



1  
2 DISCLAIMER  
3  
4

5 UNITED STATES NUCLEAR REGULATORY COMMISSION'S  
6 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
7

8  
9 The contents of this transcript of the  
10 proceeding of the United States Nuclear Regulatory  
11 Commission Advisory Committee on Reactor Safeguards,  
12 as reported herein, is a record of the discussions  
13 recorded at the meeting.  
14

15 This transcript has not been reviewed,  
16 corrected, and edited, and it may contain  
17 inaccuracies.  
18  
19  
20  
21  
22

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS  
1323 RHODE ISLAND AVE., N.W.  
WASHINGTON, D.C. 20005-3701

1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

3 + + + + +

4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 (ACRS)

6 MEETING OF THE SITING SUBCOMMITTEE

7 + + + + +

8 OPEN SESSION

9 + + + + +

10 THURSDAY

11 AUGUST 19, 2010

12 + + + + +

13 ROCKVILLE, MARYLAND

14 + + + + +

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

19 SUBCOMMITTEE MEMBERS:

20 DANA A. POWERS, Chairman

21 J. SAM ARMIJO

22 MICHAEL T. RYAN

23 DESIGNATED FEDERAL OFFICIAL:

24 NEIL COLEMAN

25

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26

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

AGENDA ITEM	PAGE
Opening Remarks and Objectives .....	3
Opening Remarks - NRC Staff .....	5
Overview of the Mox Facility .....	6
Overview of the Regulatory Process .....	104

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 29<sup>th</sup>, 2010.

Please notice that the meeting notice incorrectly stated that the entire meeting will be open to public

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealgross.com](http://www.nealgross.com)

1 attendance. The published meeting agenda correctly  
2 shows that most of the presentations will be held in  
3 closed session. The first half of the day will be  
4 held in public session.

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

11 OPENING REMARKS - NRC STAFF

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

14 I guess for formality I am Larry Campbell.

15 I am the branch chief of the Mixed Oxide and Uranium  
16 Conversion Branch. I've been in this position since  
17 about the end of June.

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

25 We look forward to receiving comments from

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

4 Thank you very much.

5 CHAIRMAN POWERS: Thank you.

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

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

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

13 MR. CHASSARD: I will do my best.

14 OVERVIEW OF THE MOX FACILITY

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 plant for the aqueous polishing part. And Melox which  
2 is the reference plant for all the fuel fabrication  
3 process.

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 question you want.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

9 (Video presentation.)

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

23 Aqueous polishing is a five-level chemical  
24 process where plutonium powder is converted to a  
25 liquid form and then purified to remove byproducts

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 such as gallium, americium and uranium. The purified  
2 plutonium liquid is converted back to a powdered oxide  
3 form, packaged and canned, and stored until it is  
4 needed.

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

12 The plutonium and uranium oxide powder are  
13 mixed to the desired blend and pressed into a pellet  
14 about the size of a pencil eraser . The MOX facility  
15 will provide upwards of 70,000 pellets each day. To  
16 strengthen and increase their density the pellets are  
17 ground to within a few microns of their required  
18 diameter and sorted by means of a fully automated  
19 system. Then samples of the pellets are checked and  
20 verified - dimension, density, marking and color. The  
21 rods are manufactured by arranging the pellets in a  
22 long tray and inserting the pellets into a zirconium  
23 alloy tube, each rod containing approximately 360  
24 pellets. An end plug is then inserted into the open  
25 end and the rod closes shut. The rods are cleaned and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 decontaminated. And then arranged on trays to be  
2 stored.

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

7 The MOX facility will have the flexibility  
8 to produce 17 X 17 fuel arrays, 10 X 10 fuel bundles  
9 as well as fuel assemblies for the new generation  
10 reactors. One MOX fuel assembly can provide enough  
11 energy to power nearly 9,000 homes for an entire year.

12 In 2008 four MOX fuel assemblies successfully  
13 completed two fuel cycles in a U.S. commercial nuclear  
14 power reactor. The location for the MOX sited SRS was  
15 prepared for construction and on the morning on August  
16 1<sup>st</sup>, 2007, construction of the MOX facility was  
17 officially started.

18 During the first two years of  
19 construction, MOX Services has successfully placed  
20 over 50,000 cubic yards of reinforced concrete, over  
21 10,000 tons of reinforcing steel, and over 5,100 feet  
22 of piping. According to Southeast Construction  
23 magazine, MOX was the largest construction project in  
24 the Southeastern United States as of 2008.

25 Currently over 4,500 people work in the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

16 NNSA continues implementation of its  
17 plutonium disposition program. The MOX facility will  
18 play a key role in the safety and security of removing  
19 excess nuclear material from the national inventories  
20 in accordance with the U.S. international agreement  
21 for the disposition of excess weapons grade material.

22 The beneficial reuse of these legacy materials in  
23 commercial nuclear reactors will mean less dependence  
24 on fossil and foreign fuels.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

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

21          MR. BADER:   Well, it's part of the  
22 challenge.   I'll describe a little more the  
23 purification process in detail.   But yes, essentially  
24 the - first we dissolve everything.   And in the  
25 process of dissolving some of the AFS feedstock,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 alternate feedstock, is chlorine contaminated. So the  
2 first impurity that we remove is actually in the  
3 dissolution unit where we are going to first cycle  
4 through the process, the electrolyzer to remove the  
5 chlorine. It comes out as a gas form, and then we end  
6 up treating it and producing sodium chloride waste  
7 product at the end.

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

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

16 MR. BADER: Correct.

17 MEMBER ARMIJO: Because they are really  
18 different.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

23 MR. BADER: It is, and I have to tell you  
24 the way we are set up to operate, the PDCF right now  
25 is not like you show in the picture. There is no work

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 going on right now other than I believe some assigned  
2 work activities.

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

7 MEMBER ARMIJO: Could you repeat that?

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

16 MR. BADER: DOE Complex.

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

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

21 MR. HENNESSEY: Yes, we are.

22 MEMBER ARMIJO: Okay.

23 MR. BADER: Go back a slide, finish that  
24 up, the rest of the MP process Scott will talk about  
25 in more detail. But essentially we ended up doing a

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 master plan and final blend, pellet production through  
2 the process, centering, and then rod production and  
3 fuel sending.

4 All right, this is the aqueous polishing  
5 process. The rest of the presentation is going to  
6 focus on this. The main blocks for the plutonium that  
7 the plutonium is going to follow are these heavily  
8 outlined blocks. And we start out with the KDD and  
9 KDB dissolution units, so those are three  
10 electrolyzers that are going through silver catalyzed  
11 electrolysis, which is basically move the PuO<sub>2</sub> into  
12 Pu nitrate. We will then treat the Pu nitrate with  
13 hydrogen peroxide, to get it correctly on state and  
14 also to reduce the silver valence state.

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

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

20 MR. BADER: We had depleted uranium in  
21 the dissolution process because further down in the  
22 KJPA process in this KPA stripping we will remove the  
23 uranium and to - for criticality purposes we add  
24 depleted uranium because the uranium in the feedstock

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 is high caliber U-235 content. So we add U-238  
2 essentially to dilute it.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

15 I don't know if that helps.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1                   MEMBER ARMIJO:       Still as a nitrate  
2 solution?

3                   MR. BADER:       Still as a nitrate solution.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

8 MEMBER ARMIJO: Okay, thank you.

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

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

13 CHAIRMAN POWERS: Oxygen?

14 MR. BADER: Oxygen.

15 CHAIRMAN POWERS: And what do you do with  
16 that?

17 MR. BADER: Send it up the ventilation  
18 system.

19 CHAIRMAN POWERS: How concentrated is the  
20 oxygen?

21 MR. BADER: I don't know the  
22 concentrations, but everything maintains below any  
23 pressure limits. We have done calculations that the  
24 venting is able to - during the whole process these  
25 tanks are all, they are sealed tanks; they are not

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 open to the environment. And they are vented by a  
2 ventilation system which is drawing a slightly  
3 negative pressure on all the tanks.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

9 CHAIRMAN POWERS: Are they paper?

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

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

13 CHAIRMAN POWERS: Glass fiber.

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

22 CHAIRMAN POWERS: Why do you use  
23 tetrapropylene?

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 CHAIRMAN POWERS: I know there is a  
2 relative term.

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

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

10 CHAIRMAN POWERS: It says tetrapropylene?

11 MEMBER RYAN: Oh, okay.

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

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

23 CHAIRMAN POWERS: B using the branch  
24 chain you cut down on the amount of cross-linking you  
25 get and polymerization. The expense of that is that

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 you do increase radiolytic hydrogen generation. Do  
2 you have a database on radiolysis of tetrapropylene?

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

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

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

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

20 MR. NORATO: Mr. Chairman, if I may, Mike  
21 Norato with NRO again. The staff did look at this  
22 during the review, and you are right, there is not a  
23 lot of hard data. However experiential - operating  
24 experience from La Hague indicated that this diluent  
25 actually did perform quite well under the red fields

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 that were much higher than would be expected at this  
2 facility.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

11          MR. BADER: Absolutely.

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

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

17                 The hand hydrazine plutonium then move  
18 down to the oxidation column, and the oxidation  
19 column, we destroy the hydroxylamine and the  
20 hydrazine, and oxidize the plutonium to Pu-4 nitrate.

21         The - we then - next slide - some of the equipment in  
22 the process. And this is the mainstream, many  
23 substreams here. Basically it's columns, tanks,  
24 mixers, settlers, slab settler we insert in the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 process after we do the diluent wash just to remove  
2 any other separate phase organic material.

3 Then the oxidation and stripping columns  
4 and air stripping columns.

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

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

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

18 MR. BADER: No, those temperatures are  
19 lower.

20 MEMBER ARMIJO: Lower?

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

3 CHAIRMAN POWERS: Your stainless steel is  
4 304 or 316?

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

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

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

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

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

24 MR. BADER: The dissolution unit is  
25 batch-wise. It sits in the electrolyzer for several

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 hours, in solution. And then we batch it through the  
2 hydrogen peroxide and the depleted uranium addition,  
3 and then we come to the purification process, the  
4 cycle which is a continuous cycle, so we have a large  
5 holding tank up front of the process to make sure  
6 there is a continuous feed going through the process.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 of gallium accumulating between boundaries in the  
2 stainless steel?

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

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

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

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

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

14 CHAIRMAN POWERS: Say that again.

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

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

22 CHAIRMAN POWERS: You want to be able to  
23 accommodate an accident. Has anybody done any  
24 material study to say if this gallium at these very

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 low concentrations you are going to anticipate going  
2 to accumulate in the grain boundary?

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

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

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

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

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

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

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

23 MR. BADER: In nitrate.

24 CHAIRMAN POWERS: It depends on how  
25 oxidizing it is. Depends on how complete it is, and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 how much transition you get, and we are going into a  
2 transition from one metal to the next. Who knows  
3 what's going to happen? I mean I wouldn't trust a  
4 model on this, would you?

5 MEMBER ARMIJO: No, experiments are best.

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

10 CHAIRMAN POWERS: Like to see what that  
11 was.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

18          MEMBER ARMIJO:        You just went plain  
19 vanilla?

20          MR. BADER:        Yes. I think the next slides  
21 --

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

22 The following the furnace we have the  
23 homogenization sampling unit. These are basically  
24 glovebox units where we pull samples to make sure we  
25 have proper material coming out of the furnace and in

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 preparation for the MOX processor. This is pretty  
2 foreign units, so we can move on. Some of the support  
3 units, if you look at these block diagrams, the KPB  
4 process comes off the KPA process over here. That is  
5 - this process here basically is removing the  
6 degradation products from the organic material after  
7 we have already separated the plutonium, and we have  
8 also removed the uranium from this. The uranium gets  
9 separated in a mixture settler in the purification  
10 process. And the organic moves to this process unit,  
11 and here we end up treating the organic with soda,  
12 sodium carbonate, and acid, through mixer settler.

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

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

23 CHAIRMAN POWERS: And one of the issues  
24 that comes to mind in this is the accumulation that is

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 suspended, otherwise unidentified particulate in this  
2 material; how well do you filter it?

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

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

10 MR. BADER: Yes.

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

24                   MR. BADER:       Yes.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

2 MEMBER RYAN: Something new.

3 MEMBER ARMIJO: Fair enough.

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

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

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

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

24 MR. BADER: No, I don't think it's up to  
25 us to classify the waste, because it's all getting

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 sent to Savannah River site into the waste  
2 solidification building for treatment.

3 MEMBER RYAN: Are those in the same box?

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

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

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

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

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

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

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

22 From the KCA unit we have the oxalic  
23 mother liquors, basically nitric acid and there might  
24 be some plutonium left in that stream. It would be  
25 considered a waste stream, but we recycle this stream,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 on my flow diagram. Basically this is the KCD unit  
2 here. These end up going back into the process, and  
3 into the acid recovery. So what we end up doing is,  
4 we send the material into an evaporator. It  
5 concentrates, ideally ,with all the plutonium. Our  
6 recycle to the front end of the purification process.

7 The distillates are sent to the acid recovery unit  
8 which I believe is the next slide.

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

10 There --

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

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

7 MR. BADER: From there? From DOE  
8 complex?

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 possible release facility with respect to plutonium  
2 feedstock.

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

13 MR. BADER: Okay.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

3 MR. BADER: I skipped that second slide.

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

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

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

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

20 MEMBER ARMIJO: They're stainless steel.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MEMBER ARMIJO: Zirconium alloy?

2 MR. STONE: Yes.

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

19                   I believe that is it.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

21           MR. SALZMAN:    Okay.

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

25           MR. SALZMAN:    Yes.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

18                  MEMBER ARMIJO:        I think you are going to  
19 have - sometimes your UO2 scrap in a conventional fuel  
20 factory which is too dirty to fix by centering or  
21 baking and it has to just - it's called dirty scrap,  
22 you either have to clean it up chemically or get rid  
23 of it. And do you have a process stream that takes it  
24 all the way back to your chemical plant, or do you

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 just - because you don't want to put it back in to the  
2 fuel element.

3 MR. CHASSARD: Can I help you?

4 MR. SALZMAN: Sure.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 (Simultaneous speaking.)

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

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

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

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

17 MR. SALZMAN: Okay.

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

21  
22 MR. SALZMAN: Dust control. Well, if you  
23 want we can discuss dust control on certain dusty  
24 boxes, where we are pouring powder, where we are  
25 grinding, we do have systems that collect the dust,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and we collect the dust through centered metal  
2 filters, that are back pulsed with nitrogen, and we  
3 collect those with pots.

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

6 MR. SALZMAN: It's dry grinding.

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

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

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

19 MR. SALZMAN: Yes.

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

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

25

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

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

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

24 MEMBER ARMIJO: Depending on the fuel  
25 design you would adjust that concentration? Okay, and

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 so when you are grinding and your scrap all goes back,  
2 I'm just trying to see how you keep everything --

3  
4 MR. SALZMAN: We have a scrap process  
5 unit where that scrap comes back, gets blended and  
6 added to a jar; it's all sampled, and then they add  
7 that according to, in the back end and front end, and  
8 that is all done with the batch orders, and that stuff  
9 is all --

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

12 MR. SALZMAN: For any one campaign those  
13 are designated. Those jars are designated. The PuO<sub>2</sub>,  
14 the UO<sub>2</sub>, and specific scrap jars are designated for a  
15 batch, depending on what campaign we are running and  
16 what percentage of plutonium you want to produce for  
17 any given pellet.

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

23 (Simultaneous speaking.)

24 MR. CHASSARD: So you clean the old line  
25 before producing the next one. So you clean the whole

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 thing you got an inventory, and after, Gary Bell will  
2 talk about MMIS, which is a system that we are using  
3 to try to quantities we've got. But the key thing is  
4 that we clean all the equipment before moving to the  
5 next one.

6 MEMBER ARMIJO: And that includes  
7 grinding dust, everything?

8 MR. CHASSARD: Everything. MR.

9 SALZMAN: Okay, so get to the receiving block  
10 diagram.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

8 MEMBER ARMIJO: What is a DCE?

9 MR. SALZMAN: That is plutonium buffer  
10 storage. That is our polished plutonium oxide powder.

11 It's a reusable can that are canned up in KCC units  
12 and sent to buffer storage, and we call those a batch  
13 of master mix of 20 percent, that is our first blend  
14 down. The U02 drums are moved to a club box; they are  
15 emptied; and PO2 and U02 end up in our first blend  
16 down, 20 percent, which is in the powder area.

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

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

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

23 MR. SALZMAN: You get used to it.

24 MEMBER RYAN: Not today.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 dosing, where we blend down to our final PuO2  
2 concentrations.

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

6 MR. SALZMAN: Yes, it's basically  
7 blending the PuO2 down to our final concentration, 4,  
8 5, 6 percent whatever is required in that campaign.

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

20 From jar storage we have 80 kilogram jars  
21 that the final mixture is in. Those go to our  
22 palletizing units, palletizing units we - there are  
23 some additives added to the powder. It's zinc  
24 stearate in a pore former, one is for the pellet press  
25 dye, there is some lubrication there; the other is to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 get proper pellet densities. We mix the stearate in  
2 an homogenizer. That powder is then dropped down  
3 through and fed to the pellet presses where we punch  
4 out our pellets. And those are loaded into molybdenum  
5 boats, and get ready to go into the pellet side.  
6 Those are our pellet process units. Our pellet block  
7 diagram, we have a powder area, and we basically have  
8 a bunch of storage units as we process these pellets,  
9 see those in the middle. This stuff is all  
10 transported around back and forth by a spinning tube  
11 carriage system called the PML, so it picks up these  
12 various containers full of pellets and moves them from  
13 unit to unit.

14 So what we do as we press out the green  
15 pellets, those are then stored in green pellet storage  
16 in molybdenum boats. Those get processed through the  
17 centering furnace. We have two centering furnaces.  
18 Molybdenum boats are put on molybdenum shoes and slid  
19 through the centering furnace, the standard centering  
20 process. We have a preheat section where we - the  
21 zinc stearate and the core former are removed. It's  
22 all done in a reducing atmosphere, and we go through  
23 the centering section to get the proper ceramic  
24 characteristics, densities, and it goes in a cool down  
25 section, and we end up exiting the centering furnace,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 they go into a centering pellet storage area, down to  
2 grinding down to a specific size, and then on into  
3 ground and sort of pellet storage there, visual  
4 checks, and mechanical checks that are done on those  
5 pellets, quality control. They sample some of those  
6 to make sure - they sample some every little boat that  
7 comes through to make sure that we are hitting our  
8 percentage and the proper ceramic characteristics, and  
9 once they are ground and sorted then we are off to the  
10 - okay, but I have a little typo there - we are off to  
11 the rod area, once we have our --

12 MEMBER ARMIJO: What is your centering  
13 furnace atmosphere?

14 MR. SALZMAN: It's argon hydrogen.

15 CHAIRMAN POWERS: Plumbing gas  
16 composition? Four percent hydrogen?

17 MR. SALZMAN: Four and a half, five  
18 percent, yes. Then we are on to the rod area. This  
19 is where we assemble our rods. From the pellet area  
20 we come into rod cladding and decontamination of the  
21 pellets brought in the big pellet tray. And I think  
22 we saw a picture in a video earlier. They line up the  
23 pellet trays they are indexing in the pusher, and the  
24 pusher pushes those pellets into a rod blank and as  
25 soon as we stack the pellets in there the end fittings

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and the spring is put on, we weld the end plug, then  
2 it goes into a sealed chamber where we evacuate it,  
3 back fill it with helium, and then hit with the C  
4 weld. Those are decontaminated and checked, and at  
5 that point then we bring them out of the glovebox  
6 through inflatable seals and load them on rod trays.

7  
8 CHAIRMAN POWERS: What are you  
9 pressurizing the rods to?

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

10          MR. SALZMAN: Inside the rod, yes. Yes.  
11 Well, we have waste limits that we would be meeting  
12 there. So once we have these rods ready to go, they  
13 are all identified. The rod trays are identified. So  
14 they call for specific rods to manufacture assembly,  
15 so we go first we bring the rods in and this is all  
16 done in a mechanical system. The rod trays are  
17 brought in, and we have a mock up unit where we  
18 basically mock up the assembly, and this thing is  
19 indexed, and a mechanical system pushes the rods into  
20 this mockup assembly as it indexes back and forth on  
21 the 17 by 17 grid, the mock up is then rotated, and  
22 it's backed up this assembly fabrication table. The  
23 grids are all locked down on a pulley table, and the  
24 assemblies or the rods are then manually pulled from  
25 the mock up, which is right up to our pulling table,

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and manually pushed into the grids. We have our guide  
2 thimbles, and as the facility install all the rods in  
3 the guide thimbles, and into the grids. The end  
4 fittings are put on, and installed. Some of those are  
5 cribbed and dimpled. Once we have our assembly  
6 finished, the locks are taken off, the pins are  
7 pulled, the keys are pulled, the grids are locked  
8 down, and we up end that fuel assembly and it's  
9 attached to a hoist and we start sending it over to  
10 dry cleaning. We have a pit where we put the fuel  
11 assembly into a pit and there is a big blower down  
12 there that blows up and down the sides of the rod to  
13 clean the rod. Any amount of contaminants, foreign  
14 material. There could be some small zircalloy pieces,  
15 that is collected in a filter at the bottom of the  
16 cleaning pit on a rolling paper filter.

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

21 MR. SALZMAN: No, we can generate during  
22 the assembly process we can generate some zirconium  
23 turnings as these things get pulled into the grids,  
24 and that is a hazard. It's been addressed. We handle  
25 that thing basically through housekeeping and regular

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 cleaning of those pulling tables and dry cleaning  
2 tables, and I think we are going to talk about that  
3 tomorrow under virally event. We do have an event  
4 where we address that.

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

8 MR. SALZMAN: Yes.

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

13 MR. SALZMAN: They are all prepared.  
14 Those rod blanks come in, the end plugs come in, they  
15 are fitted up and sealed up, or welded around, and  
16 then seal welded. Okay, so where are we? So we go  
17 through a couple of inspections. There is a visual  
18 inspection where an operator visually inspects, and  
19 then there are some dimensional inspections where we  
20 check lengths and dimensions, how parallel it is, and  
21 that's all done with some mechanical sensors and  
22 lasers. So once you get done with inspection, they  
23 are moved with the hoisters into the storage area,  
24 they are stored, and as they are called for for  
25 shipping, we take those out. They are bolted up to a

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 strong back, three to a strong back. Strong back sits  
2 on a rotating table, the hoist moves and then there is  
3 an assembly over there. They are bolted down to the  
4 strong back, and the strong back then is downended and  
5 slid into fresh fuel shipping package. That is then  
6 bolted up. Impact limiters are installed and an air  
7 palette that is taken out through our receiving  
8 shipping area. And it's loaded onto a transport truck  
9 and off we go to the reactor.

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

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

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

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

24 MR. CAMPBELL: Larry Campbell again.  
25 It's my understanding that it could have been last

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 week that spent fuel storage and transportation  
2 received a presentation regarding the transportation  
3 packages for the MOX fuel. I was not present at that,  
4 so I'm not sure what was said.

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

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

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

14 CHAIRMAN POWERS: The United States.

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

17 CHAIRMAN POWERS: Dr. Ryan.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MEMBER ARMIJO: At the utility site?  
2 Okay.

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

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

19 MEMBER RYAN: Shipment to where?

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

23 MEMBER RYAN: So far your waste outline  
24 is WHIP?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

9  
10 MR. SALZMAN: The transuranics we will do  
11 next.

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

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

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

19 MR. HENNESSEY: Oh, sure.

20 MEMBER RYAN: Okay.

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

23 MEMBER RYAN: Okay, great.

24 MR. SALZMAN: We have a pneumatic  
25 transfer system that we can, we move our cans around

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 from unit to unit. We have sort of like a bank  
2 transfer, and a couple of our utility units.

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

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

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

20 We also have done a very comprehensive  
21 analysis, ISA analysis, for the MOX facility. We have  
22 looked at hundreds of gloveboxes on the MP side,  
23 hundreds of vessels and tanks on the AP side. We  
24 evaluated thousands and thousands of deviations and  
25 event scenarios, doing very detailed HAZOPS. Start

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 out with a very elementary process, preliminary  
2 hazards analysis, looking at a broad spectrum of  
3 potential hazards. And as the design evolved we went  
4 into very intense sessions, workshop sessions on doing  
5 HAZOPS workshops what-ifs. I'll explain that in more  
6 detail later, but we spent over \$80 million doing the  
7 ISA, and I think it was very complete. It was  
8 equivalent to roughly 45 full time equivalents over 10  
9 years of supporting this integrated safety analysis.  
10 So we are very confident that it is complete, as well  
11 as conservative.

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 5,000 times the Part 20 Appendix B values,  
2 concentration values.

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

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

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

13 MR. HENNESSEY: Say again.

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

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

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

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

24 MEMBER ARMIJO: You handle that under the  
25 dose?

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and a third would be administrative controls.

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

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

11 MR. HENNESSEY: Right.

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

13 MR. HENNESSEY: It's one per year.

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

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

19 MEMBER RYAN: I don't understand it.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. HENNESSEY: Well, these are official  
2 definitions for our frequency terms that we meet. But  
3 we like to think in terms of some quantitative  
4 numbers. Engineers like to think in terms of numbers.

5 So they are roughly equivalent to  $10^{-5}$ ,  $10^{-2}$ , and  
6 in that range, of plus or minus factors of 10, not  
7 likely is --

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

11 MR. HENNESSEY: Per year.

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

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

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

24 MR. HENNESSEY: The regulations are --

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

5 MR. HENNESSEY: The official currency is  
6 those definitions.

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

10 MR. HENNESSEY: Right, well, they are  
11 the consequence criteria. High consequences are over  
12 100 rem to a worker, must be made highly unlikely.

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

17 MR. HENNESSEY: That is part of  
18 regulations. That is part of 10 CFR 70. That is not  
19 my definition. 10 CFR 70 spells it out very clearly,  
20 and it's 100 rem per worker is the criteria you need  
21 to meet. That's not to say if we go over - typically  
22 worker doses, we don't need to go through the  
23 analytical part of that, because it doesn't take much  
24 plutonium to get you to 100 rems. So we don't do the  
25 transport analysis in the glovebox to the worker. We

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 just assume anything getting out of the glovebox has  
2 got to be made highly unlikely.

3 CHAIRMAN POWERS: Was this slide intended  
4 to be - this is just a restatement or summary of  
5 70.61. This is not the criteria. Nothing original?

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

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

25 Now we achieved highly unlikely by

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

23 Management measures, this is important to  
24 us because frequent failure, frequent surveillance,  
25 periodic surveillance of the IROFS say on a monthly

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 basis can reduce your likelihood by the order of a  
2 factor of 10. So that is typically what we aim for is  
3 surveillance on a monthly or in or about basis.

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

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

23 Demonstrate the IROFS perform their  
24 intended safety function when necessary. That's  
25 spelled out and we submit that in the license

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 application and the ISS summary, then we prepare the  
2 ISA or maintain it really for the life of the  
3 facility.

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

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

13 The safety assessment phase, again, we  
14 identify hazards and events. We identify safety  
15 strategy in what's called at the time principal  
16 systems structures or components, PSSCs. These are  
17 analogous to what we now call IROFS, items relied on  
18 for safety. That was the term that was used for the  
19 CAR. You will hear more about that, I guess. The  
20 last bullet year it says, proper implementation of the  
21 principal PSSCs was verified during the construction  
22 and inspection process. This is ongoing as we speak.

23 And the staff, sort of a third step in our licensing  
24 process, the staff needs to ensure that the PSSCs have  
25 been properly fabricated and installed and so forth

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 before they will give us an operating license.

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

16 I just want to go through an example to  
17 try to clarify the process a little bit. This is an  
18 example of a breach in the glovebox, the powder  
19 glovebox, primary dosing is my favorite example, is  
20 dosing just means that initial mixing step. The event  
21 here is a loss of confinement or dispersal of nuclear  
22 material, dispersal of plutonium. We do a PHA,  
23 identify the hazards, based on a checklist from the  
24 NRC's guidance document, NUREG 1513, and AICHE, some  
25 hazards evaluation guidelines as well to identify

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 hazards, in this case the radioactive material, the  
2 Pu, and the glovebox is the location of it. You  
3 assess the likelihood. If it not unlikely then we do  
4 have failures of gloves once in awhile, there is the  
5 potential, they do tear and they do develop pinhole  
6 leaks.

7 The consequences from such an event we  
8 assess at the facility would be high. It only takes  
9 about a microgram to reach the 100 rem dose criteria.

10 IOC is - there are three receptors as we call them,  
11 the IOC is the individual outside of control boundary  
12 of the facility. We assess that as the public, you  
13 know, even though it's only a couple of hundred yards  
14 away. And the environment as I mentioned before is  
15 also a criteria that we need to meet when we develop  
16 mitigative features.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

4                   MR. HENNESSEY:       This is an accident  
5 condition.

6                   MEMBER RYAN:     Just accident.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

5 MEMBER RYAN: Okay.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1           And the environment area is that small  
2 area in between, restricted area in boundary, about  
3 200 meters.

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

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

21           The ISA phase, its purpose is to identify  
22 IROFS at a much lower level, the component level at  
23 the CAR stage where it's done more at the system  
24 level. We just like you demonstrate that the IROFS  
25 are adequate to ensure the performance criteria are

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 met and also the reliability and availability  
2 criteria. Next slide.

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

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

18 We also develop safety limits. Oops.

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

3                   MR. HENNESSEY:   Oh, yes, there's a major  
4 feedback into the design process.  At the high point  
5 of our doing our haz ops and what-ifs, we had maybe  
6 4,000 action items to go back to the engineering staff  
7 to do more detailed analysis to show that the IROF  
8 could perform its safety function.  For example a jar  
9 dropped from a lift in the glovebox, to make sure it  
10 doesn't fall through the glovebox.  We added probably  
11 1,000 IROFS at that point during that stage, just were  
12 upgraded many systems to be IROFfed, to be safe.

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

20                   The ISA process, again, the process hazard  
21 analysis.  Really it's the meat of our safety analysis  
22 ISA process.  The NSC, then NCSEs.  NSCs, we have -  
23 say we do those for nine criticality events, the fire,  
24 loss of confinement, explosion and so forth.  And  
25 NCSEs are just a little different focus.  And we also

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 do the double contingency criteria, verification, in  
2 the NCSEs. Next slide.

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

14 This is the team makeup. You have a  
15 couple of process experts, depending on whether it's  
16 an AP unit or a MOX fuel fab. So I have the  
17 engineering disciplines as well as fire protection as  
18 an important part, human factors engineer, and  
19 probably five or six safety guys, chemistry, an AP  
20 unit, criticality safety, nuclear safety, rad  
21 protection. And we have operations personnel from  
22 Melox and La Hague as part of the haz ops team, follow  
23 those documents as I mentioned before at the bottom  
24 there, as guidelines for the approach. Haz op  
25 methodology is pretty standard. You divide the units

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 into discrete modes, tanks, post columns and so forth,  
2 identify the design of the intended node, and then you  
3 do the systematic applied guidewords - systematically  
4 apply the guide words of high , low, temperature  
5 pressure and so forth, pretty standard stuff.

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

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

18 What-if methodology is similar but you  
19 don't have the guide words like you did for haz ops.  
20 But you postulate scenarios in the form of questions.

21 What if a jar of Pu falls off the jar lid for  
22 example. During the workshop, and this is an intense  
23 workshop where all the team members are participating  
24 and developing a set of questions, so it is very  
25 thorough, systematic, comprehensive approach.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

5           MR. HENNESSEY:     Say again.

6           CHAIRMAN POWERS:     Masks, credited?

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

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

23           NSCs IROF safety function describes, it's  
24 also part of the NSC, and an important part of this is  
25 the single failure criteria demonstration as well as

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 failure detection, goes in standards, QA requirements,  
2 other management measures applicable. And do a fair  
3 job of describing defense in depth features as well.

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

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

23 Next slide. Operating phase is a  
24 continuous process. ISA is a continuous process for  
25 the life of the facility. So as we go into operations

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 we will have a formal change control process, under  
2 50.59 for reactors. And 70.72 for our facility. But  
3 continue to demonstrate IROFS are adequate to ensure  
4 performance criteria, and also ensure the IROFS  
5 liability factors.

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

13 CHAIRMAN POWERS: How do you evaluate  
14 human reliability?

15 MR. HENNESSEY: Human reliability?

16 CHAIRMAN POWERS: Yes.

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

20 MR. IMKER: Imker. We are not doing a  
21 PRHA reliability analysis, because we are based on a  
22 deterministic analysis for the project. So we are  
23 essentially looking at human error from the  
24 perspective of carrying out operations and making

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 mistakes. And omissions, commissions, that kind of  
2 thing.

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

5 MR. IMKER: No.

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

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

19 That's all.

20 CHAIRMAN POWERS: I am still unclear  
21 exactly how you do your assessment of errors of  
22 omission and commission. Because you are a  
23 qualitative probabilistic criteria you are trying to  
24 live to, I don't see how that interfaces here, because  
25 I've got a worker who makes a mistake. He doesn't

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 always make a mistake. We just assume that he does  
2 one time, and you say, okay, now how do I get - how do  
3 I get to my probabilistic criterion that I'm trying to  
4 live to.

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

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

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

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

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

24

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

6 MR. HENNESSEY: Absolutely.

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

11 MR. SALZMAN: It gets into training and  
12 procedures.

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

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

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

20 MEMBER RYAN: Right, exactly.

21 CHAIRMAN POWERS: The first time they go  
22 through this process I'm quite certain that it will be  
23 done in excruciating detail. The 100<sup>th</sup> time, maybe  
24 not.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

3  
4 MR. BADER: For the aqueous polishing we  
5 did haz ops. And so there is a certain number of  
6 deviations that you go through, and for the interfaces  
7 we did assume what happens in deviation one process,  
8 its impact on the downstream process. At those times  
9 we usually had to bring in the downstream experts into  
10 our haz ops so it could be documented. So it was  
11 definitely an iterative process. We couldn't just go  
12 have one process group go all the way through their  
13 process and be done. We had to understand that there  
14 are interfaces here that would impact the safety  
15 potential, so the haz ops were extensive for the  
16 deviations. And that's really how we picked up all  
17 the operator errors and so forth. You just assume the  
18 operator makes an error. If it's not IROF, it's  
19 credited as likely to her, he, whatever that number  
20 is, it's likelihood during the lifetime of that  
21 facility that that operator is going to err. So now  
22 next step is, what are we going to do to prevent any  
23 safety consequences as a result of that. That's the  
24 way we went through our haz ops.

25 CHAIRMAN POWERS: That I understand.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1           Okay, any other questions on this  
2 particular topic?

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

6           (Whereupon, at 10:50 a.m. the above-  
7 entitled matter went off the record and resumed at  
8 11:07 a.m.)

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

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

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

16  
17          CHAIRMAN POWERS:    And you have a double  
18 contingency to assure that this happen?

19          MR. COLEMAN:     We will find a way.

20          CHAIRMAN POWERS:    We have ways?

21          Dave, are you going to lead this  
22 presentation?

23                 NRC STAFF - OVERVIEW OF REGULATORY PROCESS

24          MR. TIKTINSKY:     Yes, I'm Dave Tiktinsky.  
25 I'm the project manager for NRC for the licensing

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 review, and I'll start talking a little bit about the  
2 staff, what we have done in the review.

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

16 Just a little background, the staff's SER  
17 and the construction authorization was issued in 2005.

18 That was reviewed by the ACRS at that time. The  
19 comments from the committee were integrated. Some of  
20 the comments were carried over to the future step,  
21 which are things that are being addressed here over  
22 the next couple of days.

23 The actual LA for license and possess and  
24 use was submitted in 2006, and has gone through a  
25 process of review, sectional reviews over a 3-1/2 year

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 period. The staff developed this safety evaluation  
2 report on the LA, completed that in June. An  
3 additional side, there is litigation ongoing. This is  
4 kind of a unique, where there was no mandatory hearing  
5 that was required, but there were two separate  
6 opportunities for petitioners to come in and file  
7 contentions. One was in the construction  
8 authorization which was closed, the second portion  
9 there was one contention that was accepted by the ASLB  
10 for the current licensing proceeding. There were  
11 other contentions that have been submitted recently.

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

20 The PSSC verification which I will get  
21 into in a few slides estimated 2014 for us to complete  
22 that, based on when the applicant completes  
23 construction. Following that we would issue the  
24 license to possess - use radioactive material, but  
25 also there would still be conditions including the

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 operational readiness review which is the second piece  
2 that is normally done for other fuel facilities. We  
3 would also be doing that for this facility. And after  
4 we granted that license and allowed the applicant to  
5 start up, and the hot start would begin for the  
6 applicant to begin processing material.

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

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

24 As our staff review, we followed, we have  
25 a standard review plan, NUREG 1718, that was written

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 specifically for reviewing MOX facility. That's what  
2 the staff used. Our reviews that we have done over  
3 the last 3-1/2 plus years were multifaceted and  
4 included in-office reviews of applicants, some of the  
5 things you've talked about, of looking at  
6 calculations, of NSEs, NCSEs, backup documents, a lot  
7 of those were done by the staff on a selected basis  
8 with the applicant looking at those documents trying  
9 to make sure they understood what the processes were  
10 to try to come to a conclusion related to the safety  
11 of the facility.

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

17 Substantial communications, we used kind  
18 of a communicative approach, and make sure everybody  
19 understood what was going on, before we'd issue an REI  
20 we'd issue them in draft. We'd have meetings with the  
21 applicant to make sure they understood what our  
22 questions were. When the applicant had prepared their  
23 responses, before they sent them in officially they'd  
24 come in and discuss them. So we had a good back and  
25 forth to make sure that the staff and the applicant

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 were talking about the same things, speaking the same  
2 language, and making sure we got answers to the  
3 questions that we had.

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

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

21 Other fuel facilities and other things  
22 where the committee has reviewed, the staff has done  
23 its review, and we issue a license with a condition  
24 for operational readiness, but the applicant can go  
25 ahead and basically build it, and they just have to

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 operate and go through that last step. For us we  
2 cannot issue that license until this particular step  
3 is done, and it's a very extensive effort.

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

24 I'll talk a little bit about the plan  
25 itself of what we are doing is developing the scope

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 and identify items for inspection. There are many  
2 many thousands of safety IROFS that the applicant has  
3 provided and has in this facility. The NRC needed to  
4 figure out exactly what we are going to look at, how  
5 we are going to look at it, risk significance. We  
6 also needed to develop programs to track --

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 look at a little bit of everything else, but what we  
2 try and emphasize are the items that were of most  
3 significance to the reviewers.

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

7 MR. TIKTINSKY: Well, the regulations  
8 are, we have to verify all the PSSCs, but we take a  
9 sampling of basically the subset of what's in a PSSC.

10 So each PSSC, some of them may be just in one  
11 particular IROF, some of them may have thousands of  
12 component IROFS within a particular PSSC. So really  
13 it depends on the nature of the PSSC what our sampling  
14 level is.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 function.

2 Also what we are doing is for each PSSC we  
3 are developing what we call independent verification  
4 plans, so each PSSC will have its own staff plan of  
5 what we are going to do and how we are going to do it.

6 And I won't say the next word there, but what we  
7 tried to do is look at prioritizing the IROFS at the  
8 ISA summary level which were event groups, and then  
9 after we've done that looking at components and trying  
10 to prioritize those for key areas that we want to  
11 emphasize, and then developing an informed level of  
12 inspection effort, which includes what kind of  
13 sampling we are going to do, how much sampling, and  
14 then inspection attributes, which are different things  
15 that are done in the inspection world of different  
16 things like looking at quality assurance, looking at  
17 vendors, looking at other receipt installation, there  
18 are various attributes that are done in inspection  
19 space.

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

23 Developing a plan for each particular  
24 PSSC, then also a part of that is, we need to make  
25 sure we are tracking everything. There are 53 of

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 these, they vary in complexity in multiple years, and  
2 at the end we have to be able to pull it all together.

3 So we developed a system for tracking.

4 We are developing procedures for looking  
5 at tech reviews of an admin control, what exactly we  
6 have to do, because we want to be able to hand off  
7 procedures to tech reviewers that are experts in the  
8 area, and say you need to look at these procedures to  
9 see if they meet the safety functions. We will  
10 develop guidance to outline exactly what we want them  
11 to do. At the end of each PSSC when it's done the  
12 applicant will submit what's called a PSSC completion  
13 letter. They need to know when it's complete so they  
14 can tell us, so we've been doing inspection all along,  
15 when they are done with that piece they will be  
16 sending that in as a letter. The staff will basically  
17 be writing a letter back called a verification letter  
18 for each PSSC, basically to document all the  
19 inspection and review activities we've done, and how  
20 we verified that it is actually complete. So you can  
21 imagine we will have - there are 53 PSSCs, there will  
22 be 53 completion letters, 53 verification letters.  
23 And then at the end when we are all done with all of  
24 these things, we will issue an SER supplement which  
25 basically summarizes all the verifications that were

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 done, references that the 53 documents of verification  
2 and completion, and after we completed that SER  
3 supplement, then we would -- every time we would  
4 actually issue a license.

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

12 CHAIRMAN POWERS: Lucky you.

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

15 MR. TIKTINSKY: That's how it's written.

16 It was a ruling from the ASLB that was appealed to  
17 the Commission. The Commission basically gave them  
18 the opportunity to file contentions related to that  
19 closure.

20 MEMBER ARMIJO: Okay.

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

23 MEMBER ARMIJO: It could go beyond that.

24

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 MR. TIKTINSKY: We have no control over  
2 that.

3 MEMBER ARMIJO: Right.

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 we will be able to finish all of our different reviews  
2 of that.

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

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

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

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

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

6 And just kind of the discussion protocols,  
7 how we felt the most efficient way of setting it up  
8 when we get into the individual events is that the  
9 applicant will make their discussions about the event,  
10 and of course the committee is free to ask them all  
11 kinds of different questions of whatever they are  
12 interested to make the case of that particular event.

13 Following each event the staff would make its  
14 presentation basically on what we did in the review,  
15 what we saw, how we made our findings on the review.  
16 So you get the opportunity for the staff to present  
17 what it did, and summarize basically what you saw in  
18 the SER.

19 Just kind of in conclusion that the staff  
20 is requesting the ACRS endorsement of the SER. We are  
21 implementing the PSSC verification program, that is  
22 happening over the next multiple years. And just that  
23 the license will not be granted until that PSSC  
24 verification is completed, which is different than

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 other fuel facilities and other facilities that the  
2 committee has reviewed in the past.

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

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

18 MEMBER ARMIJO: Okay.

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

21 CHAIRMAN POWERS: Okay. I am sitting  
22 here thinking about presentations for the full  
23 committee. And they certainly need to understand that  
24 the verification of the PSSCs is going to take place  
25 prior to the granting of the license. But the problem

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 is, I'm quite sure they are going to be fascinated by  
2 that. And unfortunately what they should be  
3 interested in is the safety evaluation report. And  
4 consequently, and how that was done.

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

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

22 The strategy we have to adopt is keeping  
23 that to an hour. Offering them fresh meat is not  
24 considered commensurate with that objective. So we  
25 have to understand that this is peculiar work we are

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1 doing, but I would really focus in your overview  
2 comments on the SER, and oh by the way the process is  
3 this, and then finally a license is granted.

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

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

8 MR. COLEMAN: So far.

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

17 MR. MORRISSEY: Choosing your topics  
18 wisely.

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

24 Okay, so.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

8 MR. HENNESSEY: On environmental issues.

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

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

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

15 MR. HENNESSEY: But that's it.

16 MEMBER RYAN: Nothing radiological?

17 MR. HENNESSEY: No.

18 MEMBER RYAN: Okay, just wanted to make  
19 sure.

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

24 MR. COLEMAN: That is entirely up to  
25 you.

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

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

5 Okay, so why don't we come back at 20 of  
6 1:00, and we will be in closed session, and we can  
7 start this thing. And so all be aware that only  
8 permitted people are in here for the closed session,  
9 and that we are going to start 20 minutes early.

10 So we are recessed until 20 of.

11 (Whereupon at 11:36 a.m. the above-  
12 entitled matter went off the record.)  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

1  
2  
3

**NEAL R. GROSS**

COURT REPORTERS AND TRANSCRIBERS

1323 RHODE ISLAND AVE., N.W.

WASHINGTON, D.C. 20005-3701

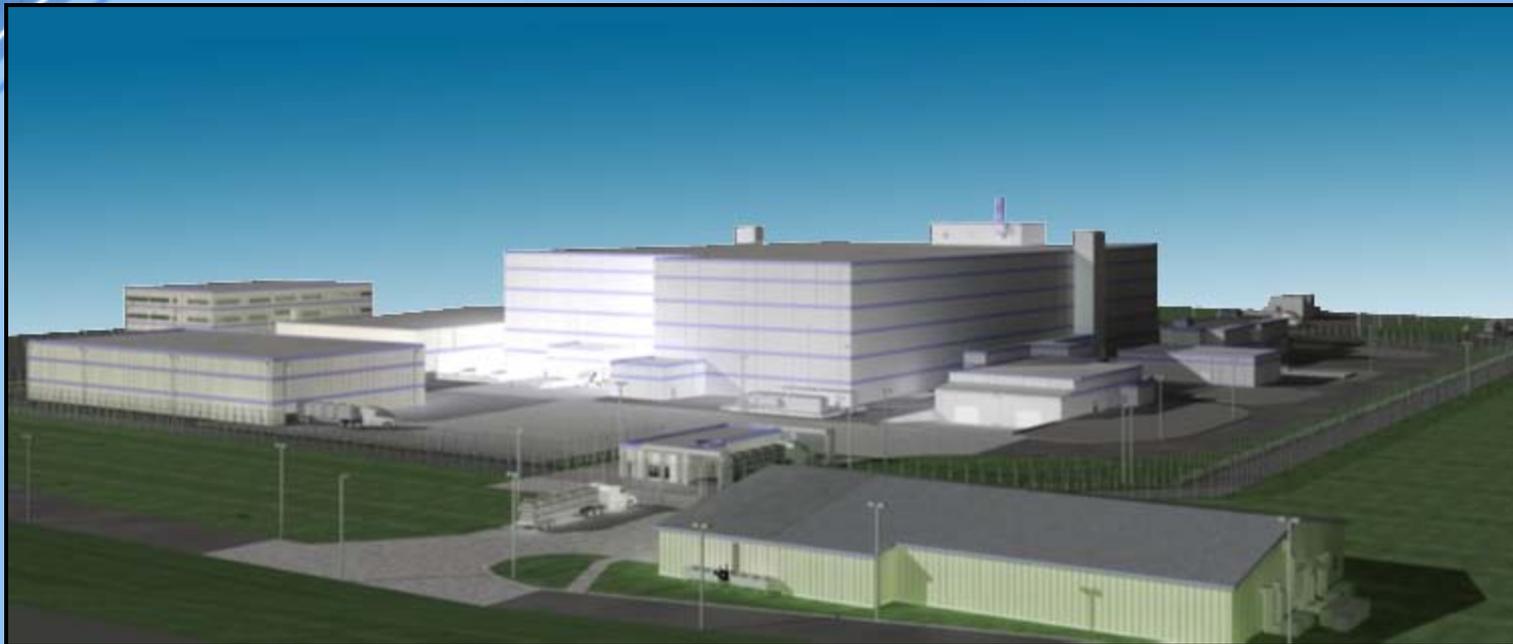
(202) 234-4433

[www.nealrgross.com](http://www.nealrgross.com)

# 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
- $k_{\text{eff}}$  – 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

# Overview of the MOX Facility



**Eric Chassard**  
**Executive Vice President**

*MOX SAFETY FUELS THE FUTURE*

# Agenda

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

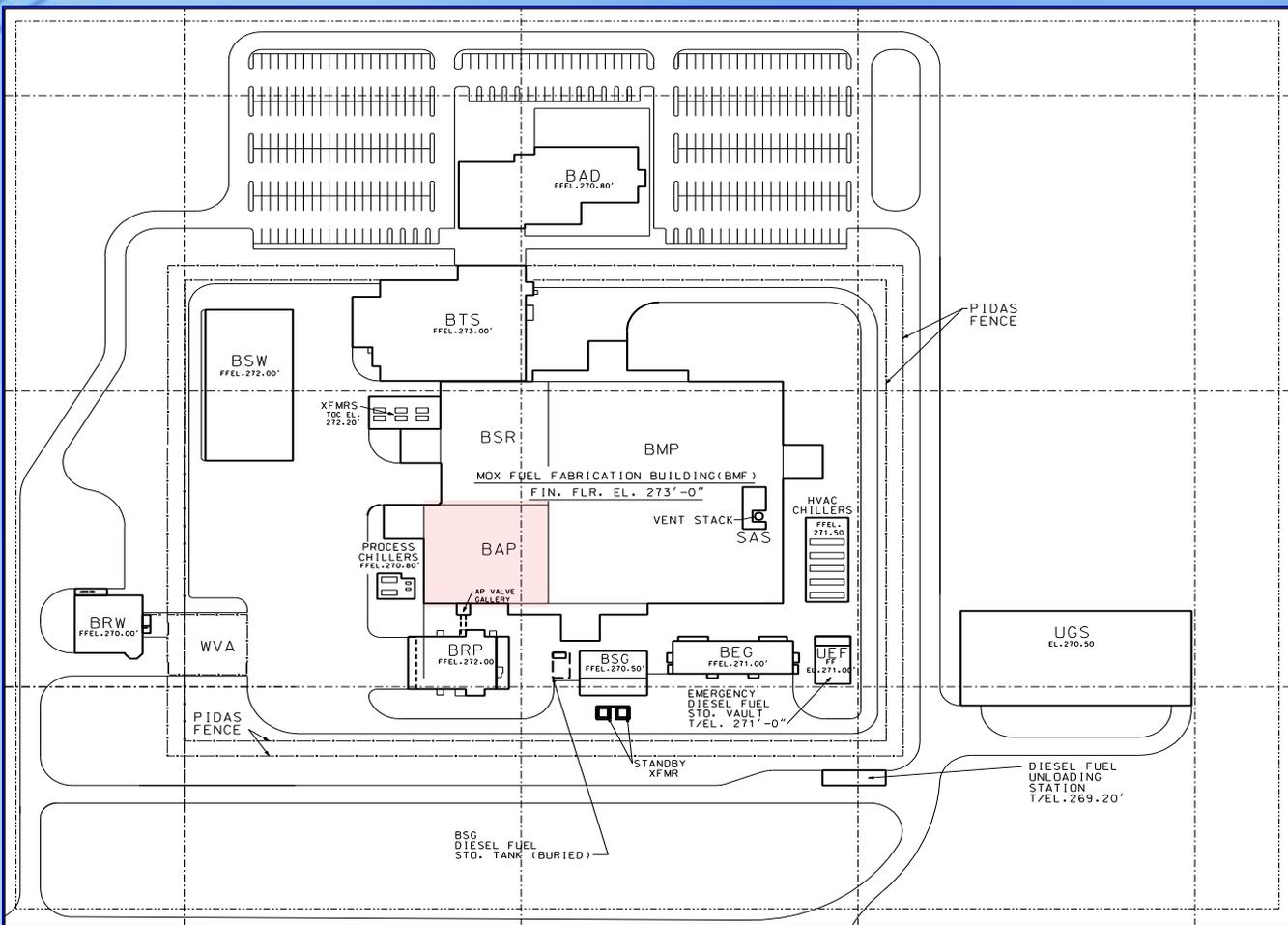
# Aqueous Polishing



**Sven Bader**  
**Integrated Safety Analysis**

*MOX SAFETY FUELS THE FUTURE*

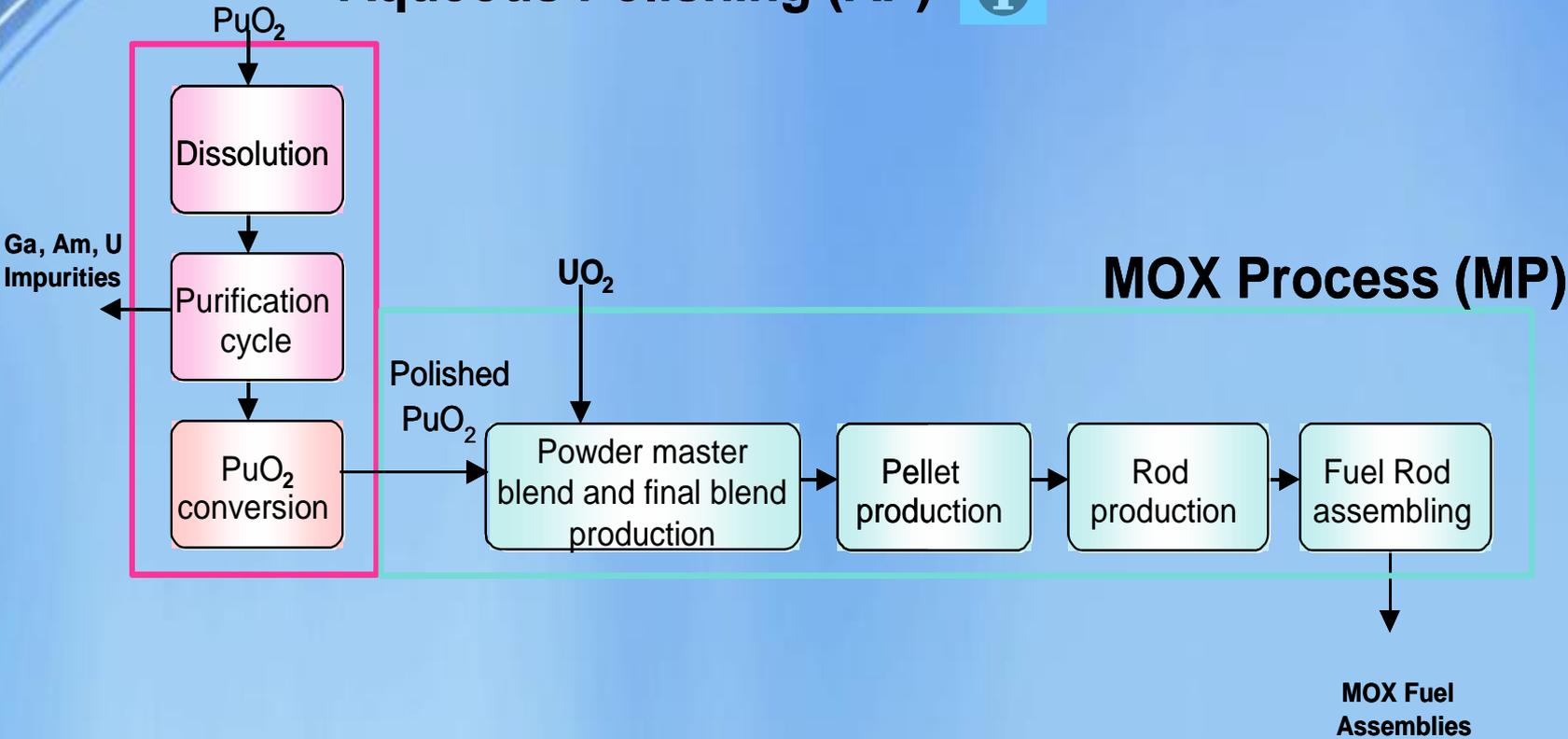
## The MOX Site



**MOX SAFETY FUELS THE FUTURE**

# Aqueous Polishing and MOX Process Main Steps

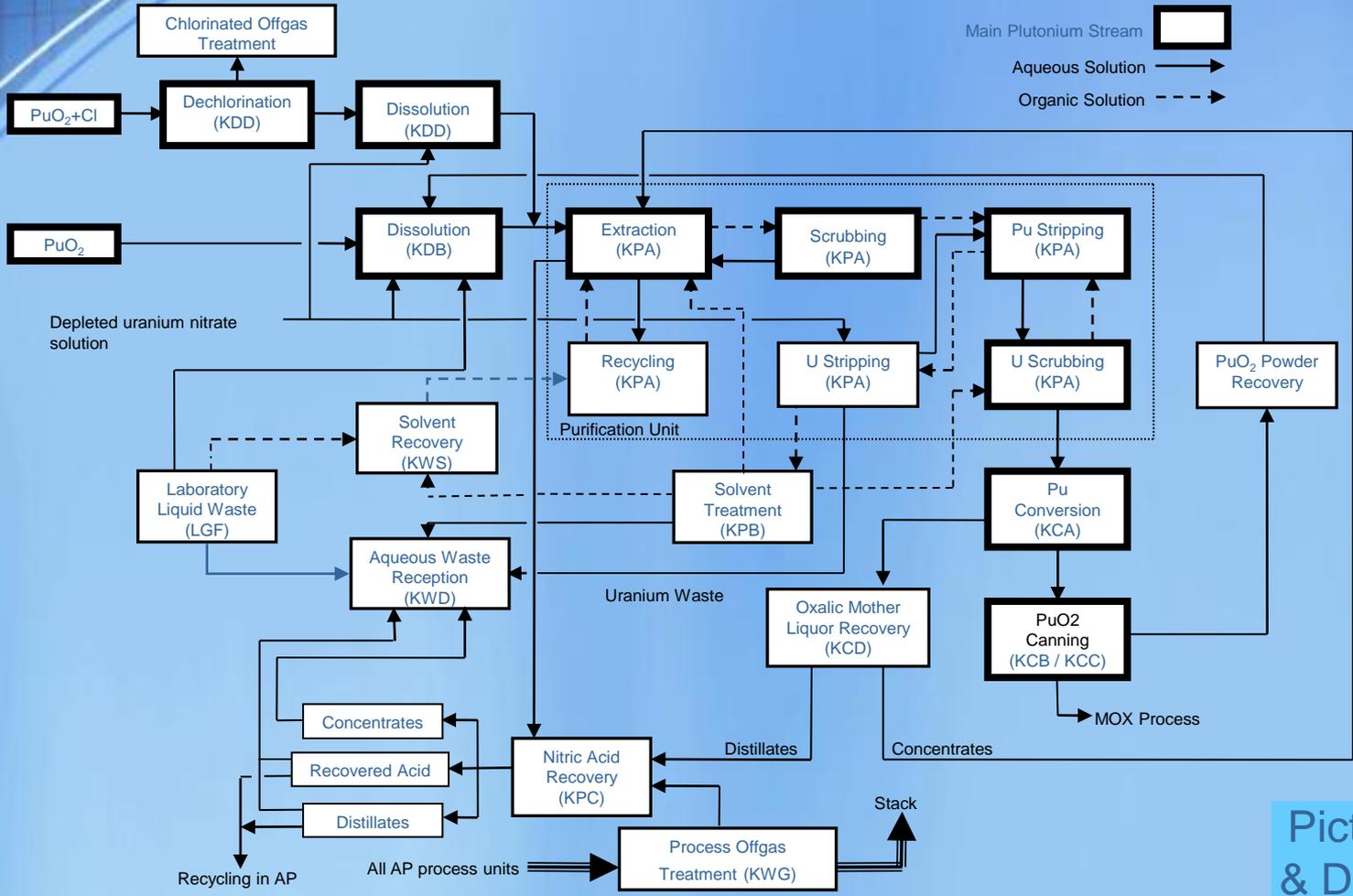
## Aqueous Polishing (AP)



## Feedstock and Throughput

- Feed from Pit Disassembly Conversion Facility (PDCF):
  - Weapon grade plutonium in  $\text{PuO}_2$  powder form
  - 100.5 kg Pu/week
- Feed of Alternate Feedstock (AFS): 
  - Non-PDCF plutonium in  $\text{PuO}_2$  powder form
  - Includes impurities of various salts and chlorides
  - Particle size may be coarser material than PDCF
  - 35 – 89 kg Pu/week

## Overview of the AP Process



Pictures & Details

MOX SAFETY FUELS THE FUTURE

# **Main Plutonium Chemical Processing Units of the Aqueous Polishing Process**

*MOX SAFETY FUELS THE FUTURE*

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

- Purpose
  - Dechlorinate  $\text{PuO}_2$  (AFS only) and dissolve  $\text{PuO}_2$
- Process
  - Dechlorination & dissolution performed with nitric acid
  - Dechlorination performed prior to dissolution by chemically and electrolytically dissolving & evolving  $\text{Cl}_2$  (monitored)
  - $\text{Cl}_2$  treated in a scrubber with final form of  $\text{NaCl}$
  - Silver catalyzed electrolytic batch dissolution in nitric acid
  - Pu and Ag valence states adjusted by  $\text{H}_2\text{O}_2$  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  $\text{NO}_x$  + 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)

# 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<sub>2</sub> after filtering, drying, and calcining the plutonium oxalate
  - Transfer PuO<sub>2</sub> 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)

**MOX SAFETY FUELS THE FUTURE**

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

- Purposes
  - Receive, homogenize, and cool the  $\text{PuO}_2$  powder produced in KCA
  - Fill reusable cans with  $\text{PuO}_2$  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

*MOX SAFETY FUELS THE FUTURE*

## 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

## **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
  - 1<sup>st</sup> stage natural recirculation thermosiphon evaporator and demister operated under vacuum (distillates to 2<sup>nd</sup> stage and condensates to KWD)
  - 2<sup>nd</sup> stage natural recirculation thermosiphon evaporator and demister operated under atmospheric pressure (distillates to 3<sup>rd</sup> stage and condensates to feed tank)
  - 3<sup>rd</sup> 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<sub>x</sub> 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<sub>x</sub> scrubbing
  - gas stripping
  - filtration and exhausters
- Equipment
  - One baffle-and-tray NO<sub>x</sub> scrubbing column
  - One baffle-and tray gas stripping column
  - Dedicated two-stage HEPA filtration and exhausters

**MOX SAFETY FUELS THE FUTURE**

## 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)

**MOX SAFETY FUELS THE FUTURE**

# 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

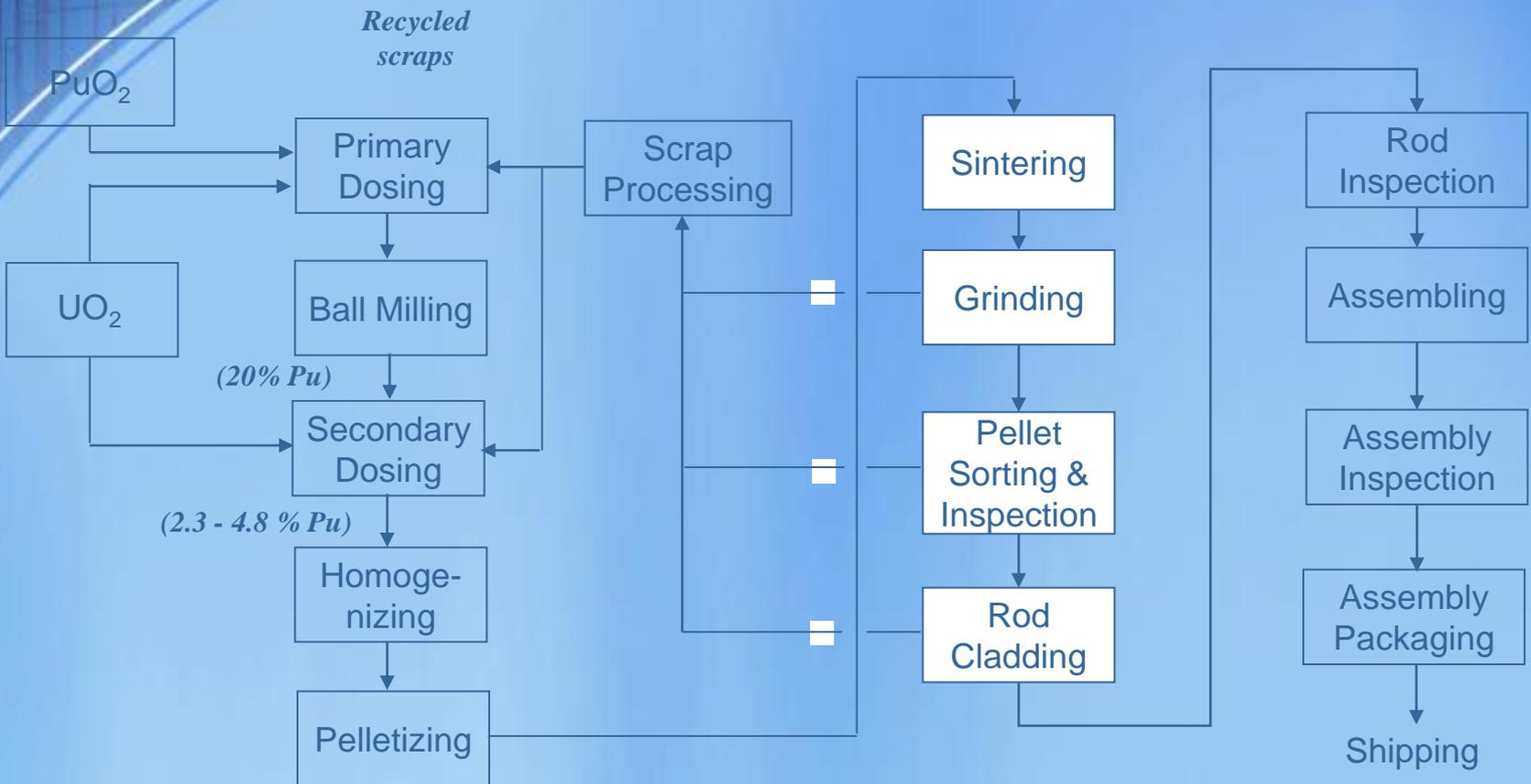
# MOX Processing



**Scott Salzman**  
**Integrated Safety Analysis**

*MOX SAFETY FUELS THE FUTURE*

# MOX Process General Block Diagram



RECEIVING AREA	POWDER AREA	PELLET AREA	ROD / ASSEMBLY AREA
----------------	-------------	-------------	---------------------

**MOX SAFETY FUELS THE FUTURE**

## Receiving Area

The functions of the Receiving Area include

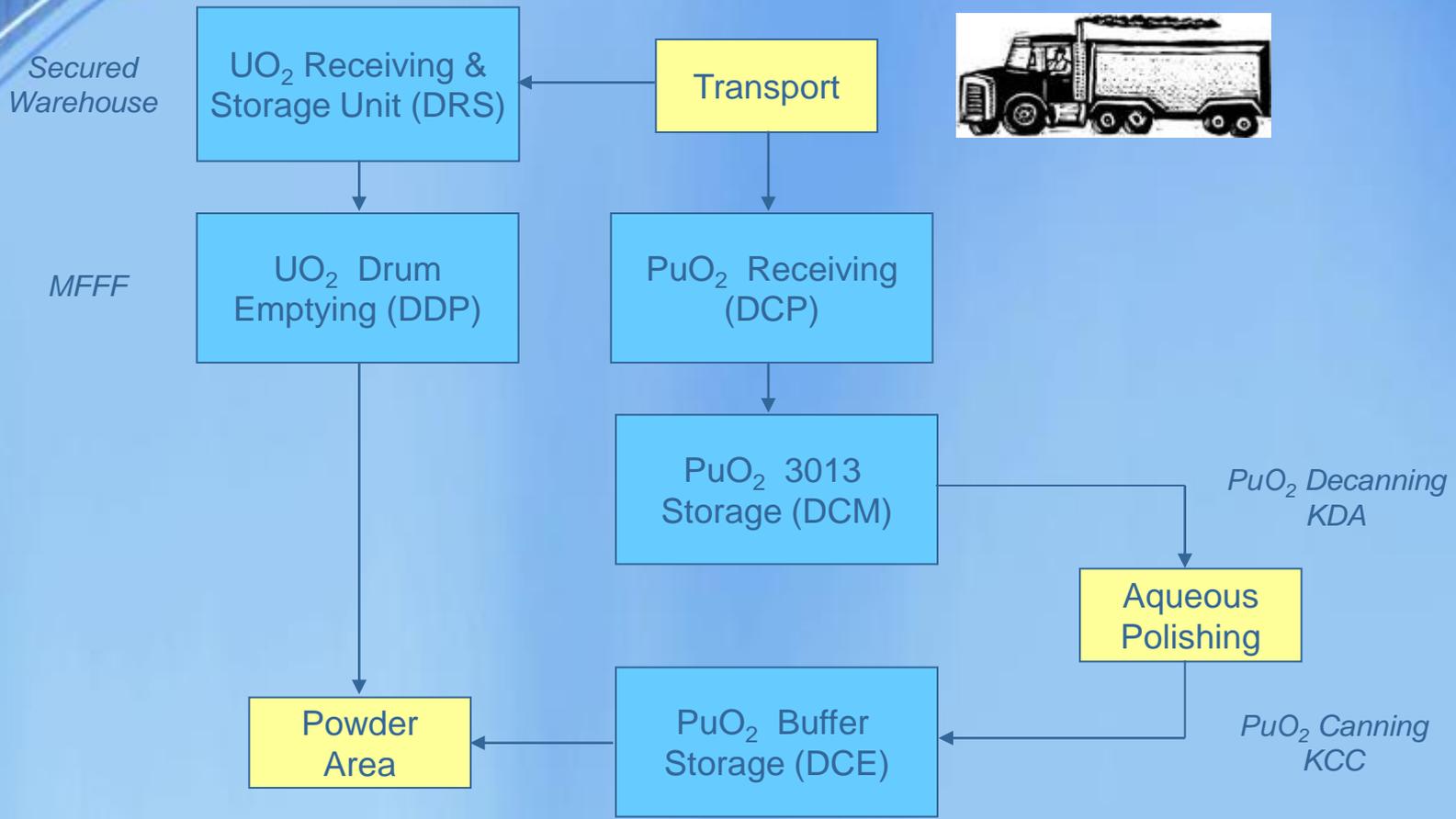
- Receive and store UO<sub>2</sub> and PuO<sub>2</sub>
- Open individually sealed drums containing depleted UO<sub>2</sub> powder and pour the powder into either the Primary Dosing Hopper or the Final Dosing Hopper
- Unpack, assay and transfer to secure storage, shipments of PuO<sub>2</sub> contained 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

- UO<sub>2</sub> Receiving and Storage Unit (DRS)
- UO<sub>2</sub> Drum Emptying Unit (DDP)
- PuO<sub>2</sub> Receiving Unit (DCP)
- PuO<sub>2</sub> 3013 Storage Unit (DCM)
- PuO<sub>2</sub> Buffer Storage Unit (DCE)

## Receiving Block Diagram



## Powder Area

The functions of the Powder Area include

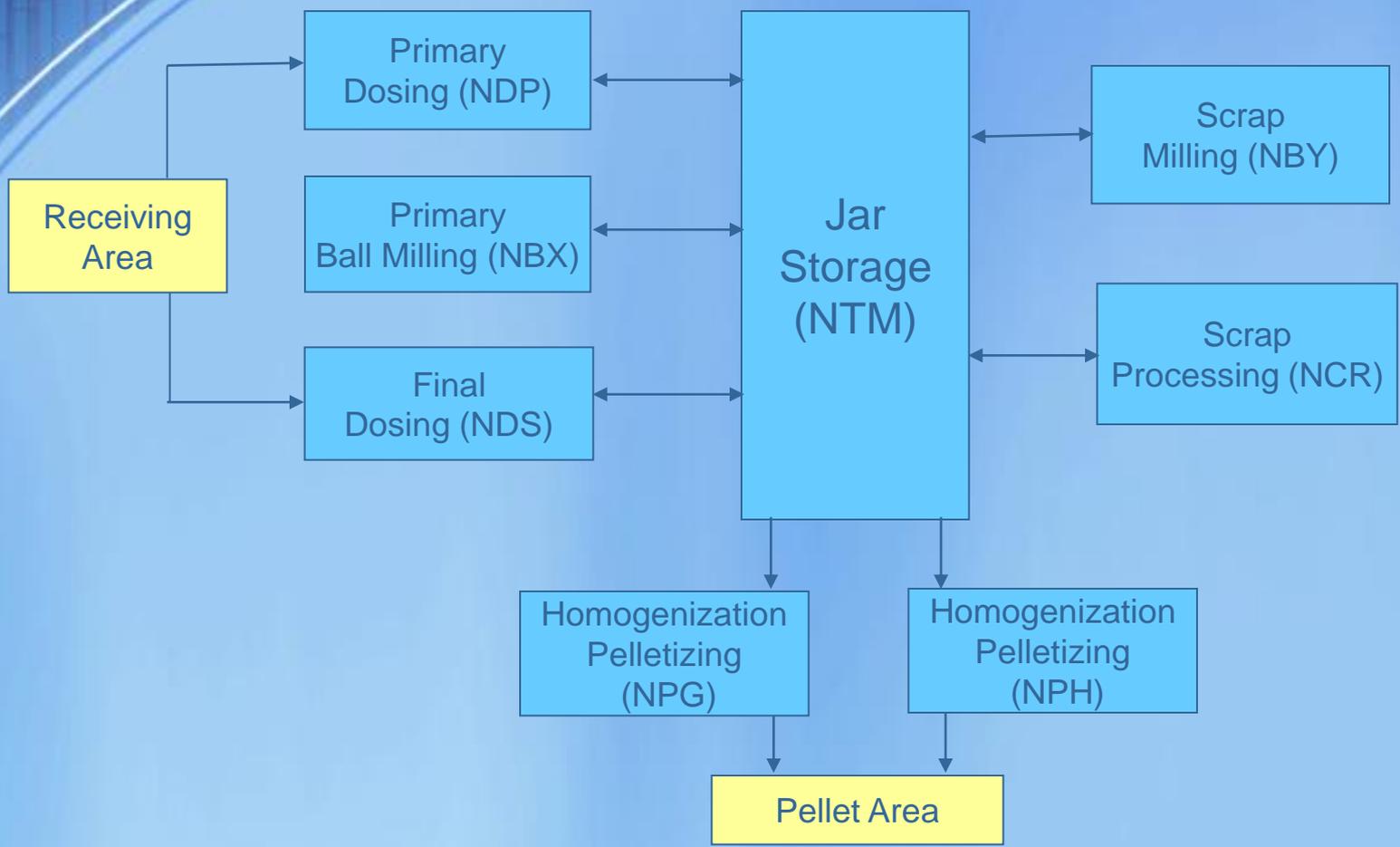
- Receive  $\text{UO}_2$  and  $\text{PuO}_2$  powder
- Produce a mixture of specific plutonium content suitable for the production of MOX fuel pellets

## Powder Process Units

The Powder Area is composed of the following units

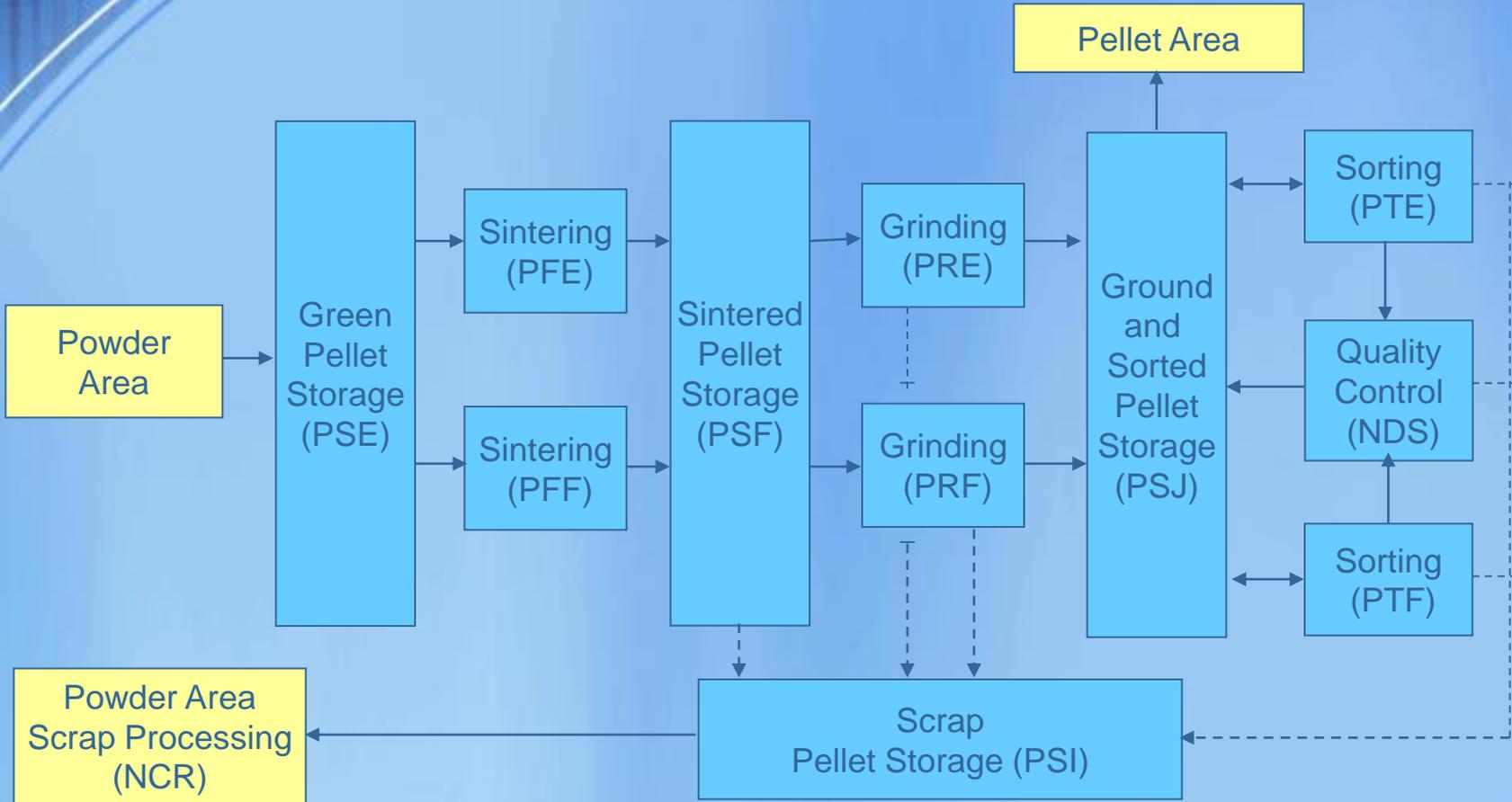
- PuO<sub>2</sub> Can Receiving and Emptying Unit (NDD)
- Primary Dosing Unit (NDP)
- Primary Blend Ball Milling Unit (NBX)
- Final Dosing Unit (NDS)
- Homogenization and Pelletizing Units (NPG / NPH / NPI)
- Scrap Processing Unit (NCR)
- Scrap Ball Milling Unit (NBY)
- Powder Auxiliary Unit (NXR)
- Jar Storage and Handling Unit (NTM)

# Powder Block Diagram



- 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)

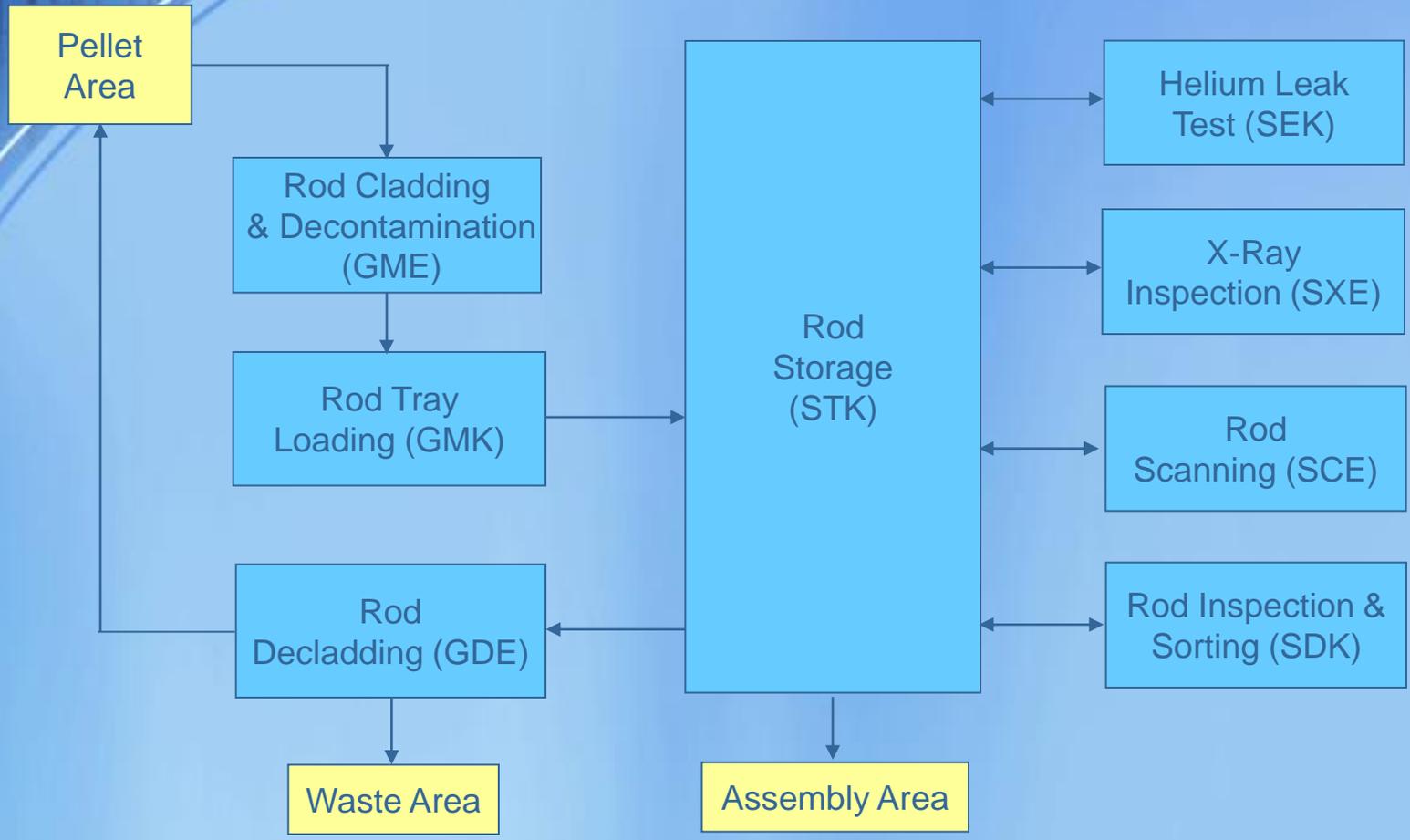
## Pellet Block Diagram



## Rod Area

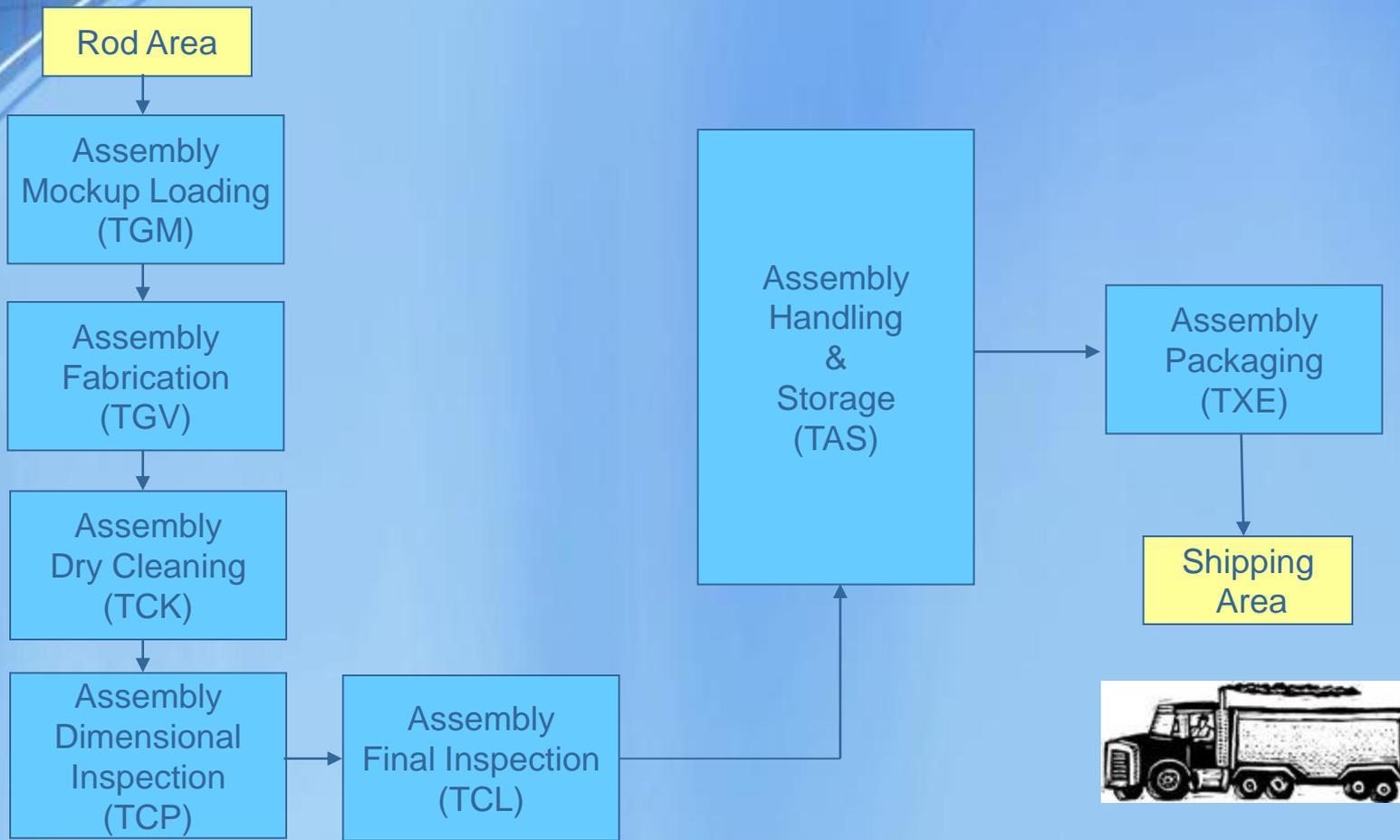
- Function
  - Load fuel pellets into the cladding (install springs, end plugs and weld), inspect and store fuel rods
- This area is composed of the following units
  - Rod Cladding and Decontamination Unit (GME)
  - Rod Tray Loading Unit (GMK)
  - Rod Tray Handling Unit (SMK)
  - Rod Storage Unit (STK)
  - 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



- **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)

## Assembly Block Diagram



**MOX SAFETY FUELS THE FUTURE**

## **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

# ISA Process/Event Development



**Bill Hennessy**  
**Nuclear Safety Manager**

*MOX SAFETY FUELS THE FUTURE*

# 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

*MOX SAFETY FUELS THE FUTURE*

# 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

*MOX SAFETY FUELS THE FUTURE*

# 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

# 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

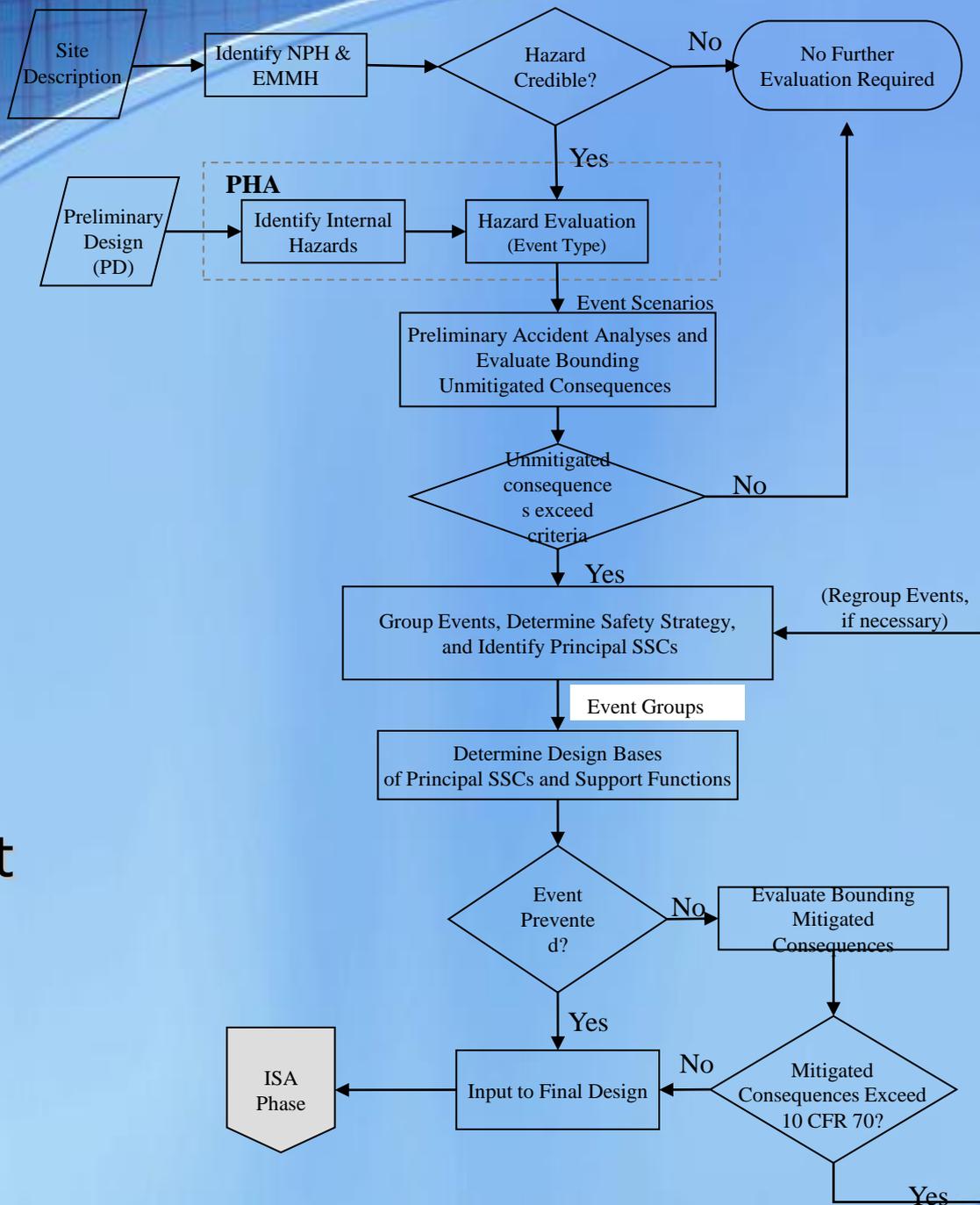
- 1<sup>st</sup> Phase: Safety Assessment / Construction Authorization Request
- 2<sup>nd</sup> Phase: Integrated Safety Analysis / License Application and ISA Summary

# 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

*MOX SAFETY FUELS THE FUTURE*

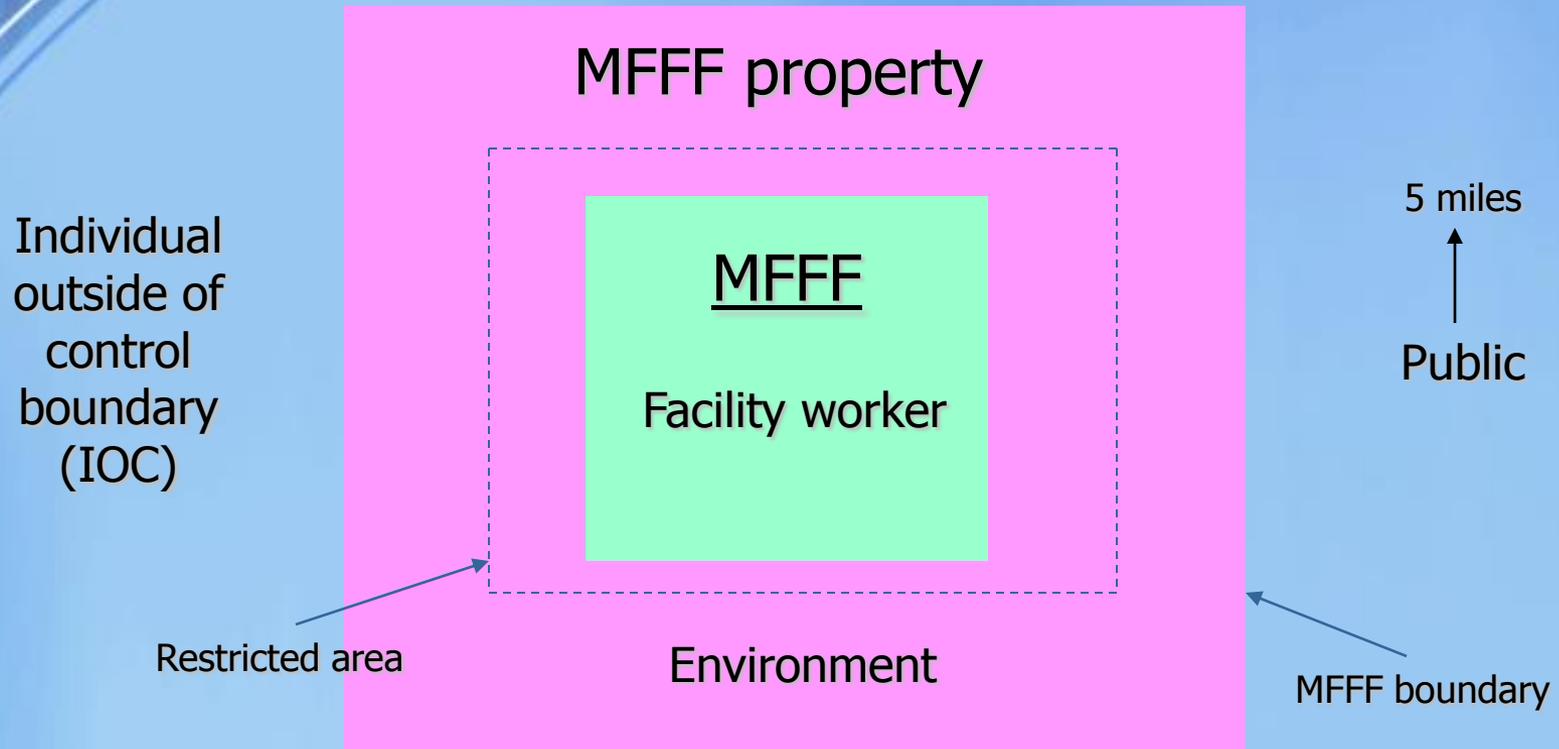
# Safety Assessment Phase



## 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



Savannah River Site

## Example - Event Development

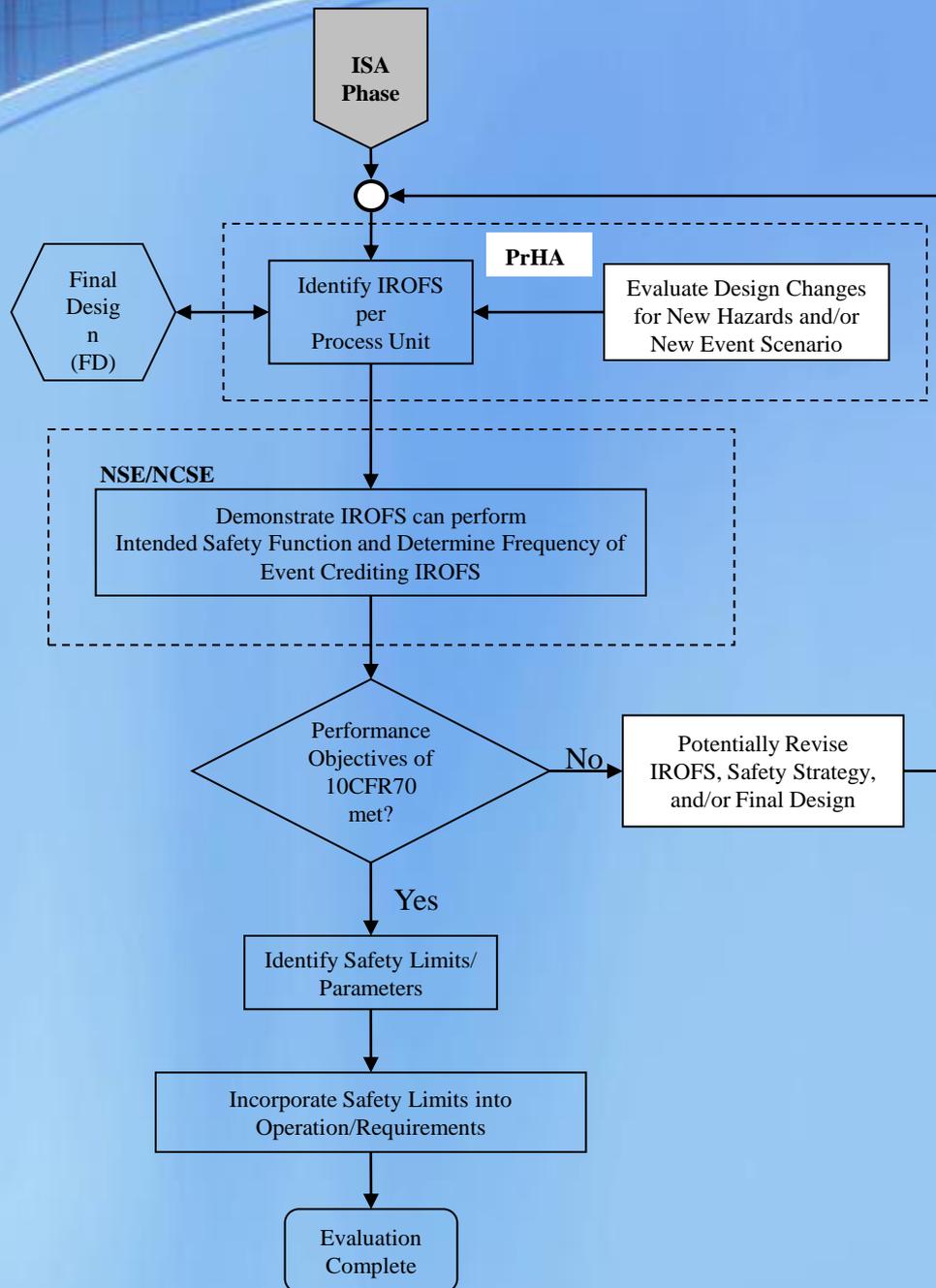
- Event/type: Breach of glovebox / loss of confinement
  - Preliminary Accident Analysis
    - Small Breaches in a Glovebox Confinement Boundary or Backflow From a Glovebox Through Utility Lines
    - Includes event groups: GB-4, GB-5, AP-13, AP-22
    - Consequence analysis: Facility Worker – High, 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

*MOX SAFETY FUELS THE FUTURE*

# ISA Phase



# 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

***MOX SAFETY FUELS THE FUTURE***

# 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

*MOX SAFETY FUELS THE FUTURE*

# 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)

**MOX SAFETY FUELS THE FUTURE**

# 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, UO<sub>2</sub> 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

*MOX SAFETY FUELS THE FUTURE*

# 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

*MOX SAFETY FUELS THE FUTURE*

# 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 SAFETY FUELS THE FUTURE*

# 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

*MOX SAFETY FUELS THE FUTURE*

## ISA Methodology

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

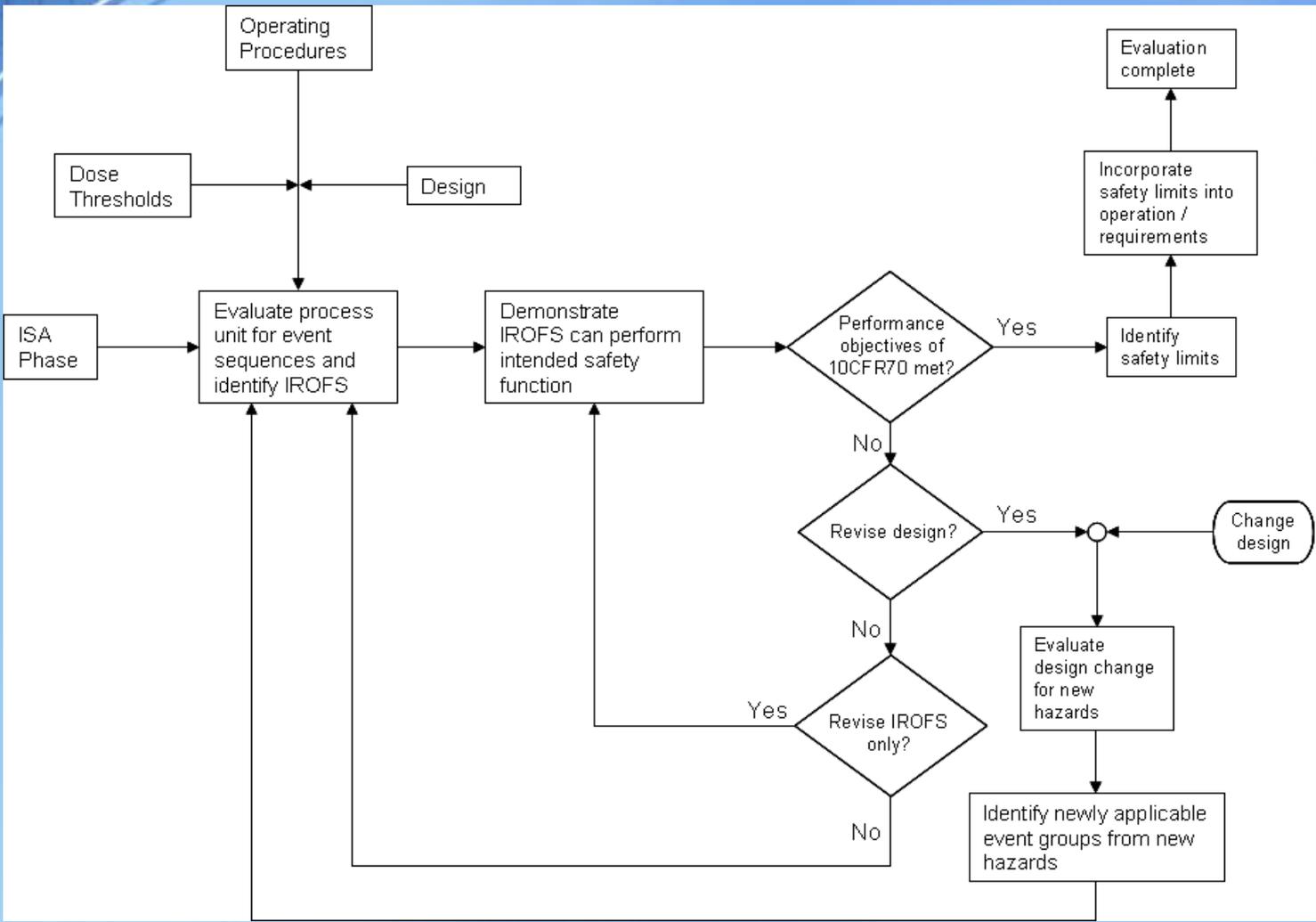
*MOX SAFETY FUELS THE FUTURE*

# 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

*MOX SAFETY FUELS THE FUTURE*

# Operating Phase



# 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*

**MOX SAFETY FUELS THE FUTURE**

# 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

*MOX SAFETY FUELS THE FUTURE*

# Backup slides

*MOX SAFETY FUELS THE FUTURE*

# ISA Methodology

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

*MOX SAFETY FUELS THE FUTURE*

# 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:

$$\text{TEDE} = \text{BR} \times X/Q \times \text{ST} \times \text{DCF}$$

where,

BR is the breathing rate

$X/Q$  is the atmospheric dispersion factor

ST is respirable source term

DCF is the inhalation dose conversion factor

*MOX SAFETY FUELS THE FUTURE*

## ISA Methodology

- Radiological consequences
  - where
    - BR is based on Reg. Guide 1.25
    - $\lambda/Q$  is based on ARCON96, a straight line Gaussian dispersion model
    - $ST = MAR \times DR \times ARF \times RF \times LPF$
    - DCF = isotopic mass fraction  $\times$  mass-based DCF for each isotope

*MOX SAFETY FUELS THE FUTURE*

# 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



**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

# 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

# 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**

# 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 construction 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

# **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