didn't provide them here; they are in the ISA summary, and it's almost a table of elements if you want to look at it.

MEMBER ARMIJO: Just for perspective, the total mass, the whole project, is it primarily the PDCF source material or is it the alternate feedstock material? Because when I read the documentation I got in my mind that the alternate was also a by-the-way type thing also with this, but it looks like 89 kilograms a week compared to 100 kilograms per week, that's quite a lot of material.

MR. BADER: It is, and I have to tell you the way we are set up to operate, the PDCF right now is not like you show in the picture. There is no work going on right now other than I believe some assigned work activities.

MR. HENNESSEY: Excuse me, Bill Hennessey. Let me just add something. The AFS feed represents that nine kilograms of material of the 34 metric tons that we plan --

MEMBER ARMIJO: Could you repeat that?

MR. HENNESSEY: Nine metric tons is going to be AFS material of the 34 metric ton total. So the project had originally started out just with PDCF feed. The AFS feed was added several years into the project. So the original purpose of AP and the purpose of the previous slide was just to get rid of those americium, plutonium and gallium --

MEMBER ARMIJO: It sounds like you are going to start with the AFS when you start the plant up.

MR. BADER: Right, to make up the gap between the building of the PDCF and the operation of our facility we are going to be accepting this alternate feedstock and processing that.

CHAIRMAN POWERS: In your sampling process what happens if you reject the material?

MR. BADER: Scott, do you want to address that one?

MR. HENNESSEY: We send it back to DOE. We can't re-can it and send it back to the Department of Energy.

MR. BADER: It is part of a powder processing. That's why I kind of defaulted to Scott.

In our front units, we have several up front units in front of AP, where you actually have to un-can, and Scott can go over those I believe. And one of those is a sample that they are projected, they go through a projection line, dedicated projection line.

MEMBER ARMIJO: And the people who are going to provide this non-PDCF plutonium in PuO2 form, is that just one facility or is it many DOE facilities?

MR. BADER: DOE Complex.

MR. HENNESSEY: DOE complex countrywide. I mean it's a number of different sources.

MEMBER ARMIJO: You are going to have a lot of variability in that --

MR. HENNESSEY: Yes, we are.

MEMBER ARMIJO: Okay.

MR. BADER: Go back a slide, finish that up, the rest of the MP process Scott will talk about in more detail. But essentially we ended up doing a master plan and final blend, pellet production through the process, centering, and then rod production and fuel sending.

All right, this is the aqueous polishing process. The rest of the presentation is going to focus on this. The main blocks for the plutonium that the plutonium is going to follow are these heavily outlined blocks. And we start out with the KDD and KDB dissolution units, so those are three electrolyzers that are going through silver catalyzed electrolysis, which is basically move the PuO2 into Pu nitrate. We will then treat the Pu nitrate with hydrogen peroxide, to get it correctly on state and also to reduce the silver valence state.

We will also add some depleted uranium to the process to reduce the isotopic sum of the uranium for criticality reasons later down in the process.

CHAIRMAN POWERS: I didn't understand that. Isotopics on the uranium?

MR. BADER: We had depleted uranium in the dissolution process because further down in the KJPA process in this KPA stripping we will remove the uranium and to - for criticality purposes we add depleted uranium because the uranium in the feedstock is high caliber U-235 content. So we add U-238 essentially to dilute it.

From the dissolution process we move - so this is the dissolution process. I'll go over that again. So it's silver catalyzed electrolysis. We add silver nitrate to the PuO2 that has been added to an electrolyzer. We add charge, and eventually we get the plutonium to move into solution. The plutonium then moves down to a tank where we add hydrogen peroxide, and then as I said the uranium is added adjusting those tops, the uranium that will move further on.

The main equipment in this process is three electrolyzers. There are filters to remove any of the undissolved materials, and tanks where we do the majority of the treatment with the hydrogen peroxide and the depleted uranium.

These are all made out of titanium due to corrosion issues.

MEMBER ARMIJO: The electrolyzers, could you just explain that a little bit more? So the plutonium oxide just won't dissolve well in straight nitric acid, but what is actually happening in your electrolyzer?

MR. BADER: The way that the electrolyzer - we first add nitric acid to - there are essentially three compartments in this electrolyzer. Some are called hopper. And then there is an electrolysis pot and a complementary pot. And in the hopper we have it initially full of nitric acid. And we pour in the PuO2 into that, and so essentially we just have PuO2 in solution now. There is a pump that essentially starts a flow to the electrolysis pot. We add silver nitrate just before we start - well, the pump is running as we pour in the PuO2, then we add some silver nitrate, and turn on the power to the electrolyzer, and we essentially get the plutonium moving into solution through the silver catalyzation.

I don't know if that helps.

MEMBER ARMIJO: I'm just wondering, the plutonium has to go into solution somehow.

MR. BADER: It's a batch process, and this thing is pumped and circulated. We are adding heat, so we have to have a cooler on this as well. And through the Pu chemistry eventually the plutonium moves valence states, I believe to Pu6 nitrate when it goes out of the electrolyzer, and then we treat it with hydrogen peroxide to get it down to the Pu4 valence state.

MEMBER ARMIJO: Still as a nitrate solution?

MR. BADER: Still as a nitrate solution.

MR. NORATO: Mr. Chairman, if I may, Mike Norato, NRO. The dissolution of plutonium oxide in this fashion is not uncommon. The Pu oxide doesn't like to go into solution, so to speak initially. So usually you need something to help it along. The electrolytic dissolution is not uncommon. It's been used at Hanford and Savannah River for years. Usually the only thing that really varies is the choice of catalyst. Sometimes potassium fluoride is used, in this case they are using silver to catalyze it. But basically you kind of need to give the Pu oxide a little help to get into solution. And once it's in solution then you can proceed --

MEMBER ARMIJO: But eventually something is plating out on an electrode somewhere. Is it the sliver that is plating out? Not plutonium, I'm sure.

MR. NORATO: Well, the silver doesn't -well, I'll let the applicant answer that question.;

MR. BADER: The silver does not plate out. The silver also stays in the solution. I don't know if you want to add to this?

DR. DUVAL: Paul Duval, chemical safety. What the purpose of the silver, too, is that it will actually oxide the U-02, uranium-4, into soluble uranium-5 and subsequently uranium-6, and that is the purpose of the silver too in the process. And once you get to plutonium-5 and/or plutonium-6 those are soluble in aqueous solutions.

MEMBER ARMIJO: Okay, thank you.

CHAIRMAN POWERS: And the product of the reaction with peroxide is what?

MR. BADER: With the hydrogen peroxide will be the Pu nitrate 4 and some off gasses.

CHAIRMAN POWERS: Oxygen?

MR. BADER: Oxygen.

CHAIRMAN POWERS: And what do you do with that?

MR. BADER: Send it up the ventilation system.

CHAIRMAN POWERS: How concentrated is the oxygen?

MR. BADER: I don't know the concentrations, but everything maintains below any pressure limits. We have done calculations that the venting is able to - during the whole process these tanks are all, they are sealed tanks; they are not open to the environment. And they are vented by a ventilation system which is drawing a slightly negative pressure on all the tanks.

CHAIRMAN POWERS: Can't be sealed and open to the environment. They have to have an off gas. That off gas is oxygen. Everywhere in your line you are going to have fire hazard in this ventilation system.

MR. BADER: Yes, we don't discount that. We are not saying it's flammable, if that is what you are indicating. We have flammable gases, but that's what we are going to end up preventing, and there is a discussion tomorrow - or later today actually - about that actual issue. There's oxygen gas. These are all coming up to a header. There are other gases that are coming off the electrolyzer, chlorine for example, that is a dedicated system. There are some NOx releases as well, into the ventilation system, and this ventilation system then, it's drawing a slightly negative pressure and it's moving up into treatment units, we have a NOx scrubber, and then an air scrubber downstream of that. And then it goes through HEPA filters before it's actually released to the environment.

CHAIRMAN POWERS: My recollection is you are using metal HEPAs?

MR. BADER: No, not on the - I have to be careful. This is the AP process. We have a dedicated ventilation system. That has HEPA filters on the end of it, and there are several treatments. There is heat treatments; actually we condition air before it gets to those HEPA filters.

CHAIRMAN POWERS: Are they paper?

MR. SALZMAN: They are glass. They are glass fiber.

MR. BADER: They're glass fibers? Okay.

CHAIRMAN POWERS: Glass fiber.

MR. BADER: The next process from the dissolution we move to the purification cycle. This is where we are going to end up separating the impurities form the plutonium and the uranium. The plutonium and uranium are extracted by solvent, the tributyl phosphate, and the tributyl phosphate itself is HTP, the hydrogenated tetrapropylene. The plutonium and the uranium --

CHAIRMAN POWERS: Why do you use tetrapropylene?

MR. BADER: The - it's basically inert, doesn't decay within the acid --

CHAIRMAN POWERS: I know there is a relative term.

MR. BADER: Sorry, yes, I'm about to qualify that. It's not susceptible to the acid degradation that some of the other dilutants have been used in the past. It's also fairly robust with respect to the radiation field that's in the process.

MEMBER RYAN: What is the organic solvent for the TPP?

CHAIRMAN POWERS: It says tetrapropylene?

MEMBER RYAN: Oh, okay.

CHAIRMAN POWERS: I'm trying to understand why tetrapropylene. The only reason I could think of is that you have less polymerization reaction.

DR. DUVAL: One fairly significant benefit is that it really inhibits third base formation, because it is not a linear molecule like dodecane and a lot of other dilutants that are used. So that is - a lot of the other properties, chemical and radiological stability, are comparable to some of the others. But the third base formation is enhanced.

CHAIRMAN POWERS: B using the branch chain you cut down on the amount of cross-linking you get and polymerization. The expense of that is that you do increase radiolytic hydrogen generation. Do you have a database on radiolysis of tetrapropylene?

MR. BADER: I'm sorry. Do we have a database? I mean yes, this is the same dilutant they used at La Hague.

CHAIRMAN POWERS: I mean I look around at my readily available source, I don't work with tetrapropylene and look around for radiation data on it and I don't find very much.

MR. BADER: I tend to agree. It hasn't been studied as much as a lot of the other dilutants, but of the studies that have been reported and it's fairly general reports is that the radiolytic stability is a little bit lower than what you get in comparable longer chain alkanes. But that seems to be by and large more of a generic --

CHAIRMAN POWERS: I just don't find the G-values at all. I don't find any G-values on hydrogen.

MR. NORATO: Mr. Chairman, if I may, Mike Norato with NRO again. The staff did look at this during the review, and you are right, there is not a lot of hard data. However experiential - operating experience from La Hague indicated that this diluent actually did perform quite well under the red fields that were much higher than would be expected at this facility.

CHAIRMAN POWERS: Those are comforting words. I'd really like to see a calculation, a number. I mean I can compare, I know something about dodecane and even crude terracing, but I don't know anything about the tetrapropylene, and so somebody telling me, well, it's better, it can't be better, it's got to produce more hydrogen, because they're lost the cross-linking capabilities there. So what is this warm feeling? It doesn't come from a number. I don't have any quantitative data. I don't find any quantitative data. All I found it just exactly what's been said, well, you know it's pretty good. We got a lot of experience with it. I have a lot of experience with kerosene, too; I don't like it.

MR. BADER: The plutonium, once it's been extracted into a solvent, is now moved on to a scrubbing column, add some aluminum nitrate, and then we move on to the stripping column, which essentially is removing the plutonium from the uranium, so we are changing the valence state of the plutonium, moving it into solution - move it into the aqueous phase, and the uranium remains in the organic phase.

The plutonium then goes from there to a dual unit wash column, or a uranium scrubbing column depending on the feedstock. If it was a particularly heavy uranium quantity in the feedstock then we go through an additional uranium scrubbing column. And then we go to a diluent washing column where we are trying to make sure all the organic material has been removed from the aqueous stream.

CHAIRMAN POWERS: And I understand we are going to discuss the HAN problem in detail.

MR. BADER: Absolutely.

CHAIRMAN POWERS: So we won't go into that problem right now.

MR. BADER: That's a good point. The material removing the plutonium from the organic phase is hand, and we have hydrazine there as well.

The hand hydrazine plutonium then move down to the oxidation column, and the oxidation column, we destroy the hydroxylamine and the hydrazine, and oxidize the plutonium to Pu-4 nitrate. The - we then - next slide - some of the equipment in the process. And this is the mainstream, many substreams here. Basically it's columns, tanks, mixers, settlers, slab settler we insert in the process after we do the diluent wash just to remove any other separate phase organic material.

Then the oxidation and stripping columns and air stripping columns.

MEMBER ARMIJO: Just to - what are the temperatures of these various solutions while this is all going on?

MR. BADER: Depending on where we are in the process, but the maximum temperature we reach is just below 50 degrees Celsius, and we are talking about the purification process. It's - we actually heat the organic before we send it into the stripping column to basically entice the plutonium to move into the aqueous phase.

MEMBER ARMIJO: And is that pretty much the same all the way back to the dissolution, the first initial dissolution?

MR. BADER: No, those temperatures are lower.

MEMBER ARMIJO: Lower?

MR. BADER: Yes, lower. Generally the majority of the process operates around 40 Celsius.

MEMBER ARMIJO: Forty to 50 is kind of the range.

MR. BADER: Forth to 50 is the normal plutonium stream process until you get to the furnace.

CHAIRMAN POWERS: Your stainless steel is 304 or 316?

MR. BADER: Hey, Brian. Sorry, this is Brian Stone. It is 304 or 316 stainless steel?

DR. DUVAL: 316 for most of the vessels in KPA at least.

CHAIRMAN POWERS: And somewhere you do a transition from your titanium tanks, and titanium piping up to a certain point, and then you do a transition to stainless steel?

MR. BADER: Yes, we go from - the transition point is after we add the hydrogen peroxide in the dissolution unit, basically we reduce the plutonium and the silver, Silver 2 plus, our main concern with respect to corrosion. So once we reduce the silver, we move to stainless steel piping in vessels.

MEMBER ARMIJO: And all of this kind of thing is in a continuous chemical stream? Or does a batch come out that's, okay, it's been purified, and then it goes to another process?

MR. BADER: The dissolution unit is batch-wise. It sits in the electrolyzer for several hours, in solution. And then we batch it through the hydrogen peroxide and the depleted uranium addition, and then we come to the purification process, the cycle which is a continuous cycle, so we have a large holding tank up front of the process to make sure there is a continuous feed going through the process.

MEMBER ARMIJO: Okay, so your dissolution creates dissolved feedstock for your purification, and that's into some sort of a tank bed.

MR. BADER: In the closed sessions we will have more detailed drawings.

MEMBER ARMIJO: Okay, I'd like - it's a little bit hard to picture. The back end of your process I'm very familiar with. Maybe I'll just hold off. It's easier for me to kind of understand your process if I can actually see how it works.

CHAIRMAN POWERS: Let me understand something about, you made a point starting from the beginning of this meeting to current technology comes from fuel reprocessing in France. You have a different feed material here, and in particular this feed material, some of it, has gallium in it. And that gallium is still present at this titanium-stainless steel transition, and do you have problems of gallium accumulating between boundaries in the stainless steel?

MR. BADER: I can't answer that to be honest with you. Even if it does, I'm not sure --

CHAIRMAN POWERS: Wouldn't that kind of be a thing to worry about a little bit?

MR. BADER: No, because ultimately what we are trying to do is separate the gallium from plutonium, and an accumulation of gallium --

CHAIRMAN POWERS: In the grain boundaries of stainless steel usually causes cracking.

MR. BADER: And we have a loss confinement discussion as well in the closed session.

CHAIRMAN POWERS: Say that again.

MR. BADER: We have a loss confinement discussion in the closed session. And we will - I can talk about the strategies there.

MEMBER ARMIJO: Well, I think the general question of material integrity, corrosion, stress corrosion, cracking, liquid, metal embrittlement, any kind of phenomena that causes you to lose confinement.

CHAIRMAN POWERS: You want to be able to accommodate an accident. Has anybody done any material study to say if this gallium at these very low concentrations you are going to anticipate going to accumulate in the grain boundary?

DR. DUVAL: Gallium was certainly evaluated in all the corrosion studies, so that is factored in.

CHAIRMAN POWERS: Good. I wonder how they did it.

DR. DUVAL: Well, there are sort of two trains. One is how much of it that would have remained soluble and how much can actually stick on to the metal surfaces. They did some modeling to sort out --

CHAIRMAN POWERS: So we are trusting a model instead of an experiment here?

DR. DUVAL: I believe they would have probably would have done corrosion experiments as well that we had to perform.

CHAIRMAN POWERS: It would be interesting to see what kind of corrosion experiments they actually did.

MEMBER ARMIJO: Was your gallium in a nitrate form, or is it some other form?

MR. BADER: In nitrate.

CHAIRMAN POWERS: It depends on how oxidizing it is. Depends on how complete it is, and how much transition you get, and we are going into a transition from one metal to the next. Who knows what's going to happen? I mean I wouldn't trust a model on this, would you?

MEMBER ARMIJO: No, experiments are best.

MR. BADER: But it is an experiment. We said model, but it's an experimental model that was performed; not a computational model but an actual live test.

CHAIRMAN POWERS: Like to see what that was.

MR. BADER: Okay. The plutonium once it moves out of the air stripping column is then sent to the KCA process unit which is the oxalate precipitation filtration and oxidation unit. Before we allow the plutonium to enter the processing portion of this unit we do samples there to make sure that the reducing agents have been removed. We don't allow those to move down the process. Once we have ensured that we then treat the plutonium with oxalic acid to form - to reduce plutonium oxalate. The oxalate is then sent down to a filter and basically skinned and placed into the furnace where we calcine the oxalate and we end up forming plutonium oxide.

And that is the main stream of the plutonium, and the slide here actually indicates some of the support units, the KCD unit I think will be another interesting unit we can talk in just a moment about. This unit basically consists of precipitators, a filter, a furnace and then some tanks. And again this is all criticality state design.

MEMBER ARMIJO: So this process you never considered, the co-precipitation with uranium to kind of get it - denature it from pure plutonium as soon as possible. It makes for nice pellets.

MR. BADER: This is a process that we have had since 1999, and the co-precipitation process is something that was coming out of research work at that time, and part of this Co-X process that AREVA was suggesting in different realms here is definitely on the table for here.

MEMBER ARMIJO: You just went plain vanilla?

MR. BADER: Yes. I think the next slides --

MEMBER ARMIJO: Could I come back to the hydrazoic acid. You've got silver in this system, silver --

MR. BADER: And we will be evaluating that in the closed session this afternoon, an event that covers --

CHAIRMAN POWERS: What I want to ask about is, do we have as this process operates and an accumulation of azides precipitates.

MR. BADER: And you are suggesting that that azide mixes with the silver or some other --

CHAIRMAN POWERS: Well, the chain of thought was something like this. Okay, they are going to put silver in there. Silver often has a little lead in it, so I get a lead azide precipitating out. I accumulate the azide; do I have a problem. I think maybe I got a little cadmium in this system, especially the ultimate feedstock. If I get a cadmium azide accumulating in this system, does that cause me a problem? How do I know that I am not going to get an azide problem?

MR. BADER: And the key here is keeping those metals separate from the azides. And we have a discussion this afternoon on that safety event.

The following the furnace we have the homogenization sampling unit. These are basically glovebox units where we pull samples to make sure we have proper material coming out of the furnace and in preparation for the MOX processor. This is pretty foreign units, so we can move on. Some of the support units, if you look at these block diagrams, the KPB process comes off the KPA process over here. That is - this process here basically is removing the degradation products from the organic material after we have already separated the plutonium, and we have also removed the uranium from this. The uranium gets separated in a mixture settler in the purification process. And the organic moves to this process unit, and here we end up treating the organic with soda, sodium carbonate, and acid, through mixer settler.

The recovered sample - solvent is then subsequently stored for periodic - for about 24 hours in a cold environment, and then it is sampled prior to recycling it back to the front end of the purification cycle. So we use the organic material in the overall scheme of things, and I believe that are block diagrams to show you that.

I simply point out that the block diagrams, these dashed lines, are the organic material that are floating around in the process.

CHAIRMAN POWERS: And one of the issues that comes to mind in this is the accumulation that is suspended, otherwise unidentified particulate in this material; how well do you filter it?

MR. BADER: Up front in the process coming out of the electrolyzer, we have several stages of filters. There is a pre-filter and a titanium filter downstream from that prefilter to remove any undissolved solids.

CHAIRMAN POWERS: Well, I mean presumably it moves it down for a particular size.

MR. BADER: Yes.

CHAIRMAN POWERS: So what is that particle size limit, and how much colloid do we accumulate in that material?

MR. BADER: I don't think I can say that number.

MR. GYN: If we can, we can answer that question in closed session this afternoon.

CHAIRMAN POWERS: Because that is going to show up right at the interfaces on your extraction system. Usually it's the source of no end of difficulties.

MEMBER ARMIJO: How clean is the material that goes into solid recovery as far as plutonium that got through the process or any other thing that you worry about?

MR. BADER: The simple answer is very clean. I can quantify it in a closed session. But what I can tell you, what we have in the process to make sure it's clean is, once you come out of the pulse column, where we've separated the plutonium from the uranium, we have an analyzer there that can measure down to a very low level on plutonium, and again I can tell you in a closed session what the low level is. The subsequent process, there is a mixture settler that we end up basically scrubbing one more time to remove anything else that might have been entrained in organic; send it back to the stripping column.

So the organic then comes out of that, and then we did the uranium removal in the next mixer settler. And then there is another set of radiation detectors, again making sure I don't have any - or I have a small quantity of fissile material where I can go to this unit here.

MEMBER ARMIJO: So if just to calibrate myself, whatever comes through this process after solvents are recovered, there must be some waste stream. Would that be considered rad waste?

MR. BADER: Yes.

MEMBER ARMIJO: What class, A, B, C, D?

MEMBER RYAN: Something new.

MEMBER ARMIJO: Fair enough.

MR. BADER: I guess the question is, which waste are we talking about. Because the uranium that we separate from the plutonium is actually part of our strict uranium waste. The degradation products that we get out of this are part of another waste stream which we ended up treating and then sending to the high alpha waste process, another waste stream. And the excess solvent, because we don't keep the solvent permanently in the process, we do remove solvent and put fresh solvent in periodically or regularly. And that waste stream is going into another unit I'll discuss here just briefly, and it basically goes to the Savannah River site, and that's basically where our excess solvent is going out.

MEMBER RYAN: What is that, is that a TRU waste?

MR. BADER: I would say that's true.

MEMBER RYAN: And are we going to get into some of the details of how you classify these materials as wastes?

MR. BADER: No, I don't think it's up to us to classify the waste, because it's all getting sent to Savannah River site into the waste solidification building for treatment.

MEMBER RYAN: Are those in the same box?

MR. BADER: No, no, we have several streams.

MEMBER RYAN: There's got to be a handoff.

MR. BADER: I think they understand where they are going with the final product.

MEMBER RYAN: That's fine, there is a handoff from you to them, so you have to meet specifications. So I'm asking you about it, can you give us some insights as to the specifications now or in the closed session. Closed session is fine.

MR. BADER: I'll defer to the closed session.

MEMBER RYAN: I think that speaks to your question, is there a pathway for all these wastes on the other side of the fence.

MR. BADER: There is a waste acceptance criteria, I can tell you that much.

From the KCA unit we have the oxalic mother liquors, basically nitric acid and there might be some plutonium left in that stream. It would be considered a waste stream, but we recycle this stream, on my flow diagram. Basically this is the KCD unit here. These end up going back into the process, and into the acid recovery. So what we end up doing is, we send the material into an evaporator. It concentrates, ideally ,with all the plutonium. Our recycle to the front end of the purification process. The distillates are sent to the acid recovery unit which I believe is the next slide.

So the acid recovery - we use a lot of acid in this facility, and we don't want to waste material here. So we recycle quite a bit of it. There are waste streams coming out of this that are going to KWD units. The majority of the nitric acid is however recycled back into the process, and the way we do this is we send it through basically three stages of evaporators, and the first one is running at a slight vacuum, and then the next two are basically just purifying the nitric acid, so we can get concentrated acid that we can dilute and send back into the process.

MEMBER RYAN: And then the spoils at the bottom, or whatever you want to call it?

MR. BADER: The concentrates? Yes, the concentrates go to what we call an high alpha waste unit which I believe is probably the next slide.

That's a little more description of this on the next one. One more. There we go. We go to the waste unit, the high alpha waste unit. Waste units, we have three primary waste units, for this aqueous polishing process, the high alpha waste, includes the americium and gallium, the stripped uranium waste, which is basically just the uranium that was originally in the process, and the depleted uranium that we added to the process. And then a low level waste process.

There --

MEMBER RYAN: What would be in the low level waste?

MR. BADER: Basically some of the - do we have a slide on that? Is that it?

MEMBER RYAN: It doesn't take much plutonium to take down a low level waste.

MR. BADER: Sorry, there is another presentation that I have that material, so it's in the closed session.

MEMBER RYAN: If you want to do it a little later that's fine.

MR. BADER: But it's basically the distillates that have been coming through all three stages of the evaporators would be an example.

MEMBER RYAN: So the wastes are going to end up where?

MR. BADER: The low level waste would be sent to the waste solidification building.

MEMBER RYAN: That's where it's solidified. Where is it home?

MR. BADER: From there? From DOE complex?

CHAIRMAN POWERS: Right now a bunch of holes in the ground.

MR. BADER: I think it -- is supposed to go to WHIP, the low level waste, wherever, it depends on the class obviously, Class A probably Utah, and Class --

MEMBER RYAN: Like he said plutonium gets out of Class A real fast.

MR. BADER: There is no plutonium in the stream. Or no - I can't use no, I can't use de minimus. Small quantity, teeny bit. We'll go back in a couple of slides.

We also have a lab unit. You asked about plutonium. We do a lot of testing at this facility, and so we have a dedicated lab unit to take the waste from the labs, and prepare them for putting it back in the process, we are trying to be as near zero as possible release facility with respect to plutonium feedstock.

MEMBER RYAN: And I appreciate that point, that's a good one, you want to reuse as many of these materials as you can. But when you do that you end up with wastes that tend to be more concentrated in the things you don't want. So and that's a tradeoff sometimes. How do you deal with that? And so I need to get a clearer picture of the criteria on the waste side which determines how much of it is recycled and the cleanup and all that you do, because it is a balancing act.

MR. BADER: Okay.

MEMBER RYAN: Fair enough? Is that a fair question?

MR. BADER: That's a fair question, and I think we can answer that in the course of the presentation.

MEMBER RYAN: I appreciate the schematics and so forth, but that doesn't get to it.

MR. BADER: The schematics, they are not the good pictures that we have in closed session. I'm sorry for whoever can't sit in here in the closed session. Go ahead to the next slide.

MEMBER ARMIJO: You skipped the nitric acid recovery unit or else I wasn't listening.

MR. BADER: I skipped that second slide.

MEMBER ARMIJO: A question there, is that concentrated nitric acid that you are evaporating? You say it's natural evaporation, three stages of evaporation. What temperature does that process go at?

MR. BADER: Each one operates at a different temperature, and that is going to be discussed in the closed session. I know red oil is going to be one to touch on these temperatures.

MEMBER ARMIJO: Okay, that's into the red oil issue, is that what you are saying? I was addressing, I'm thinking about problem that might be there in case of a corrosion problem, where your stainless steel and concentrated nitric acid.

MR. BADER: Let's see, did I write about what these columns are made of.

MEMBER ARMIJO: They're stainless steel.

MR. BADER: Not all of them. Brian, you got to step up to the microphone and say your name. Brian Stone is an expert on this.

MR. STONE: Brian Stone. The first one, first evaporator, is zirconium.

MEMBER ARMIJO: Zirconium alloy?

MR. STONE: Yes.

MEMBER ARMIJO: Okay, and whatever you can say about it. I would just like to know what is the hottest nitric acid that you contain in this thing, somewhere along the line.

MR. STONE: As soon as we are in closed session I can tell you the temperatures.

MR. BADER: Does that answer your question on that KBC?

MEMBER ARMIJO: There's a mark on the reply. Let me know when you can talk about it.

MR. BADER: Okay, one of the more interesting units here is, all the vessels here are vented to this KWG unit. There are two portions of this KWG unit, there's one for the pulse columns, and then there is one for the rest of the process. And the system is designed to remove any entrained plutonium offgasses. We have demisters in the process units themselves before you get to this unit, and then we have a NOx scrubbing column, and air scrubbing column, and then following that there are several other pieces of equipment to treat the air in preparation for going through final filters.

And the exhausters, there are exhausters downstream of those as well, downstream of HEPA filters.

The goal of this process is to maintain a slight vacuum in all the vessels. And to treat all the air so it's suitable for release to the environment.

I think we already addressed the KWD. I believe the last unit is the KWS unit which basically consists of two tanks where basically the excess solvent is removed from the KBB process unit primarily. There are a couple of other legs from KWD which is the waste unit and the LGF unit which is the lab unit; we get some organics from the lab as well. So if they meet certain criteria they can be disposed of in this waste stream.

The waste from this is packaged into a carboy and shipped to Savannah River site.

I believe that is it.

MR. SALZMAN: Okay, my name is Scott Salzman. I'm the Shaw AREVA MOX Services nuclear safety. I'm the MOX process safety lead in the ISA group. I'm going to go over an overview of the MOX process. I guess this is the easy side of the process I hope.

Dry side, okay, so I just had this general MOX process diagram here. Basically we are going to receive plutonium oxide. Once we get done polishing on Sven's side, depleted uranium oxide, we receive that, we go ahead and mix that to proper plutonium percentages, press it into pellets, load the pellets into rods, load those up, put them together as an assembly and ship it off.

Again our reference facility is the Melox facility in France. So we make - kind of keep that up - so we are split up into what we call workshops. We have a receiving area where we have all the receiving units, powder units where we mix, and get powder pellets, we have a pellet area, a rod and an assembly area, so we'll be talking about those.

We'll start off in the receiving area. We receive uranium dioxide in five-gallon drums. That is stored in a secured warehouse.

MEMBER ARMIJO: Could you go back to that block diagram?

MR. SALZMAN: Okay.

MEMBER ARMIJO: Now you put your scrap back into the primary, what you call the primary dosing box.

MR. SALZMAN: Yes.

MEMBER ARMIJO: But that is pretty conventional with the O2 facility. But there is such thing as dirty scrap, things that shouldn't go back into a fuel rod. So you must have some sort of a scrap process that goes all the way back to the chemical plant?

MR. SALZMAN: Well, once - the scrap process comes from various process units, some of it goes back - and what we may do is run it through the green powder back through the centrium furnace before we recycle that scrap powder back in. But once we have this powder, and it's in our process unit, we go ahead and that scrap is processed out of grinding in those three units, and we're back to scrap processing, and that stuff is sampled, and there is a sampling program that takes a look at that powder before we put it in a jar and recycle it.

MEMBER ARMIJO: I think you are going to have - sometimes your U02 scrap in a conventional fuel factory which is too dirty to fix by centering or baking and it has to just - it's called dirty scrap, you either have to clean it up chemically or get rid of it. And do you have a process stream that takes it all the way back to your chemical plant, or do you just - because you don't want to put it back in to the fuel element.

MR. CHASSARD: Can I help you?

MR. SALZMAN: Sure.

MR. CHASSARD: Eric Chassard. So there is a big difference between the Mox facility and a uranium facility is that everything is dry. You don't have any water for grinding and so on because of criticality. So we don't have what you call the dirty scrap. What we can have is some you know is something mixed so everything is clean in one special glovebox we got, so either it's green border and we are going to make you know some pellets and it will be integrating into the primary blend, or mainly what we have is coming from the grinding, and we also make pellets with this. And that's why it's cleaned up in the scrap part. So we don't really have any dirty you know like you have in uranium dry process.

MEMBER ARMIJO: Well, dirty is in the eye of a beholder. It's just that it's not suitable to go into a fuel element.

CHAIRMAN POWERS: I mean for instance, what are the balls in your ball mill?

MR. CHASSARD: Uranium. So it's part of the process.

(Simultaneous speaking.)

MR. CHASSARD: And most of it is removed by the centering process.

MEMBER ARMIJO: Where there is lubricants in pellet presses. There are sometimes additives to get you better pressing. There is centering furnaces. Sometimes things don't go right, and you wind up with dirty material, and at some point - ultimately you could just choose to discard it?

MR. SALZMAN: The lubricants and additives, those are removed. That's why when we scrap green powders or green pellets we run those back through a centering process to remove the lubricants and those additives.

MEMBER ARMIJO: So nothing goes back from the dry process back into the upstream? Okay.

MR. SALZMAN: Okay.

CHAIRMAN POWERS: Are we going to discuss dust control for all of this stuff? This whole process, are we going to discuss dust control?

MR. SALZMAN: Dust control. Well, if you want we can discuss dust control on certain dusty boxes, where we are pouring powder, where we are grinding, we do have systems that collect the dust, and we collect the dust through centered metal filters, that are back pulsed with nitrogen, and we collect those with pots.

MEMBER ARMIJO: Do you use dry grinding or wet grinding?

MR. SALZMAN: It's dry grinding.

MEMBER ARMIJO: It's dry grinding. So you will have dust?

MR. SALZMAN: We will have dust. We do have vacuum units and blowers that collect dust at critical points, and that dust is collected again on centered metal filters. It's back pulsed with nitrogen, drops into a hopper; that is collected in dust jars, and that goes back in it's added to scrap and sent to recycling.

CHAIRMAN POWERS: All of your mechanical collection systems are going to have a minimum efficiency.

MR. SALZMAN: Yes.

CHAIRMAN POWERS: So how much penetration do you get through this system?

MR. SALZMAN: I mean the centered metal filters are on the order - HEPA filters, they are efficient. All this stuff stays inside the glovebox.

CHAIRMAN POWERS: There will be some amount that will penetrate even a HEPA.

MR. SALZMAN: Well, I mean nothing leaves the glovebox. These systems are inside the glovebox.

MR. CHASSARD: The question is why it is -- and that's why we've got some units and we are going into detail with the process and we also collect, we recover all the dust coming from the filters. So we've got a special unit to get the dust from the filter to be able to reintroduce it in the process. So we will go into details.

MEMBER ARMIJO: Do you have different concentrations of plutonium in your pellets, you know, equivalent to different enrichments in conventional fuel elements.

MR. SALZMAN: Depending on what type of campaign we are running and what type of pellets we are making for what specific fuels.

MEMBER ARMIJO: So you will have a 20 percent mix of 10 percent --

MR. SALZMAN: Oh, yes, we started out - in the beginning the first blend down is 20 percent, and then the second --

MEMBER ARMIJO: Depending on the fuel design you would adjust that concentration? Okay, and so when you are grinding and your scrap all goes back, I'm just trying to see how you keep everything --

MR. SALZMAN: We have a scrap process unit where that scrap comes back, gets blended and added to a jar; it's all sampled, and then they add that according to, in the back end and front end, and that is all done with the batch orders, and that stuff is all --

MEMBER ARMIJO: I think I know what you are doing.

MR. SALZMAN: For any one campaign those are designated. Those jars are designated. The PuO2, the U02, and specific scrap jars are designated for a batch, depending on what campaign we are running and what percentage of plutonium you want to produce for any given pellet.

MR. CHASSARD: Just to give you the big picture it depends on the design, it depends on what the customer, and the key thing is that you never different content at the same time. So once you produce.

(Simultaneous speaking.)

MR. CHASSARD: So you clean the old line before producing the next one. So you clean the whole thing you got an inventory, and after, Gary Bell will talk about MMIS, which is a system that we are using to try to quantities we've got. But the key thing is that we clean all the equipment before moving to the next one.

MEMBER ARMIJO: And that includes grinding dust, everything?

MR. CHASSARD: Everything. MR. SALZMAN: Okay, so get to the receiving block diagram.

So we have a secure warehouse where we bring 55-gallon drums of depleted uranium in, they are stored there. They are brought into the facility as needed on forklift palette. They are brought in and put into a buffer storage room. Plutonium oxide is brought in to a secure area where we unload 9975 shipping packages will be unloaded, that is just a short trip from one side of the site to the next. So we unload those into a DCP unit, they come in shipping packages, they are unpackaged in a line. The 30-13 cans are removed and placed in PCM 3013 storage. They are placed in some temporary holding facility - or spots. There is some NDA, done some calorimetry and some other analysis to accept those cans, and they are put in a storage spot, and as we call for those

those are decanned in our KDA unit, sent to a tilter and start their way through the aqueous polishing process which Sven already went over.

On the other end of the aqueous polishing process we collect those in reuseable cans. They are stored in DCEs, Pu2 buffer storage. Those cans are then called according to our batches --

MEMBER ARMIJO: What is a DCE?

MR. SALZMAN: That is plutonium buffer storage. That is our polished plutonium oxide powder. It's a reusable can that are canned up in KCC units and sent to buffer storage, and we call those a batch of master mix of 20 percent, that is our first blend down. The U02 drums are moved to a club box; they are emptied; and PO2 and U02 end up in our first blend down, 20 percent, which is in the powder area.

MEMBER ARMIJO: I am just trying to understand, is DCE a facility?

MR. SALZMAN: Some of those are based on French.

MEMBER ARMIJO: Process unit. Okay, I thought it was a can.

MR. SALZMAN: You get used to it.

MEMBER RYAN: Not today.

MR. SALZMAN: So in the powder area what we have is receive UO2 Plutonium Oxide powder, and we end up producing a batch of powder at a specific PO2 concentration, again, based on what ever pellets are going to be made.

Those are our powder process units. I'll be going over those in detail. Here is our powder block diagram. From the receiving area, we go on in, as I said, the UO2 and PuO2 go through a primary dosing unit. It's all gravity fed. The PO2 is put on tilter. It's tilted in. Those are blended into what we call a J60 jar. They are put in the J60 jars, some scrap UO2 and plutonium, to about 20 percent is our initial blend down. Those - the J60 jar, and the jar storage right in the middle, all these process units sit on each side of that jar storage. It's a big hall where it's all remote conveyor operator, these big powder jars move in and out.

So we blend down primary to 20 percent. It goes into jar storage. Jar storage into ball milling. These jars are hooked up to the ball milling mouth, they are turned up, and we go through a ball milling process to get the proper grain sizes. They are then moved back out of ball milling into final dosing, where we blend down to our final PuO2 concentrations.

MEMBER ARMIJO: So does dosing mean adjusting your composition? Is that what you mean by dosing?

MR. SALZMAN: Yes, it's basically blending the PuO2 down to our final concentration, 4, 5, 6 percent whatever is required in that campaign.

We have a couple of scrap processing units sitting over here to the other side, and we have discussed those earlier where we can go in there, and we have a scrap milling unit and a scrap processing, scrap processing, they bring the scrap in for various powder jars, scrap pellets, those are crushed and they can be sent back to centering if it's green; if it's not that stuff is processed, put into a jar, and then that is all sampled, and they get those sample results and that stuff gets ready to go back into process in the primary secondary dose, or final dose.

From jar storage we have 80 kilogram jars that the final mixture is in. Those go to our palletizing units, palletizing units we - there are some additives added to the powder. It's zinc stearate in a pore former, one is for the pellet press dye, there is some lubrication there; the other is to get proper pellet densities. We mix the stearate in an homogenizer. That powder is then dropped down through and fed to the pellet presses where we punch out our pellets. And those are loaded into molybdenum boats, and get ready to go into the pellet side. Those are our pellet process units. Our pellet block diagram, we have a powder area, and we basically have a bunch of storage units as we process these pellets, see those in the middle. This stuff is all transported around back and forth by a spinning tube carriage system called the PML, so it picks up these various containers full of pellets and moves them from unit to unit.

So what we do as we press out the green pellets, those are then stored in green pellet storage in molybdenum boats. Those get processed through the centering furnace. We have two centering furnaces. Molybdenum boats are put on molybdenum shoes and slid through the centering furnace, the standard centering process. We have a preheat section where we - the zinc stearate and the core former are removed. It's all done in a reducing atmosphere, and we go through the centering section to get the proper ceramic characteristics, densities, and it goes in a cool down section, and we end up exiting the centering furnace, they go into a centering pellet storage area, down to grinding down to a specific size, and then on into ground and sort of pellet storage there, visual checks, and mechanical checks that are done on those pellets, quality control. They sample some of those to make sure - they sample some every little boat that comes through to make sure that we are hitting our percentage and the proper ceramic characteristics, and once they are ground and sorted then we are off to the - okay, but I have a little typo there - we are off to the rod area, once we have our --

MEMBER ARMIJO: What is your centering furnace atmosphere?

MR. SALZMAN: It's argon hydrogen.

CHAIRMAN POWERS: Pluming gas composition? Four percent hydrogen?

MR. SALZMAN: Four and a half, five percent, yes. Then we are on to the rod area. This is where we assemble our rods. From the pellet area we come into rod cladding and decontamination of the pellets brought in the big pellet tray. And I think we saw a picture in a video earlier. They line up the pellet trays they are indexing in the pusher, and the pusher pushes those pellets into a rod blank and as soon as we stack the pellets in there the end fittings and the spring is put on, we weld the end plug, then it goes into a sealed chamber where we evacuate it, back fill it with helium, and then hit with the C weld. Those are decontaminated and checked, and at that point then we bring them out of the glovebox through inflatable seals and load them on rod trays.

CHAIRMAN POWERS: What are you pressurizing the rods to?

MR. SALZMAN: I think it is 300, 300 psig. We load those on big rod trays, 32 to a rod tray, and they start going in and out of rod storage. Have a bit stacker in there, it slides these things on shelves in the rod storage, we go through several inspections and tests, we go through a helium leak test. We put them in a chamber, evacuate it, check for helium, make sure they are sealed up. There is an X-ray inspection, where we take a look at the pellet stack and the spring and the end caps, and we do rod scanning where we go through and check plutonium concentrations along the length of the rod. And then there is some visual sorting inspections done at the end. And then we are on to assembly. Oh, go back a second.

We do have the ability to unwrap decladding if we fail this helium leak test for example or one of our inspections, we can insert the tube into one of our gloveboxes and cut the end off, they can remove the pellets. Those pellets are scrapped, and the rod cladding ends up on the waste.

MEMBER ARMIJO: But it has got to be some sort of deconned or something, to get rid of any plutonium that might be inside the --

MR. SALZMAN: Inside the rod, yes. Yes. Well, we have waste limits that we would be meeting there. So once we have these rods ready to go, they are all identified. The rod trays are identified. So they call for specific rods to manufacture assembly, so we go first we bring the rods in and this is all done in a mechanical system. The rod trays are brought in, and we have a mock up unit where we basically mock up the assembly, and this thing is indexed, and a mechanical system pushes the rods into this mockup assembly as it indexes back and forth on the 17 by 17 grid, the mock up is then rotated, and it's backed up this assembly fabrication table. The grids are all locked down on a pulley table, and the assemblies or the rods are then manually pulled from the mock up, which is right up to our pulling table, and manually pushed into the grids. We have our guide thimbles, and as the facility install all the rods in the guide thimbles, and into the grids. The end fittings are put on, and installed. Some of those are cribbed and dimpled. Once we have our assembly finished, the locks are taken off, the pins are pulled, the keys are pulled, the grids are locked down, and we up end that fuel assembly and it's attached to a hoist and we start sending it over to dry cleaning. We have a pit where we put the fuel assembly into a pit and there is a big blower down there that blows up and down the sides of the road to clean the rod. Any amount of contaminants, foreign material. There could be some small zircalloy pieces, that is collected in a filter at the bottom of the cleaning pit on a rolling paper filter.

MEMBER ARMIJO: Do you do any kind of zirconium matching either in preparation of welding or anything like that that could lead to a zirconium fire?

MR. SALZMAN: No, we can generate during the assembly process we can generate some zirconium turnings as these things get pulled into the grids, and that is a hazard. It's been addressed. We handle that thing basically through housekeeping and regular cleaning of those pulling tables and dry cleaning tables, and I think we are going to talk about that tomorrow under virally event. We do have an event where we address that.

MEMBER ARMIJO: But as far as all the components, the tubes and everything, and end plugs, all that stuff is procured?

MR. SALZMAN: Yes.

MEMBER ARMIJO: How about weld preparation on the ends in order to make sure that your welds are quality? Are they already prepared for you?

MR. SALZMAN: They are all prepared. Those rod blanks come in, the end plugs come in, they are fitted up and sealed up, or welded around, and then seal welded. Okay, so where are we? So we go through a couple of inspections. There is a visual inspection where an operator visually inspects, and then there are some dimensional inspections where we check lengths and dimensions, how parallel it is, and that's all done with some mechanical sensors and lasers. So once you get done with inspection, they are moved with the hoisters into the storage area, they are stored, and as they are called for for shipping, we take those out. They are bolted up to a strong back, three to a strong back. Strong back sits on a rotating table, the hoist moves and then there is an assembly over there. They are bolted down to the strong back, and the strong back then is downended and slid into fresh fuel shipping package. That is then bolted up. Impact limiters are installed and an air palette that is taken out through our receiving shipping area. And it's loaded onto a transport truck and off we go to the reactor.

MEMBER ARMIJO: This isn't your garden variety of transport of fuel since it has plutonium. So is a special DOE-type truck, security, all that stuff?

MR. SALZMAN: Yes. Yes, the security is all going to be there, and this is a special shipping package designed for plutonium fuel, and the security is there. I'm not familiar with it.

MR. CAMPBELL: Larry Campbell. The security would well be outside the scope of this presentation.

MEMBER ARMIJO: I just want to know, it's not the way we ship conventional light water reactor fuel. It's some DOE-related, we hope --

MR. CAMPBELL: Larry Campbell again. It's my understanding that it could have been last week that spent fuel storage and transportation received a presentation regarding the transportation packages for the MOX fuel. I was not present at that, so I'm not sure what was said.

CHAIRMAN POWERS: Right now it's outside our scope.

MR. CAMPBELL: But like I said I think AREVA came in last week and made a presentation about their proposed design for the shipment package, and I think you were here - Mr. Gynn was here. I did not attend the presentation.

MEMBER ARMIJO: Who owns this fuel? Is this government-owned fuel?

CHAIRMAN POWERS: The United States.

MEMBER ARMIJO: The owners of UO2 fuel are the utilities until --

CHAIRMAN POWERS: Dr. Ryan.

MR. CAMPBELL: We do have an NNSA representative here. I don't know if he would -

MR. GLENN: I'm Sam Glenn. I'm the deputy project director for NNSA for this project. And I can tell you the baseline is to ship in secure transports. And DOE will maintain title to the fuel until it's signed over to the utility.

MEMBER ARMIJO: At the utility site? Okay.

MR. SALZMAN: We do have some utility units we want to go over real quick, filter dismantling. We can take HEPA filters, some of our dustier boxes, the globe box filters do accumulate some plutonium. We bag those out. They are taken to filter dismantling, mechanically remove as much powder as can be, then they spend the filter, they shake that all out, that is recycled into a dust pot and then goes back to scrap. Have a big glovebox where we can dismantle some larger pieces of equipment and get those ready for shipment.

We drum up our waste storage. We have s waste storage unit and waste counting unit where we make sure we meet our waste acceptance criteria. Those drums are stored waiting for shipment. We have a couple --

MEMBER RYAN: Shipment to where?

MR. SALZMAN: Well, those would be shipped to WHIP. So we have plutonium limits in those drums.

MEMBER RYAN: So far your waste outline is WHIP?

MR. SALZMAN: Yes, transuranics, anything that would end up being low level, any job control waste or that I think is - end up --

MR. HENNESSEY: Or the site, most low level waste would stay on the site. Handled by DOE.

MEMBER RYAN: We are going to talk about that more in the closed session. I've heard DOE, I've heard Utah. I'm just curious what the specifics are.

MR. SALZMAN: The transuranics we will do next.

MEMBER RYAN: Right, I got that. Now where does the rest of it go?

MR. HENNESSEY: Basically we hand it over to DOE, and then it's up to DOE to dispose of it, to keep it on site or send it to Utah.

MEMBER RYAN: So you hand it off to DOE with some specification?

MR. HENNESSEY: Oh, sure.

MEMBER RYAN: Okay.

MR. SALZMAN: We have an action item to go chase that.

MEMBER RYAN: Okay, great.

MR. SALZMAN: We have a pneumatic transfer system that we can, we move our cans around from unit to unit. We have sort of like a bank transfer, and a couple of our utility units.

MR. HENNESSEY: I'm Bill Hennessey, and I'll be talking about the ISA process for the MOX facility.

Basically we do this integrated safety analysis, because it's a great way under Part 70 to provide a systematic approach to identifying all relevant hazards that could result in unacceptable consequences.

The MOX facility, since it's a chemical facility, we use a lot of the AIChE methodologies and approaches and guidelines and so forth, as well as NRC staff's guidelines for doing the analysis based on, and that's a conservative survey to evaluate the hazards, and we identify all the appropriate protective measures. What we call IROFs, items relied on for safety, includes administrative procedures as well as safety systems and components and structures.

We also have done a very comprehensive analysis, ISA analysis, for the MOX facility. We have looked at hundreds of gloveboxes on the MP side, hundreds of vessels and tanks on the AP side. We evaluated thousands and thousands of deviations and event scenarios, doing very detailed HAZOPS. Start out with a very elementary process, preliminary hazards analysis, looking at a broad spectrum of potential hazards. And as the design evolved we went into very intense sessions, workshop sessions on doing HAZOPS workshops what-ifs. I'll explain that in more detail later, but we spent over $80 million doing the ISA, and I think it was very complete. It was equivalent to roughly 45 full time equivalents over 10 years of supporting this integrated safety analysis. So we are very confident that it is complete, as well as conservative.

ISA is required by 70.62 to meet the performance requirements of 70.612, last three goals there, that is basically the criteria, high consequence events remain highly unlikely. Intermediate are made unlikely, and criticality events are prevented.

The next slide will show the consequence criteria themselves. It's a combination of dose to the operators, facility workers, lower dose to the public; also includes a uranium uptake value in chemical exposures, sniffing for instance at facilities, pretty obvious.

Under intermediate consequences there is also an environmental limit, environmental criteria of

5,000 times the Part 20 Appendix B values, concentration values.

These don't really come into play too much, not limiting, but those are limiting events relating to the high consequence potentials of the dose limits to the operator or anybody else.

And the third criteria is, criticality events must be prevented with an improved margin of subcriticality which we use 5 percent administrative margin for our margin of subcriticality.

CHAIRMAN POWERS: You don't cite double contingency in this slide.

MR. HENNESSEY: Say again.

CHAIRMAN POWERS: You did not cite double contingency in this slide.

MR. HENNESSEY: Double contingency is certainly adhered to. I will mention it several times throughout the next 10 to 20 slides, but double contingency is a requirement.

MEMBER ARMIJO: You have soluble uranium intake, but why not plutonium?

MR. HENNESSEY: Plutonium we look at it on a dose level.

MEMBER ARMIJO: You handle that under the dose?

MR. HENNESSEY: Yes, right. It doesn't take you a lot of micrograms, plutonium, to be equivalent to the 100 rem values to the workers, so it's very significant.

The regulation defines those consequence criteria but doesn't define the likelihood criteria. It's Part 70 risk informed, performance based regulation, it allows for a qualitative approach for evaluating event likelihoods, and we define them as such. And this is based on standard review plan guidance. We chose these definitions. Highly unlikely is high consequence events that originally were classified as unlikely or not unlikely to which sufficient IROFs are applied, so their likelihood is at an acceptable level.

What this means is that maybe you have a high consequence event, say over 100 rem to a facility worker, it's not mitigated; we are going to mitigate that value or prevent the event until the dose level gets down below the criteria of 100 REM.

And typically what that means is there are two active components, IROFs, safety components, or one very robust passive component. The order of priority would be a very robust passive component, the second priority would be two active safety systems;

and a third would be administrative controls.

Not likely assimilated fine, and not unlikely are events that may occur during the lifetime of the facility. The - even though these are qualitative, we do roughly equate these to quantitative values for our mindset anyway of saying highly unlikely is roughly equivalent to 10 ^-5 events per year. Unlikely is 10^-2, and not unlikely is 1.

MEMBER RYAN: But again that is tagged to the lifetime of the facility.

MR. HENNESSEY: Right.

MEMBER RYAN: So that's not one per year.

MR. HENNESSEY: It's one per year.

MEMBER RYAN: It's one divided by 30, one event during the lifetime of the facility, that's divided by the time.

MR. HENNESSEY: I'm saying it's a rough equivalent. It's a range.

MEMBER RYAN: I don't understand it.

MR. HENNESSEY: It is a range, it is required to meet 10^-2 or 1, it's not a requirement. For talking purposes --

MEMBER RYAN: But you've got mixed units in how you are expressing it, so I'm confused.

MR. HENNESSEY: Well, these are official definitions for our frequency terms that we meet. But we like to think in terms of some quantitative numbers. Engineers like to think in terms of numbers. So they are roughly equivalent to 10^-5, 10^-2, and in that range, of plus or minus factors of 10, not likely is --

MEMBER RYAN: But when you said those earlier, I thought you said 10^-2 per year or for the lifetime of the facility?

MR. HENNESSEY: Per year.

MEMBER RYAN: Okay, and then there are some ways you think about it's for the lifetime of the facility. So I don't know how you equate those. I've got to figure out how to get one coinage here.

MEMBER ARMIJO: Well, this gets into the issue that we've had before on the terminology, risk informed, performance based. And there are members of the committee you will find that won't warm up to that terminology for an ISA.

CHAIRMAN POWERS: Unfortunately it's part of the rules, so they don't have much choice. They may not like it, but that is the rule.

MR. HENNESSEY: The regulations are --

MEMBER RYAN: Yes, I'm not arguing with the regulations. I'm simply trying to understand the currency that you are describing it with. And it seems like you've got two or three.

MR. HENNESSEY: The official currency is those definitions.

MEMBER RYAN: And you translated that into the 100 rem for a worker, 25 rem for a member of the public?

MR. HENNESSEY: Right, well, they are the consequence criteria. High consequences are over 100 rem to a worker, must be made highly unlikely.

MEMBER RYAN: I've been a worker, and I'll tell you something over 50 or 10 might be high consequence to me. I'm just trying to figure out how you got 100.

MR. HENNESSEY: That is part of regulations. That is part of 10 CFR 70. That is not my definition. 10 CFR 70 spells it our very clearly, and it's 100 rem per worker is the criteria you need to meet. That's not to say if we go over - typically worker doses, we don't need to go through the analytical part of that, because it doesn't take much plutonium to get you to 100 rems. So we don't do the transport analysis in the glovebox to the worker. We just assume anything getting out of the glovebox has got to be made highly unlikely.

CHAIRMAN POWERS: Was this slide intended to be - this is just a restatement or summary of 70.61. This is not the criteria. Nothing original?

MR. HENNESSEY: We must define according to the regs the term, credible, and we defined credible events in terms of its inverse, not credible, and not credible is very infrequent or natural phenomena that are less than say one in a million, or extremely low initiating event frequency, like for earthquakes. Process deviation that consists of a sequence of many unlikely human actions or errors for which there is no reason or motive and no such sequence has ever happened. I can describe this in terms of the spillage of many boats of pellets in the glovebox, and this guy talked about you need to get to a criticality event that would have to happen over many shifts, many operators, at the glovebox and not being observed. So we think that is not credible.

And the process upsets, for which there is no convincing arguments based on physical laws, in other words you can't defy gravity and things like that. Next slide.

Now we achieved highly unlikely by

application of these criteria to our IROFS, safety systems. It's the application of single failure or double contingency is appropriate in the application of 10 CFR 50, appendix B, and then NQA-1, as the implementation criteria in the application of this because of standards ASME, IEEE set forth, and management measurements, specifically most important for us is the surveillance of IROFS to detect failure if they should happen.

The first one of these we consider the most important, and that is application of single failure and double contingency, precludes single failure vulnerability. It's a classic application of single failure criteria in the industry.

QA program, that ensures the reliability of IROFS, not only throughout design but also through fabrication, installation and operation of the facility. Application of industry codes and standards helps ensure the safety functions are achieved of the IROFS. For example we apply IEEE 384 for separating power cables, electrical cables, to preclude shorts and faults.

Management measures, this is important to us because frequent failure, frequent surveillance, periodic surveillance of the IROFS say on a monthly basis can reduce your likelihood by the order of a factor of 10. So that is typically what we aim for is surveillance on a monthly or in or about basis.

Major steps of the ISA process, standard chemical industry approach, determine the hazards, the preliminary hazards analysis, the internal hazards, the natural phenomena hazards, and external man-made events based on NRC staff reg guides. In terms of radiological hazards and the chemical hazards, we developed potential event scenarios for each hazard so you have a basis for coming up with the likelihoods and consequences in defining safety systems. Next slide.

The next set of major steps, then you do a consequence analysis. Personally do a sort of qualitative consequence analysis of the likelihood as we get to the formal consequence analysis. Determine IROFS as needed included the safety function. It could be something as the design of the fissile thickness of our tabular tanks and then slab tanks that are crit safe, need to be crit safe, and we just need to specify the fissile thickness of those tanks.

Demonstrate the IROFS perform their intended safety function when necessary. That's spelled out and we submit that in the license application and the ISS summary, then we prepare the ISA or maintain it really for the life of the facility.

The ISA was done in two phases, it's a continuous process. But the first phase was done in support of construction authorization requests. As mentioned earlier you already reviewed that years ago, as well as the safety assessment and design basis. We didn't have really detailed design; just had design basis documents for that.

The second phase is what's done to support the license application and ISA summary. Next slide.

The safety assessment phase, again, we identify hazards and events. We identify safety strategy in what's called at the time principal systems structures or components, PSSCs. These are analogous to what we now call IROFS, items relied on for safety. That was the term that was used for the CAR. You will hear more about that, I guess. The last bullet year it says, proper implementation of the principal PSSCs was verified during the construction and inspection process. This is ongoing as we speak. And the staff, sort of a third step in our licensing process, the staff needs to ensure that the PSSCs have been properly fabricated and installed and so forth before they will give us an operating license.

A flow chart that describes the process. In the interests of time we will skip that, but in the top part we collect site information, we collect site data for seismic conditions, wind and so forth, flooding. Do an NPH and external hazards analysis. Again, it's based on reg guides, do a screening analysis, safety events credible or not, feeds into preliminary hazards analysis which is based also on the plenary design. That feeds into a preliminary accident analysis, which defines the event sequences. We do a nonmitigated consequence analysis to see if it is above the criteria or not. If it is then we develop a safety strategy and find the principal SSCs. Next slide.

I just want to go through an example to try to clarify the process a little bit. This is an example of a breach in the glovebox, the powder glovebox, primary dosing is my favorite example, is dosing just means that initial mixing step. The event here is a loss of confinement or dispersal of nuclear material, dispersal of plutonium. We do a PHA, identify the hazards, based on a checklist from the NRC's guidance document, NUREG 1513, and AICHE, some hazards evaluation guidelines as well to identify hazards, in this case the radioactive material, the Pu, and the glovebox is the location of it. You assess the likelihood. If it not unlikely then we do have failures of gloves once in awhile, there is the potential, they do tear and they do develop pinhole leaks.

The consequences from such an event we assess at the facility would be high. It only takes about a microgram to reach the 100 rem dose criteria. IOC is - there are three receptors as we call them, the IOC is the individual outside of control boundary of the facility. We assess that as the public, you know, even though it's only a couple of hundred yards away. And the environment as I mentioned before is also a criteria that we need to meet when we develop mitigative features.

Cartoon here about where the receptors are and the facility workers inside the facility. I guess Part 70 is somewhat different than other reactors for example. The facility worker has to be protected from the accident conditions. But it has limits. Even though 100 rem dose is high, it's still - it drives an awful lot of our safety system.

MEMBER RYAN: You mentioned this 100 rem dose. The annual dose to a worker is well below that as you well know.

MR. HENNESSEY: This is an accident condition.

MEMBER RYAN: Just accident.

MR. HENNESSEY: We have normal worker ALARA limits, certainly, 500 millirem. This is an accident condition.

MEMBER RYAN: I'm struggling to understand how we take a lot of confidence in a 100 rem prevention, when we have to actually operate at 5 or less. I mean it's 5 rem per year is the annual limit for a worker, and that is a whole lot less plutonium that can occur from things that are not events.

MR. HENNESSEY: Well, a factor of 10 less than that.

MEMBER RYAN: Sure, absolutely, so I'm just trying to understand how a normal operational health physics program isn't completely subsumed by this kind of level - I understand what you are doing. I don't disagree. But are you going to get to the part where you talk about normal operations?

MR. HENNESSEY: We do have a couple of slides on that late tomorrow.

MEMBER RYAN: The reason I'm picking on this a bit is, it's very difficult to do bioassay or any kind of measure on a worker that actually receives small amounts of annual intake. So how do you know when you've got a problem? Is it air sampling? Is it bioassay? Is it both? How do I know I'm even getting close to the 100 REM? So I need to understand a little bit about how the program works to understand the piece, the structure and the evaluation criteria at this level satisfying.

MR. HENNESSEY: We certainly have normal health physics programs that measure --

MEMBER RYAN: But again I want to make a point: the plutonium in the absence of anything else that you can use as a marker, very hard to detect at levels that are well under an overexposure by an annual limit.

MR. HENNESSEY: We do have an extensive continuous air monitoring system, the CAM ray at the workers' workstations, at the hand level, waist high.

MEMBER RYAN: I'm getting down to how many DAC hours can you detect?

MR. HENNESSEY: You're going into the normal operational type of aspects of this as opposed to accident analysis. We are strictly talking about accident analysis.

MEMBER RYAN: Okay.

MR. HENNESSEY: The program to protect the worker is to make sure he doesn't get any dose.

MEMBER RYAN: Well, if we are going to get to that. You mentioned the worker several times, and I'm just curious about the worker monitoring on a routine basis, not just this accident condition. Maybe we will get to it later.

MR. GYN: We have a presentation tomorrow afternoon where we talk about the normal radiation protection as part of the confinement presentation.

MR. HENNESSEY: The other two receptors, the IOC as I mentioned, an individual outside the control boundary, that is the property area MFFF, and that is - the MFFF boundary is about 400 meters by 400 meters, so it's well away from the public. I would say we apply the public limits to the IFC. That is really -- in reality it's going to be the SRS worker who is trained and badged in the emergency control program. But the actual public is really five miles away.

And the environment area is that small area in between, restricted area in boundary, about 200 meters.

Back to our example of a breach in the glovebox, we do a preliminary accident analysis as part of the safety assessment in design basis, and I guess we do some grouping or minting of common type of events, and then we do a consequence analysis, a more formal consequence analysis, that is values. And then we do a mitigating strategy. For the glovebox we pull out a confinement zone, glovebox, maintain a negative pressure in the glovebox at all times, maintain inward flow even through a breach. The design basis is to maintain inward flow if you had two glove failures. Next slide.

And there is also as I mentioned there's CAMs, we'll take credit for CAMS, they are not in IROFS, but there are many CAMs around the glovebox itself in work stations as well as around the room that pick up any plutonium.

The ISA phase, its purpose is to identify IROFS at a much lower level, the component level at the CAR stage where it's done more at the system level. We just like you demonstrate that the IROFS are adequate to ensure the performance criteria are met and also the reliability and availability criteria. Next slide.

Major elements, let me just point them out, is the PrHA, you call process hazard analysis. These are haz ops or what ifs. The haz ops are done on the flue system, the MP fluid systems. The what-ifs are done on the MP, the mechanical systems. And this is really the heart of the ISAs is doing these, these are intense workshops of a dozen specialists in the room for two or three weeks to walk through these event scenarios.

This feeds into what are called NSCs. They are safety evaluation, criticality safety evaluations. These are narrow to just sort of demonstrate the IROFS to perform their safety function, and just sort of feeds into our ISA summary and license application. Next slide.

We also develop safety limits. Oops.

MEMBER RYAN: Does your ISA process have any feedback in the design and facility particulars that changed how you might do it? Or was the design fixed when you did the ISA?

MR. HENNESSEY: Oh, no, the design - especially when we started out, the design was very - you just had the sketchy information from --

MEMBER RYAN: Really, that process really helps you in some of the details of design.

MR. HENNESSEY: Oh, yes, there's a major feedback into the design process. At the high point of our doing our haz ops and what-ifs, we had maybe 4,000 action items to go back to the engineering staff to do more detailed analysis to show that the IROF could perform its safety function. For example a jar dropped from a lift in the glovebox, to make sure it doesn't fall through the glovebox. We added probably 1,000 IROFS at that point during that stage, just were upgraded many systems to be IROFfed, to be safe.

I just want to make the point, I guess near the bottom there we have identified safety limits as well as the - in this step as part of the NSC and NCSE and this feeds in to development of setpoints for our IROF components as well as the operation limits manual for tech specs for our facility.

The ISA process, again, the process hazard analysis. Really it's the meat of our safety analysis ISA process. The NSC, then NCSEs. NSCs, we have - say we do those for nine criticality events, the fire, loss of confinement, explosion and so forth. And NCSEs are just a little different focus. And we also do the double contingency criteria, verification, in the NCSEs. Next slide.

Haz ops and what-ifs, detailed evaluations, reach process unit, probably you know KPA and KCA, all those, electrolyzer, those units as well as Scott's workshop units, dosing units, pellets in assembly, break it up that way. We looked at all modes of operation. Started out with normal operation, shut down and so forth, maintenance. And then we look at software malfunctions, communications, human errors, human factors is clearly a major part of the process, human factors engineer is on our team, ISA team. Next slide.

This is the team makeup. You have a couple of process experts, depending on whether it's an AP unit or a MOX fuel fab. So I have the engineering disciplines as well as fire protection as an important part, human factors engineer, and probably five or six safety guys, chemistry, an AP unit, criticality safety, nuclear safety, rad protection. And we have operations personnel from Melox and La Hague as part of the haz ops team, follow those documents as I mentioned before at the bottom there, as guidelines for the approach. Haz op methodology is pretty standard. You divide the units into discrete modes, tanks, post columns and so forth, identify the design of the intended node, and then you do the systematic applied guidewords - systematically apply the guide words of high , low, temperature pressure and so forth, pretty standard stuff.

And the purpose of establishing a deviation can lead to an unmitigated consequence and concern of criticality or explosion. Criticality explosions we prevent by design, events, types that we mitigate.

Identify critical causes, critical causes, and that will help us define IROF safety systems that we can apply to make the event highly unlikely. So identify action items as I mentioned, we have 4,000 in the2005-6 timeframe that these two guys developed here, made the engineering guys submit proof that we could make these things safe. Next slide.

What-if methodology is similar but you don't have the guide words like you did for haz ops. But you postulate scenarios in the form of questions. What if a jar of Pu falls off the jar lid for example. During the workshop, and this is an intense workshop where all the team members are participating and developing a set of questions, so it is very thorough, systematic, comprehensive approach.

Next slide is, back to our example, the breach of a glovebox, IROFS for the facility worker. Back to our example of the breach of the glovebox for the ability to process hazard analysis. The glovebox would be a what-if checklist method, you commonly group events, just sort of bin events to simplify the process, it's common in these areas. Again, identify causes and unmitigated consequences. And if needed identify the IROFS.

IROFS for the glovebox were to mitigate the loss of confinement event or prevent aspects of it. The glovebox itself you would make structurally robust to make sure it met the industry codes and standards for such a mechanical design.

Make the VHD system - VHD stands for very high depressurization systems, exhaust systems for the glovebox, to ensure that we always maintain a vacuum within the glovebox. We have glovebox dump valves in case the pressure in the glovebox increases rapidly, you want dump valves to get a lot of flow out of the glovebox so maintain the flow through the breach area.

The glovebox, low differential pressure, in case the pressure does down, gets negative, then you want to alarm the operator to don his mask, and evacuate.

Next slide is nuclear safety evaluations, the next phase of the ISA.

CHAIRMAN POWERS: Let me ask you, like masks, are they credited?

MR. HENNESSEY: Say again.

CHAIRMAN POWERS: Masks, credited?

MR. HENNESSEY: No, not really. In fact the alarms are credited, and the ability of the operator to run as fast as he can out the door. You have also CANs like I said which I think are important. You have a ventilation system, it's a flow down system at the glovebox, and it's a shower curtain type of effect that washes the potential plutonium away from the operator and out towards the exhaust.

NSCs integrate the results of the PHA, process hazard analysis and all that other safety analysis, these sort of upper tier documents for supporting our ISA summary license application. NSCs reach type of event explosion. So for, identify a safety strategy and do a fairly detailed description of the safety system and the safety function.

NSCs IROF safety function describes, it's also part of the NSC, and an important part of this is the single failure criteria demonstration as well as failure detection, goes in standards, QA requirements, other management measures applicable. And do a fair job of describing defense in depth features as well.

Next one is criticality. There are six NSCs of criticality. We developed on NFC basically for each unit. There were 48 of those. They did a similar job of integrating results and identifying safety strategy and describing the IROFS. Next slide.

That's the same as the NSCs. We can skip that. Additional nuclear criticality safety evaluations. Do the double contingency principle, describe that in a fair amount of detail. Also it gets into the K effective calculations that criticality people do to show that your K effectiveness is less than one. We also go through calculations to show the calculated K effective is lower than the upper safety limit. The upper safety limit like I said includes the 5 percent administrative margin that is given, but it also includes the roughly about 2 percent for code -- computer code and experimental data, 2 percent. So it led to about roughly a .93 K effective limit.

Next slide. Operating phase is a continuous process. ISA is a continuous process for the life of the facility. So as we go into operations we will have a formal change control process, under 50.59 for reactors. And 70.72 for our facility. But continue to demonstrate IROFS are adequate to ensure performance criteria, and also ensure the IROFS liability factors.

Just a little flow diagram describing that simple process. But we can skip that. As I mentioned human factors are an important element of our team, now that we have a human factors person who is on the term. The team is to evaluate operation actions and inactions, including errors of commission and omission.

CHAIRMAN POWERS: How do you evaluate human reliability?

MR. HENNESSEY: Human reliability?

CHAIRMAN POWERS: Yes.

MR. HENNESSEY: Rick Imker, could you please answer that for us? Rick Imker is our human factors engineer.

MR. IMKER: Imker. We are not doing a PRHA reliability analysis, because we are based on a deterministic analysis for the project. So we are essentially looking at human error from the perspective of carrying out operations and making mistakes. And omissions, commissions, that kind of thing.

CHAIRMAN POWERS: Does it have a probability associated with it?

MR. IMKER: No.

MR. HENNESSEY: Those NUREGs at the bottom there, 1718 is the MOX standard review plan where we look to the reactor guidance documents for human factors evaluation. So that is a thorough review process by the staff that we include as part of our safety basis. Next slide.

So in conclusion we think we have a very rough, systematic comprehensive approach to analyzing the hazards. We think we identified all the potential accident sequences of concern, identified all the safety systems, and IROFS to protect the public and the workers. We demonstrated we meet the regulatory requirements.

That's all.

CHAIRMAN POWERS: I am still unclear exactly how you do your assessment of errors of omission and commission. Because you are a qualitative probabilistic criteria you are trying to live to, I don't see how that interfaces here, because I've got a worker who makes a mistake. He doesn't always make a mistake. We just assume that he does one time, and you say, okay, now how do I get - how do I get to my probabilistic criterion that I'm trying to live to.

MR. HENNESSEY: Well, it's not a probabilistic criteria that we are living to.

CHAIRMAN POWERS: Yes, you do, the highly unlikely, the unlikely, not unlikely, those are definitely probabilistic criteria.

MR. HENNESSEY: Well, we apply our single failure criteria, we apply code and standards, the QA program. We have a human factors specialist on the team that looks at the size of commissions, omissions. We do have administrative IROFS. Scott, do you want to say something?

MR. SALZMAN: I was just going to say that during our process hazards analysis, we go ahead and operator errors are many of our initiators. So as we go through and step through the process and take a look at potential failures, that the operator is one of those failures.

MEMBER RYAN: I guess the operator errors are probably the biggest list of failures.

CHAIRMAN POWERS: At these facilities it's always operator error.

MR. SALZMAN: Now we have important items, and I think Bob Foster will discuss that. We go through and there are a lot of operations where we invoke some independent verifications. Actually we have two operators on many of our important functions, going out there and independently verifying that some action has been taken.

CHAIRMAN POWERS: You might also have an operator function and a safety function or an observer of some kind whether it's health physics or something. It's usually that sort of team to avoid one single point of failure.

MR. HENNESSEY: Oh, yes, we never rely on one operator for a safety function, an administrative IROF. It's got to be two and sometimes three. It needs a verifier and sometimes a supervisor check.

MEMBER RYAN: Or a compliance measurement of some kind that gives the operator he needs to say, I'm good to go to the next step?

MR. HENNESSEY: Right, we call that enhanced admin control. There's an alarm that goes off.

MEMBER RYAN: We just don't have time to talk about it in great detail, but I would guess that you are in a very formal procedural control situation which does include lots of safety steps, safety checks, and stopping.

MR. HENNESSEY: Absolutely.

MEMBER RYAN: And then you are back to, well, do they do it, do they do what they are trying to do? So it's the human reliability that gets you back to --

MR. SALZMAN: It gets into training and procedures.

MR. HENNESSEY: But it is never just one operator making that safety function.

MEMBER RYAN: And that to me is really the thing, you've got somebody whose function it is to make sure that the task gets done right.

CHAIRMAN POWERS: It works wonderfully right up to the point that it doesn't.

MEMBER RYAN: Right, exactly.

CHAIRMAN POWERS: The first time they go through this process I'm quite certain that it will be done in excruciating detail. The 100th time, maybe not.

MEMBER RYAN: I got you. I'm with you, I understand that risk well.

MR. IMKER: I wanted to interject another point. During the design phase, when we were looking at the design, we're looking closely to make sure the design doesn't lead the operator to an error. For example maybe a controller display is missing that needs to be in the design. So we will call that out and have that put back into the design. So we are looking at the design as well to make sure that the design is not leading the operator into an error situation.

MR. HENNESSEY: That was Rick Imker, I-m-k-e-r.

So that runs us up to almost our break time here, 10:45, so if there are any more questions on the ISA process?

MEMBER ARMIJO: You put your ISA together, and I'm just imaging that you put it together at each process step and at each interface between process steps. How do you integrate the whole thing?

MR. HENNESSEY: We march it out unit by unit, first of all we certainly do look at interfaces as we go, that is always a big step in the process.

Certainly there are feedback systems or downstream systems that are important. Anything to add on that?

MR. BADER: For the aqueous polishing we did haz ops. And so there is a certain number of deviations that you go through, and for the interfaces we did assume what happens in deviation one process, its impact on the downstream process. At those times we usually had to bring in the downstream experts into our haz ops so it could be documented. So it was definitely an iterative process. We couldn't just go have one process group go all the way through their process and be done. We had to understand that there are interfaces here that would impact the safety potential, so the haz ops were extensive for the deviations. And that's really how we picked up all the operator errors and so forth. You just assume the operator makes an error. If it's not IROF, it's credited as likely to her, he, whatever that number is, it's likelihood during the lifetime of that facility that that operator is going to err. So now next step is, what are we going to do to prevent any safety consequences as a result of that. That's the way we went through our haz ops.

CHAIRMAN POWERS: That I understand.

Okay, any other questions on this particular topic?

We have one more overview topic, but in the name of inherent retention, I think I will take a break until 10 after.

(Whereupon, at 10:50 a.m. the above-entitled matter went off the record and resumed at 11:07 a.m.)

CHAIRMAN POWERS: Let's go back into session. Mr. Coleman has an announcement to make.

MR. COLEMAN: I wanted to remind everyone if you have not signed up on our sign-up sheets they are back up there in the area where the handouts are.

So please do that whenever you get a chance sometime this morning. Thank you very much.

CHAIRMAN POWERS: And you have a double contingency to assure that this happen?

MR. COLEMAN: We will find a way.

CHAIRMAN POWERS: We have ways?

Dave, are you going to lead this presentation?

NRC STAFF - OVERVIEW OF REGULATORY PROCESS

MR. TIKTINSKY: Yes, I'm Dave Tiktinsky. I'm the project manager for NRC for the licensing review, and I'll start talking a little bit about the staff, what we have done in the review.

And the general sense - later on you will hear form individual staff members as we go through events that are presented by the applicant. So today I'll go over the purpose of our presentation, I'll talk a little bit about our licensing process and SER development, where we have been, it's a long history, of course ACRS has been involved in part of that in the construction authorization.

Bill Hennessey had mentioned something about PSSCs and verification. I will go over what that is and what we are doing with that over the next year and just how we developed all the topics for discussion here the next two days.

First of all the purpose of the presentation is for really for the ACRS review of the staff SER. We are looking for an endorsement of the staff's evaluation of that, of our SER for the MFFF.

After we hopefully get the blessing from the ACRS our plan is to take the draft SER that you have and prepare a final version of it. And the goal is to submit that and complete it by December. I'll also talk about some of the future licensing steps and the PSSC verification process.

CHAIRMAN POWERS: Do you intend to complete this SER in December, and submit it to the Commission or not?

MR. TIKTINSKY: Well, I'll get into it. We are not actually issuing a license yet. So that will be some years. So we are trying to have it completed, then we have to finish the rest of the regulatory required licensing pieces before we could actually issue a license.

CHAIRMAN POWERS: What I'm interested in is, when do you send something to the Commission?

MR. TIKTINSKY: We don't have an exact time yet of when we are going to do it. Again it will depend somewhat on our PSSC verification, how we complete that one that's done.

Just a little background, the staff's SER and the construction authorization was issued in 2005. That was reviewed by the ACRS at that time. The comments from the committee were integrated. Some of the comments were carried over to the future step, which are things that are being addressed here over the next couple of days.

The actual LA for license and possess and use was submitted in 2006, and has gone through a process of review, sectional reviews over a 3-1/2 year period. The staff developed this safety evaluation report on the LA, completed that in June. An additional side, there is litigation ongoing. This is kind of a unique, where there was no mandatory hearing that was required, but there were two separate opportunities for petitioners to come in and file contentions. One was in the construction authorization which was closed, the second portion there was one contention that was accepted by the ASLB for the current licensing proceeding. There were other contentions that have been submitted recently.

But as for that one contention which actually related to some of the waste issues that will be discussed here tomorrow, some of the same topics, in fact some of the words that were used from the ACRS letter were also used in that particular contention. The schedule for the hearing is after the completion of their - the staff's final SER that we would go to hearing to try to close that particular contention.

The PSSC verification which I will get into in a few slides estimated 2014 for us to complete that, based on when the applicant completes construction. Following that we would issue the license to possess - use radioactive material, but also there would still be conditions including the operational readiness review which is the second piece that is normally done for other fuel facilities. We would also be doing that for this facility. And after we granted that license and allowed the applicant to start up, and the hot start would begin for the applicant to begin processing material.

CHAIRMAN POWERS: Now my recollection from the previous discussions on this is that this facility will be operated with a non-plutonium feed at first to learn about the facility, and then it goes to plutonium feed?

MR. TIKTINSKY: Yes, there is a cold startup phase, and a hot start up phase. They can do some things in cold startup without having all of the licensed things, but some of they things they can't test without material, so they can't do it until they actually have our license. So after we complete the verifications of PSSCs and the operational readiness, then that will allow them to begin their cold startup because they have to have some material to run the cold startup. But the hot startup for them is actually when they are going to actually begin production of fuel assemblies.

As our staff review, we followed, we have a standard review plan, NUREG 1718, that was written specifically for reviewing MOX facility. That's what the staff used. Our reviews that we have done over the last 3-1/2 plus years were multifaceted and included in-office reviews of applicants, some of the things you've talked about, of looking at calculations, of NSEs, NCSEs, backup documents, a lot of those were done by the staff on a selected basis with the applicant looking at those documents trying to make sure they understood what the processes were to try to come to a conclusion related to the safety of the facility.

We had numerous discussions with the applicant, including a series of meetings. We have used requests for additional information, and the staff did need additional information to make sure things were in the license application.

Substantial communications, we used kind of a communicative approach, and make sure everybody understood what was going on, before we'd issue an REI we'd issue them in draft. We'd have meetings with the applicant to make sure they understood what our questions were. When the applicant had prepared their responses, before they sent them in officially they'd come in and discuss them. So we had a good back and forth to make sure that the staff and the applicant were talking about the same things, speaking the same language, and making sure we got answers to the questions that we had.

So that has been developed over - technical discipline was somewhat different depending on the complexity of how many issues there were. And it has wound up in the development of a staff SER in which no open items have been identified.

And next I'll talk about the PSSE, verification process. This is a unique requirement only for plutonium fuel processing facilities. So this is the first time the agency has had to do this, and probably unless there is another plutonium processing facility, it will be the only time the agency will have to go through this particular process. And what it requires is that the NRC verify construction of the PSSEs that they have been completed in accordance with the application. Now what that means is that we cannot issue a license until this step is done. So this is different.

Other fuel facilities and other things where the committee has reviewed, the staff has done its review, and we issue a license with a condition for operational readiness, but the applicant can go ahead and basically build it, and they just have to operate and go through that last step. For us we cannot issue that license until this particular step is done, and it's a very extensive effort.

The PSSEs were identified in the construction authorization request. There were 53 of them identified. They varied in complexity from relatively simple items and things that are administrative controls to very complex things like criticality controls. The verification process is a joint process. There are significant inspections that need to be done. There are also technical reviews and administrative reviews of administrative control. Because some of the things we have to verify, even though it's construction of a PSSE, you don't really construct an admin, but you do have a procedure, you have other things. And part of our process would be verifying what those procedures are, making sure they can meet safety functions that were outlined for the PSSEs. In order to develop this whole process we've had a joint group between NMSS and Region 2 who does the inspections to implement all these different verification activities, come up with a plan, and implement through the plan.

I'll talk a little bit about the plan itself of what we are doing is developing the scope and identify items for inspection. There are many many thousands of safety IROFS that the applicant has provided and has in this facility. The NRC needed to figure out exactly what we are going to look at, how we are going to look at it, risk significance. We also needed to develop programs to track --

CHAIRMAN POWERS: I'm drying to know how you do risk significance on this facility.

MR. TIKTINSKY: Well, what we've done with risk significance is, each reviewer individually has done basically vertical slice reviews of certain portions of their processes they believe were most important. So in our risk assessment of that significance we looked at, based on the knowledge and expertise of the staff of what they have looked at, they have taken the pieces of it that are most important. So we tried to select of that the IROFS that are of the higher significance to meet that safety function, and then we will get down to the level of individual components, certain areas of a facility are more vulnerable than others in terms of different events that could happen, so we will look at those ones and try and emphasize in terms of our inspection space the kind of things we would do looking at vendors, looking at installation. We may look at a little bit of everything else, but what we try and emphasize are the items that were of most significance to the reviewers.

MEMBER ARMIJO: So this is really a sampling. It's not 100 percent verification of every PSSC? Or is it?

MR. TIKTINSKY: Well, the regulations are, we have to verify all the PSSCs, but we take a sampling of basically the subset of what's in a PSSC. So each PSSC, some of them may be just in one particular IROF, some of them may have thousands of component IROFS within a particular PSSC. So really it depends on the nature of the PSSC what our sampling level is.

We have also developed something called level of inspection effort, in which we kind of rank them to see how much time and effort we are going to spend for each particular one on a risk significance basis. For some ones that are highly risk significant we are going to spend more inspection effort, we are going to use a higher sample, compared to some PSSCs which have lower risk significance. So we have broken it down, but all 53 will be verified, and I'll get into a little bit how we are going to document the verification of that.

CHAIRMAN POWERS: Just a general warning to all, the word, significance, is fine. Risk significance will only get you in trouble. So for all concerned, I know it's a temptation to say risk significance. In front of a less tolerant group, which you will eventually get to meet, drop the adjective. Safety significant is good.

MEMBER ARMIJO: Risk is always capitalized in the full committee.

MR. TIKTINSKY: The other part is developing the process for documenting the staff's finding. We had to do this process and document it to demonstrate regulatory compliance, and we have to complete it prior to issuance of the license.

As I said there were 53 PSSCs that are identified in the construction authorization. They vary quite a bit. Each PSSC has a different type of controls, engineered, active engineered, admin controls, passive engineered controls. Some are also use of an approved item, things like the transport cask is a PSSC. So it's a little bit unique.

So each PSSC could have multiple safety functions, some of them the chemical safety controls have a list of who's who, red oil is a particular one, and all these particular events are safety functions -

actually the safety function is preventing all those events from occurring.

So some PSSCs have a lot of safety functions; are complicated. Some of the PSSCs also are part of other PSSCs. Different parts of the confinement system that interrelate with each other are also all PSSCs, so you need - one supports the other. So when we look at verification we have to make sure that some certain ones we are going to be basically verifying them in a block, that you can't do one without some other three. So all those three or four would have to be done at the same time.

And the verification activities will vary based on the nature. Many of them will be inspections, looking at components. Some of them are looking at programmatic stuff. Some of them are just looking at procedures. And some of them are looking at other approvals like certificates of compliance for a transportation packet.

And really what verification is, it's assuring that the design basis safety function for each PSSC can be met. So we are not testing operational things, and we are not looking at is it operational and ready to go. We are looking at assuring that it can meet its design basis safety function.

Also what we are doing is for each PSSC we are developing what we call independent verification plans, so each PSSC will have its own staff plan of what we are going to do and how we are going to do it. And I won't say the next word there, but what we tried to do is look at prioritizing the IROFS at the ISA summary level which were event groups, and then after we've done that looking at components and trying to prioritize those for key areas that we want to emphasize, and then developing an informed level of inspection effort, which includes what kind of sampling we are going to do, how much sampling, and then inspection attributes, which are different things that are done in the inspection world of different things like looking at quality assurance, looking at vendors, looking at other receipt installation, there are various attributes that are done in inspection space.

So we tried to look at it so we choose the ones and spend the most time on the ones that are the most significant.

Developing a plan for each particular PSSC, then also a part of that is, we need to make sure we are tracking everything. There are 53 of these, they vary in complexity in multiple years, and at the end we have to be able to pull it all together. So we developed a system for tracking.

We are developing procedures for looking at tech reviews of an admin control, what exactly we have to do, because we want to be able to hand off procedures to tech reviewers that are experts in the area, and say you need to look at these procedures to see if they meet the safety functions. We will develop guidance to outline exactly what we ant them to do. At the end of each PSSC when it's done the applicant will submit what's called a PSSC completion letter. They need to know when it's complete so they can tell us, so we've been doing inspection all along, when they are done with that piece they will be sending that in as a letter. The staff will basically be writing a letter back called a verification letter for each PSSC, basically to document all the inspection and review activities we've done, and how we verified that it is actually complete. So you can imagine we will have - there are 53 PSSCs, there will be 53 completion letters, 53 verification letters. And then at the end when we are all done with all of these things, we will issue an SER supplement which basically summarizes all the verifications that were done, references that the 53 documents of verification and completion, and after we completed that SER supplement, then we would -- every time we would actually issue a license.

There is one thing that the committee might be interested in, the way that the ASLB worked for looking at the licensing hearing. The petitioner actually has an opportunity after we complete our final review, that final step there, to have additional contentions related to our verification activities.

CHAIRMAN POWERS: Lucky you.

MEMBER ARMIJO: But is it limited to the verification? Are those contentions limited?

MR. TIKTINSKY: That's how it's written. It was a ruling from the ASLB that was appealed to the Commission. The Commission basically gave them the opportunity to file contentions related to that closure.

MEMBER ARMIJO: Okay.

MR. TIKTINSKY: When things go into the ASLB, it could be --

MEMBER ARMIJO: It could go beyond that.

MR. TIKTINSKY: We have no control over that.

MEMBER ARMIJO: Right.

MR. TIKTINSKY: As part of the verification of where we are on this program is that we have prioritized the ISA summary IROFS. We have - we are in the process of developing verification plans for each PSSC. We actually, even though some of the plans aren't all developed, we are actually performing inspections. There are many inspections that have gone on by the region over the last four years as construction began. Many of them related to the structure. In the future obviously there will be a lot more things to look at as they kind of reach that stage where they are installing - they've installed many vessels now, but they are doing tanks, working on gloveboxes, many other things. We have developed the tracking system to make sure we can get all this information. We also expect that the inspection activities, as we head through 2011, 2012, 2013, to increase substantially. We will have multiple things going on at one time related to different PSSCs. And this whole verification process is multiple year. As I said we expect at least somewhere in 2014 before we will be able to finish all of our different reviews of that.

I'll talk a little bit here just the topic of technical discussion for the next couple of days. How we develop our topics is, we went back and looked at the ACRS letter that you developed on the construction authorization, refer to various items that you were interested in that would be completed in the ISA phase, which is the current phase. We also went back and looked at the transcripts of the past meetings to make sure - we tried to capture the flavor of what you'd be interested in.

We met with Dr. Powers to make sure we discussed it in terms of significance, we tried to choose the topics that would have the most interest of the things that the staff has looked at.

And kind of the layout, individual staff. We've had a great team of staff doing the reviews over the last 3-1/2 years, and the lead individuals from the different areas that looked at it, will be discussing things today. For selected explosion events, Mike Norato was our lead chemical reviewer. Chris Tripp for criticality, for seismic response, Asad Chowdhury, for fire events, Rick Wescott. The liquid waste that we'll get into tomorrow will be Mike

Norato. For ISA discussion Kevin Morrissey will lead that for the staff. For the instrumentation and control, David Rahn, and the confinement we get to the aspects you are concerned with, I will be talking about that.

And just kind of the discussion protocols, how we felt the most efficient way of setting it up when we get into the individual events is that the applicant will make their discussions about the event, and of course the committee is free to ask them all kinds of different questions of whatever they are interested to make the case of that particular event. Following each event the staff would make its presentation basically on what we did in the review, what we saw, how we made our findings on the review. So you get the opportunity for the staff to present what it did, and summarize basically what you saw in the SER.

Just kind of in conclusion that the staff is requesting the ACRS endorsement of the SER. We are implementing the PSSC verification program, that is happening over the next multiple years. And just that the license will not be granted until that PSSC verification is completed, which is different than other fuel facilities and other facilities that the committee has reviewed in the past.

MEMBER ARMIJO: David, I should already know this, but I'm going to ask it again. Who is the licensee? Is it Shaw AREVA? Or is it some governmental entity?

MR. TIKTINSKY: The applicant is Shaw AREVA Mox Services. They are - DOE/NSA is the owner, but they are under - MOX Services is under contract to them and NSA, so they have actually submitted the application, all of our correspondents in terms of RAIs and issuance of the construction authorization is Shaw AREVA Mox Services. Any future licensing is Shaw AREVA Mox Services. So we deal with them as our direct entity with DOE kind of in the background overseeing Mox Services, but we don't have any direct interaction with them.

MEMBER ARMIJO: Okay.

MR. TIKTINSKY: That is the end of the open session discussion.

CHAIRMAN POWERS: Okay. I am sitting here thinking about presentations for the full committee. And they certainly need to understand that the verification of the PSSCs is going to take place prior to the granting of the license. But the problem is, I'm quite sure they are going to be fascinated by that. And unfortunately what they should be interested in is the safety evaluation report. And consequently, and how that was done.

And so let me encourage you, when you talk to the full committee, go ahead and mention that this PSSC ha to be - verification has to be done before. But I would not go into it in the detail you have done here. I would focus much more on the SER, because that is what they are supposed to be interested in.

I mean inherently the difficulty that you all face is this is a complicated facility, the ACRS is used to working with reactors and not facilities, and as Kevin will attest to you, there are lots and lots of questions that arise in connection with facilities that require lots of explanation. If you have two hours to cover both describing the facility and the SER. And these are incompatible things as you have quickly ascertained. And in fact you really only have an hour, because the schedule actually allows for an hour of questioning.

The strategy we have to adopt is keeping that to an hour. Offering them fresh meat is not considered commensurate with that objective. So we have to understand that this is peculiar work we are doing, but I would really focus in your overview comments on the SER, and oh by the way the process is this, and then finally a license is granted.

MEMBER ARMIJO: Will this be an open session presentation to the full committee?

CHAIRMAN POWERS: I think we are fully open in the committee.

MR. COLEMAN: So far.

CHAIRMAN POWERS: And in fact when you look at the time schedule that is available to you, plunging into the details is just incompatible with this thing. And so I mean I can easily forecast us getting into questions that have to go into closed session, and we will handle that when they arise. But I just do not see how to heft 10 pounds of stuff into a 5-pound bag.

MR. MORRISSEY: Choosing your topics wisely.

CHAIRMAN POWERS: Wisely, and not saying anything about risk significance. I mean I guarantee you you are going to get a lecture on PRA versus ISA; that is just kind of required. They probably got a designated member to stand up and do that.

Okay, so.

MEMBER RYAN: I just have a little question. It struck me as you were talking about the licensing aspects that South Carolina has agreement state status of course, and has had liaison activities of one sort or another with SRS for many years. Are they going to have any interaction with the Mox facility at all?

MR. HENNESSEY: On environmental issues.

MEMBER RYAN: Yes, the environmental stuff. But none whatsoever --

MR. HENNESSEY: Environmental permits and stuff, ground, soil permits.

MEMBER RYAN: Yes, soil and water hookups, and sewer and all that.

MR. HENNESSEY: But that's it.

MEMBER RYAN: Nothing radiological?

MR. HENNESSEY: No.

MEMBER RYAN: Okay, just wanted to make sure.

CHAIRMAN POWERS: Okay, Mr. Designated Federal Official. The next part of this is to go into closed session. I have a twist, go into closed session now or wait until after lunch.

MR. COLEMAN: That is entirely up to you.

CHAIRMAN POWERS: We'll break for lunch and we'll come back and we'll start just a little bit early. Since we are in closed session I think I can get away with starting early.

Okay, so why don't we come back at 20 of 1:00, and we will be in closed session, and we can start this thing. And so all be aware that only permitted people are in here for the closed session, and that we are going to start 20 minutes early.

So we are recessed until 20 of.

(Whereupon at 11:36 a.m. the above-entitled matter went off the record.)

Acronyms

- AC – simple administrative control
- AEC – active engineered control
- AFS – alternate feedstock
- AOV – automatically operated valve
- AP – aqueous polishing
- AS – automatic sampling point
- CAR – Construction Authorization Request
- CFR – code of federal regulations
- CLMN – column
- C4 – glovebox confinement zone
- DMST - demister
- DNFSB – Defense Nuclear Facilities Safety Board
- DT – density transmitter
- EAC – enhanced administrative control
- EMMH – external man-made hazard
- EV – evaporator
- EZR – electrolyzer
- FLT – filter
- FUR – furnace
- GB – glovebox
- HAN – hydroxylamine nitrate
- HAW – high alpha waste
- HazOp – hazard and operability study
- HFE – human factors engineering
- HPT – hydrogenated polypropylene tetramer
- I&C – instruments and controls
- IOC – individual outside of controlled area
- IROFS – items relied on for safety
- ISA – Integrated Safety Analysis
- ISAS – ISA Summary
- KCA – oxalic precipitation filtration oxidation unit
- KCB – homogenization & sampling unit
- KCC – canning unit
- KCD – oxalic mother liquor recovery unit
- KDA – decanning unit
- KDB – dissolution unit
- KDD – dechlorination & dissolution unit
- KDM – milling unit
- KDR – recanning unit
- k_{eff} – criticality effective multiplication factor
- KPA – purification cycle
- KPB – solvent recovery unit
- KPC – nitric acid recovery unit
- KPG – automatic sampling unit
- KWD – waste units
- KWG – off gas treatment unit
- KWS – solvent waste unit
- LA – License Application
- LFL – lower flammability limit
- LGF - laboratory liquid waste receipt unit
- LLP – sampling pneumatic system
- LLW – low level waste
- LOC – loss of confinement
- MIXS – mixer settler
- MP – MOX fuel fabrication process
- MPQAP – MOX Project Quality Assurance Plan
- NCSE – nuclear criticality safety evaluation
- NDP –primary dosing unit
- NPH – natural phenomena hazard
- NQA-1 – nuclear quality assurance requirements
- NSE – nuclear safety evaluation
- P – pump
- PDCF – pit disassembly conversion facility
- PEC – passive engineered control
- PHA – preliminary hazards analysis
- PLC – programmable logic controller
- POE – process cell HVAC system
- PREC – precipitator
- PrHA – process hazards analysis
- PSCS – process safety control system
- PSSC – principal SSC
- PULS – pulsed column
- RDO – diluent reagent unit
- RMN – manganese nitrate reagent unit
- RNA – nitric acid reagent unit
- RSH – sodium hydroxide reagent unit
- RSS – sodium sulfite reagent unit
- RTP – TBP reagent unit
- SET – slab settler
- SMPT – sample point
- SSC – system, structure, and component
- SUW – stripped uranium waste
- TBP – tri-butyl phosphate
- TK – tank
- VHD – GB HVAC system
- WMAP – waste management area project
- WSB – waste solidification building

MOX
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Overview of the MOX Facility

Eric Chassard
Executive Vice President

MOX Safety Fuels the Future

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Agenda

- Introduction of MOX team
- Video of MOX Facility
- Aqueous Polishing – Sven Bader
- MOX Processing – Scott Salzman
- ISA Process/Event Development – Bill Hennessy

Aqueous Polishing

Sven Bader
Integrated Safety Analysis

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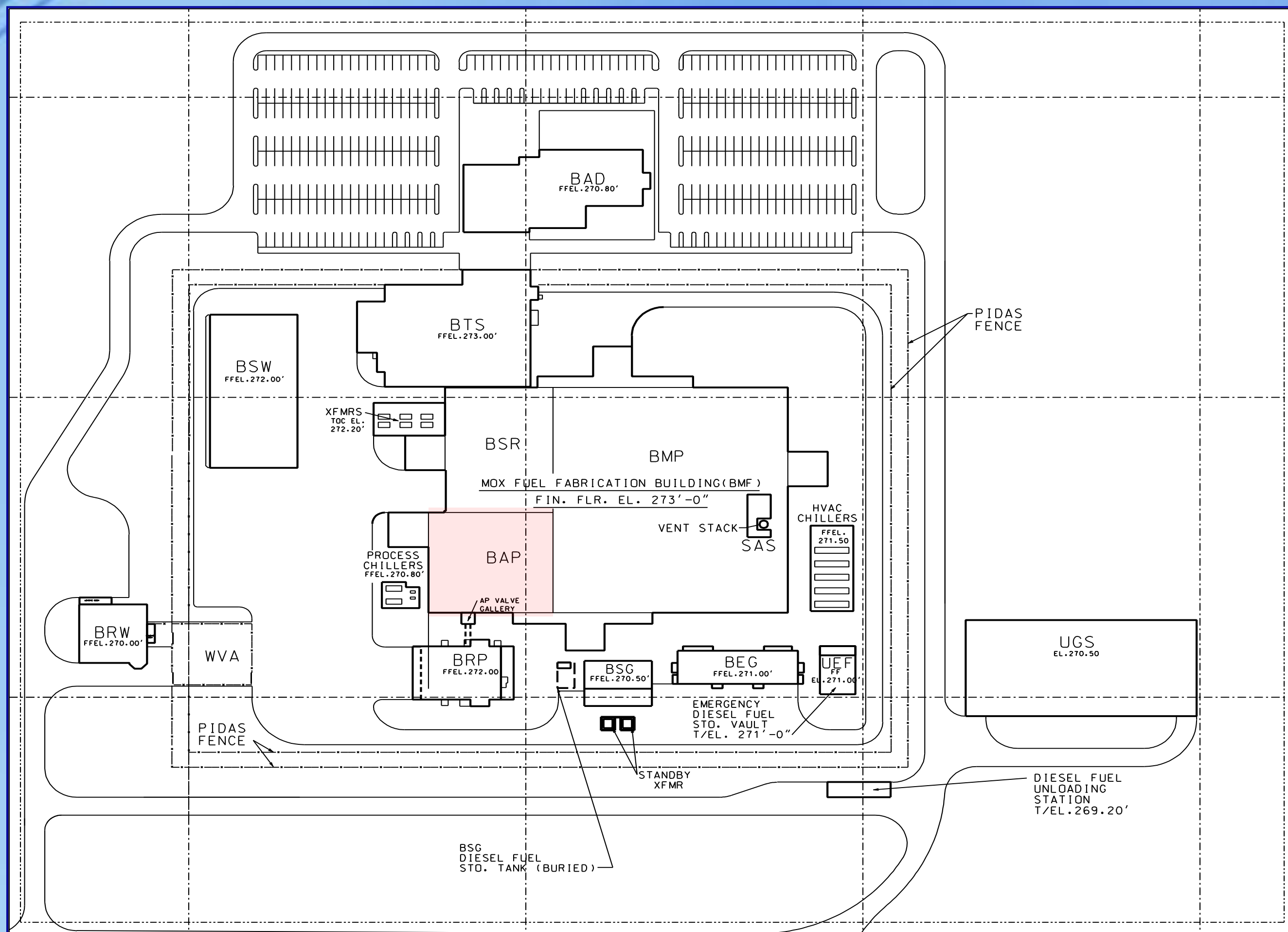
The MOX Site



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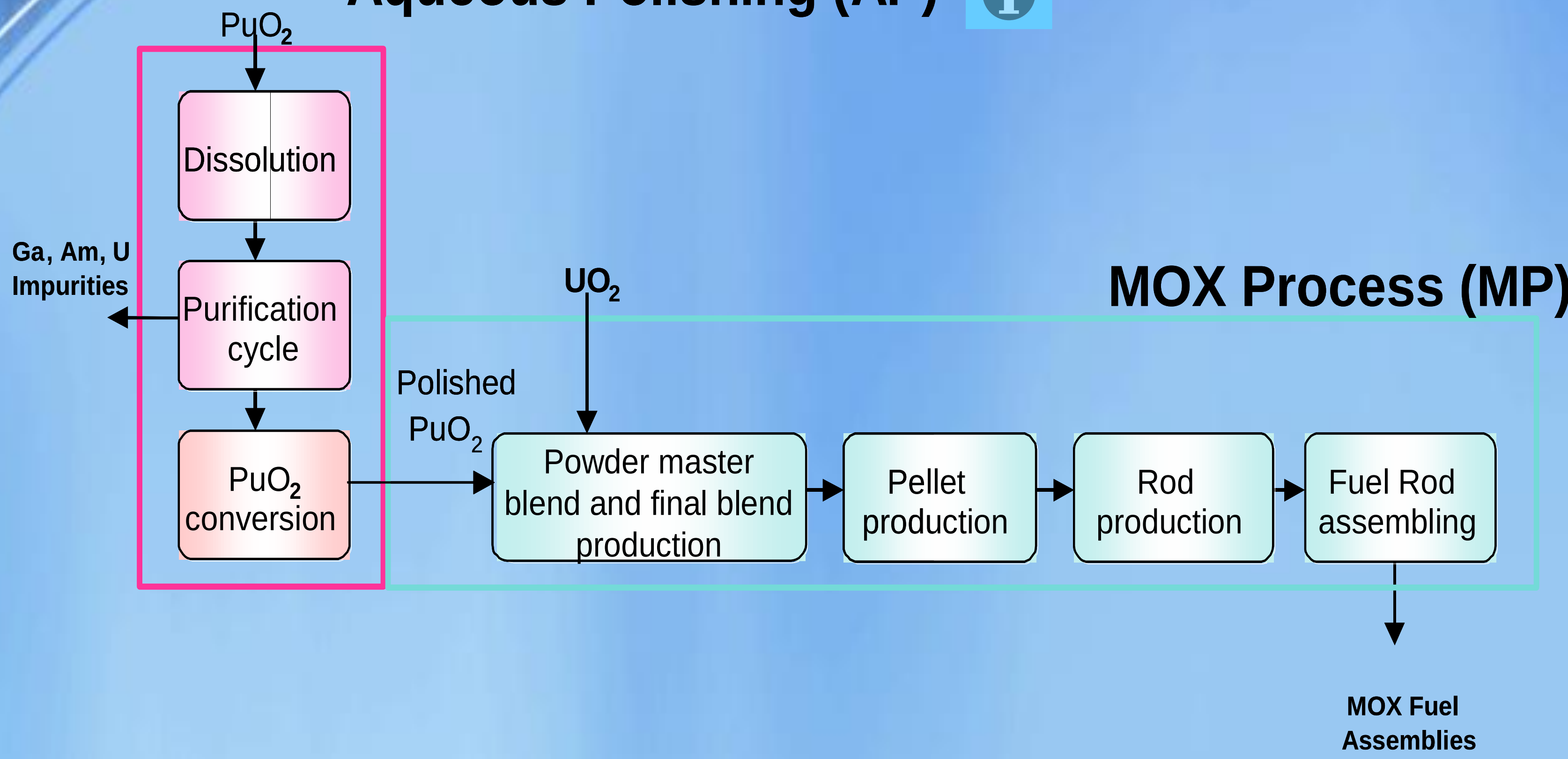
Aqueous Polishing and MOX Process Main Steps

Aqueous Polishing (AP)



Feedstock and Throughput

- Feed from Pit Disassembly Conversion Facility (PDCF):
  - Weapon grade plutonium in PuO_2 powder form
  - 100.5 kg Pu/week

- Feed of Alternate Feedstock (AFS):
  - Non-PDCF plutonium in PuO_2 powder form
  - Includes impurities of various salts and chlorides
  - Particle size may be coarser material than PDCF
  - 35 – 89 kg Pu/week

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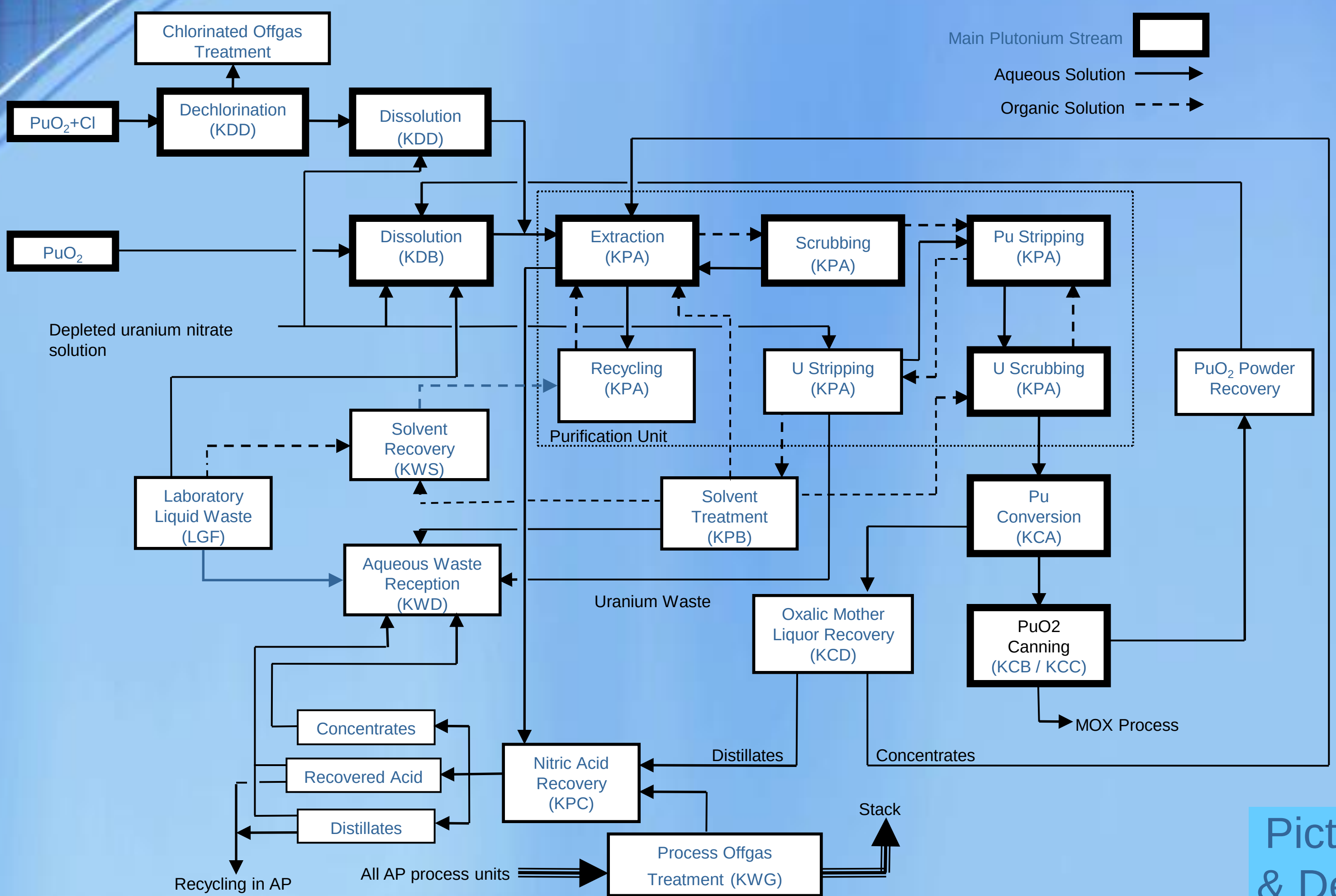
Overview of the AP Process



Pictures & Details

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Main Plutonium Chemical Processing Units of the Aqueous Polishing Process

Dissolution Unit (KDB)
Dechlorination & Dissolution Unit (KDD)

- Purpose
  - Dechlorinate PuO_2 (AFS only) and dissolve PuO_2
- Process
  - Dechlorination & dissolution performed with nitric acid
  - Dechlorination performed prior to dissolution by chemically and electrolytically dissolving & evolving Cl_2 (monitored)
  - Cl_2 treated in a scrubber with final form of NaCl
  - Silver catalyzed electrolytic batch dissolution in nitric acid
  - Pu and Ag valence states adjusted by H_2O_2 addition
  - U isotopics adjusted by addition of depleted uranyl nitrate
- Equipment
  - Electrolyzer (titanium, in glovebox)
  - Filters (removal of undissolved species, in glovebox)
  - Tanks (titanium, slab/annular, in process cell)

KDA

KDM

Purification Cycle (KPA)

- Purpose
  - Purify the plutonium nitrate from impurities, mainly gallium and americium
- Process
  - Tributyl Phosphate (TBP) continuous liquid-liquid extraction in pulsed columns
    - Extraction by TBP 30% in hydrogenated Tetrapropylene diluent
    - Acid scrubbing
    - Plutonium stripping through reduction to valence III by hydroxylamine nitrate (HAN) stabilized by hydrazine
    - Uranium stripping
  - Oxidation by NO_x + air stripping to adjust the valence to IV

Purification Cycle (KPA)

- Equipment
  - Tanks (stainless steel, annular/slab, in process cell)
  - Pulsed columns (stainless steel, in process cell)
  - Mixer settlers (stainless steel, in glovebox)
  - Slab settler (stainless steel, in process cell)
  - Oxidation & stripping columns (stainless steel, in process cell)

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Oxalic Precipitation Filtration Oxidation Unit (KCA)

- Purposes
  - Receive purified plutonium nitrate concentrated to approximately 40 g/L from the Purification Cycle (KPA) and prepare uniform batches
  - Precipitate out the plutonium nitrate as plutonium oxalate
  - Produce PuO_2 after filtering, drying, and calcining the plutonium oxalate
  - Transfer PuO_2 to the Homgenization Unit (KCB)
  - Transfer the mother liquors and the filter washing solutions to the Oxalic Mother Liquor Recovery Unit (KCD)
  - Ensure reducing agents, hydrazoic acid, and Pu(VI) do not propagate into downstream processing units
- Equipment
  - Precipitators (borosilicate glass, metallic casing, magnetic stirring rod, in glovebox)
  - Rotating filter (stainless steel, horizontal rotating axial drum, in glovebox)
  - Calcining furnace (Incolloy 800 H, screw conveyor, in glovebox)
  - Tanks (stainless steel, annular, in process cell)

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Homogenization & Sampling Unit (KCB) Canning Unit (KCC)

- Purposes
  - Receive, homogenize, and cool the PuO_2 powder produced in KCA
  - Fill reusable cans with PuO_2 in such a manner that the mass of plutonium per can is constant
  - Prepare samples for laboratory analysis to characterize the batch
  - Perform sample-based residual moisture measurement and gravimetric analysis (Pu content determination by gravimetry)
  - Store reference samples (spare samples for laboratory analyses)
- Equipment
  - Hoppers (stainless steel, rotating vanes, in glovebox)
  - Can docking station (in glovebox)

Supporting Units of the Aqueous Polishing Process

Solvent Recovery Unit (KPB)

- Purpose
  - Remove solvent degradation products to enhance the process efficiency
- Process
  - Sequence of soda, sodium carbonate, and acid addition to organic in a 4 stage mixer settler to separate degradation products into a separate aqueous stream
  - Recovered solvent is sampled and adjusted to maintain solvent to diluent ratio
  - Separated aqueous stream is diluent washed, collected, and transferred to waste unit (KWD) for treatment
- Equipment
  - Tanks (stainless steel, cylindrical, in process cell)
  - Mixer settlers (stainless steel, in glovebox)

Oxalic Mother Liquor Recovery Unit (KCD)

- Purposes
  - Continuously receive oxalic mother liquors adjusted to 3.3N with nitric acid (Mn^{2+} also mixed in) from KCA
  - Concentrate the oxalic mother liquors in a subcritical evaporator to destroy the oxalic ions and to remove residual Pu from the distillates
  - Check and then transfer the distillates to the Acid Recovery Unit (KPC)
  - Monitor and recycle, by batch, the concentrates to KPA
- Process
  - Natural circulation thermosiphon evaporator
- Equipment
  - Tanks (stainless steel, annular/slab/cylindrical, in process cell)
  - Thermosiphon evaporator

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Nitric Acid Recovery Unit (KPC)

- Purposes
  - Receive extraction raffinates from KPA, oxalic mother liquors distillates from KCD, and effluents from laboratories in batches & continuously receive active liquid effluents from the Offgas Treatment Unit (KWG)
  - Concentrate the radioactivity contained in the effluents and send it to the Liquid Waste Reception Unit (KWD)
  - Recover concentrated acid for recycling in the process
  - Recover distillates from the rectification column for use in KWG KPA, with excess liquid to KWD

Nitric Acid Recovery Unit (KPC)

- Process – 3 stages of evaporation
  - 1st stage natural recirculation thermosiphon evaporator and demister operated under vacuum (distillates to 2nd stage and condensates to KWD)
  - 2nd stage natural recirculation thermosiphon evaporator and demister operated under atmospheric pressure (distillates to 3rd stage and condensates to feed tank)
  - 3rd stage thermosiphon evaporator and rectification column operated under atmospheric pressure (distillates to distillate reception tank and condensates to nitric acid recovery unit)
- Equipment
  - Thermosiphon evaporators
  - Rectification Column
  - Tanks (stainless steel, cylindrical, in process cell/accessible room)

Laboratory Liquid Waste Receipt Unit (LGF)

- Three types of laboratory liquid wastes
  - Pu-containing aqueous liquid wastes
  - Decontaminated organic liquid wastes (mixture of TBP/HPT)
  - Aqueous liquid wastes generated by glovebox rinsing operations
- Purposes
  - Acidity adjustment of Pu-containing aqueous liquid wastes before transfer to KDB for Pu recycling
  - Control transfers to AP units based on compatibility of the liquid wastes with these units to ensure
    - Compatibility of decontaminated organic liquid wastes (mixture of TBP/HPT) with the Solvent Liquid Waste Reception Unit (KWS)
    - Compatibility of glovebox rinsing liquid wastes with the Low Level Liquid Waste Reception Unit (KWD)
- Equipment
  - Tanks (stainless steel, slab/cylindrical, in process cell)

Offgas Treatment Unit (KWG)

- Purposes
  - Remove plutonium from offgases collected from AP units
  - Recombine nitrous fumes in specific NO_x scrubbing columns
  - Clean, by water scrubbing, off-gases collected from AP units
  - Treat off-gas flow by HEPA filtration before release to the stack
  - Maintain negative pressure in equipment connected to the process ventilation system
- Process
  - NO_x scrubbing
  - gas stripping
  - filtration and exhausters
- Equipment
  - One baffle-and-tray NO_x scrubbing column
  - One baffle-and tray gas stripping column
  - Dedicated two-stage HEPA filtration and exhausters

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Waste Units (KWD)

- Units
  - High Alpha Waste (HAW)
  - Stripped Uranium Waste (SUW)
  - Low Level Waste (LLW)
- Purposes
  - Destroy hydrazoic acid present in alkaline wastes from KPB by sodium nitrite addition (HAW)
  - Collect and merge three waste streams: americium, alkaline waste after hydrazoic acid destruction, and excess acid (HAW)
  - Receive stripped uranium (< 1% U-235) waste stream from the uranium dilution tanks in KPA (SUW)
  - Collect and transfer to the WSB low level wastes from: (LLW)
    - Laboratories (from LGF)
    - Chlorinated wastes (from KDD)
    - Distillates (from KPC)
    - Reagent rooms
- Equipment
  - Tanks (stainless steel, cylindrical, in process cell/accessible room)

Solvent Waste Unit (KWS)

- Purposes
  - Receive the excess organic waste from KPB, KWD, and LGF
  - Package excess organic waste for shipment to SRS

- Equipment
  - Tanks (stainless steel, cylindrical, in process cell/accessible room)
  - Container for transfer to SRS

MOX Processing

Scott Salzman
Integrated Safety Analysis

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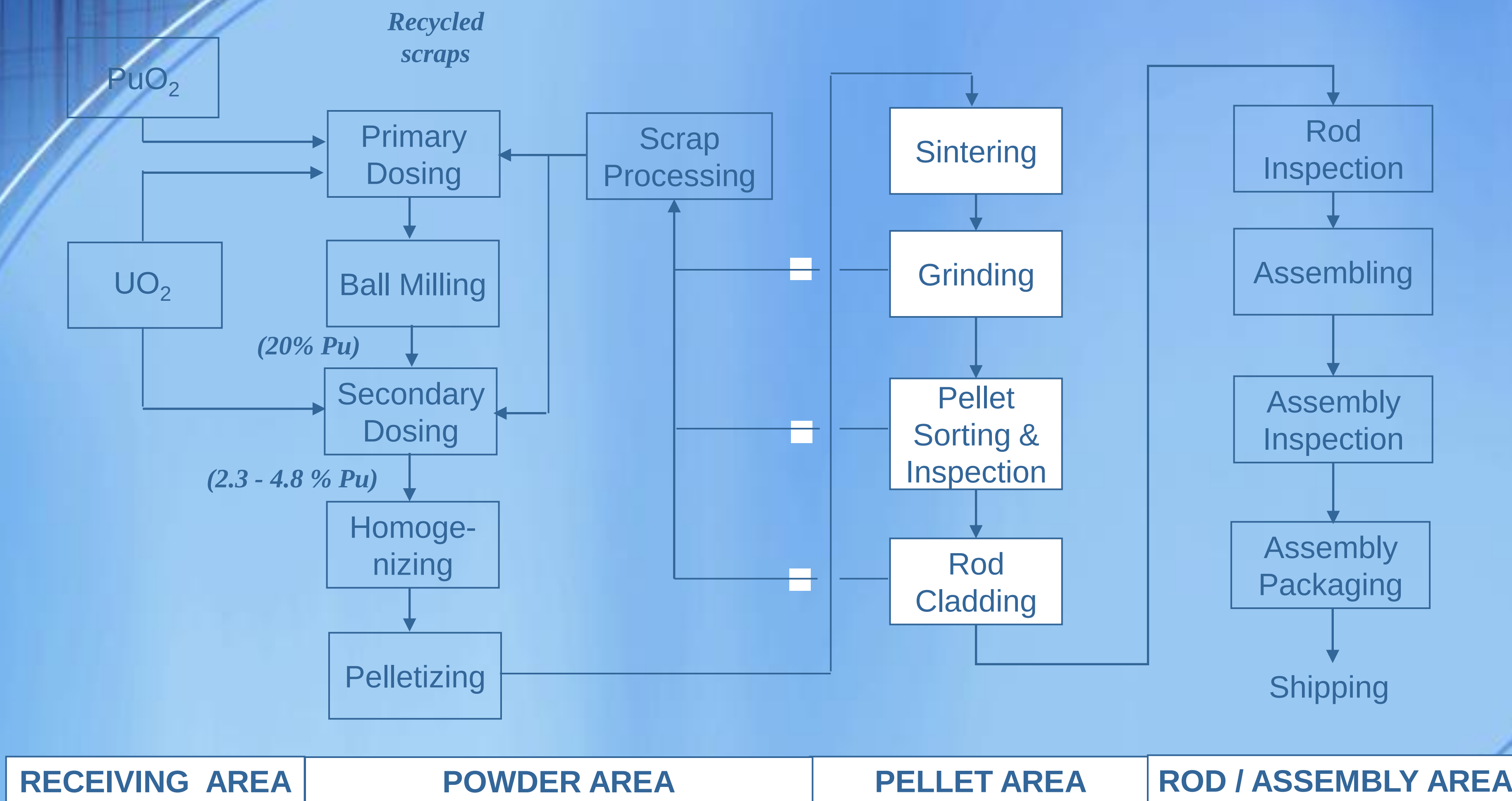
MOX Process General Block Diagram



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Receiving Area

The functions of the Receiving Area include

- Receive and store UO_2 and PuO_2
- Open individually sealed drums containing depleted UO_2 powder and pour the powder into either the Primary Dosing Hopper or the Final Dosing Hopper
- Unpack, assay and transfer to secure storage, shipments of PuO_2 contained in 3013 containers
- Handling, identification and storage of 3013 containers into and out of the AP Process

Receiving Process Units

The Receiving Area is composed of the following units

- UO2 Receiving and Storage Unit (DRS)
- UO2 Drum Emptying Unit (DDP)
- PuO2 Receiving Unit (DCP)
- PuO2 3013 Storage Unit (DCM)
- PuO2 Buffer Storage Unit (DCE)

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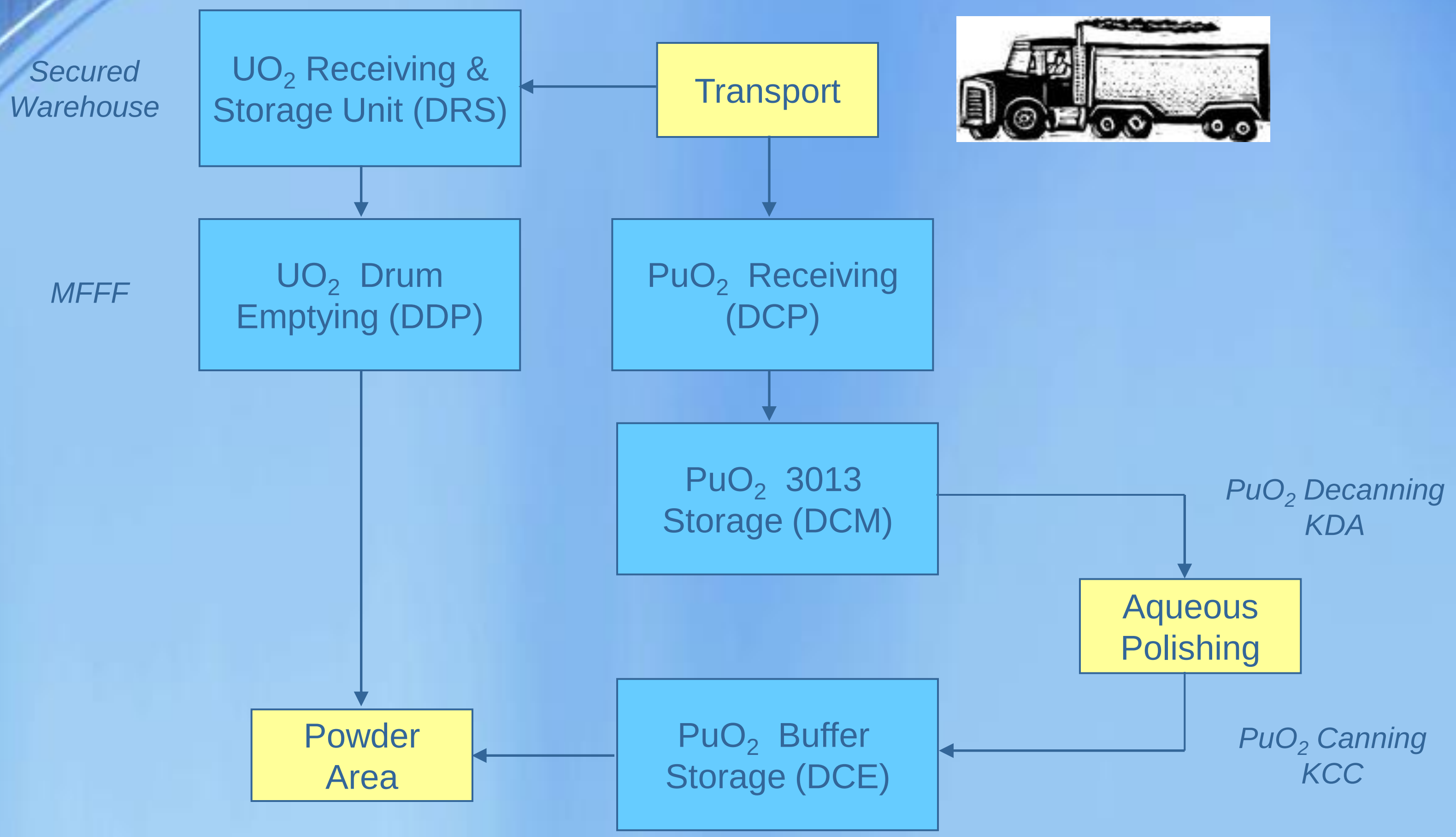
Receiving Block Diagram



Powder Area

The functions of the Powder Area include

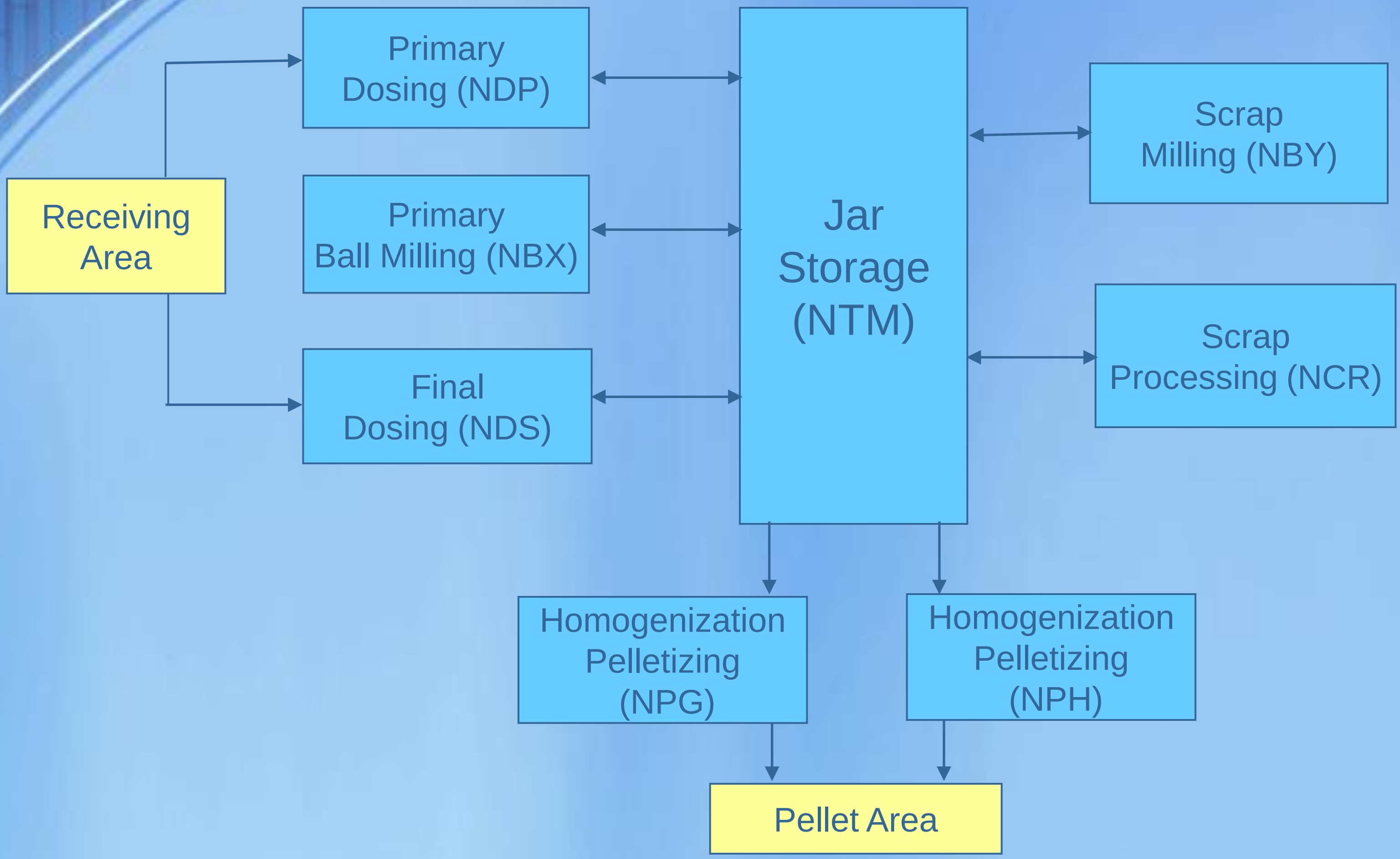
- Receive UO_2 and PuO_2 powder
- Produce a mixture of specific plutonium content suitable for the production of MOX fuel pellets

Powder Process Units

The Powder Area is composed of the following units

- PuO2 Can Receiving and Emptying Unit (NDD)
- Primary Dosing Unit (NDP)
- Primary Blend Ball Milling Unit (NBX)
- Final Dosing Unit (NDS)
- Homogenization and Pelletizing Units (NPG / NPH / NPI)
- Scrap Processing Unit (NCR)
- Scrap Ball Milling Unit (NBY)
- Powder Auxiliary Unit (NXR)
- Jar Storage and Handling Unit (NTM)

Powder Block Diagram



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Pellet Process Area

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- Function
  - The Pellet Process Area receives, stores, processes and handles fuel pellets
- The Pellet Process Area is composed of the following units
  - Sintering Units (PFE, PFF)
  - Grinding Units (PRE, PRF)
  - Pellet Inspection and Sorting Units (PTE, PTF)
  - Quality Control and Manual Sorting Unit (PQE)
  - Scrap Box Loading Unit (PAR)
  - Pellet Repackaging Unit (PAD)
  - Pellet Storage Units (PSE, PSF, PSJ, PSI)
  - Pellet Handling Unit (PML)

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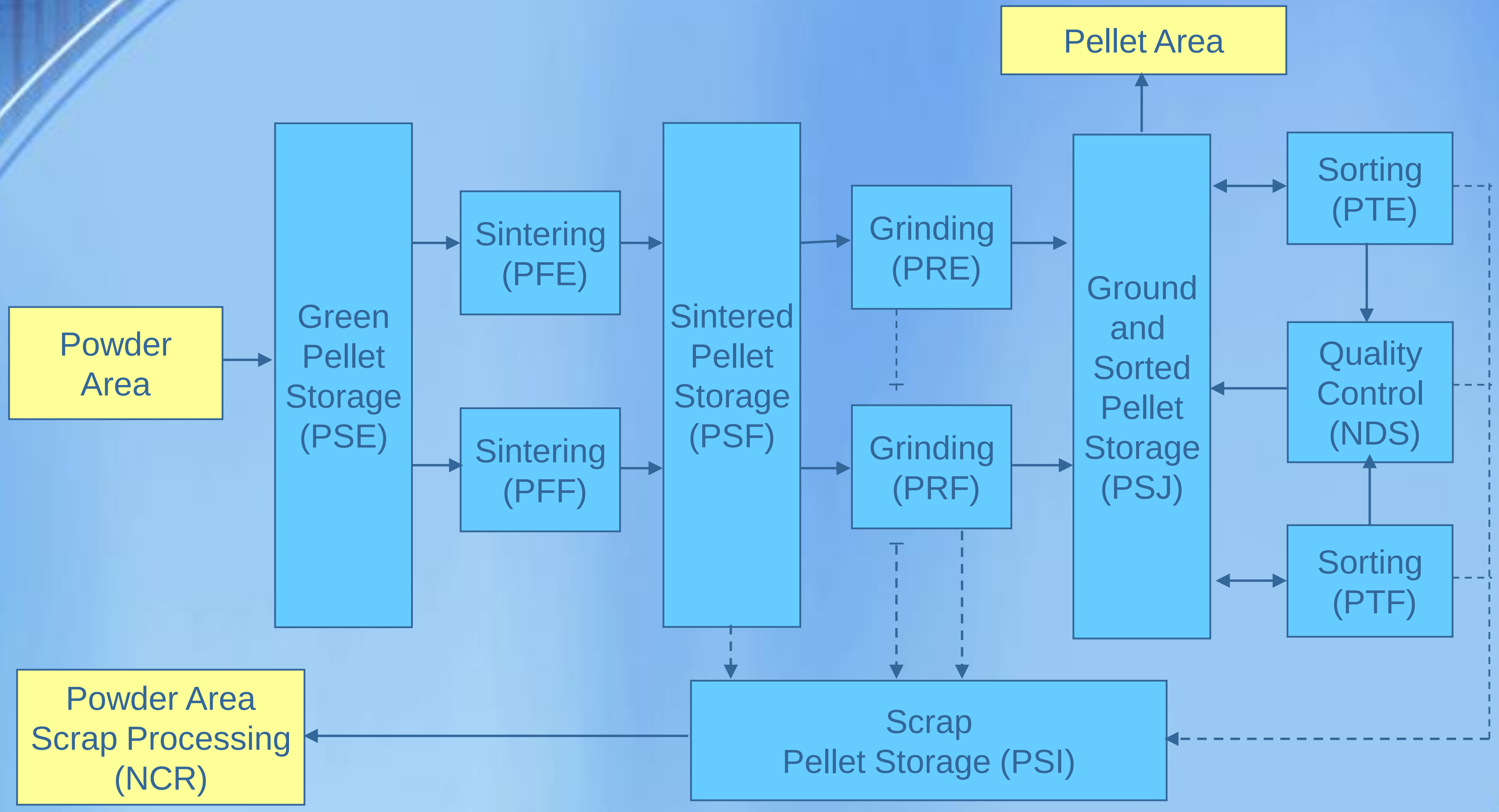
Pellet Block Diagram



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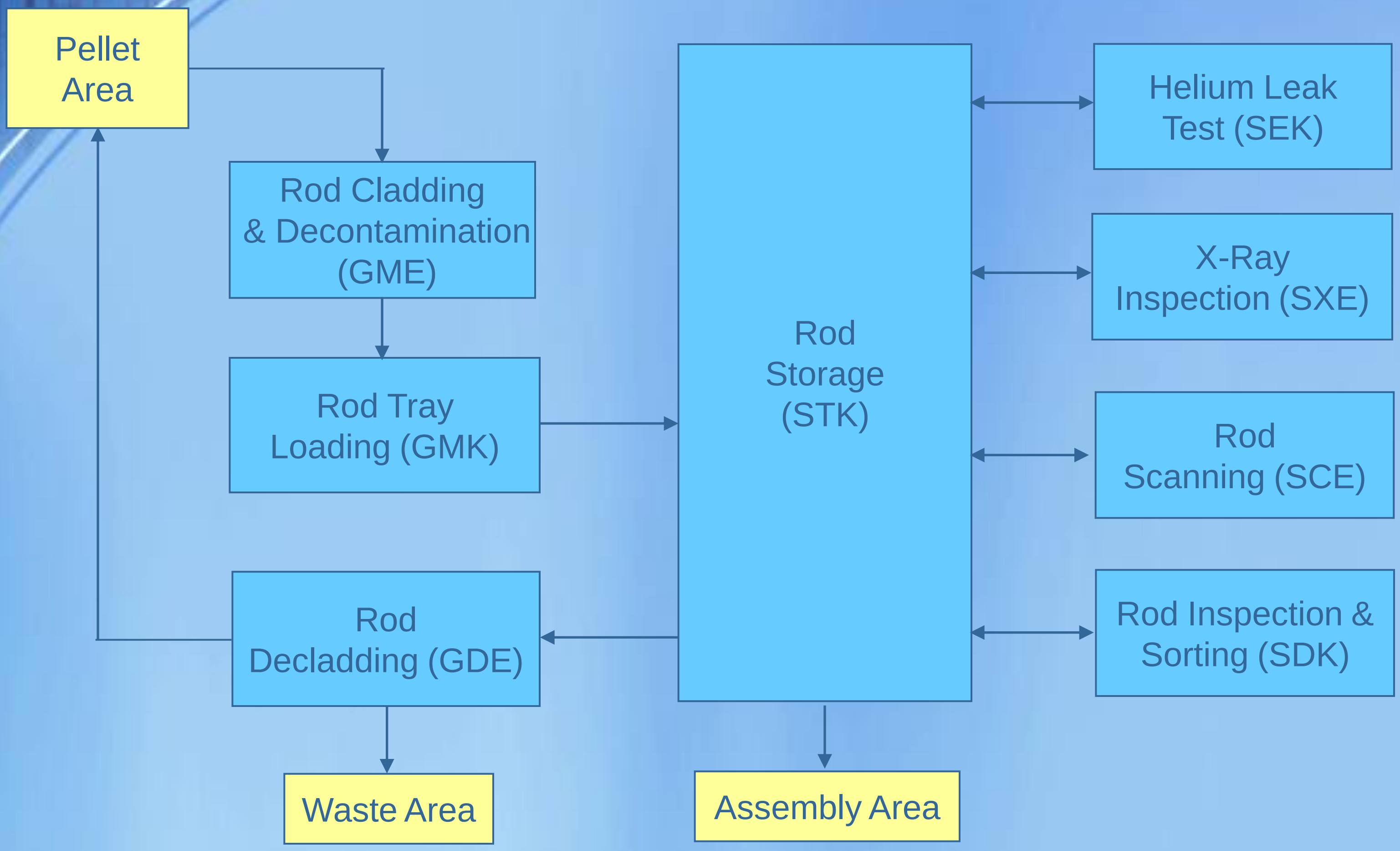
Rod Area

- Function
  - Load fuel pellets into the cladding (install springs, end plugs and weld), inspect and store fuel rods
- This area is composed of the following units
  - Rod Cladding and Decontamination Unit (GME)
  - Rod Tray Loading Unit (GMK)
  - Rod Tray Handling Unit (SMK)
  - Rod Storage Unit (STK)
  - Helium Leak Test Unit (SEK)
  - X-Ray Inspection Unit (SXE)
  - Rod Scanning Unit (SCE)
  - Rod Inspection and Sorting Unit (SDK)
  - Rod Decladding Unit (GDE)

Rod Block Diagram



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Assembly Area

- Function
  - Receive fuel rods and the required fuel assembly components and to assemble, inspect, store and package for shipment the completed MOX fuel assemblies
- The Assembly Area is composed of the following units
  - Assembly Mockup Loading Unit (TGM)
  - Assembly Spare Pit Unit (TGJ)
  - Assembly Fabrication Unit (TGV)
  - Assembly Dry Cleaning Unit (TCK)
  - Assembly Dimensional Inspection Unit (TCP)
  - Assembly Final Inspection Unit (TCL)
  - Assembly Handling and Storage Unit (TAS)
  - Assembly Packaging Unit (TXE)

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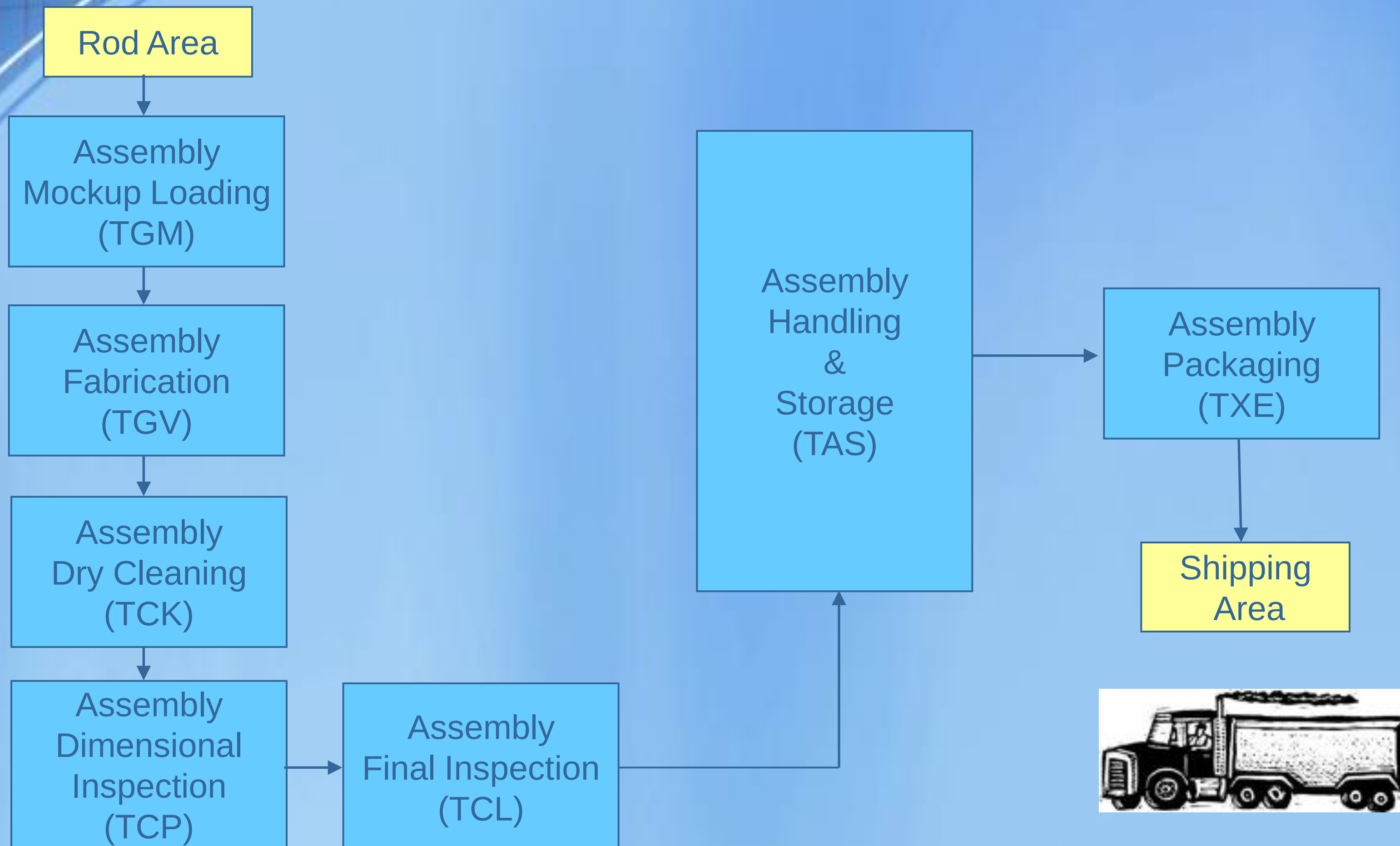
Assembly Block Diagram



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MOX Process Utility

- MOX Process Utility is composed of the following units
  - Filter Dismantling Unit (VDR)
  - Maintenance and Mechanical Dismantling Unit (VDU)
  - Waste Storage Unit (VDQ)
  - Waste Nuclear Counting Unit (VDT)
  - Can Pneumatic Transfer System (NTP)
  - Sample Pneumatic Transfer System - 76 mm Diameter (LTP)
  - Additives Preparation (NPP) Unit

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ISA Process/Event Development

Bill Hennessy
Nuclear Safety Manager

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Integrated Safety Analysis

- Purpose
  - Provide a systematic approach to identify all relevant hazards that could result in unacceptable consequences
    - Conservatively evaluates hazards
    - Identifies appropriate protective measures
  - ISA is required by 10 CFR 70.62 to demonstrate compliance with performance requirements of 10 CFR 70.61
    - High consequence events are made highly unlikely
    - Intermediate consequences are made unlikely
    - Criticality events are prevented

Integrated Safety Analysis

- High consequence events
  - 100 rem worker, 25 rem public, 30 mg soluble uranium intake, chemical exposure (worker - life endanger, public – long term health effects)
- Intermediate consequences
  - 25 rem worker, 5 rem public, environmental (5000 times 10CFR20), chemical exposure (worker - long term health effects, public – mild, transient health effects)
- Criticality events
  - All nuclear processes are subcritical, including use of an approved margin of subcriticality for safety

Integrated Safety Analysis

- Risk-informed / performance-based regulation
  - Allows for qualitative approach for evaluating event likelihood
    - Highly unlikely: Events originally classified as Unlikely or Not Unlikely to which sufficient IROFS are applied to further reduce their likelihood to an acceptable level
    - Unlikely: Events originally classified as Not Unlikely or those that are not expected to occur during the lifetime of the facility to which sufficient IROFS are applied to further reduce their likelihood to an acceptable level
    - Not unlikely: Events that may occur during the lifetime of the facility

Integrated Safety Analysis

- Risk-informed / performance-based regulation
  - Credible: Events that are not "Not Credible"
  - Not credible
    a) Natural phenomena or external man-made events with an extremely low initiating event frequency, or
    b) A process deviation that consists of a sequence of many unlikely human actions or errors for which there is no reason or motive, and no such sequence of events can ever have actually happened in any fuel cycle facility, or
    c) Process upsets for which there is a convincing argument, based on physical laws, that are not possible, or are unquestionably extremely unlikely

Integrated Safety Analysis

- Highly unlikely is achieved by applying the following design criteria to Items Relied on For Safety (IROFS)
  - Application of the single failure criteria or double contingency
  - Application of 10 CFR 50 Appendix B / NQA-1
  - Application of Industry Codes and Standards
  - Management Measures, including surveillance of IROFS (i.e., failure detection and repair, or process shutdown capability)

ISA Methodology Major Steps

- Determine hazards
  - Internal to the facility
  - Natural phenomena hazards (NPHs)
  - External man-made hazards (EMMHs)
- Determine radiological hazards
- Determine chemical hazards
  - Associated with licensed material and hazardous chemicals produced from licensed material
- Develop potential event scenarios for hazards

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ISA Methodology Major Steps

- Determine consequence and likelihood of potential events
- Determine Items Relied On For Safety (IROFS)
  - Including safety function characteristics of their preventive / mitigative features
- Demonstrate that the IROFS will perform their intended safety functions when necessary
- Prepare the ISA and maintain it for the life of the facility

ISA Methodology

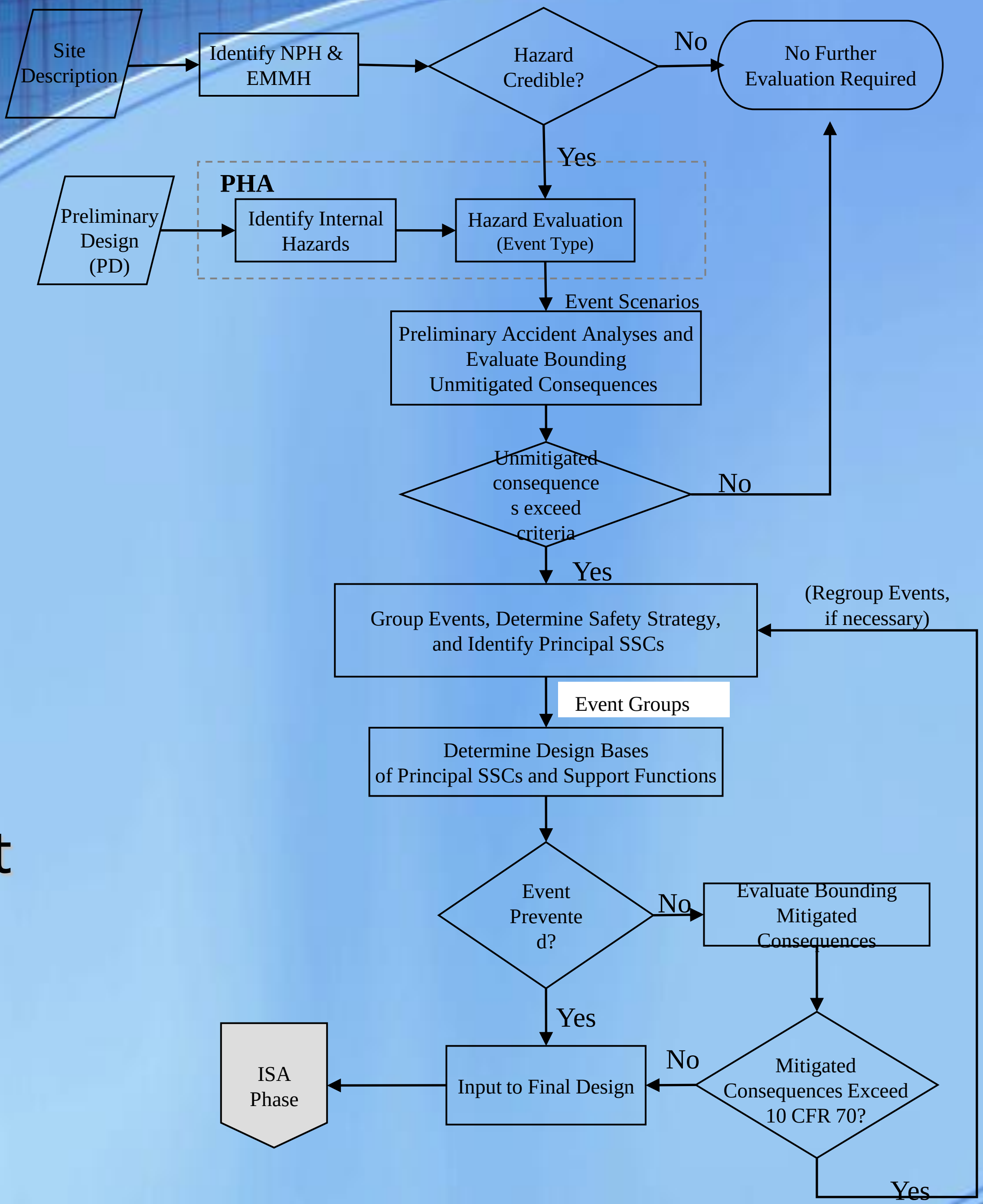
- 1st Phase: Safety Assessment / Construction Authorization Request

- 2nd Phase: Integrated Safety Analysis / License Application and ISA Summary

ISA Methodology

- Safety Assessment Phase
  - Identify hazards and events associated with MFFF design and operations
  - Identify safety strategy and associated Principal System, Structures and Components (PSSCs) required to mitigate or prevent these events, and identify their design bases
  - Describe PSSCs capability through commitment to codes, standards, and preliminary design
  - Proper implementation of PSSCs verified during NRC construction inspections

Safety Assessment Phase



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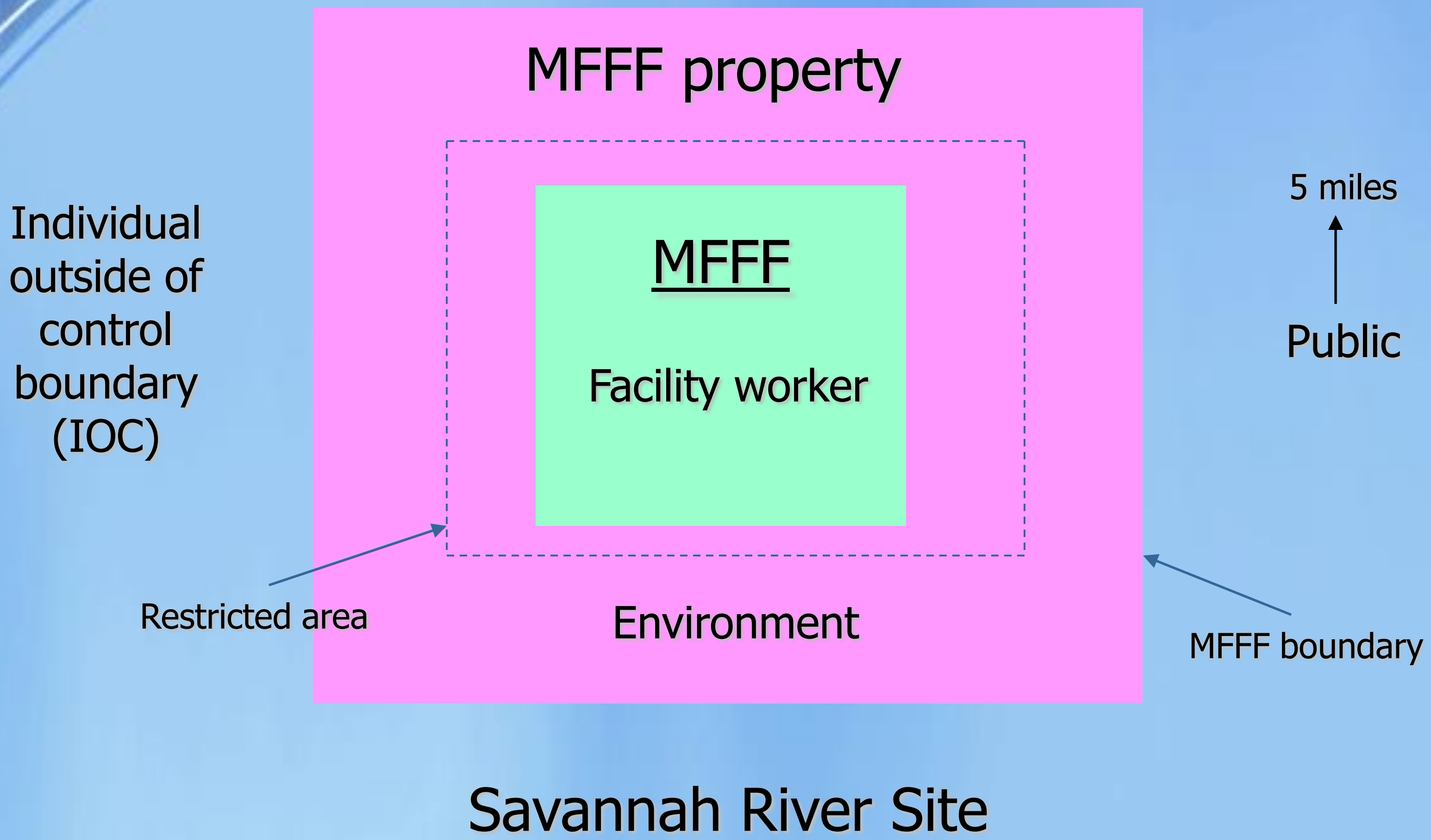
Example - Event Development

- Event/type: Breach of glovebox / loss of confinement and dispersal of nuclear material
  - PHA / Hazard identification & evaluation
    - Checklist approach based on NRC & AIChE guidelines
    - Identified hazards: “Radioactive Material” and “Gloveboxes” for Primary Dosing process unit
    - Likelihood: Not Unlikely
    - Consequences: Facility Worker – High, IOC – Low, Environment - Low
    - Mitigative features proposed

RECEPTORS


MFFF property
5 miles
Individual outside of control boundary (IOC)
MFFF
Public
Facility worker
Restricted area
Environment
MFFF boundary
Savannah River Site

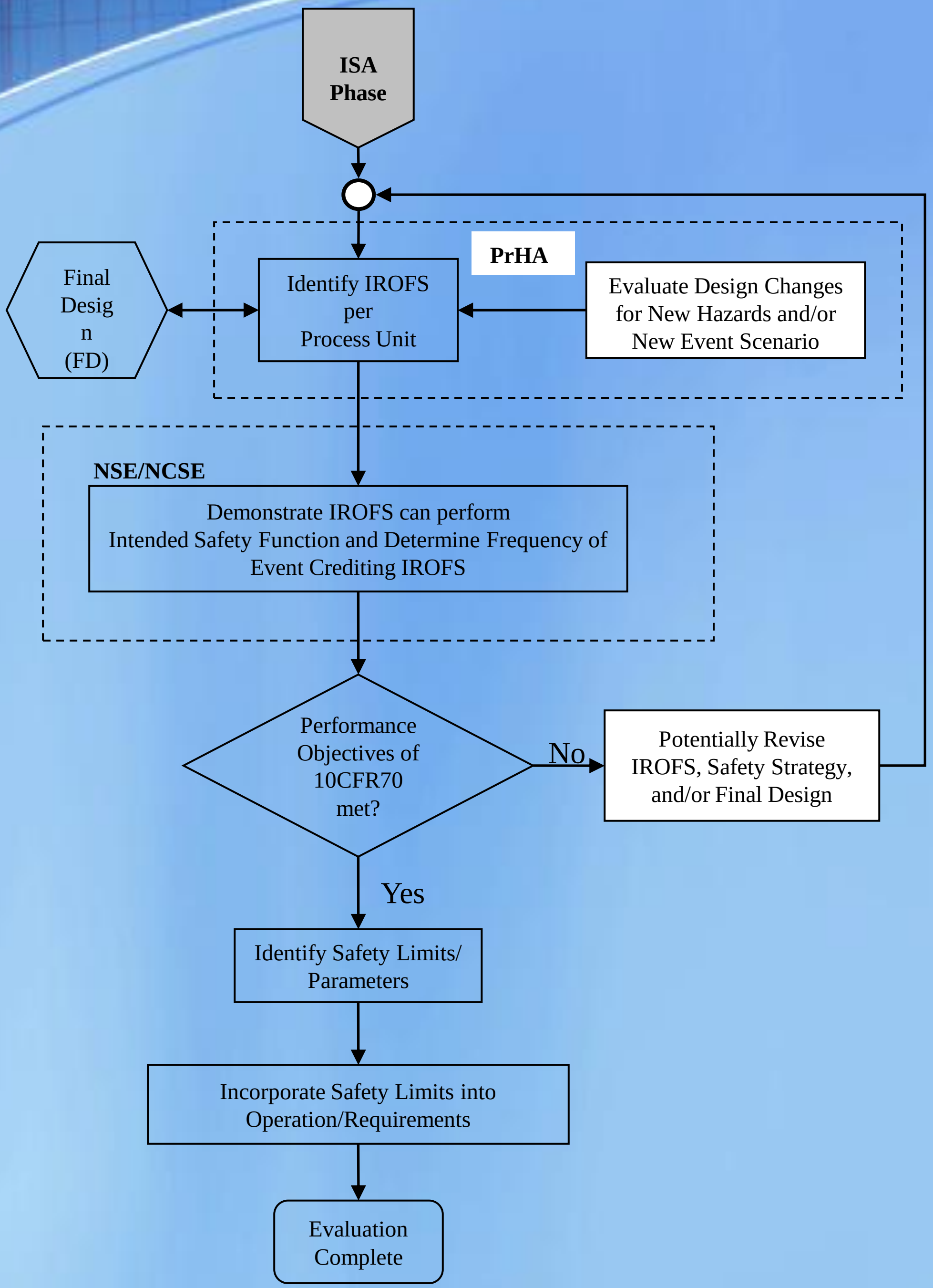
Example - Event Development

- Event/type: Breach of glovebox / loss of confinement
  - Preliminary Accident Analysis
    - Small Breaches in a Glovebox Confinement Boundary or Backflow From a Glovebox Through Utility Lines
    - Includes event groups: GB-4, GB-5, AP-13, AP-22
    - Consequence analysis: Facility Worker – High, IOC – Low, Environment - Low
    - Mitigation strategy: C4 Confinement System – Maintain negative glovebox pressure differential & maintain inward flow through small glovebox breach

ISA Methodology

- ISA Phase
  - Identify IROFS at component level
  - Demonstrate IROFS are adequate to ensure the performance requirements of 10 CFR 70.61 are satisfied
  - Ensure IROFS reliability & availability via supporting management measures and QA

ISA Phase



ISA Phase
PrHA
Final Design (FD)
Identify IROFS per Process Unit
Evaluate Design Changes for New Hazards and/or New Event Scenario
NSE/NCSE
Demonstrate IROFS can perform Intended Safety Function and Determine Frequency of Event Crediting IROFS
Performance Objectives of 10CFR70 met?
No
Potentially Revise IROFS, Safety Strategy, and/or Final Design
Yes
Identify Safety Limits/ Parameters
Incorporate Safety Limits into Operation/Requirements
Evaluation Complete

ISA Methodology

- ISA Phase
  - Process Hazards Analyses (PrHAs)
    - Hazop/What-If for each unit/area
  - Nuclear Safety Evaluations
    - Demonstrates that 10 CFR 70.61 performance criteria are satisfied for non-criticality events (fire, loss of confinement, explosion, etc)
  - Nuclear Criticality Safety Evaluations
    - Demonstrates that 10 CFR 70.61 performance criteria are satisfied for criticality events
    - Demonstrate compliance with double contingency requirements

ISA Methodology

- Process Hazards Analyses (PrHAs)
  - Detailed evaluations performed for each process unit/area to identify specific event scenarios, including causes of the events, and associated prevention and mitigation features (IROFS)
  - All modes of operation are considered: startup, normal operation, shutdown, and maintenance
  - Software malfunctions, including communication and common mode malfunctions, are considered
  - Event causes include personnel actions and in-actions (e.g., operator error) that could result in adverse consequences

ISA Methodology

- Process Hazards Analyses (PrHAs)
  - Team consists of discipline experts including:
    - Process: AP chemical process, MOX fuel process, glovebox design
    - Engineering: mechanical, electrical/I&C, fire protection, HVAC, human factors, civil/structural
    - Safety: radiochemistry, criticality safety, nuclear safety, radiation protection
    - Operations: with Melox and LaHague experience
  - Performed consistent with guidance in:
    - AIChE's *Guidelines for Hazard Evaluation Procedures*
    - NRC's *Integrated Safety Analysis Guidance Document* (NUREG-1513)

ISA Methodology

- Hazop methodology
  - Divide unit into discrete nodes (e.g., tank, pulse column, pump, glovebox)
  - Identify design intent for each node (e.g., pulse column to remove contaminants from Pu stream)
  - Systematically apply guide words to process functions and parameters to generate a list of deviations (e.g., high/low temperature, pressure, flow, concentration, etc)
  - Establish if deviation can lead to unmitigated consequences of concern (e.g., criticality, explosion, loss of confinement, etc)
  - Identify credible causes for the deviation
  - Identify IROFS applicable for all potential causes
  - Identify Action Items

ISA Methodology

- What-If methodology
  - Postulate scenario in the form of a question (e.g., what if a jar of Pu falls off the jar lift in a dosing glovebox)
  - Identify credible causes for the event (e.g., seismic) and potential unmitigated consequences
  - Evaluate scenario to identify preventive or mitigative controls (e.g., design unit for seismic loading)
  - Use Checklist to ensure all potential initiators have been covered
  - Identify any action items

Example - Event Development

- Event/type: Breach of glovebox / loss of confinement
  - Process Hazards Analysis (PrHA)
    - What-If / Checklist methodology
    - Group events that have common scenarios, e.g., GB glove fails, bag port fails, UO2 feed line/hopper leak
    - Identify causes and unmitigated consequences
    - Identify Items Relied On For Safety (IROFS) to implement safety strategy

Example - Event Development

- Event/type: Breach of glovebox / loss of confinement
  - IROFS for facility worker
    - Glovebox
    - VHD Exhaust System
    - Glovebox Dump Valves
    - Glovebox Low differential pressure alarms
    - Facility worker evacuation in response to alarms

ISA Methodology

- Nuclear Safety Evaluations
  - Integrate results of the PHA, PrHAs and other safety analyses to demonstrate that the performance requirements of 10 CFR 70.61 are satisfied
  - NSE for each event type: explosion, loss of confinement, fire, load handling, & NPH/EMMH
  - Identifies the selected safety strategy for each hazard event scenario and the IROFS required to implement the safety strategy
  - Describes each IROFS to show that the IROFS is capable of reliably performing its safety function

ISA Methodology

- Nuclear Safety Evaluations
  - IROFS safety function is described together with the associated parameters, safety limits, justification for satisfying the single failure criteria, failure detection, and surveillance requirements
  - Codes and standards, QA requirements, and management measures applicable to the IROFS
  - Defense-in-depth features

ISA Methodology

- Nuclear Criticality Safety Evaluations
  - 48 NCSEs / approximately one per unit
  - Integrates results of the PHA, PrHAs and other safety studies to demonstrate that the performance requirements of 10 CFR 70.61 are satisfied
  - Identifies the selected safety strategy for each hazard event scenario and the IROFS required to implement the safety strategy
  - Describes each IROFS to show that the IROFS is capable of reliably performing its safety function

MOX FUEL FABRICATION FACILITY

NNSA National Nuclear Security Administration

ISA Methodology

- Nuclear Criticality Safety Evaluations
  - IROFS safety function is identified together with the associated parameters, set points, justification for satisfying the single failure criteria, environmental qualification, failure modes, failure detection, and operating and surveillance requirements
  - Codes and standards, QA requirements, and management measures applicable to the IROFS are also described
  - Defense-in-depth features described

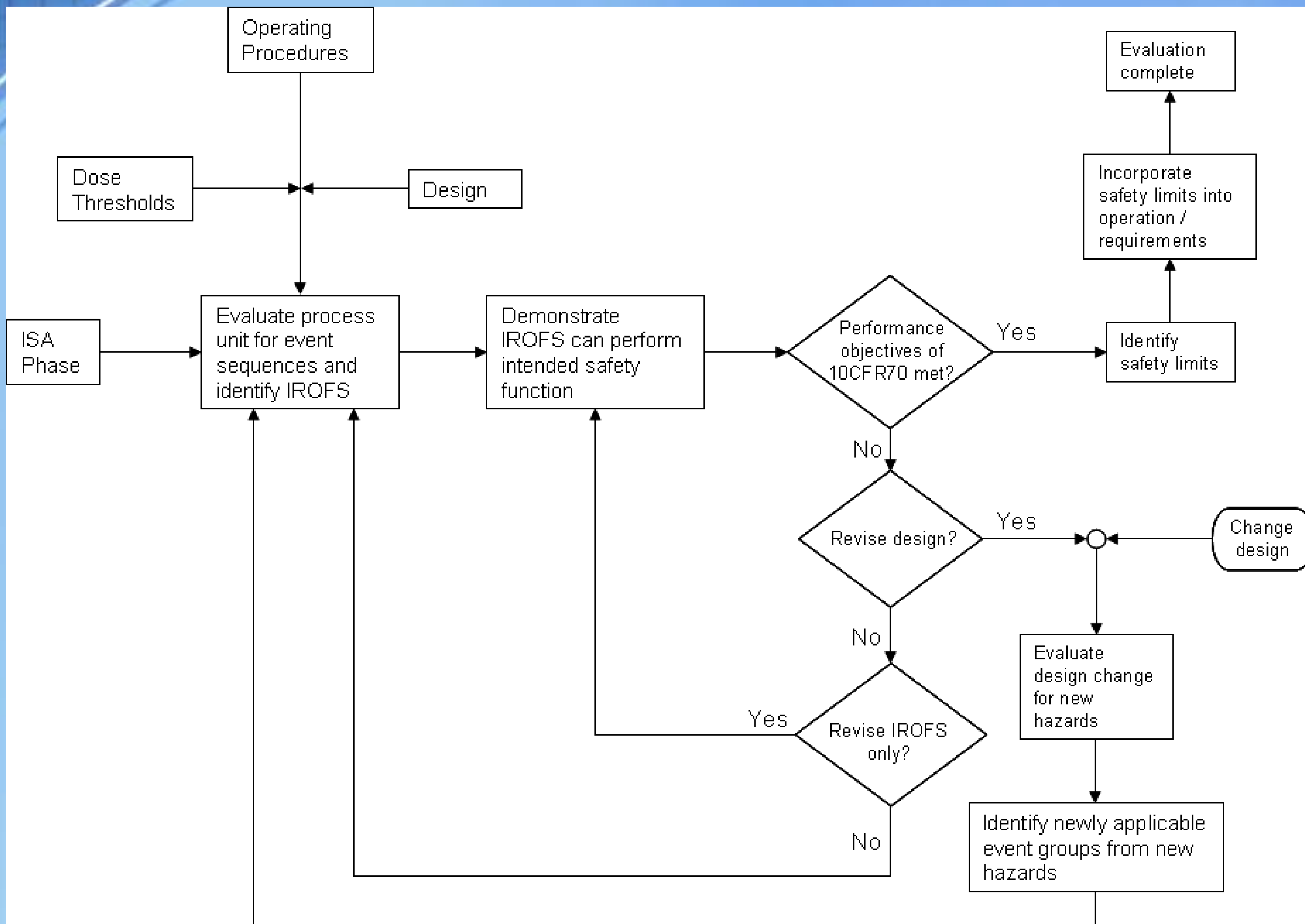
ISA Methodology

- In addition, Nuclear Criticality Safety Evaluations
  - Demonstrate compliance with the double contingency principle
  - Include criticality k_{eff} calculations that show that the units are criticality safe for controlled parameters (mass, moderation, geometry, etc)
  - Calculations show that the maximum calculated k_{eff} value is lower than the Upper Safety Limit (USL)

ISA Methodology

- Operating Phase
  - Evaluate facility changes and update ISA as needed. Identify any new IROFS at component level
  - Demonstrate IROFS are adequate to ensure the performance requirements of 10CFR70.61 are satisfied
  - Ensure IROFS reliability & availability via supporting management measures and QA

Operating Phase



MOX SAFETY FUELS THE FUTURE

Human Factors and ISA

- Human Factors Engineering (HFE) support the ISA
  - Evaluating operation actions and inactions
  - Including errors of commission and omission
- HFE evaluations of administrative IROFS
  - Human interactions requirement is compatible with human capability under required conditions
- MOX Project HFE Program basis
  - NUREG 1718, *Standard Review Plan for the Review of an Application for a Mixed Oxide (MOX) Fuel Fabrication Facility*
  - NUREG 0711, *Human Factors Program Review Model*
  - NUREG 0700, *Human System Interface Design Review Guidelines*

Integrated Safety Analysis

- Conclusion
  - Robust and systematic approach to analyzing MFFF hazards and potential accident sequences
  - IROFS identified to protect the public and workers
  - Demonstrates compliance with 10 CFR 70.61 requirements

Backup slides

ISA Methodology

- Event types & groups
  - Types
    - explosion
    - criticality
    - fire
    - loss of confinement
    - load handling
    - natural phenomena hazards / external man-made hazards

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ISA Methodology

- Event types & groups
  - Groups: potential chemical explosions
    - Radiolysis (EXP03)
    - HAN (EXP04)
    - Hydrogen Peroxide (EXP05)
    - Solvent (EXP06)
    - TBP-Nitrate (Red Oil) (EXP07)
    - AP Vessel Overpressure (EXP08)
    - Hydrazoic Acid (EXP10)
    - Metal Azide (EXP11)
    - Pu (VI) Oxalate (EXP12)
    - Electrolysis (EXP13)
    - Perchlorate (EXP17)

ISA Methodology

- Consequence assessment
  - Unmitigated and mitigated consequences determined for each PrHA event
  - Facility worker: conservative qualitative consequences used
  - Other receptors: individual outside controlled area (public) and environment

ISA Methodology

- Radiological consequences
  - Methodology based on NUREG/CR-6410, *Nuclear Fuel Cycle Facility Accident Analysis Handbook*
  - Total effective dose equivalent for potential releases is:

$$TEDE = BR \times \chi/Q \times ST \times DCF$$

where,

BR is the breathing rate

χ/Q is the atmospheric dispersion factor

ST is respirable source term

DCF is the inhalation dose conversion factor

ISA Methodology

- Radiological consequences
  - where

    BR is based on Reg. Guide 1.25

    X/Q is based on ARCON96, a straight line Gaussian dispersion model

    ST = MAR x DR x ARF x RF x LPF

    DCF = isotopic mass fraction x mass-based DCF for each isotope

ISA Methodology

- Chemical consequences
  - Techniques, assumptions, and models consistent with industry practice and verified using guidance in NUREG/CR-6410
  - Used conservative bounding assumptions, e.g.,
    - Releases based on total material at risk from the largest single tank
    - No credit assumed for process equipment installed to remove/scrub released chemicals prior to release from the MFFF
  - Consequences to the IOC (public) based on
    - Ground level release
    - No mechanical or buoyancy plume rise
    - Neutrally buoyant gas model
  - Concentrations compared to TEEL chemical limits

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NRC STAFF REVIEW OF THE APPLICATION FOR A LICENSE TO POSSESS AND USE RADIOACTIVE MATERIAL AT THE MIXED OXIDE FUEL FABRICATION FACILITY

David Tiktinsky, FCSS/NMSS

OUTLINE FOR DISCUSSION

- Purpose of Presentation
- Licensing process and SER development
- Principal Structures, Systems and Component (PSSC) verification
- Topics of discussion

Purpose of Presentation

- ACRS review of NRC staff SER
  - Seek ACRS endorsement of the staff's evaluation of the LA for the MFFF
    - Final SER planned to be completed by December 2010
- Outline future licensing steps and PSSC verification process

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Licensing process

- Background
  - Staff SER on Construction Authorization Request and Construction Authorization issued (March 2005) (previously reviewed by ACRS)
  - LA/ISAS submittal (September 2006)
  - Staff acceptance of LA for docketing (12/06)
  - Technical reviews (12/2006-2010)
  - Draft SER on LA prepared with no open items (6/2010)
  - Licensing in litigation with ASLB (one contention accepted)
    - Hearing after completion of final SER
  - PSSC verification (2014 estimated completion)
  - Issuance of license to possess and use radioactive material
  - Operational readiness review
  - Hot startup

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SER Development

- Followed Standard Review Plan (NUREG-1718)
- Staff review included:
  - In-office reviews
  - Discussions with Applicants
  - Requests for Additional Information
  - Substantial communications between staff and applicant
- No open items identified

PSSC Verification Process

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PSSC Verification Background

- 10 CFR 70.23 (a)8 – requires for plutonium processing facilities that NRC verify that the construction of principal structures systems and components (PSSC's) (design basis) has been completed in accordance with the application
  - PSSCs were defined in the Construction Authorization Request
  - Verification is a joint NRC inspection, technical review and administrative review activity
  - Joint NMSS/Region II expert panel was formed to implement PSSC verification activities

Purpose of Verification Program

- Develop clear scope and identify items for inspection and review
- Develop a program to track and document progress and completion of the verification of each PSSC
- Develop a process for documenting the staff's findings for demonstrating regulatory compliance
- Program must be completed and contruciton verified prior to issuance of a license to possess and use radioactive material

What needs to be verified

- 53 PSSC’s were defined in the Construction Authorization Request and approved by staff in the Construction Authorization
- PSSC’s can be administrative controls, active engineered controls, passive engineered controls, or use of an approved item
  - PSSCs may include multiple safety functions and IROFS
  - PSSCs may support or be part of other PSSCs
- Verification of construction of a PSSC varies depending on nature of PSSC
  - Inspections (component specific or programmatic)
  - Procedure reviews
  - Other approvals (e.g., transportation package certification)
- Verification assures that the design basis safety function for each PSSC can be met (through technical reviews and inspections)

PSSC Verification Process

- Develop formats and guidance for PSSC independent verification plans
- Risk informed prioritizing of verification activities
  - Prioritize ISA summary level IROFS by PSSC
  - Prioritize component level IROFS for key ISA summary IROFS
  - Develop a risk informed level of inspection effort for each PSSC
    - Inspection sampling
    - Inspection attributes

PSSC Verification Process (cont)

- Develop a Verification plan for each PSSC
- Develop a tracking system to capture verification activities (including scheduling) and documenting results
- Perform required inspections and technical reviews of administrative controls
- PSSC Completion letters to be submitted by MOX Services
- Verification letters to be prepared by staff to document completion of construction and verification for each PSSC
- Final issuance of an SER supplement to document PSSC verification (after all 53 PSSCs have been verified) for meeting requirements for license approval

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PSSC Verification Program Status

- ISA Summary level IROFS have been prioritized on a risk informed basis
- Developing Verification plan for each PSSC
- Performing Inspections to support verification
- Documentation tracking system has been developed
- Inspection activities to increase substantially as construction proceeds
- Multiple year verification process

Topics for Technical Discussion for ACRS

- Topics for technical discussion developed based on:
  - Previous ACRS letter on Construction Authorization Request
  - February 2005 transcript of ACRS meetings
  - Meeting with Subcommittee Chairman
  - Risk Significance

Discussion Topics

- Selected explosion events (M. Norato)
- Criticality events (C. Tripp)
- Seismic response (A. Chowdhury)
- Select fire events (R. Wescott)
- Liquid waste at the MFFF(M. Norato)
- ISA (K. Morrissey)
- Safety instrumentation and control (D. Rahn)
- Confinement (D. Tiktinsky)

Discussion Protocol

- Applicant to make initial presentations on specific topics
- Staff to make presentations related to its technical review

Conclusion

- Staff requesting ACRS endorsement of SER
- Staff is implementing a PSSC verification program
- License will not be granted until after PSSC verification completed