UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

April 2, 2012

MEMORANDUM TO: File

FROM: Sherry Meador **/RA/**
Technical Secretary, ACRS

SUBJECT: CERTIFICATION OF THE RADIATION PROTECTION AND NUCLEAR MATERIALS SUBCOMMITTEE MEETING TRANSCRIPT, OPEN SESSION, MAY 25, 2011

The attached document of the subject meeting is the official record of the proceedings of this meeting. A copy of the official record is attached.

Attachment:
As stated

Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Reactor Protection and Nuclear Materials
Open Session

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Wednesday, May 25, 2011

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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SUBCOMMITTEE ON REACTOR PROTECTION AND

NUCLEAR MATERIALS

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OPEN SESSION

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WEDNESDAY, MAY 25, 2011

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 1:30 p.m., Dr. Michael T. Ryan, Chairman, presiding.

SUBCOMMITTEE MEMBERS PRESENT:

MICHAEL T. RYAN, Chairman

J. SAM ARMIJO

DENNIS C. BLEY

SANJOY BANERJEE

JOHN D. SIEBER

CONSULTANT TO THE SUBCOMMITTEE PRESENT:

JOHN FLACK

NRC STAFF PRESENT:

DEREK WIDMAYER, Designated Federal Official

THOMAS HILTZ

MATTHEW BARTLETT

YAWAR FARAZ

SUSAN COOPER

SEAN PETERS

JULIE MARBLE

ALSO PRESENT:

STEVE LAFLIN

JOHN J. MILLER

JAMES THOMAS

RON GREEN

BILL BROWN

AGENDA

Opening Remarks and Objectives 4

Opening Remarks NRC Staff 6

Overview of International Isotopes, Inc. Facility 7

Overview of Regulatory Process 72

Risk-Informing Nuclear Materials 120

Committee Discussion 174

Adjourn

P R O C E E D I N G S

1:29 p.m.

CHAIRMAN RYAN: Okay, it's the appointed hour. The meeting will now come to order. This is a meting of the Advisory Committee on Reactor Safeguards Subcommittee on Radiation Protection and Nuclear Materials. I'm Michael Ryan, Chairman of the Subcommittee. Members in attendance are Dana Powers, Dennis Bley, Harold Ray, Jack Sieber, Said Abdel-Khalik and Sam Armijo.

Drs. Bley and Banerjee announced on the phone a few minutes ago they're a little late getting in from the airport by plane, but they will be joining us shortly, and Dr. Powers is otherwise engaged on another matter, and he will join us shortly. So I think I've covered everybody.

MR. WIDMAYER: Said, I think, is the only one that --

CHAIRMAN RYAN: Said will not be here.

MR. WIDMAYER: Will not be here, yes.

CHAIRMAN RYAN: Okay, and Dr. Abdel-Khalik will not attend this subcommittee briefing. The purpose of this meeting is to review and hold discussions with the NRC staff and representatives from International Isotopes Fluoride Products, Inc.,

regarding the license application and integrated safety analysis summary for the fluorine extraction process and depleted uranium deconversion plant, to be located in Lee County, New Mexico.

Portions of the meeting may be closed, to protect against the release of proprietary-related information. The Subcommittee will also be briefed on NRC's HRA research activities, as they apply to (1) dry cast storage ad potential for cast drops, and (2) medical procedures and applications.

The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate. Derek Widmayer is the Designated Federal Official for this meeting. The rules for participation in today's meeting have been announced in the *Federal Register* as part of the notice of this meeting, previously published in the *Federal Register* on May 10th, 2010.

A transcript of the meeting is being kept, and will remain available as stated in the *Federal Register* notice. It is requested the speakers first identify themselves and speak with sufficient clarity and volume, so they can be readily heard. We have not received any requests from members of the public to provide comments. If there is anyone on the phone

line at this time, would you please introduce yourself? Do we have anyone? Yes please. Is there anybody on the phone line?

(No response.)

CHAIRMAN RYAN: Hearing none, the briefings are being held for information only. Unless otherwise decided by Committee members, ACRS letters are not being proposed at this time, based on this briefing.

We will now proceed with the meeting, and I call upon Mr. Thomas Hill, acting Deputy Director, Special Projects and Technical Support, Division of Fuel Cycle Safety and Safeguards, NMSS, to open the presentations.

MR. HILTZ: Thank you, Dr. Ryan. As Dr. Ryan said, my name is Tom Hiltz. I'm an acting Deputy Director in the Division of Fuel Cycle and Safeguards, in the Office of Nuclear Material Safety and Safeguards, and it is a pleasure, and we're grateful for the opportunity to come before the Subcommittee and discuss our review of the proposed International Isotopes facility to be located near Hobbs, New Mexico.

With me at the table is Matt Bartlett. Matt Bartlett is the project manager in charge of the

licensing review, and in support is Yawar Faraz. He's the senior reviewer for the ISA, and Dennis Morey. Dennis is the acting Branch Chief for the Conversion, Deconversion and Enrichment Branch.

We have a presentation prepared. I understand we'll follow the International Isotopes presentation. I do want to, again, express our appreciation to be able to come and provide information to the Subcommittee.

I think as you know, several months ago, we made you aware of this project and thought it may be of interest, certainly from awareness perspective, for the ACRS to be aware of the review, because in our view, it's unique in a couple of aspects.

It is the first deconversion facility that the NRC will license, and although it's not a terribly complex activity or complex facility, it is the first of a kind. It also the first Part 40 facility that will be licensed, using the Part 70 ISA requirements. So with that, I thank you again for the opportunity.

CHAIRMAN RYAN: Thanks, Tom. Steve from INIS will be, I think, the first speaker from the applicant.

MR. LAFLIN: Thank you, Mr. Chairman. I'm Steve Laflin. I'm the CEO of International Isotopes.

I've been the CEO of International Isotopes since about 2001. Prior to that, I started off my career in the nuclear Navy submarines about a dozen years, and then had worked in the nuclear industry, after picking up a degree in Physics from Idaho State University.

So this afternoon, also presenting for the company is John Miller. John is our radiation safety officer. He's been our one and only radiation safety officer. We've been very fortunate to have John on board. He's also a former Navy nuke. He also has a Masters, a Bachelor's degree in Health Physics, a Master's in Environmental Science, and nearly complete with a Ph.D., I believe.

John's been absolutely key to our role in establishing rigorous safety programs for the company, handling our licensing process, and he's been an integral part of the licensing for the new nuclear facility that we did, the uranium deconversion project.

Also joining us this afternoon is Jim Thomas, sitting on the table over here. Although Jim won't be, we hadn't planned on him speaking, he is certainly there to help, here to help us and backup and answer questions that we may have on it.

Jim is the president of Advanced Process

Technology Systems, or APTS. We hired Jim and his staff at APTS to help us with the licensing, the engineering work on this project. Jim's background is quite impressive in the front end of the fuel cycle. He was the operations manager for the Honeywell conversion plant, the metropolis facility back in the older days. He as the operation manager for gas diffusion projects.

He was a senior executive with USEC before and during the transitions. He's been involved in both DOE and NRC licensing, and I believe transitions from one to the other. He was also working on developing the SILEX technology with USEC back in the day, before they dropped their technology and NGE picked that up.

So you know, Jim's background, 30 plus years in all of those areas in the front end of the fuel cycle has been incredibly valuable to us. Jim's been able to put together a team of equally experienced and skilled engineers, that have helped us with the design of the licensing for the project.

So one of these skilled folks is Ron Green, who is also joining us today. Ron is our expert on integrated safety analysis. So we will leave probably the majority of this presentation to

his topics on integrated safety analysis.

Ron has about 20 years of experience in ISA, DOE or DOE facilities primarily, nuclear criticality facilities and such, the kinds of things where you would typically, more typically expect to see ISA analysis performed.

So with that, we'll just give a, just a few slides here, just as a brief intro on International Isotopes, and stress a couple of points that may or may not have come out in the previous materials. We've been in business since '95, so we're celebrating our 15th year of business this coming October.

As a public company, we carry out licensing under the Part 30 facility for our nuclear medicine products, cobalt products for radiation therapy, iodine-131, also for imaging and thyroid cancer treatment, and then a whole range of nuclear medicine calibration and reference standards.

We're one of only two companies really in the world today that are manufacturing those calibration standards. That's been our core business in Idaho.

The new opportunity we're here, of course, to talk about today is our new expanded business

opportunity, which is our vision for this first commercial depleted uranium deconversion and fluorine extraction facility. A big mouthful for a title for a project, and maybe we'll come up with an acronym some day for this thing. But right now, we'll leave it as it is.

The object here is not just to deconvert uranium, which is important enough, and I'll explain why we think that's important, but also to produce important products during that process, extract as much value from every step of the deconversion process as we can, and we have the patents that allow us to do that deconversion step, extract very pure products, and also save a great deal of energy in that extraction process, because we're effectively mining a fluorine resource out there in depleted UF_6, depleted uranium hexafluoride.

Well, why are we so interested in this business segment? Well, it's basically being driven by the expiration of the megatons to megawatts program in 2013. Because of that, the stage has been set in the U.S. to establish a lot of new commercial enrichment capacity in the U.S.

So the chart shows the four major companies that have announced plans to build

enrichment facilities in the U.S., and there's four companies in four various stages of operations. URENCO is clearly leading the way. They are operating a facility. They're producing tails today.

They've started off at three million separative work units. They've increased it to 5.7, and I believe they are trying to expand that to nine. So they've grown almost triple their capacity, almost before within the first six month of their operations.

AREVA, of course, I think I would say they're in probably second place. They have a license right now under review by the Nuclear Regulatory Commission, which they're anticipating, I think, approval and issuance of that license some time late this year. They have a site located in Idaho and plan to start construction in the spring. It's also about a three million SWU facility, but they've also doubled the fed facility capacity as well.

General Electric, with their SILEX technology, which is under license review right now, and then USEC, which has a license for their American Centrifuge Project, and some work under way there, waiting on a loan guarantee and some other financing issues.

The key point, I think, to make with these

four guys coming online is that these four facilities are not really based on a speculation in a nuclear renaissance. These four facilities are coming online to address a current opportunity for fuel, for uranium enrichment that has to be satisfied today, as a result of this megatons to megawatts agreement with the Russians.

URENCO, for example, already has, as far as I'm aware, over ten years of contract commitments for their output of their facility. So these companies have made sure that they have had contracts in place before their commitment comes in place.

So that said, if one of these does not succeed, say for example, a GE SILEX technologies does not succeed, we believe that the other guys that have technologies and have licenses will readily expand.

Ultimately, the total capacity that's represented on that map, we think, will come to past. The output, just roughly in terms of ratios of these things, it's basically ten pounds of natural UF_6 into the enrichment process, to produce one pound of enriched UF_6 for fuel. So you end up with nine pounds of byproduct or depleted material.

The result of the activities that have been done in the U.S. over the last 40 or 50 years

have already produced this stockpile, which there's a picture of here, material that has basically never been deconverted or treated. 1.6 billion pounds at the last count, which has simply been stored outside, some of it for nearly 50 years.

What we're trying to do is provide a commercial solution to new enrichment capacity, to prevent this, so that they'll never be a picture 20 years from now of another 1.5 billion pounds of material that's out there. The DOE conversion plants that are coming online some time in the near future, those facilities will be running for about 25 years, in order to process the existing stockpile.

If you look at the projected output of enrichment capacity from those four enrichment plants, you can see that within 20 years, we're going to build up another 1.5 billion pounds, roughly, of new commercial depleted material that would be sitting on the ground some place. So we can --

MEMBER SIEBER: Will you be -- at the three government gaseous diffusion plants, there must be tons and tons and tons of UF_6, as tailings. Will you be processing any of that?

MR. LAFLIN: No. We've planned our business purely on a commercial basis, purely to

address new commercial depleted uranium that's produced by URENCO, AREVA, USEC, under a commercial operation NGE.

MEMBER SIEBER: So they'll be in relatively new cylinders when you get them?

MR. LAFLIN: Yes.

MEMBER SIEBER: Okay, as opposed to the 40, 50, 60 year-old cylinders --

MR. LAFLIN: Yes, exactly. We're going to -- we'll let the government deal with their own existing stockpiles of material. We're going to address new material, and in fact, you know, you mentioned the old cylinders.

But that's just another one of the benefits we can offer, is if we're processing cylinders on a regular basis, we can reempty, reuse and recover those cylinders, as opposed to what the DOE will do, which is cut them open and refill them and use them as a waste package. So that wastes a lot of steel and a lot of energy as well.

MEMBER SIEBER: When you recover them, you would use them again for UF_6, as opposed to any other use, right?

MR. LAFLIN: Right.

MEMBER SIEBER: Okay, and you need

separate packaging for the uranium tailings, that's the output at your facility?

MR. LAFLIN: Right. The ultimate product will be uranium oxide from our process, after the fluorine's been removed, and that's --

MEMBER SIEBER: In some form, UO2.

MR. LAFLIN: UO2, U-308.

MEMBER SIEBER: And are you, would you describe what that packaging looks like, because I think your storage and shipping package would also be a disposal package?

MR. LAFLIN: That's correct.

MEMBER SIEBER: Is that part of this license application?

MR. LAFLIN: No. Waste package is not. I mean the waste process, in describing the complete cradle to grave operation is.

MEMBER SIEBER: Yes. I didn't find anything in your application that referred to the package, but if you know anything about it, I would be curious what it is.

MR. LAFLIN: It's a Type A waste, so it basically requires a strong, tight container. So anything from a 55-gallon drum through, you know, CVAN (ph) containers, depending on the quantities,

that we work out the most economic disposal path with the disposal site, will determine the type of package that we use.

CHAIRMAN RYAN: And you had to balance all of the DOT requirement in there somewhere along the line?

MR. LAFLIN: Right. Yes, absolutely, absolutely.

MEMBER SIEBER: And it has low specific activity. It's not -- it can migrate if the package fails, and it doesn't chemically react with anything?

MR. LAFLIN: Right. The uranium oxide is very chemically stable.

MEMBER SIEBER: Okay.

MR. LAFLIN: So it's a two-step process envisioned for the facility. We'll take in the UF_6 cylinders and then step it down from UF_6 to UF_4. That first deconversion step will produce anhydrous hydrochloric acid is our first product, and that's a commercial product that can be sold.

Then the second step, UF_4 using a FEP, which is our fluorine extraction process, patents to produce silicon tetrafluoride and boron trifluoride. Boron trifluoride will be the major gas we'll produce out of the facility.

MEMBER ARMIJO: Those gases would go into the semiconductor industry or integrated circuitry?

MR. LAFLIN: Several. BF_3, for example, our major customers, will be to go to, there's a company that uses BF_3 to make B10 for reactor poisons and shielding and neutrons. They will be a major customer of ours. Also, other customers which take BF_3 and then make complexes with that for the petrochemical industry, for the solar industry, and for the pharmaceutical industry.

CHAIRMAN RYAN: Are you going to talk somewhere about carryover or what contamination levels of uranium in your products would be, or you expect?

MR. LAFLIN: Yes. I wasn't going to talk specifically about it, but you asked the question. There's two major advantages to this fluorine extraction process. The first is that it's a solid to solid reaction process. You heat UF_4 in the presence of a metal oxide, and experimentally, it would say that nothing should carry over.

But we've demonstrated that. We've built a pilot plant in Idaho and we've operated that. There's absolutely no uranium carryover into the product whatsoever on the outlet side. We've even installed mechanical filters immediately in the

reaction vessels, that should be exposed to, and we still can't detect uranium even on those vessels.

The other big advantage is that since you're extracting fluorine right off of UF_6, you already end up with a pure product from the very beginning. You know, the folks that we compete with in the industry to produce something is 4, 5, 9 pure, and they have to expend a lot of energy to get there.

We don't. We're able to produce, even anhydrous hydrofluoric, we're even able to produce a pound of hydrofluoric acid for about six times less energy than the conventional methods for producing anhydrous hydrofluoric. There is a chance, because HF, the hydrofluoric, comes off in this first step of the process, in the UF_6 deconversion stage.

There is, during possibly upset conditions or unusual conditions, a chance that you could have uranium in that anhydrous hydrofluoric acid. So we've designed our system to have filter systems in initial receiving tanks, so that we can stop and we can evaluate that material.

If it does have uranium, there is a market out there for uranium conversion, that really doesn't care if uranium is present in the anhydrous hydrofluoric acid. So we'll have a market for it,

even if it does carry a uranium legacy.

CHAIRMAN RYAN: Thank you.

MEMBER SIEBER: Will your plant operate as a batch plant or a continuous process?

MR. LAFLIN: It will be a continuous process, but there's a separation between each step of this process.

MEMBER SIEBER: Right, different equipment.

MR. LAFLIN: Two parallel -- right, two parallel continuous processes.

MEMBER SIEBER: Okay.

MR. LAFLIN: We spent a lot of time on site selection. The last thing in the world I wanted to do is to try and build a facility some place where people would not welcome a nuclear facility. We were just not willing to take on and fight an uphill battle.

So we get a pretty extensive site selection screening. We looked in several states, and then conducted a lot of public meetings beforehand, and we had -- and then basically created a scorecard, a score sheet for all of the different sites, and let them bid for us and for our facility there.

New Mexico won. I mean New Mexico put a

very aggressive package together, offered lots of incentives for us to locate there, one of which was the property that was really ideally suited for us. Large piece of ground. Our facility itself will stretch out and occupy about a 40 acre footprint.

We'll actually have a full section of properties. We can locate almost smack dab in the middle of that facility. There's an aerial view here of that, and where you see the small facility up there in the upper left corner, this is the full section, Section 27 that's identified, so just to give ourselves further isolation from neighbors and anybody around the facility.

The public reception has been outstanding down here. We've gone through two public meetings so far on the licensing process. We conducted 40 meetings before we selected this location down there.

We've had some folks raise some concerns, which they rightfully should do, because this is a chemical facility really, and once people recognize that, they want to know that we're safely handling the chemicals down there, and we've explained to them that, you know, how our processes work and how we'll do that.

They believe the NRC licensing process

itself gives them a lot of confidence that we'll be regulated and operating safely once we're in place.

MEMBER ARMIJO: What is that facility or that area where all those white splotches are? Is that another chemical facility --

MR. LAFLIN: It's this area?

MEMBER ARMIJO: That, yes. What is it?

MR. LAFLIN: That's just -- it's an old road or gravel pit, but it's only like eight or ten feet deep to mine. They mine caliche there typically, which looks like white chalk rock.

MEMBER ARMIJO: I'm very familiar with it.

MR. LAFLIN: On this earlier picture, that's basically what the site looks like.

MEMBER ARMIJO: Yes, okay. I just wanted to make sure that that wasn't another chemical plant of some sort.

MR. LAFLIN: No, no.

MEMBER SIEBER: Well, that site has some mixed blessings. I understand the water table's 120 feet below the surface, and you require, what 10,000 gallons a month?

MR. LAFLIN: Yes, 10,000 a day, and we have water rights for 50 acres, 50 acre feet. So we have enough water rights for about ten times the

capacity of the facility. It's a mixed blessing, though, because if you look at all those lines crossed out, you know, it's a relatively scarred region, with power lines, with gas lines, with easement rights.

So that's why we're not quite dead center there, because we had to pick a spot that was 40 acres, that was free of any underground gas lines or access right-of-ways that could give us problems in the future.

MEMBER SIEBER: You feel you'll have enough water supply to operate your facility, and you have tank storage for fire water, I understand, in your plan?

MR. LAFLIN: Yes, yes.

MEMBER SIEBER: So you'll have sufficient fire water to handle any expected fires?

MR. LAFLIN: Yes. Part our criteria for site location was making sure that we had plenty of access for utilities, for water, for all of those services.

MEMBER SIEBER: No tornadoes, no real seismic activity?

MR. LAFLIN: No. It's a pretty benign region actually.

MEMBER SIEBER: I was thinking it would

make a great retirement home for me.

MR. LAFLIN: You get sand storms, though. Dust and sand storms. They call it breezy conditions, though, down there, the sand. It's like Idaho. It's a breezy condition until it's over, sustained winds over 30 miles an hour, and then it's actually a wind.

So now I'd like to turn it over for a few minutes here to John first, just to talk about our licensing for this facility and some of the evaluations and engineering controls that we've put in place.

MR. MILLER: Okay. Thank you for the opportunity. I'd like to start out and say that we took a defense indepth approach to the facility and process design, relying primarily on engineered controls. A good example is all of our effluents are treated three times before they're released.

You know, the defense indepth approach also supports worker safety. In addition, it reduces the impacts to the environment and the public. If you look at the data that we have on the screen there, you know, our public dose that we modeled to the NEI is three to the minus six rem per year, and our air emissions, fluorine as HF, if you compare that with

the state of Idaho, we're at 0.1 percent of what is emitted right now in the state of New Mexico.

Just for informational purposes, the bulk of that HF release is from the two coal- fired power plants up in the northwest corner of the state.

Additionally, we've talked about water usage. Water is at a premium in this part of the country. So we went to great effort to reduce the amount of water we need.

We've got that down, estimated uses at 10,000 gallons per day, primarily where recycling and recovering our process water to reduce the amount of water that we do use, and the 10,000 gallon per day is about 40 percent waste water, sanitary water, and then water that's lost as condensate, and then groundwater protection.

Groundwater is the water source down there. So the state of New Mexico, the communities, are very concerned about the ground water. So we've went to a zero discharge facility, zero discharge including sanitary waste. There's a lot of septic systems down there, but we've went to a water treatment facility instead of using a septic --

MEMBER SIEBER: You still have a septic system, but you're treating the effluents --

MR. MILLER: The effluent's treated. It's not a septic system. The effluent of the water treatment facility was going to go onto a tree farm.

MEMBER SIEBER: Okay, yes. I read that.

CHAIRMAN RYAN: I was going to ask you a couple of questions on this slide. What's your aquifer look like? Is it continuously connected with regional aquifers? Are you isolated in a system or --

MR. MILLER: It's the Ogallala aquifer. It's a large --

CHAIRMAN RYAN: It's a very large aquifer.

MEMBER ARMIJO: Very large aquifer.

CHAIRMAN RYAN: You really don't have any isolation from the important ground water aquifer. Not that you're going to put anything in it, but that's your connection is to a -- I see. Let's see. I had one other question. You said you had a three-tiered system of measurement to verify the --

MR. MILLER: Filtration.

CHAIRMAN RYAN: Are you monitoring in between each filter, or only out the back end?

MR. THOMAS: We have monitoring between every --

CHAIRMAN RYAN: Please speak into the mic, sorry.

MR. THOMAS: Yes. We have monitoring between all of the treatment systems that have uranium.

CHAIRMAN RYAN: Yes.

MR. THOMAS: Now the sanitary system wouldn't have monitoring in between. It's a triple system too that uses UV as the final disinfection, before we put the water onto the tree farm.

CHAIRMAN RYAN: Right.

MR. THOMAS: But all the other, all the uranium systems have monitoring in between as protective devices. We did not want to operate, for example, one dust collector without the secondary in place. So we'd want to know if that dust collector's a problem so we can stop the operation.

CHAIRMAN RYAN: That's the key.

MR. THOMAS: You can't keep a tertiary system.

CHAIRMAN RYAN: You have to stop the operation before you inundate, you know, the other parts of the system downstream.

MR. THOMAS: That's correct.

CHAIRMAN RYAN: That's interesting. That's great. And the tree farm, how much water does it use up? Have you figured out that you'll actually

be using all the water you put in the tree farm? I know that's a tough calculation.

MR. THOMAS: No. We've actually calculated how much water a tree needs in New Mexico. A two inch diameter tree uses about nine gallons of water a day, and we'll have about 4,000 gallons. So we're looking at about a two acre tree farm.

CHAIRMAN RYAN: Okay. So you're going to size the tree farm, to make sure the water is used locally --

MR. THOMAS: And of course we've got additional land there if we need to expand the tree farm.

CHAIRMAN RYAN: Yes. Fair enough. Okay. That's all.

MEMBER SIEBER: I don't think an overabundance of water is the big issue.

CHAIRMAN RYAN: No.

CHAIRMAN RYAN: No, here in the east, people put water on tree farms and there's already enough water, and their water tends to go somewhere else.

MR. MILLER: Now, at the tail end, and we talked about this earlier as well, we're left with depleted uranium oxide, which is destined for

disposal. As soon as we identified the location, we began engaging with the Rocky Mountain Low Level Waste Compact, to discuss the waste disposal issues.

And, you know, there's two aspects that we needed to get clear with the Rocky Mountain Low Level Waste Compact. The first one was, you know, they agreed with our interpretation of the depleted uranium hexafluoride. I mean we're utilizing the depleted uranium hexafluoride, strip the fluorine gas, fluorine off of it to produce product.

So we view the UF_6 as a resource, as a raw material for our process. We wanted the Rocky Mountain Waste Compact to concur with that interpretation, and they did. So that now, there's an order, what they put into place for DUF_6, what is being sent to International Isotopes for fluorine extraction does not enter the Rocky Mountain Low Level Waste Compact as a waste, so there is not any waste import issues associated with that.

You know, the other aspect is, you know, we're going to be exporting waste out of the Rocky Mountain Low Level Waste Compact. So we needed to, you know, work with them to plan in the future on how we were going to handle, you know, all these multiple waste exports, what we would be doing.

Now as far as sites, you know, we've looked at U.S. or Energy Solution's Clive, Utah facility, at WCS, about 45 miles to the east. There's an opportunity there. Then if you look at the amount of waste that we will be producing, that kind of follows the same chart that Steve showed earlier, as the fuel enrichment facilities ramp up production. So that's --

CHAIRMAN RYAN: Just so everybody's clear, you're out of Compact for Texas; correct?

MR. MILLER: Correct. That would be an out-of-compact. We would be importing into the Texas Low Level Waste Compact if we chose to go WCS.

CHAIRMAN RYAN: And I guess, let's say the annual volumes, you have fairly reasonable annual volumes, is that right? Help me read those charts.

MR. LAFLIN: Up to 70,000, or between 70 and 80 thousand cubic feet, and that's based on the initial two phases of capacity of the plant. The initial plant capacity that's actually under licensing today would be more around that 35,000 cubic feet per year level.

CHAIRMAN RYAN: So just in practical terms, how many shipments a week, a day, a month or a year is that facility?

MR. LAFLIN: That's about 250 shipments a year.

CHAIRMAN RYAN: That's one every day of the working week year.

MR. LAFLIN: Roughly one semi-truck a day.

CHAIRMAN RYAN: Yes.

MEMBER SIEBER: Now the Rocky Mountain Compact waste site that would receive depleted uranium from your facility, where is that located?

MR. MILLER: Yes. The Rocky Mountain doesn't have a compact. But they're authorized to use the Northwest Compact. So going straight into Clive, Utah would not require, you know, importation from Clive. They have access to Clive.

MEMBER SIEBER: That's pretty close?

MR. MILLER: It's fairly close.

MEMBER SIEBER: Yes. In the west, it's pretty close.

MR. MILLER: Yes.

CHAIRMAN RYAN: It's over 100 miles, as opposed to hundreds.

MEMBER ARMIJO: Yes. Just give me some help here. The waste volume you're talking about, 70,000 max under maximum conditions, is that a significant fraction of what the Energy Solutions site

can take? I mean is that a small amount or is that a moderate amount?

MR. LAFLIN: We're told it's not. I mean we ran these numbers and looked at what their waste capacity is down there, and I believe we could ship to them for 20 years, and they've also got access to expand their facility possibly. If we run into -- if we go to waste control specialists instead of Energy Solutions, they have even greater capacity there.

MEMBER ARMIJO: Okay. But that would be more complicated, because you'd be out of the Compact.

MR. LAFLIN: A bit more complicated, and a lot depends on what their Compact, their newly-established Compact and what decisions they make with that over the next year or so.

MEMBER ARMIJO: So you'd agree that -- I mean as far as I understand the Texas situation. That's in a state of development. You know, it's not real clear how that's all going to land, but that's in negotiation at this point, among all parties.

MR. LAFLIN: Yes, absolutely.

MEMBER ARMIJO: Okay.

MEMBER SIEBER: And your waste product is, how shall I say it, relatively inert?

MR. LAFLIN: Yes, I would agree with that.

Chemically inert.

(Simultaneous speaking.)

MEMBER SIEBER: -- natural uranium ore would be?

MR. LAFLIN: Well you know --

MEMBER SIEBER: It travels, but it takes a million years to move across the room. Okay.

MR. LAFLIN: Yes.

MR. MILLER: I'll go through the licensing process. You're familiar, I'm sure, with the licensing process. I'll just give you a real quick summary. The first slide up there, we discuss, you know, a letter of intent submitted to the NRC in April 2009.

You know, prior to that letter, we met several times with the NRC, to provide them a presentation of the product or the process, you know, to let them know that we were planning on submitting a license, and then eventually we submitted the letter of intent.

We received, you know, a letter back from the NRC. It was in May of 2009, that they acknowledge the intent to license the facility. In that letter, consistent with SECY Paper 07-146, you know, we were directed to prepare the license application, you know,

using Part 70, Subpart H.

So we prepared the license application, had that submitted in December of 2009, used Reg Guide 1520, Revision 0, and for the environmental report, we used Reg Guide 1748. NRC formally accepted the application in February of 2010, and then we received a request for additional information in September of 2010 and then in November of 2010.

We just finished up the responses to the RAIs, and you know, what isn't on the slide and what I'd like to say is, you know, hats off to Matt and Tom and the reviewing team, because this process, you know, it's been a trying process, but it was a lot less difficult than what I expected it to be.

You know, Matt and I probably talked two or three times a week, to make sure that the license application and the RAIs and the responses are all constantly going through.

CHAIRMAN RYAN: So the RAIs are complete from the applicant's point of view, and I guess the staff will tell us on their, where they are in the acceptance process for all of this a little bit later on.

MR. MILLER: Right. Now our next big step was with the New Mexico Environmental Department, and

we don't like to reinvent the wheel, and we like to take advantage of lessons learned. We really used URENCO LES as a resource for us. They had a bit of a difficult time going through the NMED permitting process.

We met with LES and in fact, we even entered into a contract with them, to help us, you know, go through the permitting requirements. Some of the permits that we need are listed up there.

Ground water discharge, air emissions, waste water, land application permit for the tree farm, you know, hazardous waste generators, storm water discharge permit, which is out of EPA. We met early on with --

CHAIRMAN RYAN: Now just a clarification. Are all these -- these are all state level. So your EPA permit is the state EPA? Do you have an agreement with the federal EPA in their issuing a permit?

MR. MILLER: Not surface water, storm water, storm water.

CHAIRMAN RYAN: Okay.

MR. THOMAS: The storm water permit is a federal, but the state --

CHAIRMAN RYAN: So it's the state program, on authority from the federal EPA?

MR. THOMAS: Right.

MEMBER ARMIJO: Is that the only permit you require directly from the EPA?

MR. MILLER: Yes.

MEMBER BLEY: Where do you stand on these?

MR. MILLER: Well, we still have to submit applications for, formal applications for all the permits.

MR. LAFLIN: But the two long-lead items, for the ground water and the air discharge permit, both we're anticipating roughly 18 months for both of those. The ground water permit is actually in process right now, and then the air permit process will start -- or I have that backwards.

MR. THOMAS: We're doing the air permits and we start the ground water permit in August.

MR. LAFLIN: Yes.

CHAIRMAN RYAN: Thanks.

MR. LAFLIN: Just to avoid either one from being critical path. But just go back to the meetings with NMED, you know. We met, again shortly after, or even before selecting Hobbs, and then again after the selection was made.

You know, we had meetings with all the NMED bureaus, gave them presentations on the process,

you know, just to be as transparent as possible, to let them understand what we were intending to do.

We did enter into an agreement with NMED, similar to URENCO, where we limit the quantity of uranium that we have on site, and the time that we can store cylinders and oxide disposal containers. Then we have some reporting requirements.

You know, this isn't -- it really doesn't affect our process. We're a just-in-time type of operation. So what we envision is bringing UF_6 in, processing it and, you know, oxide's going to go out. So the agreement with NMED, we don't think, is going to really be a burden.

MEMBER ARMIJO: Just before you go on, you know, do you buy the depleted uranium hexafluoride from these various suppliers, or do you just take it off their hands, do your process and send them back in their containers?

MR. LAFLIN: We're actually paid to take the UF_6. So we're providing a --

MEMBER ARMIJO: So you take it off their hands, and you process that material? At that point, it's really your property?

MR. LAFLIN: We take title to it at the time we accept the UF_6. But part of our current

contract with URENCO, and we envision the same term in our other contracts, is that we're actually paid for the waste disposal at the time we take title to it. So in addition to the toll, there's a waste disposal cost, based on the cubic foot charge at the ultimate disposal sites.

MEMBER ARMIJO: Right, and the containers, the cylinders, do they go back to the source?

MR. LAFLIN: Depends on the customer. Some customers want their cylinders recycled, recovered and reused, and that's something we'll consider. It's not part of this application, but we plan to address in the future is a cylinder cleaning-testing-reuse station at the facility.

For the time being, I think the way it's described in the license application now is the cylinders would be used possibly as waste containers.

MEMBER ARMIJO: Okay.

MR. LAFLIN: Or could be just simply shipped back to the customer if they wanted it back.

MEMBER ARMIJO: Yes. But you wouldn't maintain an inventory of cylinders on your own, just --

MR. LAFLIN: Not planned right now, no.

MEMBER SIEBER: You wouldn't actually have

to clean them. All you'd have to do is hydrotest them, right?

MR. LAFLIN: If they require testing, and if they're within a five year life, you could just send them back for reuse. With that, I guess we'll hand over to Ron and talk about the integrated safety analysis parts of the license application.

MR. GREEN: Okay.

MEMBER ARMIJO: Ron, before you go into the ISA, could you just give us a little overview of the chemical process steps, you know, the main pieces of the process? I'm familiar with part of it, having worked at a fuel factory at GE. So I think we knew that part of the conversion process. But you do something else. I'd like to understand what you do with your FEP that's different.

MR. LAFLIN: Right, and Jim, if I say anything stupid, help me and jump in. Feel free to jump in and help me out here with this. But I'll give you the layman's term for the chemistry part of it, because it's really a quite simple process.

So UF_6 is a solid material above 135 degrees Fahrenheit. So we bring these cylinders into the facility. They go into an autoclave, which is a steel shell basically, expose them to steam heat. It

vaporizes the UF_6. We feed that UF_6 at a very low pressure into a reaction tower.

The reaction tower, you basically mix hydrogen with the UF_6 gas. You get a pyrophoric reaction in that tower. As it reacts, it basically travels down the tower. The UF_6 or the UF_4 is formed, falls to the bottom of the tower.

The hydrofluoric acid comes off as a gas, basically is extracted off the side of that process and packaged through filters, into compressors, pumps, into a receiving tank.

MEMBER SIEBER: Now that's an exothermic reaction?

MR. LAFLIN: Yes.

MEMBER SIEBER: So there is some kind of potential for that to get out of control, unless you really control that process?

MR. LAFLIN: No. In fact, it has to be assisted with heaters. We actually have to heat that reaction tower, in addition to exposing it to the hydro --

MEMBER SIEBER: Yes, just to get the UF_6 out of the cylinder you have to heat it.

MR. LAFLIN: Right, right. But the reaction tower itself, we also have to heat that as

well, to help it achieve early stage reaction temperatures.

MEMBER SIEBER: Now I've forgotten the answer to this, but I understood at one time, the Type 48 cylinder, if you broke the valve off, you could get a bad reaction, including a reaction inside the cylinder. Is that correct?

MR. LAFLIN: The autoclaves that hold the UF_6 cylinders have got many interlocks built in there, to detect any leakage of UF_6 into that autoclave, looking at -- I mean obviously, there's an inspection on the cylinder before it goes in, but then there's parameters and alarms on the condensate, on the water, on the water levels, on the flow rates, anything that could -- any signs or symptoms of a leak in the cylinder would show up in those alarms and indicators.

MEMBER SIEBER: That's not a truly benign process, right? Just heating up UF_6 to get it out of the cylinder and into your reaction chamber. There are things that can go wrong.

MR. GREEN: Sure.

MEMBER SIEBER: Okay, and you'll explain that when you get to it.

MR. GREEN: I don't think we're getting into that kind of detail, but the ISA did evaluate

that.

MEMBER SIEBER: Well, could you get to just that little bit, and --

MEMBER BLEY: Well, before you answer that, given the large coefficient of thermal expansion and the accident at Sequoyah Fuels 15 years ago, whatever it was, what happens if you've got a cylinder that's too full when you get it? How do you make sure you don't, or that if it blows apart when you start trying to heat it, you don't have a serious problem?

MR. LAFLIN: Jim Thomas was actually one of the investigators for that event at Sequoyah, and I mean that heating and creating a hydraulic in a cylinder is something that can be engineer designed around. It has to be considered, and Jim can probably address that very specifically for you if you'd like.

MR. THOMAS: Well, of course it starts with our customers being licensed in our safe facilities, enrichment plants, and yes, yes, Sequoyah Fuels was. So they go through their procedures and process, to ensure they don't ship an overfilled cylinder.

When it arrives, we have some IROFS, Items Relied On For Safety, to ensure that they haven't sent us one accidentally.

MEMBER BLEY: Such as?

MR. THOMAS: We weight them.

MEMBER BLEY: Yes, right.

MR. THOMAS: We also check their paper work. We would not, and then when the cylinder goes into the autoclave, we also do a cold pressure check, to make sure there's not non-condensables in there that might cause gas pressure. Obviously, the greatest concern of a UF_6 cylinder is not to heat when it's overfilled, and we'll have trained people.

We'll have IROFS, and we'll weigh the cylinders to ensure that if someone did a misweight at the shipper, we catch it at the receiver. That's one of our Items Relied On For Safety and requires a double-check. It requires a sign-off by the operator, and we use a weigh-in scale before we place it into the autoclave.

MEMBER BLEY: What if one is overfilled and ends up in the autoclave? Is it -- can the autoclave withstand it?

MR. THOMAS: It depends on how much it's overfilled. The autoclave probably would have withstood the Sequoyah, because that was an open steam chest. It was not an autoclave. It was not a containment-type autoclave. But what we need to be

careful to understand that even containment-type autoclaves aren't totally leak tight. There can be places where they leak around seals. But it would contain it, to some degree.

Also, ruptured the cylinder releases the liquid, if it comes to the liquid point of expansion. So the pressure inside the autoclave -- the autoclave design is for 200 pounds working pressure, it's actually tested higher than that. So if you leak into the autoclave, it is a secondary containment, and the pressure of UF_6, even at that overfill of cylinders, is in the order of 70 to 80 pounds.

So having IROFS on making sure temperatures aren't exceeded, pressures aren't exceeded, water levels aren't exceeded, connectivity to show that if you have a leak, that's very important. So it's a very important part of the process.

Our autoclaves are very similar to the ones that's been used on the gas diffusion plants for 50 years, and many have them. So we have the same type of safety systems and a lot of defense indepth.

MEMBER ARMIJO: I presume --

MEMBER BLEY: But weighing is your crucial step on this?

MR. THOMAS: As far as the over-filled cylinder, that's correct.

MEMBER BLEY: Okay.

MEMBER ARMIJO: I suspect your autoclaves look at lot like what the fuel manufacturers --

MR. THOMAS: They look like the Paducah gas diffusion plant autoclaves, and the ones that were at K-25 and the ones that were at Portsmouth, that's operated, you know, many years so they're well-proven.

Some people use other types of autoclaves, but the steam autoclave is a well-proven system.

CHAIRMAN RYAN: In addition to the weighing, which I understand it's a critical step aspect, do you have an operating margin, you know, that you have built in to, you know, we'll accept a drum that weighs no more than this, and then that's got some margin of safety?

MR. THOMAS: We won't accept any cylinder that doesn't meet the shipping weight of a 48 wire, 48. They all have their --

CHAIRMAN RYAN: Yes, I understand that part. But then that cylinder going into the process and getting heated up is in a different setting then that particular requirement. Is there a margin between that and --

MR. THOMAS: The margin's been built into the ANSI standard for 220 or 235 degrees.

CHAIRMAN RYAN: Okay, all right.

MR. THOMAS: So if you follow the standard, you've got the margin built in.

CHAIRMAN RYAN: I got you, all right.

MEMBER BLEY: I'll just ask you one more question about that. Within the IROFS that you have to check for the over-filled cylinder, do you have something that specifically would preclude the kind of misweighing event that occurred at Sequoyah, since you investigating that?

MR. THOMAS: Well, the autoclave itself. One of the problems that happened at Sequoyah, they had an over-filled cylinder. They over-filled it.

MEMBER BLEY: Was it weighed in the autoclave?

MR. THOMAS: No. It's weighed outside the autoclave before you place it in.

MEMBER BLEY: Before you blow up the --

(Simultaneous speaking.)

MR. THOMAS: Yes. The cylinder --

MEMBER BLEY: Or like they did, put it on a scale, and they didn't get it all the way on the scale.

MR. THOMAS: They filled the cylinder. We don't fill any cylinders.

MEMBER BLEY: No, but somebody else did.

MR. THOMAS: Yes, but that's right.

MEMBER BLEY: So you could have gotten that --

MR. THOMAS: In that accident, they filled the cylinder on a cart, on a load cell and the cart wheel was off and it caused a problem. We weigh it on an actual scale that's not on a cart. You place the cylinder on the scale.

MEMBER BLEY: Okay. You have to pick it up and put it on the cart.

MR. THOMAS: That's right.

MEMBER BLEY: That helps me. Thanks.

MR. LAFLIN: Back to your chemical process. So the first step up to UF_4, and I should mention, too, that this UF_6 to UF_4 part of the process, we actually acquired a plant that did this part of the process very, very well. Ran for about 15 years filling contracts for the Army, to produce UF_4. We're just taking the key components that are still usable today, autoclaves, for example, reaction towers, bridge cranes, those kind of components.

But along with that plant, we got all the

operating records and parameters for the plant as well, and actual operator time to help us with the start-up.

The second part of the process, the UF_4 fluorine extraction part of the process. Again, we've had a pilot plant in Idaho. We've been operating since '96. When we acquired the patents, the company we acquired them from had actually ran this process with a calciner, producing silicon tetrafluoride gas for some time as well, and demonstrating it.

It's a very robust process. It's a very simple process. You basically mix UF_4 powder with your metal oxide in a stoichiometric ratio, and you heat that to about 700 degrees Fahrenheit.

MEMBER ARMIJO: Do a replacement reaction?

MR. LAFLIN: That's it. The fluorine comes off, the uranium stays put and is converted to an oxide.

MR. THOMAS: Steve, for the record, Sequoyah only operated eight years at Gore. Now that process was used many years by other people. But the Sequoyah process ran about eight years.

MR. LAFLIN: Yes, and I should also mention too that it was at the Sequoyah facility, but totally separate from the facility, where they had, at

the conversion plant, had the events with UF_6.

MEMBER ARMIJO: In this FEP process, are you low pressure? Is that a low pressure process?

MR. LAFLIN: Yes. You know, we've developed, from our work in Idaho actually, a process patent on the top of the seven patents that we acquired, and part of those, that patented technology, was using a helium flow gas and some oxygen flow with this. But it's at about a pound of pressure for extraction.

MEMBER ARMIJO: Not a high pressure --

MR. LAFLIN: Not a high pressure, but BF_3 itself, though, that's a high pressure gas. So once we collect that BF_3, in order to package that and prepare that, it's actually being compressed up to 3,000 pounds?

MR. THOMAS: No. It's about 1,200, 1,500 pounds on the product. But that product doesn't have uranium in it, so it's not a licensed material. But the reactor is running at below atmosphere.

MEMBER ARMIJO: Okay. So that's really basically almost like a two or three-step process in the end, as far as major processes?

MR. LAFLIN: That's right.

MEMBER ARMIJO: Okay. Thank you.

MEMBER SIEBER: Now are these steps are performed by fuel clarification plants, right?

(Simultaneous speaking.)

MR. LAFLIN: Well, the conversation has been done by fuel classification plants.

MEMBER SIEBER: --Year 2. They do it through this kind of a process. So this is not new.

MR. LAFLIN: Their process would go all the way from UF_6 all the way down to oxide --

MEMBER SIEBER: Right.

MR. LAFLIN: And extract all the -- and the fluorine is of no concern, and really no value in that process. It's wasted as or sold as small amounts of hydrofluoric acid.

MEMBER SIEBER: Right.

MR. LAFLIN: The Department of Energy facilities, for example, are using a single-step process that will produce copious quantities of aqueous hydrofluoric acid, which there may or may not be a market for.

So our process, again on the hydrofluoric side, we've focused on the anhydrous hydrofluoric, as opposed to aqueous, because it has more commercial value. So, onto integrated safety analysis.

MR. GREEN: I am here to describe the ISA

process that we followed and documented, as part of our submittal. We had a team approach with this. We had safety specialists in environmental safety, radiological safety and chemical safety, along with we integrated with the engineers, the process and Design engineers in this process, through pretty much all the steps, all the way through.

We followed NUREG-1520 of the Part 70, Subpart H. We followed that recommendation. We followed it explicitly. If you look at 1520 and you look at our submittal, and you can turn the pages, and it follows it exactly as it was laid out in 1520. Some facilities, Lynchburg and NFS, they have different flavors of it. But we went strictly by 1520. We were happy with the methodology there.

We consider a low hazard nuclear facility. It doesn't have any criticality concerns, so it's primarily a chemical and radiological concern. The primary hazard we have at this facility is chemical, with the most likely candidate for concern is HF or any kind of fluoride product.

We didn't have any scenarios that led to high or intermediate consequence doses to workers or the public.

CHAIRMAN RYAN: Did you have, put some

numbers on high and intermediate?

MR. GREEN: I don't have those written down. It's in the -- it's spelled out --

MEMBER SIEBER: It's in the application.

CHAIRMAN RYAN: Okay.

MR. GREEN: I don't know the precise one. It's a certain radiological level and there are certain -- the same thing for chemical. There are certain qualities.

MEMBER SIEBER: The high was 100 rem. The medium was 25 rem.

MR. GREEN: And then there's a soluble uranium issue too, for that.

CHAIRMAN RYAN: Maybe the staff will address that when they come up here, give us those values. Not right now, but when they're presenting. Thank you. Go ahead.

MR. GREEN: Next one. The first step in the process was to use a hazard identification, and that's basically the what, where and how much hazardous material that you have. That was primarily done by the safety analysts that were on the project, although we got a lot of information and feedback from Jim and the other process engineers.

From there, we went to a hazard screening

methodology, and we would basically exclude low consequence events such as skin irritants and things like that. Also, we have standard industrial hazards that you would have at a facility. Slips, trips, falls, those type of things were excluded from further analysis.

The first major analysis that involved the entire team was the process hazards analysis. We had three separate sessions that lasted multiple days. We had Jim and his engineers come down for those, and we had -- I was the team leader for that. We had a scribe and we laid out the basic stuff and went through the PFEs, and started at nodes and did our methodology.

What we ended up using was the "what if" checklist methodology. We thought about using haz op, and we felt like the what if would get us the same amounts. I feel more comfortable with the what if when you're bringing in people that aren't familiar with haz ops, like some of Jim's folks. So with a more straightforward and still a robust approach, especially if you use the checklist with it as an oversight.

Let's see. Once we did that, the essential purpose of the PHA is to screen out for low

consequence events and identify those that could potentially, accidents that could result in high or intermediate consequences. This kind of what our forms look like. This isn't actually one of ours. It's been kind of sanitized here.

But what you end up having is you have a scenario number, and you do your what if at the process node that you're concerned about. In this case, we identified a couple of causes for this event. The failure frequency, we'll discuss that in a little bit. But you know, that's basically how likely this thing's going to occur, and it's an order of magnitude type number.

In this particular instance, we expect that failure to occur maybe once or twice during the life of the facility, maybe once every five years, ten years, in that range. The consequences --

MEMBER ARMIJO: The units are kind of funny. Minus 1 what?

MR. GREEN: Yes. They range, and I'll talk about that later, they range from a positive 2 to a minute 6, and you want a more negative number that you can get on all these. That's the way you want to be.

CHAIRMAN RYAN: Okay. So rather than --

I mean what does as minus 1 mean on a likelihood, in terms of probability of percent?

MR. GREEN: You would expect it about once every few years to occur. I'll discuss that --

CHAIRMAN RYAN: Okay. All right, okay. We'll get there.

MR. GREEN: And the consequence here is a hazardous and radioactive gas release, and this is unmitigated at this point. We don't assume we have any controls on it or mitigation. The consequence categories, you can see the categories down below. You have low, intermediate and high. At this point, we are just estimating this expert opinion at this, at this time.

We're not -- these are not definitive. We'll confirm these later. The prevention feature is what we -- we will use the PFDs and the PNIDs to just look at possible controls that we may want to make safety controls. We're not committed to them at this point. This is just to help us in the later phases of analysis.

Same thing with mitigation features. These are just things that we have available if we want to use them.

MEMBER ARMIJO: Which could become IROFS?

MR. GREEN: Could become IROFS, if we need them. But at this point, we're just listing them, and we'll pick the best ones as we need them.

CHAIRMAN RYAN: So just so I'm clear, let me state it a different way. It sounds like this process is helping you systematically evaluate, you know, features, events and processes in the system that you really want to focus in on?

MR. GREEN: Exactly. It's another screening tool, and it also like helps identify things that we're going to need, when we start doing some accident analysis.

CHAIRMAN RYAN: Some of these things, like the failure frequency, is really a ranking rather than an analytical result. Is that fair?

MR. GREEN: No. It's supposed to be based on likelihood. It's supposed to be --

CHAIRMAN RYAN: But it's not a full kind of a PRA model?

MR. GREEN: It's not a PRA. It's more of, you know, this type of failure you would expect to occur. It's being in a group of failures.

CHAIRMAN RYAN: Yes, but that rank is based on the consequence of a 6 versus a minus 1 or minus 5 or 1, right?

MEMBER ARMIJO: Well, the consequences per event is the way I read it.

MR. GREEN: Yes. Consequence is --

CHAIRMAN RYAN: Oh per event, okay.

MR. GREEN: Consequence is what happens if it does occur.

CHAIRMAN RYAN: I got you. All right, thanks.

MEMBER ARMIJO: But your frequency number comes from experience from similar facilities?

MR. GREEN: It's coming up on the next slide.

MEMBER ARMIJO: Okay.

CHAIRMAN RYAN: Fire away.

MEMBER SIEBER: Let me ask you a quick question before you leave this. As I read through the application, I did not come across any high consequence accidents that you could have; is that correct?

MR. GREEN: No. There are some high consequence accidents, chemical and --

CHAIRMAN RYAN: Is it the chemical ones? There are still radiological source material-wise.

MR. GREEN: Not from a process upset, but there are like seismic event, if we collapse a

facility would, would be a high consequence event. So there are some, but they're not process-type accidents. They're more --

CHAIRMAN RYAN: Based on events?

MR. GREEN: Yes.

CHAIRMAN RYAN: Is that your only high consequence?

MR. GREEN: From a radiological --

CHAIRMAN RYAN: It's external events?

MR. GREEN: Yes.

MEMBER SIEBER: But even that occurs over days, right, a radiological event from a seismic event?

MR. GREEN: It would be based on an immediate dose, yes. It's not a prolonged one. You would expect the release to occur, and then it would settle out. It's not like a criticality or anything where --

MEMBER SIEBER: Well, yes. The activity levels or the specific activity that's --

MR. GREEN: Yes, yes. So once we finish with the PHA, we would move on to the first step and do an accident analysis, is to figure out what the initiating event frequency is. NUREG-1520 has tables in there for types of events and values you can assign

them.

If it's a frequent event, like you expect it every week or so, it would be a 2. If it were something that would happen maybe a couple of times a year, it would be a zero. If it's every few years, it's a minus 1, and from there, it just goes order of magnitude.

So the lower the number, the less likelihood the event, and we have criteria. There's still a bit of judgment in there, but mostly it's based on experience from facilities and the type of failure you're looking at.

Then from there, you have those -- you have to determine what your protection and prevention type of controls would be. These would be your potential IROFS that you would look at, given the initiating event occurs.

Now some of your protection, you would start working some of those things out there, and start to group them. There's another table in 1520 that also gives different values for protection. Like if it's a passive engineer control, it will give you a range. It could be a minus 3 or a minus 4. If it's an active engineer, it could be a control. It could be a minus 2 or a minus 3. It's all in a range there.

We always chose the more conservative number. If it was an active engineer, we would use the minus 2 instead of a minus 3, unless we had a good, strong basis for saying it's going to be more than that. If we had redundant systems and an especially robust design on it, we would maybe consider it at the higher value.

But I think we might have only done that in one or two places on things. I think mostly across the board, we used a conservative value on that. We did not use failure duration. That's also in 1520. That's used more for criticality safety.

If you have a glove box operation and you only have one fissile can inside there, and the operator brings in another fissile can, you can recognize the failure. You can get it out relatively quick. It helps you with your probabilities.

We don't really have many situations where we're dealing with those type of events. So we just left off the failure duration point, and it's conservative to do that. So we didn't take any credit for that.

Once we have the initiating event frequency hammered down, and then also the protection and prevention-type safety systems, we can determine

the likelihood of an accident scenario.

We use this method that's also in NUREG-1520, and really you just add them up. You have a minus 1 for 1; you have an IROFS that's minus 1, and you have another one that's minus 3. You add them up and you're at minus 5.

Once you get to that point, it will go into whether the scenario is likely, unlikely or highly unlikely, and that's done by -- we use this T. We calculate the T. So if it's T is equal to minus 5 or greater, it's highly unlikely. If T is equal to 4, it's unlikely, and anything below 4 is a likely event.

After that, we do consequence, and we start with a PHA again, what we came up with initially. Then the chemical engineers and the radiological engineers would, based on the amount of flow and stuff, would determine what kind of consequence that you're going to have.

The criteria in there in what, 10 C.F.R. 70.76, I think are the criteria for that, for the consequence levels. They're simply a 1, 2 and a 3.

Now we come to the Items Relied On For Safety. These are basically the safety features that we're relying on to meet our risk goals. These are tabulated values. I've described them a little bit

before for passive engineer control. You have a minus 3 or a minus 4. You can use active engineers in minus 2 or 3.

Enhanced administrative controls are typically minus 2, and for simple administrative controls, we usually use the minus 1.

The next thing we do from there is we determine what the risk is, and that's simply likelihood times the consequences. What we will use, we will -- we use these risk tables, which I'll show you in a little bit here, to document all this and write up these scenarios. But any risk number that's a 4 or less meets our performance criteria, our performance goals that are spelled out in 70.61.

Anything that has a greater than 4, we're going to have to either reduce, mitigate the consequences or we're going to have to add additional prevention and protection features, to get the likelihood of the event down.

The accident sequences. These are risk tables that we, and I'll show you an example here in a minute. These are risk tables that we put together, and we followed the methodology in 1520. But we used -- the PHA was a starting point. That's where we got our initiating event, and of course, we refined the

probability of that initiating event with further analysis, and also the consequences.

So they weren't estimates at that point. They were our best, our best numbers that we could come up with. So we refined those event frequencies and consequences, and then just we would determine whether we meet the risk numbers or not from there.

This is what they look like. These are the columns and categories. You start out with just the unique identifier for the accident sequence, and what the accident sequence is, and that's going to match the PHA scenario down at the bottom, process gas flow valve to open system. Then you have the initiating event, and under that, the potential causes for that event.

Ignore the IROFS 1, 2 and 3 at this time, and let's stay up at the top here. The first thing you do is you analyze the uncontrolled event, and then you have no credit for any protection or mitigation of any consequences. So you base the determination on the likelihood on that, which in this case is a minus 1, which a category --

MEMBER BLEY: Which would always be the same as the initiating event?

MR. GREEN: Always. Yes, always, and the

only ones that end up being not controlled are some very unlikely natural phenomena-type event, you know, plane crash and stuff like that. Most of your process accidents are all going to require IROFS, all of them do.

So we end up with a Category 3, which is likely, and then we have an evaluation reference to the consequence. For this scenario, it's a 3. That gives us a risk index of 9, which is 3 times the 3. That gives us a 9. That means we need IROFS to control this accident sequence.

So then if you go down to the bottom column there, we added isolation valves. Really, we're just taking credit for what's already there, and there's a blind flange. This is a parallel system, so you're going to have one system that's out maybe for maintenance, for changing out traps or whatever, and it's going to be a blind flange there.

So in case the valve is turned the wrong way, you've got to get through isolation valves and then through a blind flange, in order --

MEMBER ARMIJO: Somebody would have to install that blind flange. It would be administratively controlled?

MR. GREEN: Yes. That's through

maintenance and stuff. But maintenance isn't really part of this; maintenance-type upsets are. So that gives us -- that means that's controlled. That gives us a minus 5. That changes the likelihood category to highly unlikely, and then the 1 times 3 is now a 3, and that meets acceptable risk for this scenario.

Now our last thing we did as part of this was to incorporate natural phenomena and external events. We followed the same approach in doing this, using the PHA. We documented everything in a PHA, and went and assigned values and used the risk tables. So everything on that aspect was pretty much the same.

We did have some -- a lot of these events, you'll end up having either low or no consequences, or you'll have that they're not credible. One was a dam break burst, and there's no dams within hundreds of miles. So that wasn't a credible scenario for us.

Plane crash. Now we did analysis to demonstrate that it was highly unlikely or incredible, but we had to go through that process. We just didn't dismiss it.

MEMBER BLEY: What kind of events did you have, within the process, while you still have UF_6, where the process might stop and the material might be isolated in a segment of piping?

MR. LAFLIN: I think we might want to be careful, as far as this is in a public format that we're in, to discuss the details of specific system parameters and accident and accident analysis. That's the advice that we were given, I think, by NRC staff.

MEMBER BLEY: Are you going to have a closed any time, Mr. Chairman?

CHAIRMAN RYAN: We can close the session, if you want to do that today.

(Simultaneous speaking.)

MR. LAFLIN: --you know, to answer those questions. But just --

MEMBER ARMIJO: I don't think we need to go have another meeting, you know, if we're going to ask these questions. You can just close the session and get some answers.

MEMBER BLEY: We could do it some time, you know, get through the slides.

CHAIRMAN RYAN: They'll get through this, and if it's -- I'd leave to --, to maybe tell us should we wait until the end of the session or at the break, and come back after break and do it then. That's probably a good place, but we can certainly do it --

MR. GREEN: There's only one more slide.

CHAIRMAN RYAN: Fire away.

MEMBER ARMIJO: Well on your initiating events, did you -- what did you consider and actually address a little more quantitatively? You know, flooding is not impossible in New Mexico, if you're in arroyo.

MR. GREEN: No. We looked at -- we even looked at snow and stuff, snow loads.

MEMBER ARMIJO: Snow loads?

MR. GREEN: Yes. We looked at different kinds of flooding; slowly flooding and then, you know, a flash flood. We followed NUREG-1520 on that, and Rev. 1 of 1520 has a lot of stuff on natural phenomena and external events.

We used that as a guide on that, on determining what our design basis accident, like what size magnitude seismic event we needed or frequency return period. We used the NUREG-1520 for that. Same thing with winds and all those things.

MEMBER ARMIJO: Of all those external events, which one was the most, the greatest concern to you?

MR. GREEN: Well, you know, just whatever one. You know, we didn't really look at it that way. We didn't pick out the worse one. If it just fell

into a certain bin, if it was intermediate consequences, it was grouped in with intermediate consequences. If it was high consequences, it was high consequences. We didn't rank anything.

MR. THOMAS: From a design basis standpoint, the governing natural phenomena hazard will either be seismic or straight winds. We haven't made that final determination, but it's one of those two. As we get further into the engineering, that will make that determination. We're analyzing both of those.

MR. GREEN: And that's all I have.

MR. LAFLIN: Well again, we appreciate the chance to talk about this project. We clearly think it's really an important project, that fills what would be a major void in the front end of the nuclear fuel cycle. We think we're an important, actually it's an important business opportunity, but an important operation to reduce waste and to recover value from material that could become a waste.

Nothing is more important to us than safety of our employees, protecting the environment. We've kept that into paramount consideration from day one on this whole plant and these operations. My background, John's background, our safety philosophy

driven home from our days in the nuke Navy started that off in operation.

That philosophy is in our facility in Idaho, I mean our safety performance, our license performance there, and it will be part of this facility as well.

Then, I think significantly, is that we have really -- well, we've been the first to get through this Part 40 licensing process in its newest stage, the first facility ever to go through this kind of detailed integrated safety analysis, using these new regulations, to make sure that we've evaluated our systems and our safety properly.

It's been a valuable process for us. I mean it's certainly added some complexity and some difficulties to it and some cost, but it's certainly been worthwhile. We'll have -- at the end of the day, when we're ready to be up and running and operating, we'll be confident and everybody will be confident, including the community, that it's been well-designed, well-engineered and well-regulated as well.

CHAIRMAN RYAN: Thank you, Steve. I appreciate all the briefings and presentations so far. It's been very informative. One kind of summary question. How has this process informed your start-up

planning? I mean obviously it's a key part of it, I think. But has your start-up plan changed, evolved, or become something different than what you first envisioned, now that you've been through this process?

MR. LAFLIN: No. You know, I mean we have always planned on the licensing to essentially be the long lead critical path for this project, and so I think that's the same today.

We're maybe at a point to where we're actually going to shift gears here, and actually engineering work and formal design work may end up becoming the critical path from this point forward, based on where we think the license is progressing.

So it could become a funding/financing issue, to raise the capital to actually start construction. You know, how things progress with the investment community as a result of the events in Japan, you know, over the next few months and how attractive the markets, or what kind of an appetite they get for nuclear investments again will perhaps affect the schedule, you know, more significantly.

CHAIRMAN RYAN: Okay, thank you. Okay. I guess with that, we're pretty much right on schedule. So I'd ask the staff to come on up and make your presentation. I'd note that Dr. Banerjee has

come to us finally, thanks to the mercy of some airline that let him come here before the end of the day. Welcome Sanjoy.

MEMBER BANERJEE: Thank you.

(Pause.)

CHAIRMAN RYAN: Tom?

MR. HILTZ: Thanks, Dr. Ryan. Just again, thank you for inviting us. We hope to share whatever information and address any questions that you may have regarding our review process for proposed International Isotope facilities, talk about the rule of the integrated safety analysis.

As I did mention, this is the first Part 40 facility that's being licensed using that, and give you an update on the review status.

Next slide. You probably already know this, but just to be clear about our role in the review process, the Office of Nuclear Material Safety and Safeguards is the lead office for the review of the International Isotopes application. We are the project office.

Matt is the single point of contact between the NRC and the applicant. We do that for many reasons. But all the communication from the NRC staff should be at least coordinated, if not

facilitated, through Matt. We oversee the safety review portion of the review.

The review of the environmental work and the environmental report is done by the Office of Federal and State Materials and Environmental Management Programs, FSME.

So we do not have any representatives from FSME with us here today. So if you do have any questions about the environmental review, we'll be able to give you a status, but we'll likely need to get back to you on some of those details.

And ultimately, if we can make the safety conclusions in our safety evaluation report, and complete the environment impact statement, we'll be in a position to make a decision about whether to issue a license. With that --

MR. BARTLETT: Good afternoon. My name's Matt Bartlett. As Tom mentioned, I'm the project manager for the International Isotopes license review. Some of my slides will repeat some of what the International Isotopes covered, and in those parts, I'll try and just kind of go through it quickly.

I'd like to begin by just giving you kind of an idea of where International Isotopes' key conversion facility fits in the country's conversion

and deconversion facilities. Then I'll focus in on, talk about some of the hazards specifically for International Isotopes.

I'll go over the regulatory requirements that apply. I'll touch on the ISA and its impact on the safety, the safety review, and then give you an update on where we're at in the review, the status so far.

Okay. There's a number of conversion and deconversion facilities that operate in the country. There's some that are licensed under Agreement States. For example, Aerojet Ordnance in an Agreement State licensee that is in Tennessee. This facility only deconverts depleted UF_4, and they use a process that doesn't involve HF, which part of the reason it's regulated under an Agreement State.

There's two facilities that are licensed by DOE, that operate under DOE. These are the deconversion plants that were already mentioned, that are designed to deconvert the material that's at the gaseous diffusion plants at Portsmouth and Paducah. One of these facilities is already operating and one is under construction.

That facility does deconvert UF_6. So they do handle large quantities of HF. Then of course

there's the conversion facility. That's Honeywell, Metropolis, Illinois. They are taking natural uranium, uranium oxide that's been mined or milled out of the ground, convert that into UF_6 so that it can be taken to the enrichment facilities and converted into fuel.

This facility is regulated by the NRC. It's regulated under Part 40, and obviously they handle HF also.

MEMBER SIEBER: Is that the old Allied chemical facility?

MR. BARTLETT: Yes.

MEMBER SIEBER: Okay.

MR. BARTLETT: Then that brings us to International Isotopes. The proposed facility will deconvert depleted UF_6 from the commercial enrichment facilities, and they'll be licensed under Part 40, and they'll also be required to do ISA from Part 70.

This slide I'll go through really quickly. So they'll be in the southeast corner of New Mexico, about in the middle of Lee County. This is a picture of the slide which International Isotopes showed.

It's a semi-arid area, not a lot of people in the area. There are a couple of power plants in the general area, but I think the nearest residence is

over a mile away.

MEMBER SIEBER: Are those power plants oil, gas?

MR. BARTLETT: They're gas, gas-fired power plants, yes. As International Isotopes mentioned, their process involves bringing the UF_6 into the facility, reacting with silicon dioxide, boron trioxide, in order to convert the material into depleted uranium oxide for disposal, and then high purity fluoride compounds for resale or sale.

So International Isotopes already described their conversion process, two-step process. But the thing I wanted to focus in on here is the primary hazards for this facility, even though it's regulated by the NRC, are the chemical hazards, and you can see some of the chemical inventory that they'll have on site. Large quantities of DUF_6, HF and then the fluoride compounds.

MEMBER ARMIJO: What is the reaction for making the boron tetrafluoride?

MR. LAFLIN: The trifluoride?

MEMBER ARMIJO: Is that a different --

MR. BARTLETT: So you're saying instead of the DUF_4 plus SIO_2?

MEMBER ARMIJO: Is there a similar --

MR. BARTLETT: I believe it's the same process.

MR. LAFLIN: Yes. It would be, you'd just substitute B_2O_3 in that equation for SIO_2.

MEMBER ARMIJO: Just a separate screen --

(Simultaneous speaking.)

MR. BARTLETT: Yes, separate process lines.

MEMBER BANERJEE: I missed this, but does this -- any of this is exothermic, these reactions?

MR. LAFLIN: The UF_6 to UF_4 reaction step is an exothermic reaction step.

MEMBER BANERJEE: And the formation of the fluorides of boron and silicon, are they exothermic or endothermic?

MR. LAFLIN: No, that's an endothermic reaction.

MEMBER BANERJEE: Endothermic.

MR. THOMAS: Slightly endothermic.

MEMBER BANERJEE: Slightly endothermic.

MR. THOMAS: Yes.

MEMBER BANERJEE: And the final form of the fluorides, are they solid basically or --

MR. LAFLIN: Gases.

MEMBER BANERJEE: Gases.

MR. LAFLIN: Yes. Well, the anhydrous -- yes, hydrofluoric, the anhydrous hydrofluoric, silicon tetrafluoride, boron trifluoride are all gases.

MEMBER BANERJEE: They're the gases, okay. Are they poisonous?

MR. LAFLIN: Yes. Reactive and toxic.

MEMBER BANERJEE: Reactive and toxic.

MR. LAFLIN: Also highly in demand for commercial applications all over the U.S.

MEMBER BANERJEE: Right.

MR. BARTLETT: Yes. So that's what the hazards are --

MEMBER BANERJEE: Falling under OSHA on this at all?

MR. LAFLIN: Yes.

MEMBER BANERJEE: So have you done the haz ops? I haven't followed this, so I noticed you did a PHA.

MR. LAFLIN: Yes.

MEMBER BANERJEE: Is that all that's required?

MR. LAFLIN: Yes.

MEMBER BANERJEE: You don't need a haz ops for this?

MR. LAFLIN: I don't think so.

MR. THOMAS: No. Just a hazards analysis and you could use several --.

MEMBER ARMIJO: You have to talk into the mic.

MEMBER BANERJEE: Identify yourself first, please.

MR. GREEN: Yes. You don't have use a haz ops. That's just one of several techniques you can use for OSHA or EPA or through the ISA methodology.

MEMBER BANERJEE: Do you fall under Superfund Title III at all on this, with regard to the amount of toxic chemicals on site?

MR. LAFLIN: No, I don't believe so. In fact, you know, and as far as waste goes, this is not a waste material. Even the UF_6 coming to us has been ruled as not a waste product, because we're extracting fluorine.

MEMBER BANERJEE: So you've done a what if, I noticed, and a -- I just looked -- checklist and PHA. Is that what all you've done? You didn't do anything more detailed than that for this?

MR. LAFLIN: Well no. We've done in accordance with the advance recommendations and requirements of the anticipated changes to Part 40, we have implemented full compliance with those from the

very beginning of this whole license process, which includes PHA analysis, integrated safety analysis, meeting all the requirements of NUREG-1520 Rev. 0 and then NUREG-1520 Rev. 1.

MEMBER BANERJEE: Yes. Well this is pretty -- I imagine this is pretty toxic stuff, right, and they're heavier than -- it's heavier than air, most of this?

MR. LAFLIN: I believe so, yes.

MEMBER BANERJEE: Yes. So you looked at plumes and dispersion of plumes and --

MR. LAFLIN: Oh yes.

MEMBER BANERJEE: --all this stuff?

MR. LAFLIN: Oh yes.

MEMBER BANERJEE: Okay. Sorry.

CHAIRMAN RYAN: Oh no, that's fine. Keep going. Glad you're here.

MEMBER BANERJEE: All right, okay. I'm sure I'll have more questions.

MR. BARTLETT: In addition to just the inventory quantities that are on site, of course, one of the main concerns is, since they're going to be putting the cylinders, UF_6 cylinders into an autoclave and heating it up, the potential for a liquid release is there, of course.

If the UF_6 is released in the liquid form, it would react very rapidly with moisture in the environment, to produce uranyl fluoride and large quantities of HF. These are the hazards that we are concerned about.

MEMBER BANERJEE: HF will also react with any moisture in the atmosphere if it's dispersed in the form of a polymer, which is very heavy, heavy gas.

MR. BARTLETT: Okay.

MEMBER BANERJEE: It disperses very slowly.

MR. BARTLETT: I know we definitely looked at the plumes and the clouds that could come from a release.

MEMBER BANERJEE: What codes did you use?

MR. BARTLETT: Yawar, do you want to touch on there?

MR. THOMAS: Well, for some of the dispersion modeling, we used the EPA codes.

MEMBER BANERJEE: Which one?

MR. MILLER: Well, SCREEN3 was used on one of them. SCREEN3 was used. We have -- APTS ran the models.

MEMBER BANERJEE: APTS.

MR. LAFLIN: Yes, I'm sorry. You missed

the introductions at the beginning, so I'm the CEO of the company, and the fellow behind you that's offered some comments is Jim Thomas. He's the president of APTS.

MEMBER BANERJEE: Okay.

MR. LAFLIN: And then Ron Green is to his right, and Jim has been involved in the nuke industry, the front side of the fuel cycle. He was ops manager for the Honeywell facility for the gas diffusion plants for a long time, was a senior executive for USEC.

Ron Green works with him, and they have worked as a contractor for us for all of our licensing, safety analysis review, initial engineering design for the facility and the plant. So Ron is our integrated safety analysis expert on the facility.

MEMBER BANERJEE: So your nearest habitation is a mile away, is it?

MR. LAFLIN: Yes, roughly. The facility itself will take up about 40 acres, and we've located this facility so that that 40 acre footprint will be roughly in the middle of a 640 acre section of property. Then outside of that, from the fence line to the nearest neighbor is roughly six-tenths of a mile, I think, away.

MEMBER BANERJEE: And the largest storage vessel, if it fails or leaks or whatever, you've looked at the plume?

MR. LAFLIN: Has been evaluated, yes.

MEMBER BANERJEE: And using an EPA code for heavier than air gas, I presume? Is that true?

MR. LAFLIN: Yes. Ron, do you know which code that was used specifically for the air releases?

MR. GREEN: I'm sorry, I don't. I did it one time, but it's been a while and I didn't run it. It was -- our chem processing engineer did that.

CHAIRMAN RYAN: Maybe we can just take a follow-up though. That will be helpful for us to learn what codes were used.

MR. THOMAS: We can provide.

MEMBER BANERJEE: That would be in your safety evaluation.

(Simultaneous speaking.)

MR. THOMAS: We did the dispersion modeling for two reasons. One, for the environmental report that will come in, the environmental impact statement, which was done for what we call the routine emissions. Then we looked at the accident emissions with various codes, based on the largest-sized vessel of any particular chemical.

Like if we have 8,000 pounds, let's say. I'll just pick a number. We had 8,000 pounds of HF, we would have run the code for release of that entire amount in that vessel. We did that for all the hazardous chemicals, including the powders.

MEMBER BANERJEE: Okay. So you did a postulated release basically, correct? Just the failure of the tank?

MR. THOMAS: We did a postulated release, yes, for each vessel, knowing the inventories in that vessel, the actual inventory in that vessel.

MEMBER BANERJEE: You assumed the list, whether -- or something?

MR. THOMAS: Yes. The meteorological conditions were taken in consideration as part of the worse case, as well as, you know, wind directions, that type of thing.

MEMBER BANERJEE: Going towards habitation?

MR. THOMAS: Yes.

MEMBER BANERJEE: And you were below toxic levels before you got the habitation?

MR. THOMAS: Not always, but if it was unmitigated, we were not. So that caused us -- when we do those analyses, it caused us to put in

preventive measures, to make sure we were below it. But on the unmitigated cases which we did the models, we would have had some chemical toxicity off site.

MEMBER BANERJEE: Right.

MR. THOMAS: And so then to the worker.

MEMBER BANERJEE: Yes, of course, and what was the mitigation?

MR. GREEN: Well, we actually used prevention. We didn't mitigate anything. We took credit for the building in our releases. But we didn't mitigate, we didn't plan on evacuations or anything.

What we did to meet risk criteria on those scenarios would make it, we would add controls prevention, and protection controls, such that it was highly unlikely for the event to occur.

MEMBER BANERJEE: And were these storage vessels in buildings, or were there some outside?

MR. THOMAS: Both cases. Most of the vessels are in buildings. For example, the anhydrous storage would be in a containment-type building, with a deluge system. That was what I was talking about in mitigation.

But prior to the mitigation processes, when we found the consequence of a chemical, as well

as, you know, if it were radiological to be above our risk level, we placed Items Relied On For Safety within those systems, to prevent that release.

MEMBER BANERJEE: Sorry, I missed that.

MR. THOMAS: We used Items Relied On For Safety, the IROFS, as preventers, to bring the accident consequence or likelihood, to bring that risk to an acceptable risk. So we used those models, and the results of those models to help us identify those systems that needed prevention techniques to avoid that release.

MEMBER BANERJEE: Well, let me just understand, going back to it. You have fairly large storage vessels, I presume, and --

MR. THOMAS: Relatively small, compared to most chemical industry. But yes large, in terms of concern.

MEMBER BANERJEE: Well yes, in terms of -- if there was no form of mitigation, and if this vessel failed, either catastrophically or developed a jet release, both are possible. The question is that you would get a plume, then, which potentially could be toxic, given different weather conditions at your nearest habitation.

MR. THOMAS: That's correct, if you did

not have prevention techniques or mitigation techniques to prevent that.

MEMBER BANERJEE: Well, the usual prevention technique in the chemical industry is to subdivide the tanks, and to put barriers between them, so that they don't propagate failures. That's the ones I know of.

MR. THOMAS: Well, you're correct, and we use that technique, for example, instead of storing all the anhydrous HF in one or two tanks, we stored it in separate tanks, smaller separate tanks to reduce the consequence.

MEMBER BANERJEE: With the barriers?

MR. THOMAS: Yes, with actual separate tanks.

MEMBER BANERJEE: Right. Separate tanks, but one tank failure can -- catastrophic failure can propagate to other tanks?

MR. THOMAS: That's correct. In the HF tanks, we did that. That's correct.

MEMBER BANERJEE: So you have to put some barriers?

MR. THOMAS: Right, yes.

MEMBER BANERJEE: We'd better take a quick look at the safety report.

CHAIRMAN RYAN: Okay.

MEMBER BANERJEE: Do we need a letter on this?

CHAIRMAN RYAN: No. We're not planning a letter from this meeting. This is really just the first meeting we've had, so it's kind of an introduction, and kind of an overview of the applicant's status, and also the staff's status on reviewing the applicant's materials.

MEMBER BANERJEE: They're coming to the full Committee at some point?

CHAIRMAN RYAN: At this point, this was planned as a subcommittee-only briefing, and then we could take it up, and I think after we hear it all, decide what the next steps might be as a subcommittee.

MEMBER SIEBER: We can do that with any issue.

MEMBER BANERJEE: Yes, okay.

CHAIRMAN RYAN: Okay. Thanks, Sanjoy.

MR. BARTLETT: Okay. Let me talk a little bit about the regulatory requirements. So International Isotopes, this application will be licensed under Part 40. The key requirements in Part 40 are summarized in 4031 and 4032. These would be the standard requirements which you would expect for

any facility, any fuel cycle facility.

The applicant needs to protect the environment. They need to have a decommissioning plan, an emergency plan. They have to have qualified staff in the appropriate facilities and procedures. They have to protect health and safety, and then they have to have a physical security plan.

This would be fairly similar to what would be required for Part 70 facility, which most of the fuel cycle facilities are licensed under. The one big difference between Part 40 and Part 70, just as it's written right now, is Part 40 doesn't have any ISA requirements in it.

Back in 2007, the Commission and the staff took a close look at conversion and deconversion facilities, and the chemical hazards that are at the facilities, and decided that these facilities should meet some kind of integrated safety analysis.

So the Commission, in SRM to SECY-07-146, directed the staff to undertake rulemaking to Part 40, to incorporate ISA requirements, very similar to Part 70 into Part 40. That rulemaking is ongoing.

In addition, in that same SECY paper, I mean that same SRM, the Commission also directed that any new facilities that come in during the rulemaking

should be required to meet the ISA requirements in Part 70. That's what International Isotopes is meeting.

Let me just give you a real quick overview of the proposed rule. The proposed rule will basically incorporate the ISA requirements that are in Part 70, essentially into Part 40. There's a few minor changes, because Part 40 facilities don't have criticality concerns. So that piece of the ISA has been taken out for the Part 40 facilities.

There's also a large number of source material facilities in the country. We didn't want ISA to apply to all of those. The intent was to capture facilities that have large quantities of UF_6.

So the rule establishes a threshold, that if you have 2,000 kilograms or more, then the rule would apply to you. Then we wanted these facilities to be licensed by the NRC, as opposed to an Agreement State.

The rule, the Commission in SRM to SECY-10-128 approved the staff's proposed rule. It was just recently published in the *Federal Register* for comment May 17th. We anticipate they rule will be finalized in 2012.

Okay. So let me just give you a little

bit of the staff's perspective on the ISA summary. So the applicant has to develop an ISA that they keep on site. What they submit to the NRC is a summary, and in the summary they have to list the intermediate and high consequence events that they've identified. International Isotopes has identified over 100.

MEMBER BLEY: Do they have to show you the ones that were high and intermediate before IROFS?

MR. BARTLETT: Yes, yes, yes. That's correct, unmitigated.

MEMBER BLEY: Unmitigated.

MR. BARTLETT: Yes, and then in -- because eventually they all have to be mitigated, right? If it was the other way, there wouldn't be any. Then in addition in the ISA summary, they have to list the IROFS that they're going to apply to mitigate the accident sequences.

They have around 40, and you may say well, why are there less IROFS than there are accident sequences, and that's because several of the IROFS are applied multiple, to multiple accident sequences.

These numbers should give you some feel for the safety concerns for the facility. If you compare it to a facility like MOX, which has several thousands of IROFS, this kind of gives you a scale of

the hazard. In addition, they also have to incorporate --

CHAIRMAN RYAN: But you just must admit that several thousands IROFSs kind of raises other interesting questions.

MR. BARTLETT: Okay.

MEMBER BANERJEE: But this is pretty hazardous stuff in gaseous form.

CHAIRMAN RYAN: Chemically.

MR. BARTLETT: The chemicals, yes.

MEMBER SIEBER: Right.

MR. BARTLETT: Yes.

MEMBER ARMIJO: Just a quick question. They have -- NRC has a right to audit the actual ISA?

MEMBER SIEBER: Right.

MEMBER ARMIJO: Is the staff planning to do that, or have you done that?

MR. BARTLETT: Yes. So typically, and this will be touched on in another slide, but I can touch on it here. As part of our review, you know, we begin by reviewing the application and the ISA.

Once we're into that, we go out and do a site visit. So the ISA team, several of the technical reviewers go out to the facility. We do an on site vertical slice of the ISA that's on site.

We look at accidents that were, you know, screened out. We make sure that the approach was correct. If there are questions that come up, we ask more questions and they stay longer.

MEMBER ARMIJO: When a site, when a facility actually (noise in mic) or things like that, or would you just do a -- if it doesn't exist, right?

MR. BARTLETT: Well, yes. In this case, the facility doesn't exist, right. That picture you saw of the barren land, that's the site.

So when I say a site visit, what we actually did was we went to Oak Ridge, which is where the people who designed the ISA are based, and they have the detailed documentation on site there.

So yes, you're actually talking to the people that are doing the review, and doing detailed review of documents that don't typically get submitted to the NRC.

MEMBER ARMIJO: But when the facility's built, and it's getting ready to operate, will the staff go and inspect that facility, and assure that the design is what was addressed in the ISA and that the IROFS are really there, things haven't changed?

MR. HILTZ: Absolutely. There will be, once we reach a decision to license the facility,

there will be a construction inspection plan developed, along with an operational readiness review, which will in fact go over to make sure that the facility was constructed as designed and approved.

It will focus on those Items Relied On For Safety as part of the construction program, and will make an assessment that the facility is ready to --

MEMBER ARMIJO: Well inevitably, there will be some changes.

MR. HILTZ: Inevitably, there are some changes.

MEMBER ARMIJO: I've never seen one that hasn't changed.

MR. HILTZ: And we've had lessons learned from the ongoing review of LES. We'll probably have some ongoing lessons learned from the potentially Eagle Rock facility that we'll be able to look at.

CHAIRMAN RYAN: I can imagine that at least for maybe the, not the exact start of construction, but somewhere as construction tends to take shape, there will be a pretty regular, if not continuous presence by NRC staff in an oversight role?

MR. HILTZ: Yes. I can tell you that for the new enrichment facility, we're considering a resident inspector.

CHAIRMAN RYAN: Yes.

MR. HILTZ: For the facility near Hobbs, New Mexico, I don't think a final decision has been made. But there is proximity to LES, so there will be a constant sort of NRC presence.

CHAIRMAN RYAN: But not two, but it's not one.

MR. HILTZ: Right.

MR. BARTLETT: Okay. In addition to the IROFS that they submit in their ISA summary, they're also required to submit a list of management measures in their license application. Management measures are just safety functions and items that they put in place, to make sure that the IROFS remain available and are operating correctly.

MEMBER BLEY: Before you the ISAs, when the applicant described the ISA, they talked about using the method of 1520 precisely. It's most qualitative. The appendix shows you some semi-quantitative stuff. This business of calling it the risk by multiplying the consequence category number index by the likelihood category index number, has some things that trouble me a little bit, especially the simplest case is the number three.

If you multiply a consequence category No.

1 times a likelihood Category 3, you get a 3, and that's something that has no long-term effects or immediate severe effects, and it's not unlikely. That's the same pseudo-risk number that you get if you multiply something that could kill lots of people, and it's ten to the minus 5th of that order.

Those two things don't seem remotely the same risk to me, and having them lumped together by this process just doesn't feel right. Accepting as acceptable the number 3 for a risk number, when it's one of potentially high consequence, because it's without rigorous quantification, highly unlikely, seems like it deserves a little more investigation. Can you say anything about that?

MR. BARTLETT: I think I would like my ISA expert to respond, if that's all right. Yawar, do you want to --

MEMBER BLEY: And I don't even think it's so much an ISA question, as a prudence issue. But go ahead.

MR. FARAZ: As I understood your question, I believe you're referring to the binning (ph) chart that's in NUREG-1520?

MEMBER BLEY: In the appendix, yes.

MR. FARAZ: In the appendix, yes. There

is --

MEMBER BLEY: Yes, the example, and they showed us that in their presentation a moment ago. But they didn't show us the matrix. But they took a Category 3, and so they would multiply these things before and after the IROFS, and if we get a 3 or less, it's hunkey-dorey, and that's what that chart in the appendix to 1520 has.

It's that case where you get a 3 by getting in a high consequence with a highly unlikely, that makes me say don't you need to look at that a little more closely? It doesn't seem at all the same kind of risk as the other pairing that gives you the same index number, a 3, when it's something that can't really hurt anybody badly, and it's not unlikely.

Those two things don't seem like they're remotely in the same category, to me, and I'm just -- that first piece of that is the one that troubles me, that I hope you look a little more deeply. If they just miss one because they get a 3, when it's a high consequence kind of event.

MR. FARAZ: Yes, and we do, even though on the matrix, it might appear equal, we would tend to spend more time on and more rigorous review for the sequences, where the consequences are higher.

MEMBER BLEY: Okay. When we get in the closed session, I want to ask some about those things that were high consequence events, that are okay now, and about what you guys looked at there.

CHAIRMAN RYAN: Dennis, I agree, and I think exploring the point that was just made that, you know, you can end up with the same number but perhaps different real levels of --

(Simultaneous speaking.)

MEMBER BLEY: It's a very different risk for those two things.

MR. GREEN: Can I point something out? We don't treat them the same way, because the ones that --

MEMBER BLEY: How do I know that?

MR. GREEN: Well because if it's low consequence to begin with, we don't even evaluate them. We don't have any controls on those. There's nothing there.

MEMBER BLEY: Okay.

MR. GREEN: On the high consequences ones, we establish IROFS to prevent those things.

MEMBER BLEY: Okay. But when you -- after the IROFS, you still end up a high consequence.

MR. GREEN: It still meets the risk

criteria, yes.

MEMBER BLEY: Well, then I'm questioning the risk criteria. It doesn't seem like a risk criteria if those two things are of the same order of risk.

MR. GREEN: I think that's the way PRE works too. So I think it's used the same way. I mean you do risk consequences times the likelihood of risk.

MEMBER BLEY: But these numbers, these are pseudo-risks, these numbers we're multiplying. They aren't like multiplying real health effects times frequencies.

MR. GREEN: Well, it's real health effects. I mean we do detailed consequence analysis. So they are real health effects.

MEMBER BLEY: When you get the same answer for two things that are as dramatically different as the ones we've discussed, they aren't the same kinds of things that would be equated if you did a PRA. I'll just tell you that flat-out. They're not.

MR. GREEN: All right.

CHAIRMAN RYAN: So there's a point for discussion in the closed session.

MEMBER BLEY: Well, I'd like to see some examples of those, to talk about how with the IROFS

they get there.

CHAIRMAN RYAN: Okay.

MEMBER SIEBER: That's more a question for the rulemaking in this application.

CHAIRMAN RYAN: Right, right.

MEMBER BANERJEE: But they have done some detailed consequence models, right?

MEMBER SIEBER: Yes, yes.

MEMBER BLEY: I don't agree, Jack. How they interpret and use these things, I think, is perfectly appropriate here, and it's not a rulemaking issue. I mean you have something that's semi-quantitative, you must be doing some real engineering considerations and engineering judgment, and not just following the rule or we're a bit in trouble.

MEMBER BANERJEE: I assume that they have done detailed consequence modeling, and also have evaluations of the likelihood of probability of these sequences. Is that, which we can speak about --

MR. GREEN: Yes. Every scenario, even the low consequence ones, we did a study to determine the actual, you know, exposure limits for each one of those. Even if they were dismissed as low consequences, we have all that stuff documented.

CHAIRMAN RYAN: Let me suggest that we're

about ten minutes away from a short break, and if we let the staff finish this first briefing, and then we'll take a break, 3:30 to 3:45, and then I think we'll close the session for maybe 25 minutes, and we can maybe get into the details of some of these discussions with specific examples.

It might help, the fact that we're not talking about the details and specifics here. It would be helpful --

MEMBER BANERJEE: May I just ask a general question, though? Obviously, there is a large overlapping of jurisdictions between various agencies on stuff like this. We have to be sure that nothing goes between the cracks here. Where does NRC's jurisdiction sort of -- what does it encompass? Does it encompass the chemical hazards as well?

MR. BARTLETT: Yes. There's actually an MOU, Memorandum of Understanding between OSHA and the NRC, that kind of spells out where that dividing line is, and there's -- NRC obviously has authority for radiological things.

But they also have -- that agreement also spells out that they have oversight for chemicals produced from, that would be produced from radiological material.

For example, if you had a release of UF_6, the HF that comes off would be NRC's concern, and then we also have regulatory oversight for chemicals that could impact the safety of licensed material.

So if there was an HF tank that ruptured, and that could go into a control room and impact the safety of license material, that would be evaluated and considered by the NRC.

MEMBER BANERJEE: What about the SIF_4 and boron fluoride? Do you have jurisdiction over what happens to that?

MR. BARTLETT: Once they're separated from license material, and as long as they could not impact the licensed material, no.

MEMBER SIEBER: No.

MEMBER ARMIJO: So who does have concerns about --

MR. BARTLETT: OSHA, as far as I know.

MR. HILTZ: As Matt said, we have a memorandum of agreement, memorandum of understanding with OSHA. In the Commission SRM, that came down on SECY-10, on the proposed rulemaking. They actually asked us to go back and look at that, and make sure that there was some clarity in that.

In the proposed rulemaking, there's a

question that we asked and answered about what the roles and responsibilities are. In that MOU, there are four criteria, and we are responsible for four of those criteria: the radiological risk by radiological materials, chemical risk produced by radiological materials, and plant conditions which affect the safety of radioactive materials, and thus present an increased radiation risk to workers.

The fourth criteria, plant conditions which result in an occupational risk, but do not affect the safety of licensed radioactive material, are the responsibility of OSHA. That's not a clear bright line. I mean there are some -- a lot of discussion and clarity, we're in the process now of beginning to work with OSHA, to make sure that we revise that.

There have been some changes to the Atomic Energy Act and some recent legislation regarding byproduct material, which caused us to go back and look at that.

MEMBER BANERJEE: But you have a joint team looking at this or something?

MR. HILTZ: We do not have a joint team.

MEMBER BANERJEE: Okay.

MEMBER SIEBER: You also have one

additional category that falls outside of OSHA, that doesn't affect the worker, that a release of non-radioactive material, chemical material, that impacts the environment. I think that belongs to EPA.

MR. HILTZ: Yes, I think you're right.

MEMBER SIEBER: For the state.

MR. HILTZ: But those things are not ignored in our review. I mean we consider them both in the environmental report and International Isotopes will consider those and will review those as part of the ISA, to the extent that they relate to the safety of the nuclear material on site.

MEMBER SIEBER: Yes, but there are places where that condition doesn't bound you, doesn't bound the process, where a straight chemical release could occur, not affecting an employee but affecting offsite.

MR. HILTZ: The reality is that if it occurs at an NRC-licensed facility, we're going to respond, and worry about, you know, was that really an EPA lead or was that really an NRC lead. If it's one of our licensed facilities and there's an event, we're going to respond to make sure, to the extent that we can, that the public is protected.

MR. LAFLIN: And as the licensee, if we

have a chemical release from the facility, we're concerned about the safety of the employees and the public and the environment, regardless of who the regulatory agency is.

MEMBER SIEBER: That's right.

MR. LAFLIN: I mean and that's been our attitude throughout, through this process for safety. Regardless of who the regulating agency is, we recognize these chemicals are toxic and reactive, and they've got to be handled safely.

But the advantage we have is that even though this is a new facility, the chemical industry has been producing these gases and transporting these gases and safely handling these gases for decades in the U.S.

MEMBER BANERJEE: Well, not so safely.

MR. LAFLIN: Safely. I think if you look at the industry records for these, you know, it's a phenomenally safe record nationwide for transporting, manufacturing and producing HF and these other fluoride compounds. It has to be. We're partnering with chemical companies that will actually work with us to take our product.

So the industry standards, the best practices, the OSHA requirements for packaging, for

shipping, for containing, for dealing with all of these materials, we're not going to invent that. We're not experienced with that. Our commercial partners that handle these gases are, and we're going to rely on that part of it.

MEMBER SIEBER: Well, there's a lot of agencies involved.

MR. LAFLIN: Absolutely. I mean the only thing which is difficult in transporting radioactive material is transporting fluoride products.

MEMBER SIEBER: That's right.

MR. LAFLIN: I mean it's actually harder. The requirements are tougher, and the carriers are fewer and farther between.

MEMBER SIEBER: Right. That comes under --

MR. LAFLIN: You know, it takes a great deal of thought.

CHAIRMAN RYAN: Thank you. That's helpful. Matt, press on. Let's see if we can get through your slides.

MR. BARTLETT: Right. In addition to the ISA summary, they also have to design the facility to meet the baseline design criteria, which is kind of a minimum level of quality that they have to incorporate

in their design. It includes defense indepth, which is multiple layers of protection against accidents.

MEMBER BLEY: In your area, do you have more specific definition of what defense indepth means, for the staff in this area?

MR. BARTLETT: There's definitely a definition in the regulations.

MEMBER BLEY: Okay.

MR. BARTLETT: Of defense indepth. It's actually in the regulations.

MEMBER BLEY: Is it?

MR. BARTLETT: Yes, yes.

MR. FLACK: Part 70 says it, defines defense indepth.

MR. BARTLETT: It is defined in Part 70? I don't have it.

MEMBER BLEY: The more general one.

MR. FLACK: Well, it has to do with less reliance on human actions, and more reliance on hardware, I guess, technology provides the extra defense indepth, and it's defined in that regard. It's almost like a degraded definition. I forget the exact words, but it's less reliance on administrative control; more reliance on hardware and technology.

MEMBER BLEY: Two things. Where did you

say it is in the regulation, Part 70?

MR. FLACK: Part 70.

MEMBER BLEY: And is there a way you guys interpret this within NMSS, or the way you try to enforce defense indepth? On the reactor side, they do it a couple of different ways, depending on who you're talking to. I wonder in the materials area if there's a --

MR. BARTLETT: Yawar, do you want to touch on that at all?

MEMBER BLEY: Or do you just say Part 70?

MR. FARAZ: Well, I think John is absolutely correct. Part 70, I don't have the regs with me, but it does talk about defense indepth as a requirement, and then that's immediately followed by giving preference to passive design features, and then next would be active, and then followed by administrative.

MEMBER BLEY: So I guess what I'm asking is when you get an application like this one, and you're reading some part of it, and you say are we meeting our defense indepth criteria, what do you look for? What makes you say yes or no?

MR. FARAZ: As I interpret the regulations, there should not be a single failure that

separates a significant consequence from the material. So the material should not --

MEMBER BLEY: So that's kind of the operational definition?

MR. FARAZ: Yes, and when you have layers of protection, like for instance you have the UF_6, which is a very toxic material. It's in a cylinder. The cylinder, while the UF_6 is liquefied and in a liquid state, it has to be in an autoclave, which is like a secondary containment.

Then beyond that, the workers need to be trained, and if there is a release, then they need to leave, evacuate, get away. So these are these multiple layers of protection, which essentially feed into the defense indepth definition.

MEMBER BLEY: Okay. But operationally, you kind of look at it for no single failure?

MR. FARAZ: That's exactly right, yes.

MR. FLACK: Yes. If I could just follow that up a little bit. I know in the MOX review, they said they didn't give credit for defense indepth, when they look at the sequence. In other words, they credit the IROFS.

Then you look at what else is there beyond the IROFS, but you don't credit that as part of the

reduction in sequence. So that it's an extra sort of defense against whatever that sequence might be.

MEMBER BLEY: I was looking for how they interpret that.

MR. FLACK: Oh, I'm sorry. I just --

MEMBER BLEY: That's what I'm after, not a philosophical answer.

MR. BARTLETT: Okay. Let me just touch on this slide briefly. So International Isotopes. NRC is developing an EIS for this review. We did publish an opportunity to request a hearing. There weren't any requests for a hearing. International Isotopes and the NRC are both using guidance on NUREG-1513, which basically tells the applicant how to develop an ISA, and the NUREG-1520 is our standard view plan, and we've already talked about that a lot.

Let me just flip through this. So the NUREG-1520 was originally written for Part 70. It applies to Part 40, because the requirements are similar, and they're doing an ISA. It has, covers multiple areas of review, and it's got a list of acceptance criteria, which basically spell out the commitments that the application should have.

The review team, you know, looks at the application, to make sure that the International

Isotopes has met those acceptance criteria.

I just want to emphasize that the safety review, the quality of the safety review really is dependent on the safety review team. We've got 18 technical areas with at least one, sometimes multiple individuals who are focused in on that area, and reviewing the application in that area.

The review team develops, if they run into places where they need more information, they develop Items Relied On For -- they develop requests for additional information. We've had about 174 that we've submitted to International Isotopes. It provided fairly quality responses for all of those.

It was mentioned earlier that the RAIs are done. That's true. The first set of RAIs are completed. We have a few follow-up questions, maybe in the range of 20-25, where we need additional clarification. Okay. Let me just touch on the status. So we received the application December 31st, 2009. We accepted it for formal review on February 24th, 2010.

Shortly after that, we published the opportunity to request a hearing and didn't receive any requests.

MEMBER BLEY: I'm just curious. Is that

unusual or --

MR. BARTLETT: It's a good sign. It's a good sign that the people in the area are comfortable with the application.

CHAIRMAN RYAN: Right, and other regulators also?

MR. BARTLETT: Yes.

MR. HILTZ: I can also tell you that for the AREVA Eagle Rock, there's a mandatory thing about that. But we published a request, and we got no requests for it.

MEMBER BLEY: No requests.

MR. HILTZ: So I don't know whether it's typical or not. It probably depends on the area.

MEMBER BLEY: I'm just curious. Why is there a mandatory hearing?

MR. HILTZ: It's required by regulation.

MEMBER BLEY: Because of the --

MR. HILTZ: Because it's an enrichment facility.

MEMBER BLEY: Oh, okay.

MR. BARTLETT: Yes. The Part 40 doesn't have a mandatory hearing, just this opportunity to request one.

MEMBER BLEY: Okay.

MR. BARTLETT: Okay. From that time until just recently, we've been working on RAIs, RAI responses. As I said, they submitted their last RAIs just recently here in May. So now we're going into the development of the SER phase, the safety evaluation report. I think we're on schedule to complete that in the September time frame.

CHAIRMAN RYAN: And Matt, just for the Subcommittee's benefit, let me interject here. That September time frame is the time frame where I think the Subcommittee could reengage on, you know, getting close to the end of the safety evaluation report, moving into the EIS. That's probably a productive place for us to say how we're doing at this point, and then consider a full committee briefing and perhaps a letter at that point.

MEMBER BANERJEE: Are we required to write a letter on the SER?

MR. FLACK: No, you're not. This is sort of outside the scope of ACRS activities.

CHAIRMAN RYAN: Yes, it is. So you know, if the committee chose to, you know, I could make that decision for the committee. But I think just reengaging at that point is not a bad place to think

about it. It's not mandatory.

MR. HILTZ: It's probably important to point out, though, that if we have to engage you and if we have to wait until a letter, then it's going to impact our review schedule.

CHAIRMAN RYAN: I understand that. But you know, recognizing that I cannot make the decision for the committee to write or not write one.

MR. HILTZ: I understand. I just wanted --

CHAIRMAN RYAN: But certainly, I think, reengaging on where you are and what your findings are, at the point of where the SER is coming to closure would be a good point to revisit.

MEMBER BLEY: On that, you listed categories of RAIs. So are there any of the RAIs --

MR. BARTLETT: Should we go back?

MEMBER BLEY: I don't think you need to, that you think might end up being contentious or difficult, or are they pretty much information items?

MR. BARTLETT: The Round 1 of RAIs and the responses have been very, very detailed and good quality.

MEMBER BLEY: Okay.

MR. BARTLETT: You know, I mean for

example, we might have sent them 20 RAIs and they sent back an 80 page response --

MEMBER BLEY: They covered it pretty well?

MR. BARTLETT: Yes, they covered it pretty well, and they provide not only, you know, a discussion on what the plan to do, but changes they're going to make to the application, to address our concerns. So pretty good.

The seismic structural area, you know, they're still working on that piece of that. The detail design isn't done. So some of those questions are more a time issue, and that's why we have a couple of follow-up questions where we're requesting additional detail that just haven't been available so far.

MEMBER BLEY: With respect to the seismic one, I'm assuming that under any of these scenarios, the biggest hazard is always HF?

MR. BARTLETT: Yes.

MEMBER BLEY: Right. I don't know the process well enough. Do they have substantial volumes that are still in the UF_6 state within the system, or is that pretty much goes in and begins the chemical change very quickly? Are there large volumes, within the system, of HF?

MR. BARTLETT: They can probably answer it better, but I think our concern would be if you had a cylinder that's partially liquefied in an autoclave, and then you had a seismic event that would cause --

MEMBER BLEY: The front end of the process, okay. Good enough. Thanks.

MEMBER BANERJEE: Well, you can get into the process a little bit under closed session. You can tell us about the reactor, potential runaways and all this stuff.

MEMBER SIEBER: It's exothermic, but you still have to add heat to it to make, to bring it to completion.

(Simultaneous speaking.)

CHAIRMAN RYAN: Let's wait until we get in a closed session, please.

MEMBER BANERJEE: We don't know the details of the process yet.

MEMBER SIEBER: It's all in the application.

MR. HILTZ: I just want -- Dr. Ryan, I just want to be clear that, you know, we said the RAIs are completed, International Isotopes did. There will likely be some supplemental RAIs that go out, based on their responses.

CHAIRMAN RYAN: I wouldn't expect it to be anything less.

MR. HILTZ: So we may have another --

CHAIRMAN RYAN: That's fine. I'm going to guess that's going to be a narrower set of questions, definitely more specific.

MR. HILTZ: It's going to be narrower, yes.

MEMBER SIEBER: We were sent a disk, just for the member information, that's got a lot of hotlinks in it that Derek provided, and you have to be on the Agency website for the hotlinks to work. They have all the RAIs and the answers and the application. So all that detail is available.

CHAIRMAN RYAN: Thank you.

MEMBER BLEY: It is, given infinite time.

(Simultaneous speaking; laughter.)

MR. BARTLETT: I just wanted to also mention, keep in mind that there's an EIS review that's also ongoing, empaneled by a different review team that the environmental folks. That's projected to have the draft EIS completed in November, the final in May, and then if we decide to issue the license, the license would be issued some time in the June 2012 time frame.

Just in conclusion, keep in mind that this is a facility that will be regulated under Part 40. They are also meeting the Part 70 ISA requirements, and they are meeting the acceptance criteria in NUREG-1520. That concludes my portion.

MR. FLACK: Mike, can I give more clarification?

CHAIRMAN RYAN: Please, yes.

MR. FLACK: Yes. Back to the scope of the ACRS activities, it's within the scope of the ACRS to look at Part 40 facilities. It's not required for the licensee to come through the ACRS to get their license approved. I guess that was the difference.

MEMBER BANERJEE: Explain it, John.

MR. FLACK: Okay. So the regulations require for certain facilities that they have to come to the ACRS, before they get their license approved. Part 40 facilities, as well as Part 70 facilities actually do not have to, by law, come through the ACRS.

But I think Tom came to the ACRS, wanting to show what was done as a matter of interest on the Committee's part, and that's why a letter was not envisioned to be required. But it's up to the Committee, of course, to write a letter at their own

discretion.

CHAIRMAN RYAN: And I think at this point, this meeting is certainly an introductory, I think, Subcommittee briefing, where we're learning and of course asking the usual 10,000 questions the Subcommittee has asked and learning.

And, you know, as you get to your next step and as we digest all the materials and learn all that, then we'll be in a position, as a Subcommittee, perhaps meet with you again down in that EIS time frame, September-ish or so or maybe a little before that comes in or as it comes in or a little after, and then be in a position to recommend to the full Committee a briefing, and whatever action the full Committee takes from there is the full Committee's decision. But I guess I'm just trying to get our --

MR. WIDMAYER: Could we address the scheduling item again?

CHAIRMAN RYAN: Why don't we do that --

MR. WIDMAYER: Well, I was thinking that we have some folks, I think, that showed up for the research presentation. Could we do that at the scheduled time, and then do the closed session after?

CHAIRMAN RYAN: We certainly could.

MEMBER BANERJEE: What is the research

presentation?

CHAIRMAN RYAN: The last part of the briefing, on number three. Okay, fair enough. Fair comment, and we'll do that. We will take a break at five minutes of 4:00. We'll then pick up with our Item 3 on the agenda, the qualitative HRA for cask drops. Is that what you're talking about?

MR. WIDMAYER: Yes sir.

CHAIRMAN RYAN: And we'll get that done and then go on in closed session from there.

(Simultaneous speaking.)

CHAIRMAN RYAN: Order, please.

MEMBER ARMIJO: Sorry. I thought we were --

CHAIRMAN RYAN: No, we're not.

MR. WIDMAYER: Before 4:45?

CHAIRMAN RYAN: I hope to get our break done, and then hopefully get through about on time or a few minutes thereafter at 4:45, so we can move into the closed session therein.

MEMBER BANERJEE: When are we expecting to finish?

MEMBER BLEY: Right after that.

CHAIRMAN RYAN: Right after the closed session. Depends on how many questions you ask.

MR. WIDMAYER: Yes. It's all up to you.

CHAIRMAN RYAN: You're in control. That fate is in your hands. Thank you. We'll take our break. The record's closed for the moment. We'll resume about five minutes to 4:00.

(Whereupon, a short recess was taken.)

CHAIRMAN RYAN: All right. We'll continue our briefing portion with the briefing from Research, and Susan, are you leading us off?

DR. COOPER: I am.

CHAIRMAN RYAN: Susan Cooper, take it away please.

DR. COOPER: Thank you very much, Chairman. Dr. Susan Cooper from the Office of Research, Division of Risk Analysis, Human Factors and Reliability Branch. Thank you very much for having me here, and I very much appreciate you accommodating the presentation at this time, as opposed to later in the day, after your closed session. Very much appreciate it.

CHAIRMAN RYAN: Fair enough.

DR. COOPER: Just to let you know, I'm joined by my colleague in the Human Factors and Research Branch Julie Marble here, Dr. Julie Marble, who's one of the now co-managers of the medical work,

and also we have Dr. Bill Brown from Brookhaven National Laboratory. He's one of our contractors on the medical work.

Dr. Jeff Brewer from Sandia National Laboratories was at the more or less last minute not able to join us, and he is supporting research on the spent fuel handling work that you'll be hearing about today.

So there, as you may already sense, there are two broad projects that are captured under the umbrella here of risk-informing nuclear materials. We'll get more into that as we get into the presentation. Thanks. So I'm going to try to do three things today in the hour that I have.

I'm going to give you some background on these projects for risk-informing nuclear materials. I'm going to try to summarize the efforts to date, including the early efforts, and then provide some excerpts of this work, and I want to emphasize excerpts, because you might have noticed that there are quite a number of slides. I know I can't present them as you might ordinarily present those slides in the time I have.

So in many cases, I'm going to, you know, treat those slides as illustrations of the work that

we've done. Of course, if you have detailed or more probing questions, please go ahead and ask them, and then we can try to explain.

Those excerpts will be divided between our work on the qualitative HRA for cask drops, which has been performed by Sandia National Laboratories, and then the work on risk-informed tools for medical applications, which has been done largely by Brookhaven National Laboratory and more recently by commercial contract under the WreathWood Group.

So going back in time, there was a user need from NMSS in 2003, asking the Office of Research to develop HRA capability across NMSS, as part of an overall effort to risk-inform NMSS. The user need identified two different phases to be addressed by research, and those phases were first for a feasibility assessment, for developing HRA capability, and then Phase 2, which was called implementation, but in actuality means go ahead and develop that capability that you identified.

Right off the batt, the Office of Research divided these efforts into two part, one part looking at high level waste, spent fuel handling, fuel cycle and so on, and another part to looking at medical and industrial applications of byproduct materials.

Feasibility studies were done for each of those efforts, those parts. Brookhaven performed the feasibility study for byproduct materials. That was completed in 2003.

Research did an in-house feasibility study on the high level waste fuel cycle, spent fuel handling so on and so forth, partly because the high level waste part had to be done in-house. Although maybe Dennis doesn't remember, but he did provide input to that feasibility report.

Part of the materials that were provided to you ahead of time through John Flack included the feasibility study from Brookhaven that was tasked 1 through 4 in the larger document of letter reports.

Phase 2 development then followed from those initial studies. Brookhaven continued to work on the medical applications of byproduct materials, and I'll talk a little bit about how that was chosen, and then Sandia National Labs began the work on spent fuel handling. Again, I'll talk a little bit about that.

So first, spent fuel handling. The feasibility study didn't identify an initial focus for efforts and for developing HRA capability. You know, as you can see from perhaps looking at the letter

reports from Brookhaven, there were specific tasks identified as part of the feasibility study; literature reviews, interviews with staff, so on and so forth.

And there just wasn't a conclusive answer out of the feasibility study partly, I guess, because it was quite broad. But as a follow-up to the feasibility study, staff from NMSS requested that Research focus in on the possibility of misloads in fuel handling, and cask drops.

We did some work on that. You have, we provided you with ADAMS ML numbers for two different reports, one of which is on the misloads and cask drops work, and then another one, later than where we focused even more on cask drops and developing some insights on potential human performance vulnerabilities.

So there are two different reports that are right now in research management review. Sean Peters, my branch chief, who is also here to support me, just finished up his review on those reports, so actually since Sandia's not here, maybe he can answer the questions, because he just read them in detail. So there are those two reports representing that work.

I will say though, as another follow-on,

the Division of High Level Waste, provided research with another user need. I don't have it here. It was in 2005, I believe. I have it in one of my folders, if you're interested in the user need number, requesting Research support to help them prepare for reviewing DOE's application for the Yucca Mountain Waste Repository, and also doing that review, and Research did do that, did do that work.

Moving on to medical applications then, the feasibility study, which again involved literature review, interviews of staff and management, did provide some direction for the Office of Research for follow-on work in Phase 2. The first recommendation was to start with medical applications, leave industrial applications for a later job.

The other thing was that while there were a number of different things, products, if you will, that were of interest, the consensus was that the top priorities were training and the development of some sort of job aid to help staff.

Follow-up interactions with staff also helped to identify, then, a list of initial human performance topics that we should focus on, and also to look at the Gamma Knife treatment as a test bed for, you know, developing this follow-on work and this

HRA capability.

I should say in both cases, both the spent fuel handling and the medical applications, the user offices were interested in principally qualitative support, as opposed to quantitative support at HRA for PRA. They were more interested in HRA qualitative insights and so that's been our focus from the beginning.

So let's look a little bit at some of the excerpts from the qualitative HRA for cask drops. I think almost all -- I think all of these slides come from a presentation that was also provided to you ahead of time, a presentation that was made at PSA 2011 in March of this year in Wilmington, North Carolina. It's mostly based on the more recent work, but there is at least one slide that talks a little bit about the early work.

Next slide. So the analysis approach for the spent fuel handling work, building on what was done in the feasibility study, gathered a lot of information about the spent fuel handling process, talking to subject matter experts, reviewing reports and previous analyses. I would like to point out the subject matter experts included not only folks from NMSS but also some folks from our regional offices,

especially Region IV.

Then following that work, we then started to develop some scenarios, accident scenarios or scenarios that would develop into a potential cask drop. The approach that we used is an approach that comes from the ATHEANA HRA method. ATHEANA is an NRC-developed method that both Dennis and I are authors on, and we're using a principally a haz ops sort of approach, to try to develop how something could happen, how something could happen starting with, you know, this is what you expect to happen and then how could things go wrong.

This is based on our understanding of human performance from some of these subject matter experts, the process as a whole and what we understand about human behavior in general. So we identified unsafe actions, things that you might model in the PRA if you had a PRA, which we call human failure events, and the context in which these sorts of things happen.

I should say that these scenarios have been reviewed not only by folks in NMSS and Region IV, but also Sandia National Laboratory had some of their structural engineers review them also for, you know, whether or not they're credible scenarios. So there is quite a number of layers of review, to try and make

sure that these scenarios were credible scenarios.

MEMBER BANERJEE: How do you use haz op-type methodology for a scenario like a cask drop?

DR. COOPER: Well, if you start off with how you expect the operation to occur, and one of the appendices in the reports talks about the overall steps in the process. So that's what you expect. Now you start to use key words in haz op processes, to see if you make changes to how things are happening, how could that result in a negative consequence.

MEMBER BANERJEE: You would normally have to divide any batch operation into sort of its constituent actions, like load this, move that, and so on.

DR. COOPER: Yes.

MEMBER BANERJEE: So you can actually do that with --

DR. COOPER: Well, we did. I mean partly, I mean because we did have the subject matter experts. We also, I guess I should say, we started this work not long after the NRC's -- I'm going to get it confused with the EPRI report. One is the dry cask storage PRA and the other one is the other one.

But the bottom line is that we had videotape from one of the plants, to see how the

operations were performed, and then Jim Pearson, who is my contact over in NMSS, provided us with some other videotapes from utilities, so we can observe them.

Unfortunately, we never were able to match up with a particular plant to go there and observe things in real time.

MEMBER BANERJEE: But you were able to divide them into constituent actions, step by step?

DR. COOPER: Yes, yes.

MEMBER BANERJEE: And then look at, use the guide words on each of those?

DR. COOPER: Yes.

MEMBER ARMIJO: Did you have access to the procedures that they used for these cask drops, what the plant's procedures are?

DR. COOPER: Not plant procedures, no, we did not.

MEMBER BANERJEE: But do they have detailed procedures which takes it step by step?

MEMBER ARMIJO: Oh yes.

DR. COOPER: They have procedures --

MEMBER BANERJEE: Well, if they do, then that's what you use.

MEMBER ARMIJO: That's what I was asking

why, yes.

DR. COOPER: Well --

MEMBER ARMIJO: Rather than having to infer --

DR. COOPER: Unfortunately, we're going so far back in time that I don't remember, and --

MEMBER ARMIJO: It puts you at a disadvantage if you're trying to infer from a videotape what they're actually doing.

DR. COOPER: Well, no. We did have some support on that, and we were able to interact with NMSS and regional staff to get some sort of guidance.

They do have procedures, but the nature of the tasks they do are different than what we would imagine, or what I'm more familiar with in nuclear power plant control rooms, in that many of the tasks that they do are what you might call loosely skill-based, in the sense if you don't have detailed step-by-step, you know, everything that you do prescriptions.

For example, the operation of a crane. In fact, you really wouldn't want to have a crane operator having a book open in front of him while he's manipulating the crane.

There are a number of disadvantages that

you can easily think about that, space being one of the limitations. Plus he really needs to be looking at what he's doing, in order to make the crane operate the way it should.

CHAIRMAN RYAN: Dr. Cooper, remember at the recent used fuels meeting in Baltimore, there was some discussion of that, that you know, procedures might be prescriptive in some areas and not so prescriptive in another. There was some conversation that was very helpful, to understand that plant to plant, cask type to cask type, you know, there were lots of variations in how things got done.

The good news is, I think, the staff and the licensees were talking that, you know, that's seemingly coming to a centerline, where they're beginning to have a more common understanding of what the regulator's expecting and what, you know, when they say "move the crane," this is what we really mean, as opposed to what you think we might mean.

DR. COOPER: Yes.

CHAIRMAN RYAN: So that was an interesting conversation. So I just offer that to you as an example of it seems to me that there's effort to close that gap.

DR. COOPER: Right, okay, and I guess

you'll see in a later slide, or if you've looked at the material in advance, that one of the insights that we got was, you know, exactly that, that they don't rely on procedures to -- for every step that they take, because some of the behaviors that they, or the reactions that they take, are such that it just really wouldn't sense to do so. Yes.

MEMBER SIEBER: I think the kind of procedures that you would have in the power plant would say "lift the dry cask and place it in the spent fuel pool," one step.

DR. COOPER: It might be a little bit more detailed than that.

(Simultaneous speaking.)

MEMBER ARMIJO: I don't think so, Jack. I think that's a disservice to what they do.

CHAIRMAN RYAN: That's the problem, yes.

MEMBER ARMIJO: No. I think they do quite a bit more for something that important.

MEMBER SIEBER: Well, when we drop the hook, that's all that was in the procedure.

MEMBER BLEY: That was some time ago, Jack.

MEMBER ARMIJO: That's pre-TMI.

MEMBER SIEBER: It was, and we haven't

used dry cask since.

(Laughter.)

DR. COOPER: Okay. Let's move on to the next slide, in the interest of time. Over the course of the two different reports, we've looked at two different cask types, and I just want to point that out.

In the earlier work, where Sandia looked at both misloads and cask drops, only one of these particular cask types was looked at, and then the -- and the second report, which was focused on cask drops, we looked at both.

I don't want to get into the details unless someone wants to bring it up, in which case I might have to look at this report. But one of the casks is different, and has fewer scenarios, partly because of its design and in the rigging that limits the number of cask drops or the types of cask drops that can occur. So that's the main reason for this particular --.

So in the more recent report, which is destined to be NUREG CR 7016, we looked, as I said, at two different cask types. We're looking at cask movement from the spent fuel pool to a preparation area, and for one of them from the preparation area to

the transfer pit, and then for the other -- also movement from the transfer cask to the storage cask.

In the earlier report, which strangely enough has a higher number destined to be new NUREG CR-7017, more phases in the handling of fuel are addressed, but only one of the cask types is included.

Next slide. So these two slides, this one and the next one, present a table of insights that we developed, and this was developed at the request of the user office. It's not, we haven't communicated recently, but at one point in time, the idea was that this could be useful input to inspection guidance for NMSS and the regions.

So far as things that we found, based on not only the events, but also how we developed the scenarios, that things could actually be called performance vulnerabilities.

You'll see that the first one, the first two are related to procedures, and the second is directly related to the conversation we just had about limited reliance on procedures, which has sort of a negative connotation.

But at the same time, as I pointed out and it's in the far right column there, that many of the operations are skill-based and don't lend themselves

well to being guided by written procedures.

MEMBER BLEY: If I understand what you've said, and if I understand this table, these aren't necessarily things that one would say are deficiencies; these are just, because of their nature, places you think a review should take a good look.

DR. COOPER: I would agree with that. I mean basically is, this is what it is, and you could say that if there is a negative context, it basically has to do with the fact that it's different than we might expect for operations that are directed from the control room. For example, like the limited reliance on procedures.

For control room operations, we have a pretty strong focus in making sure that they've got a formal procedure that they're using, for almost everything they do, except for field operators. There again, there may be some things that they're doing that are not, you know, not every motion or every action is going to be governed by procedures.

And there are other things like the visual challenges, number seven. That's the nature of many of the things that are being done, as part of cask handling or fuel handling. Large distances, viewing the cask under water, obstructions. The crane

operator is often relying on people on the ground to give them hand motions or use radios or whatever.

So there's a link, then, to number five, the communication difficulties, because you know, he just can't see. He doesn't have the viewpoint that's needed to understand exactly where the cask is at any point in time.

So this a collection of things that we discovered as a result of, as I said, not only looking at the events and talking with people, but also developing the scenarios. Let me skip over then.

So in conclusion on this particular work, we did introduce and use a process for developing cask drop scenarios, also misload scenarios in the earlier work, and we identified these human performance vulnerabilities. We have some illustrated guidance.

I wouldn't say it's complete, but some ideas of how you might mitigate or avoid some of the negative connotations or negative outcomes that could come from some of these vulnerabilities.

In doing the work, we did use the qualitative guidance for HRA, coming out of the ATHEANA HRA method and NRC's good practices HRA, for HRA NUREG-1792. Both of those were used and were proved to be helpful and valuable in being able to

develop the scenarios and develop the insights that were of use.

And the last item, the Office of Research at this point in time used this work as a useful basis for any potential future work, for HRA and PRA. For example, the contemplated levels, Level 3 site-wide PRA studies that might include spent fuel handling in their scope. I don't remember what the schedule is for the SECY paper that's going out to the Commission, but I think it's some time this summer. We'll see what happens with that.

But if that does go forward, I'm the identified HRA lead for anything that's going in that Level 3. So I look at this work and other people are, as being a good useful step, everything short of just the quantification and what are the numbers. So that's all I have, want to just -- had prepared to say about the spent fuel handling. So I'll move on to the medical, unless you wanted to ask any more questions.

CHAIRMAN RYAN: Any specific questions at this point?

(No response.)

CHAIRMAN RYAN: Proceed on.

DR. COOPER: Okay.

MR. FLACK: I just have one question, if

I may.

DR. COOPER: Yes.

CHAIRMAN RYAN: Please.

MR. FLACK: It seems like safety culture cross all of these vulnerabilities, right? I mean if you look at it from that perspective, that would kind of influence any one of those. Has that been looked at at all, the connection between safety culture and the vulnerabilities?

DR. COOPER: There is a section on safety culture in the more recent of the two reports on spent fuel handling, one that's specific to cask drops. We are -- that was developed some time ago, and there has been more work done on safety culture. We'll be looking at that, to see if that section needs to be updated.

I'm not personally an expert in that, and when we've talked about the influence of safety culture on risk in a general sense, me being an HRA/PRA person and an engineer, I like to look at an observable basis.

So I'm not sure exactly how to make those connections. But certainly looking at, having looked at, in my career, a variety of different technologies, and trying to evaluate human performance, there

certainly is an influence. There's no question about it.

How to measure it or how direct, or how you would reflect it, is a question that I don't know, I don't think anyone has addressed adequately at this point in time.

I will say that one thing that we're contemplating or kicking around right now in the Office of Research is the notion of changing our treatment of dependencies, especially things like latent failures, undiscovered equipment failures that might be the result of restoration failures that operators would do, maybe looking at doing sensitivity studies on the dependencies of that, and that might be --

You might call that as coming from a safety culture sort of origin, you know, changing how you would look at those dependencies, or how many dependencies you might have, how many undiscovered or latent failures you might have in a scenario. We might do. But that's not this work. This is, I guess you could say that.

But I mean we're mostly looking more at the control room operations for that.

MR. FLACK: Specific to PRA.

DR. COOPER: Yes. I haven't thought about it for this.

MEMBER SIEBER: Did you mention that there's two NUREGs that were just published on this subject in February?

DR. COOPER: No. What I said is that there are two reports, these two, that are currently in research management review.

MEMBER SIEBER: Okay.

DR. COOPER: And they're destined to be NUREGs, assuming that they don't get stopped in their tracks somewhere.

MEMBER SIEBER: Is that the 7016 and --

DR. COOPER: Yes, 7016 and 7017.

MEMBER SIEBER: And 7017.

DR. COOPER: That's right.

MEMBER SIEBER: Okay. I have -- I take it it was published for comment?

DR. COOPER: No.

MEMBER SIEBER: As final?

DR. COOPER: They were simply put into -- in order to be put into the concurrence process for research management review, they had to be put into ADAMS, in order --

MEMBER SIEBER: Right.

DR. COOPER: So I think that probably would be -- I don't know if it was February, but in any case --

MEMBER SIEBER: But they're in ADAMS and we have them.

(Simultaneous speaking.)

DR. COOPER: Yes, you have them because --

MR. PETERS: --time frame we could share them with the ACRS, yes, the draft versions.

DR. COOPER: They're draft versions, but they have not been published for public comment or anything like that.

MEMBER SIEBER: I just thought I'd mention to the other members that we have them on that disk.

MR. FLACK: On the disk.

MEMBER SIEBER: That you provided us.

CHAIRMAN RYAN: Thank you.

DR. COOPER: Okay. All right. Let's move on to medical. Again excerpts, and this time, I've more prepared, because I've got Bill and Julie here, handling the detailed questions, so go on, first slide.

All right. Aims and approach for this particular project. First of all, obviously we're trying to risk-inform again, as we were in the other

case, but -- and we went to use HRA qualitatively or incorporate the HRA perspective, to help NRC staff, and principally to help provide a technical basis for decision-making.

So the approach that we've taken for how to provide this perspective is first of all, basic information on human performance and error is something that was identified as a useful product, including the resources, literature that's relevant and so on and so forth, to help understand human performance and error in the medical context.

Specifically how we would get this across is through two different products, which were identified in the feasibility study, training materials and what's called a job aid, which is a structured knowledge base, and we'll try to show you a little bit of that in a little bit.

I see some symbol came out funny in the typing. But anyway, the training materials, and you have these, it was in one of the ADAMS numbers that we gave you, is representing what was in place in 2008. The last time it was given in 2008, it was a two, two and a half day course. We have a book which has the slides and some notes in it, that was used there.

Again, the job aid, we don't exactly have it, because it's in our software, but cannot be put into ADAMS. So there is a memo in the package that's in the ADAMS, that says where you can get it. It's on a disk.

Again, what we submitted is based on 2008. There have been some updates made since then to the job aid, including a change in software. So the slides I'm going to present are principally based on the 2008 version, but there are a couple that are a little bit updated for 2010.

Training first. Basic topics, you know, human error and medical applications, what are they; what kinds of things are happening; what is human error; what are the mechanisms and contexts in which you could expect this human error; what's the current thinking about how to understand human error; and then a little bit about some of the retrospective events, and how to understand them.

So those are some of the basic topics. Like I said, I just sort of picked, cherry-picked some specific slides out of the training, give you an idea what's in them. This slide was put together by John Reithall, who's one of our contractors, to try to give a sense for where medical errors, you know, compare to

other things that the NRC regulates and so on and so forth.

So if you look at this slide, you can see where nuclear reactor risk is imagined to be, versus where some of the other things are. So it's just kind of basically to sort of sensitize people to what's important.

Next slide. This slide, which has been updated in the new material, but I just gave you what's -- I show here what you've been given. It shows you a little bit about what types of medical events have occurred, as reported in NMED, which is the database of medical events.

CHAIRMAN RYAN: I've got to ask, just out of curiosity. The deaths, where are they in this crap? Is it --

DR. COOPER: We have some folks, excuse me, in the back. I'm not aware of NMED actually specifically culling out different consequences, and then capturing that as a data category. I've not heard of that being talked about. I mean I guess Bill, you've looked at the NMED database quite a bit as well.

MR. BROWN: I agree with what you just said. I don't recall that. We haven't used that

split. I don't know whether it exists.

CHAIRMAN RYAN: No. I'm just curious. You know, this administration is kind of what happened, but the consequence part of that, is it a no, never mind or is it significant or any of this administration is significant because it's an error.

DR. COOPER: I'm certain that's important to FSME, but I don't know that that's captured by NMED.

CHAIRMAN RYAN: That's fine. Well, let's move on.

MEMBER SIEBER: There was a case study done that resulted in a Notice of Violation to an NRC licensed hospital, where there were 180 cases of misadministration over a ten year period, and they did make the relationship between what the misadministration was and what eventually happened.

DR. COOPER: Yes.

MEMBER SIEBER: And as I remember that data, that looked pretty much like the chart that you have on the screen right now, if you're going to be consistent.

DR. COOPER: I guess if someone in the back from FSME wants to correct it, I think that perhaps part of the issue is that the NMED database

captures information, as reported by the licensees when they discover things, and that may or may not be. But there's some delay time, I think, between where they might discover that and when there may be a consequence that they care about.

So that, and I don't know that they're updated later with that kind of information. I guess I don't particularly care.

MEMBER SIEBER: But my point is that what you're showing us is consistent with what I've seen, in a different context.

DR. COOPER: Okay. That's good. This is just another one. Again, that's from 2007, but this picture has not changed, as far as I know. Largely, it's --

CHAIRMAN RYAN: I think you have an event that you've listed, but you haven't reported it. That's a funny one.

DR. COOPER: Well, this is a cause. They just haven't reported the cause of the failure, of the event.

CHAIRMAN RYAN: They had an event and we're not going to tell you what it was.

DR. COOPER: We're not going to tell you the cause, that's all.

(Simultaneous speaking.)

DR. COOPER: Or we don't know how to define it or describe it, or it could even be that there's no category provided by NMED that matches up.

CHAIRMAN RYAN: Ahh, maybe that's it. Cause undetermined would be, I understand that.

DR. COOPER: So the next few slides are trying to illustrate some of the ways, the material that's in the training, to help people understand why people make errors. This is Bill's stuff. If you can -- I didn't realize there was animation in this. Knowledge and error. Go ahead, Bill. This is your slide.

MR. BROWN: Well, we just make some points about what's called the new view of human error, and the new view of human error goes back this from Mach a century ago. We try to make the point that the things that allow an organization or an activity to succeed under normal circumstances is the very same things that cause it to fail under circumstances that aren't exactly what is expected.

It's that we tried to key just a small number of those sorts of insights to sort of pepper our audience with, since on the material side you don't have a group of human factors people working on

it, as you do on the power side. This is -- these are concepts --

MEMBER BLEY: Well, when we talk about software things, we might have very similar things going on. They were using a software system.

DR. COOPER: Yes, yes. At least within Research, we are recognizing that and trying to marry or exchange information, collaborate on the issue of automation and software. The next slide, also Bill's. Oh.

MEMBER BLEY: Are you coming to our meeting on Friday?

DR. COOPER: This, no.

MEMBER BLEY: The Subcommittee. It's not the same subcommittee. It's another one on the same contracting agency, contractor agencies, reporting on modeling failures in software systems.

DR. COOPER: Oh. I think --

MEMBER BLEY: Even on that kind of stuff, you might want to -- you might get something useful to tell us. But go ahead. I'm sorry. That's not what we're about here.

DR. COOPER: All right. That's okay. It sounds like Julie's going to be here.

DR. MARBLE: I think that's the one I'm

planning to attend.

MEMBER BLEY: Good.

DR. COOPER: Okay. I'm not going to go through all of this. It goes into a little bit more detail of what Bill just said, in that people's behavior is almost always rational and practical and economical, and conserves resources, and that works most of the time. But every once in a while, it doesn't work in the wrong context.

Another thing is that people follow familiar paths, the pattern-matching --

MEMBER BANERJEE: I thought Plato said the opposite.

DR. COOPER: Sorry?

MEMBER BANERJEE: I thought Plato said the opposite.

DR. COOPER: He did, but no. When we talk about people being rational, you make the best choice based on the amount, the way you have synthesized the information. But the problem is, is that can't process all the information or hold all the information in their active memory at one time. So you can't sit there and weigh the balances. You don't have the capability of doing it.

Perhaps, you know, Big Blue, the computer,

could do it. So people are rational, in that they try to maximize and follow the heuristic. But they aren't capable of holding al the information capable. So they use heuristics and --

MR. BROWN: People refer to it as local rationality, since you can't --

MEMBER ARMIJO: Well, yes.

MR. BROWN: It's not optimality.

MEMBER ARMIJO: Doing irrational things in a rational way or what? Given --

(Simultaneous speaking.)

MEMBER BANERJEE: In an emotional way.

MEMBER ARMIJO: You know, you have distractions.

DR. COOPER: Well, it's not just --

MEMBER ARMIJO: Let me ask a question. But it just sounds like everybody doing a good, trying to do a good job and everything else, and still make most of the human errors.

But what about the people who are distracted, talking on the cell phone, driving, trying to multi-tasking when they shouldn't be multi-tasking, human stress, alcohol, drugs, all these things. I'll bet there are a lot of human errors in those events, and they're not on the list.

DR. COOPER: That's true. But let's just think about the context, first of all, that we're thinking about. We're thinking about the context of a licensee that's regulated by the NRC, and so there are certain things that we know aren't going to happen. Okay. We have constraints.

MEMBER ARMIJO: That's kind of a certain population data.

DR. COOPER: We have certain constraints. Some of them have to do with the fact that they have to be certified. They have to be inspected and so on and so forth, so -- and the other thing is that there are consequences, you know. You could argue that some people probably shouldn't be talking on their cell phone while they're driving, because there certainly are consequences.

But on the other hand they've done them so many times that they forget or they discount the consequences. Now there are certainly times when distraction or inattention can be an issue, and we're going to talk a little -- we're going to give one example here in a minute on the medical side.

Not so much of an issue when we're talking about our licensees in the control rooms of nuclear power plants, mostly they're pretty focused on what's

going on and we've got their attention.

But when we're talking about maintenance in nuclear power plants or even essential handling, which can be a very, very long process, then we can worry about attention and distractions and stuff like that.

So different types of activities, different contexts, different constraints. I mean that's a really big thing, constraints on behavior, requirements all these layers of constraint really do allow us to focus in on certain behaviors, and separate them from some of our normal every day things that don't have large consequences.

Anyway, let's go to the next slide, and this one's Bill's also, that has to do with conditioning. So Bill, why don't you go ahead and talk us through this one a little bit?

MR. BROWN: Well, I always said I put this in here for two reasons. One is so that when people read my slides over my shoulder on the airplane, they think I'm a real doctor. The other reason is that it's meant to show that when an activity's repeated often enough, it becomes in some sense automatic.

It's not that you decide to pay less attention to it. It just does, and that's what the

brain scans are meant to show, before training and after training. That activity gets reorganized somewhat, and if I was a neurologist, I could tell you what tasks those were and how the brain focus of them is shifting. Basically, the color indicates brain activity.

The point of this is that it's going to happen, whether you want it to or not. So if the nature of the task is reorganize the brain, due to repetition, there's not much you can do about it, and it happens because it's helpful.

In other words, if it can be made automatic in some sense, that frees resources to do more demanding activities. The downside is that because it's less conscious, less consciously governed, it's subject to distraction and it can go wrong. There's something off normal in the environment. That's why that's in there.

Again, another one of those insights we hope people would take away, because we're not interested in teaching a course in human factors or design of medical devices. We're just trying to give people an appreciation of certain small things that might help them think about an event that they're investigating, or a licensee request that they're

evaluating.

CHAIRMAN RYAN: But I mean that's exactly on this point is well, are they trained, you know? I mean training's something we always look at and inspectors always look at. What's the training record look like? Now that you've given it some thought on what to tie into.

I mean it's, you know, have they been trained in a way that's been locked in, and if they do have a post-training behavior that's different than a pre-training behavior, that kind of thing, that's very helpful.

MEMBER BANERJEE: It's like hitting at tennis ball, right.

MR. BROWN: Yes. Playing a musical instrument, driving a car --

(Simultaneous speaking.)

DR. COOPER: I guess the thing is that when you're talking about something that's a little bit less constrained like driving your car or something like that, there are some subtleties that change. Now some things may stay very much the same, and those may become so practiced as to be automatic and you don't pay attention to them.

Other things, you get used to dealing with

certain slight contextual changes, and therefore then you might be more prepared to deal with some differences in the context, if you will.

That can be important, and as a matter of fact, I'm aware, at least, on our nuclear power plant, side when we're training -- when trainers are now training operators and simulators, they are trying to not do the same thing every time. They're trying to add in, you know, distracting, other equipment failures or changing the timing of things and so forth.

So the operators don't get locked into, you know, the response is always going to be this way. Whenever I see this pattern of alarms, it's always going to be this way. Now, there's some differences across plants as to how effective they are at doing that. But that is the notion behind that kind of variation in training.

But if you have a job that is quite repetitive, you're doing most of the time the same kinds of things, this kind of effect can be important. As a matter of fact, the next slide is one example, at least I think oh, it's got automation. Good. Keep on going.

All right. So the notion here is we've

got two different lines, and this is supposed to be some very grossly defined steps in performing a Gamma Knife treatment, where the basic steps, most of the time are you enter the room where the patient is, and you set coordinates, and then really you're cue then to leave is that you're done with that task of setting the coordinates, and you're done and you leave, and treatment can proceed.

So if you have a different kind of treatment, where you have change out the helmet, and there are, have been events in the past where this has been an issue. So you enter the room, you set the coordinates. If you're more frequently used to just leaving at that point in time, you might forget to swap out the helmet, because you don't have a specific cue to do that.

Now as I understand, there have been some changes, even with the existing Gamma Knife devices, where maybe they put very distinctive or noticeable lettering on the helmet, so you know which one. So there is some kind of cue to tell you, know, what are you about to do.

Obviously, you have to put that together with okay, this is the helmet that needs to be there, not that other one, in order for that cue to be

useful. But you know, at a certain point in time there were some events where they just simply forgot, partly because they were more accustomed to leaving right after that step of setting coordinates --.

MEMBER ARMIJO: I don't know anything about Gamma Knife, but I presume this is a pretty dangerous process if it's not done right, and it wouldn't surprise me that if we were doing something similar in nuclear work, there would be somebody who would confirm that the coordinates were set right, before somebody turned on the machine. Is this a different, a different culture?

MR. BROWN: Double-checks are written into the procedure. However, as the HRA people will tell you, there are independent verifications and then there are independent verifications. If the verification is done right, it's very effective. If it's just I read the prescription, I set the coordinates, then you look at the prescription.

Say you ask -- well, this activity is done hundreds of times a day. Just doing the verification the way I just said, sometimes isn't effective, because it's always right and the effectiveness, the independence goes away.

MEMBER BLEY: If you don't think that

happens in a power plant or even one of your old fuel facilities, you're not right.

MEMBER ARMIJO: No. I know people make mistakes, but I think there's --

MEMBER BLEY: And double-checks make mistakes.

CHAIRMAN RYAN: Now, I think the point, Sam, that I take away, and I agree with the point, is that people get -- maybe complacent is one word to use, but they're so used to doing it over and over again, they sometimes see the answer they think is the right answer, and not the answer that's right in front of them.

DR. COOPER: That's exactly it.

MEMBER BLEY: If I always follow you and you always do it right, no matter how good I am, I starting well, this is Mike. If I'm following somebody else, I'd look a lot more closely.

(Simultaneous speaking.)

CHAIRMAN RYAN: Yes. So I mean that's --

MR. BROWN: The example we use is instead of doing it that way --

CHAIRMAN RYAN: Check my own coordinates, maybe get a Gamma Knife.

(Simultaneous speaking.)

MR. BROWN: --especially what you see, and I'll see if it matches. That slight difference makes a huge amount of difference in the joint probability of failure.

CHAIRMAN RYAN: Well, they just -- you know, the ACRS just had a tour of the Naval Training Facility in Charleston, South Carolina, and they have a very rigid process, just like you described, for steps and procedures.

There's two people, you know. The first one says it out loud; the second one repeats it exactly out loud. Then the first one is observing the second one doing it, and then they actually touch it and verify it and --

MEMBER BANERJEE: That's a little bit like the control room, right.

MEMBER BLEY: Yes. That was a control room.

MEMBER BANERJEE: No, no. I'm saying even in a nuclear plant.

MEMBER BLEY: They do something similar. They don't quite do it --

(Simultaneous speaking.)

CHAIRMAN RYAN: Well they were dealing on simple measurements and other things. It's pretty

interesting to watch. But it was the kind of thing you're saying, that if it's done with rigor, it really does work. But if it's oh, you know, okay, looks good. See you later. Coffee break or whatever it is.

DR. COOPER: Yes, and just in contrast, on the misload work that was in the earlier spent fuel handling study, we noticed that there were similar sorts of things happening with the misloading.

I mean you've got one person on a crane lifting, you know, rods out, and they're supposed to be grabbing the right one, based on a list of certain serial numbers, and they're looking at it with binoculars and stuff like that.

Then there's somebody off to the side that's supposed to be checking their work. Well, it doesn't always work exactly that way. Then there have been definitely some --

(Simultaneous speaking.)

DR. COOPER: Yes, and then, you know, this is taking a long time and there are a lot of them and, you know, something happened over here and boy, that's real interesting. Yes, okay. You got that one too.

So you know, it's happened, and as a matter of fact in the misloading cases, they don't even necessarily know, because there's really no way

to detect if you've just misloaded a single rod or something like that, because the radiation detection that they use can't pick that up.

So it's really, you know, they could have things that have happened that they don't even know about. The ones that they self-corrected, you know. But anyway, let's go ahead and proceed, since I know you want to wrap up soon.

So you know, one of the things that we were asked to do was to take a lot at what NRC and FSME in particular was doing with respect to root cause analysis, because really what we were trying to do was to try to help them take a step further. The unknown database stops with, you know, human error.

We want to take it a little bit further to what the causes are, because if you find the right ones, you're going to be a little bit more effective in either deciding what to do, or deciding what to accept as a corrective action and so forth.

And this slide was just simply trying to stress the idea that, you know, you look for what you find. What you look for is what you find, and what you find is what you fix. So if you're not looking for the right things, then you're not going to end up fixing the right things.

You know, so some of the things, for example, NMED looks at, you know, inattention to detail, failure to follow procedures and stuff like that. It doesn't really give you a complete understanding of why that happened or what would be a useful thing to do. That doesn't fully explain, you know.

There's an example on the backup slides for an event in Beatson, which is in the U.K., which is interesting and it explains a little more detail on the --

CHAIRMAN RYAN: 74 percent of the most common errors cited are basically inattention to detail, and failure to follow procedures is inattention to detail too. So that's amazing.

DR. COOPER: Next. Okay. So now we're going to just give you some excerpts, give you an idea of what the job aid is. Next. So the notion behind the job aid is that once you've had the training, then you can use a structured, filtered knowledge base on what human performance issues ought to matter in medical context, and specifically looking at Gamma Knife.

And the way we tried to structure this information is to -- with the aim of trying to find

causes and look for effective fixes, and basically just kind of make sense of what might be going on in like an event, or what you might be looking for that would be important.

So what's in the job aid? We've got several different things. We've got summaries of human performance topics, and I want to emphasize that, you know, from if you looked at one of the tasks, letter reports that Brookhaven developed, there's a pretty long bibliography on different human performance topics.

So what NRC's contractors have done is take, you know, distill that information, that large body of information, into something that more layman types can understand, and then also focusing on those issues, or those aspects of those human performance issues that are important in medicine.

MEMBER BANERJEE: Can I ask you a question on this?

DR. COOPER: Sure.

MEMBER BANERJEE: At least anecdotally, it appears that if you're under stress, a high level of stress, you perform better.

For example, a surgeon who does surgery, brain surgery, he may have done it a thousand times,

does a much better job than a nurse, for example, attending a patient who she sees or he sees sporadically, because they're watching the heartbeat or something, and they forget. They're in the intensive care unit or maybe whatever.

So stress actually seems to be a positive factor. In fact, in chemical plants, this is very well understood, that people in the control room, who basically only will be needed to do some very few actions, become bored and they don't do them. But if they're continuously having to do something under stress, they do them rather well. I mean it seems inversely correlated.

DR. COOPER: So first of all, yes, you are correct. There are cases, and there's literature and research to support the fact that there is an optimal level of stress, and it's not zero. I mean you can -- anecdotally you know that, you know, people that can perform in, you know, in basketball games or sporting events, you know, there's a certain level of excitement and stress, and they perform better than, you know, against an anniversary, you know, a highly competitive game, as opposed to one that maybe isn't quite as competitive.

Operators I've talked to or former

operators I've talked to say that, you know, the adrenalin level goes up and you're in the groove and you're responding to things and so on and so forth.

As a matter of fact, some of the literature that we looked at recently actually indicates that a more likely time, perhaps, when you might have an error would be after that stress level drops, after sort of the high is stopped. You think that everything's under control.

That might actually be the time when it might be more likely that you would make some, you know, like slip or inattention, because now you think things are under control, and you don't have to worry so much. So I would agree that that's the case.

Now we don't have that necessarily reflected in everything that we've done, especially in HRA. Some of the newer work that we're doing, that we hope to factor into like our HRA methods to support PRA, we hope that that will be happening. What we're doing, we're very much aware of that. We're just trying to use the psychological literature to understand that.

MEMBER BANERJEE: That's the reasons I'm asking you, is that on another front I'm chairing something which has to do with the next generation

safety analysis code, which is not an NRC activity. It's a DOE activity.

DR. COOPER: Okay.

MEMBER BANERJEE: And they're trying to factor in a lot of things, but it's going to be risk-informed safety management characterization, margins characterization. So they have human factors, PRA, all this stuff going with neutronics and other things. What is really difficult is the human factors aspect, and how you have a sequence of events, many of them which are unexpected, and how you factor that in, into the safety margins characterization.

But it needs a history. It's not like each action can be called off in isolation. You have to, you know --

DR. COOPER: Yes, absolutely. We actually just heard a seminar from one of the larger figures in human factors in psychology, Dave Woods, talking about this very same notion, in the sense that you really need to think about the equipment, the interface and the operator as a system, and you need to think about them addressing a variety of different contexts.

If you have automation or a design that keeps the operator out of action and basically kind of

bored sitting there for a lot of time, and you don't think carefully about the handoff, when you get into a more exciting situation, and the operator seems to suddenly wake up and understand what's going on and take over, if you don't think about that handoff very carefully and plan for it, you can end up in some bad situations.

MEMBER BANERJEE: But will you be developing sort of databases and other things which, I mean I can see this, which has records. But you know, how do you use these things to --

DR. COOPER: How we use those ideas?

MEMBER BANERJEE: Yes. How can we sort of validate ideas of --

DR. COOPER: Well, validating that basis --

MEMBER BANERJEE: Or develop even ideas.

DR. COOPER: For the specifics of the medical context, I'm not sure how far we will go. But that certainly is the intent of treating this area with HRA, which even though it's separated from a PRA, is still supposed to be providing, first of all, a significance focus, even if it's not a risk focus, and also sort of a systems focus.

Not to just look at the human in isolation

of, you know, the interface they're working with and the equipment they're working with, and the larger context, how that might change. That is the benefit, if you will, of using HRA, as opposed to human factors alone, because HRA will bring that in, as well as these other things.

Now that's the idea. Now we're still, to the extent that we're able to do that, we haven't demonstrated this. We developed it. We're talking about right now is a follow-on task for the development team, to try to develop some illustrative examples of how you would use this structured knowledge base for some kind of task. So you could see how we would use it.

So I'm not sure what we will be doing beyond that. So I don't know --

(Simultaneous speaking.)

MEMBER BANERJEE: We've seen your database. I mean if you've got a large database, it seems useful to have.

DR. COOPER: What do you mean by "database"?

MEMBER BANERJEE: Well, all of this you're seeing in the medical applications area, right? You've got apparently are you developing this

structured knowledge base --

DR. COOPER: We have a version, a prototype right now, and it has these elements, and they're all linked. I mean you have, first of all, there are little captured bits of knowledge about human performance, the one-page summaries. Then you have task breakdowns. Why don't you go to the -- yes.

So this is sort of the structure, and this is a screen shot, if you will, of the current version of the knowledge base, right? I think this is the current version, which is in the prior software. This is not one that you have. But I've given you electronic, like this is a newer version.

So the purple highlighted things are active links. So you can go to any of these things, and then you -- also when you go to say, for example, a task breakdown, which is the specific steps in doing a Gamma Knife treatment, you can also then link to human performance topics or discussions about errors, or narratives from specific NMED events.

So this is a picture of the breakdown, and on this particular screenshot you can see the specific NMED events that have been captured for specific steps. You can then go to those events and see what happened there, and how it relates to that particular

step in the procedure.

So this tells you a little bit -- first of all, just visually looking at it, you can see setting the shot coordinates has more failures than the other ones. You can see just in the summary what some of those, what happened there. Then if you go to one of the events, then this is what you see.

Everything there is actually directly out of the NMED database. But what's been added by our team is the highlighting that helps you understand or focus in on the issues that we think are important to the human failure. I think Bill, correct me if I'm wrong, there's some things that we've also added at the bottom. Is there more to this screen?

I thought there was -- I thought there was another, something cut off from here. Oh, the human performance topics, which this one, for some reason, really doesn't have any listed. But we would identify human performance issues or topics that are then related to this particular event, and that's also added by us.

CHAIRMAN RYAN: That's good, because that's what I was thinking. You really, I mean fail to verify. Okay. That's a big, broad spectrum of things that can go wrong, failure to verify.

DR. COOPER: If you go to the next thing. This is an example, then, of what we call a one-pager, which is a very small, you know, five minute read on what's important in this topic. So for example for that NMED event, on the last page, there is one-pager on, is it independent verification or verification or checking or whatever?

So there's a discussion about it, you know, generally what the issues are. This particular one happens to be on team performance.

CHAIRMAN RYAN: I believe that's really good, because failure to verify. All team members must verify treatment coordinates. Okay. What does that mean? Does that mean I wave my hand around and say "yes, those two are looked at. Seems good to me"?

You know, you just really don't, until you really say what does verify treatment coordinates mean? How are you going to do that? Are you going to write it down?

MR. BROWN: Those words on that record point to a discussion like this one, that basically is the discussion we had earlier, about what is independent verification.

CHAIRMAN RYAN: Right.

MR. BROWN: How does it make it --

CHAIRMAN RYAN: You know, I know you go into much broader areas like, you know, there's a famous old case where a patient was crushed by a gantry and a table that moved up into a treatment head, and the technician ran down the hall to go to the kill switch, instead of just yanking the patient off the bed, and the patient was killed.

So you know, that's -- so that's a whole different thing. But it's interesting. That's kind of an equipment problem, because every treatment room in the world now has a kill switch right in the room.

MEMBER BANERJEE: I guess this tells you what the error was and perhaps something about its frequency and so on. But it doesn't really tell you about what led up to there, right?

CHAIRMAN RYAN: Yes. That's kind of what I'm saying.

DR. COOPER: That's true, and then unfortunately there, we're sort of hampered by what information was provided by the licensee.

MR. BROWN: What's in there are the verbatim narratives from the licensee's report. Sometimes an investigation is done, and you get a good sense of what happened. Other times, it's just a couple of lines, and you really have to stretch it to

try to draw a lesson from it.

MEMBER BANERJEE: How many records like this do you have?

MR. BROWN: For this, this is sort of a proof of concept. So we just took the Gamma Knife, which is a particular radiotherapy treatment, and culled the, for lack of a better word, human error misadministrations that were reported from NMED. I don't know. There are a probably a couple of dozen events.

MEMBER BANERJEE: Is that so?

MR. BROWN: Yes. So they're not that frequent. Again, for a given type of device for a given period of time, they're not -- there aren't hundreds of them. There would be hundreds of them if you consider HDR, teletherapies, just that.

MEMBER SIEBER: I think it would be better to say that ignore how many events there were, if there's not hundreds of records.

DR. COOPER: Yes.

MEMBER SIEBER: Because there are events that occur that somebody thinks I had the X-ray film in backwards, and so I gave it on the wrong side of the human being. A lot of those go unreported.

MR. BROWN: They go undiscovered.

MEMBER SIEBER: Right.

MR. BROWN: If they're undiscovered, they're not reported, right.

CHAIRMAN RYAN: All right. Our time is getting a little short, so we need to --

DR. COOPER: Okay, yes. This is the last slide. Just two comments. I didn't go over how we picked the Gamma Knife, but that was actually an exercise that we went through, and that's documented in one of the task reports that we went through with staff and management on, you know, looking at representativeness, if you will, of the human performance issues that they're concerned about. That's what we decided as a test bed.

Moving forward, we're going to be working on a NUREG, to try to capture the basic understanding of human performance and human error in medical events, and that's what the team is working on right now.

And we're also going to be, I think we're talking about documenting the training materials also in a report, that can be more widely available. But anyway, that's where we're at right now.

CHAIRMAN RYAN: Sounds great. Thank you very much. Anyone have questions, comments?

MEMBER SIEBER: I do have a question. When we were talking about periods of boredom and then an event occurs, and how people sometimes miss steps and so forth because of attention levels, I look at that as having a peak, where you get to a point where events are occurring, you fully understand them, and you're reacting to them.

If they're occurring faster than you can understand them, you go down into the error range again --

DR. COOPER: That's exactly right, that's exactly right.

MEMBER SIEBER: Is that really the case?

DR. COOPER: Yes.

MEMBER SIEBER: And does anybody attempt to measure that --

DR. COOPER: Yes.

MEMBER SIEBER: Let me give you a power plant example. I once worked in a coal-fired plant where you had six boilers, three turbines, one control room, two operators.

Something would happen to one unit. Both operators were rushed to that unit; the other ones would go sailing on their merry way. Anything could happen with the alarms going off; they wouldn't know

it.

Is there a way to analyze that, because there is a probability that that kind of overload situation can occur, and I suspect it's different for different people.

DR. COOPER: Yes. Well, I'm going to let Julie answer first, since she's the cognitive psychologist -- well these two both. They can answer from the literature first. Why don't you do that?

DR. MARBLE: Yes. There's been a lot of research on stress, and you're exactly right. What you do see is basically a bell curve. There's an optimal level. Below it, your performance is suboptimal; above it, your performance is super-optimal.

When human factors in cognitive psychology, when we try to measure that, you can take a number of physiological measures as an indicator of stress levels.

You can get heart rate variability; you can get galvanic skin response, etcetera. So they do measure those, and then they can correlate it on simplified tasks. There has been some work on stress in nuclear power plant simulators and aviation scenarios, etcetera.

To some degree, they're artificial, because you're using students. But in fact there is work that goes on on stress and how performance decrements with that stress level and distraction.

MEMBER SIEBER: I don't see that issue, though, modeled anyplace, in any of these HRA kinds of things.

DR. COOPER: Not in this. Now having said that --

MEMBER SIEBER: Or even power plant stuff.

DR. COOPER: Well, if we do the Level 3, I will.

MEMBER SIEBER: Okay.

DR. COOPER: I'm going to have to. I don't know how I'm going to, but I will.

MEMBER SIEBER: I'd be interested when you find the answer.

DR. COOPER: Me too.

CHAIRMAN RYAN: It's really interesting. Thank you all very much for coming. We appreciate your insights.

DR. COOPER: Thank you.

DR. MARBLE: Thank you.

CHAIRMAN RYAN: John, maybe we can get -- and close the meeting.

MR. FLACK: Want to take a couple of minutes?

CHAIRMAN RYAN: Yes, a couple of minutes.

MR. FLACK: I'm wondering if -- we're going to have another subcommittee, right?

CHAIRMAN RYAN: Yes. I mean this is just kind of a getting started.

MR. FLACK: I think we ought to say we want to dig into some of the ISA issues in a lot more detail at the next meeting. We've been just going through --

CHAIRMAN RYAN: No, I'm sorry. No, I'm sorry. We closed the record when we said break a few minutes. So Dennis and I are off the record.

(Whereupon, at 5:04 p.m., the meeting was adjourned to closed session.)

I³

International Isotopes Inc.

Making Clean Power Cleaner

Depleted Uranium De-Conversion Project Presentation

May 2011

INIS

Company History / Vision

Our History

- International Isotopes ("INIS") is headquartered in Idaho Falls, Idaho
- Incorporated in 1995, IPO in 1996
- Licensed by US NRC

  Initial NRC Part 30 License - September 2000 - Renewed September 2010

  NRC Approved QA Program (Part 71) - October 2004 - Renewed November 2008

  NRC Part 40 License - October 2005

  NRC Part 30 Exempt Distribution License - November 2007

Our Vision

- To license, construct and operate the first commercial depleted uranium hexafluoride de-conversion facility and offer these services to commercial fuel enrichment companies
- To produce high purity/high value fluoride products during de-conversion
- To manufacture these fluoride products using patented energy and resource savings technology

I^3

INIS

Uranium Enrichment in the U.S.

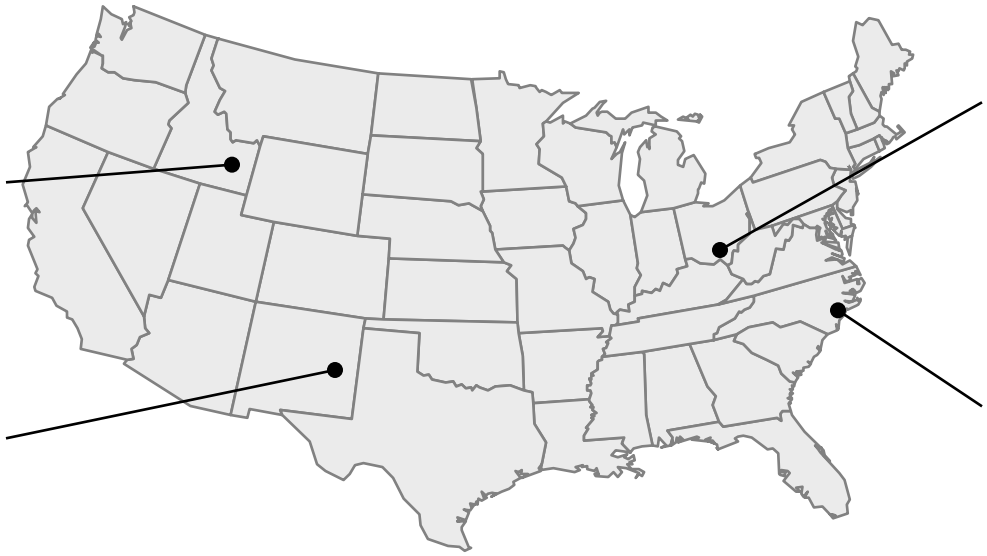
- Currently 4 companies evaluating, planning, or building enrichment capacity in the U.S.

AREVA

Facility:	Eagle Rock Enrichment
Location:	Idaho Falls, ID
Opening Date:	2014
Full Production Date:	2019
Capacity:	6.6 million SWU/yr

urenco

Facility:	Louisiana Energy Services
Location:	Eunice, NM
Opening Date:	June 2010
Full Production Date:	2015
Capacity:	5.7 million SWU/yr



USEC
A Global Energy Company

Facility:	American Centrifuge
Location:	Piketon, OH
Opening Date:	2014
Full Production Date:	2017
Capacity:	3.5 million SWU/yr

GE Energy

Facility:	Global Laser Enrichment
Location:	Wilmington, NC
Opening Date:	2012
Full Production Date:	2017
Capacity:	3.5 – 6.0 million SWU/yr

I³

INIS

Depleted Uranium Already Stockpiled

- **DUF_6 has historically been stored – not de-converted**
- **There has never been an economic solution for managing final disposition of this material**

I³

Need

Historic controls for DUF_6 - Storage – no economic incentives to de-conversion

Current DOE Inventory:

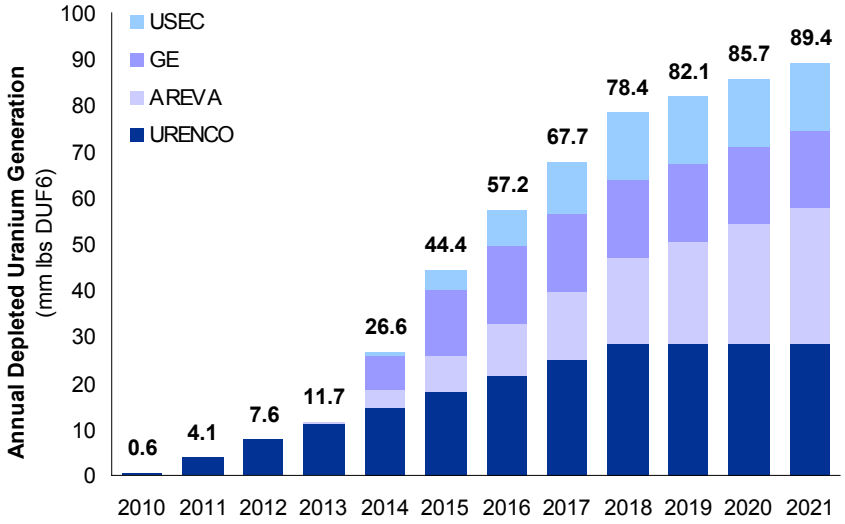
Paducah: 39,000 Cylinders - 4 lines (~1,500 cylinders/yr) = 26 years

Portsmouth: 25,000 Cylinders – 3 Lines (~1,125 cylinders/yr) = 22.2 years

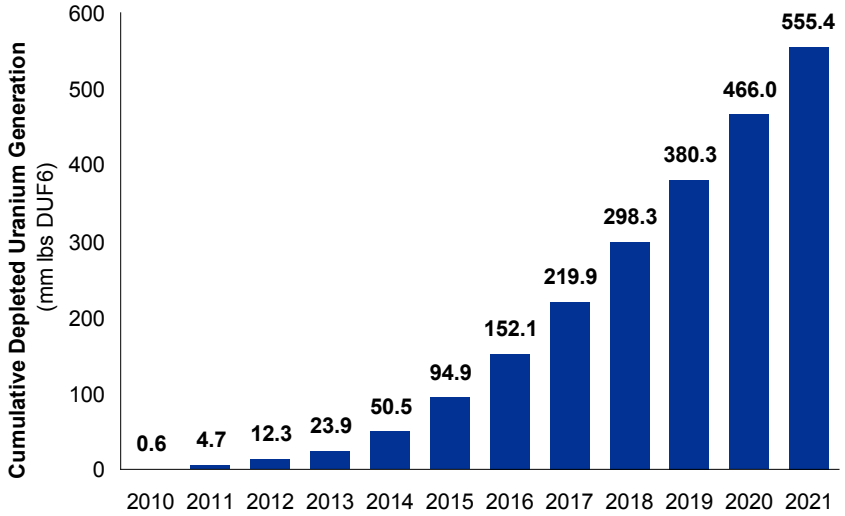
In Addition:

Fuel enrichment companies have announced capacity of >15 million SWU per annum and are expected to generate over 80 million pounds of DUF_6 annually

Annual DUF_6 Generation in U.S.



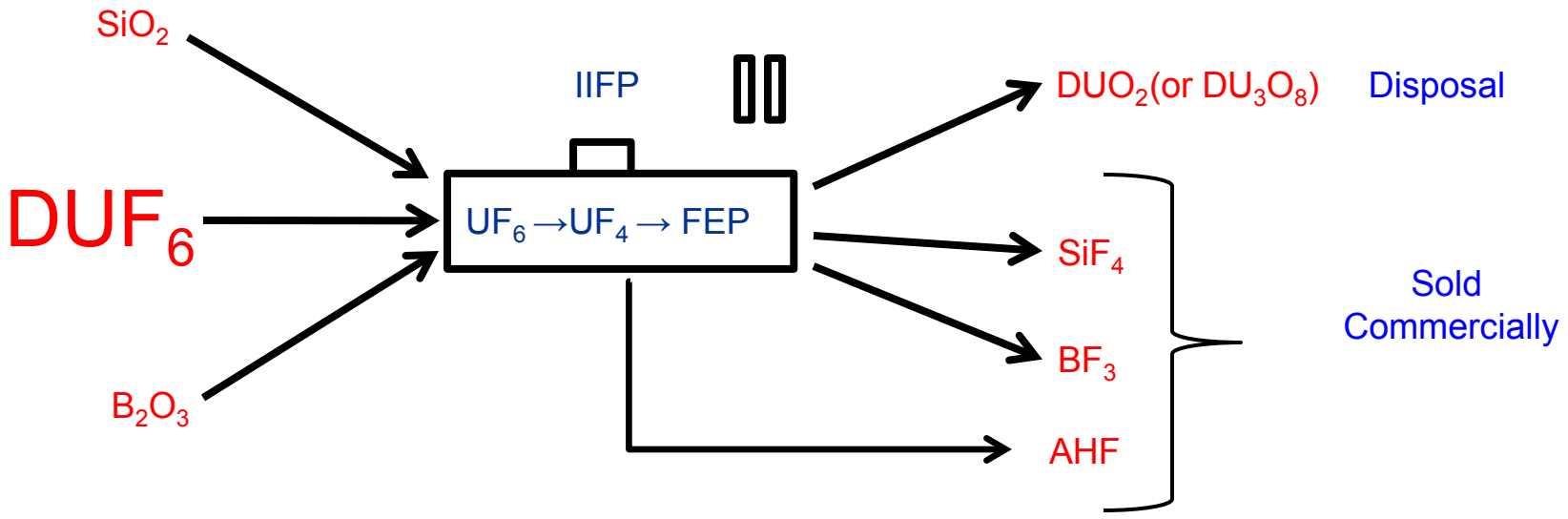
Cumulative DUF_6 Generation in U.S.



Process

Receipt: DUF_6 from enrichment facilities

Processing: Chemical De-conversion of DUF_6



Site Selection - Hobbs, NM

Site Summary

- 640 Acre Total/ 40 Acre Facility
- ≈15 miles west of Hobbs, NM
- ≈35 miles west of URENCO
- Nearest resident ≈ 1 mile northwest

- Site Selection Criteria
  - Extensive review process
  - Broad regulatory, political, environmental considerations
- Public Acceptance
  - Over 40 meetings held
  - No negative reaction, no intervention
  - Successful outcome of NRC public meetings in the license process

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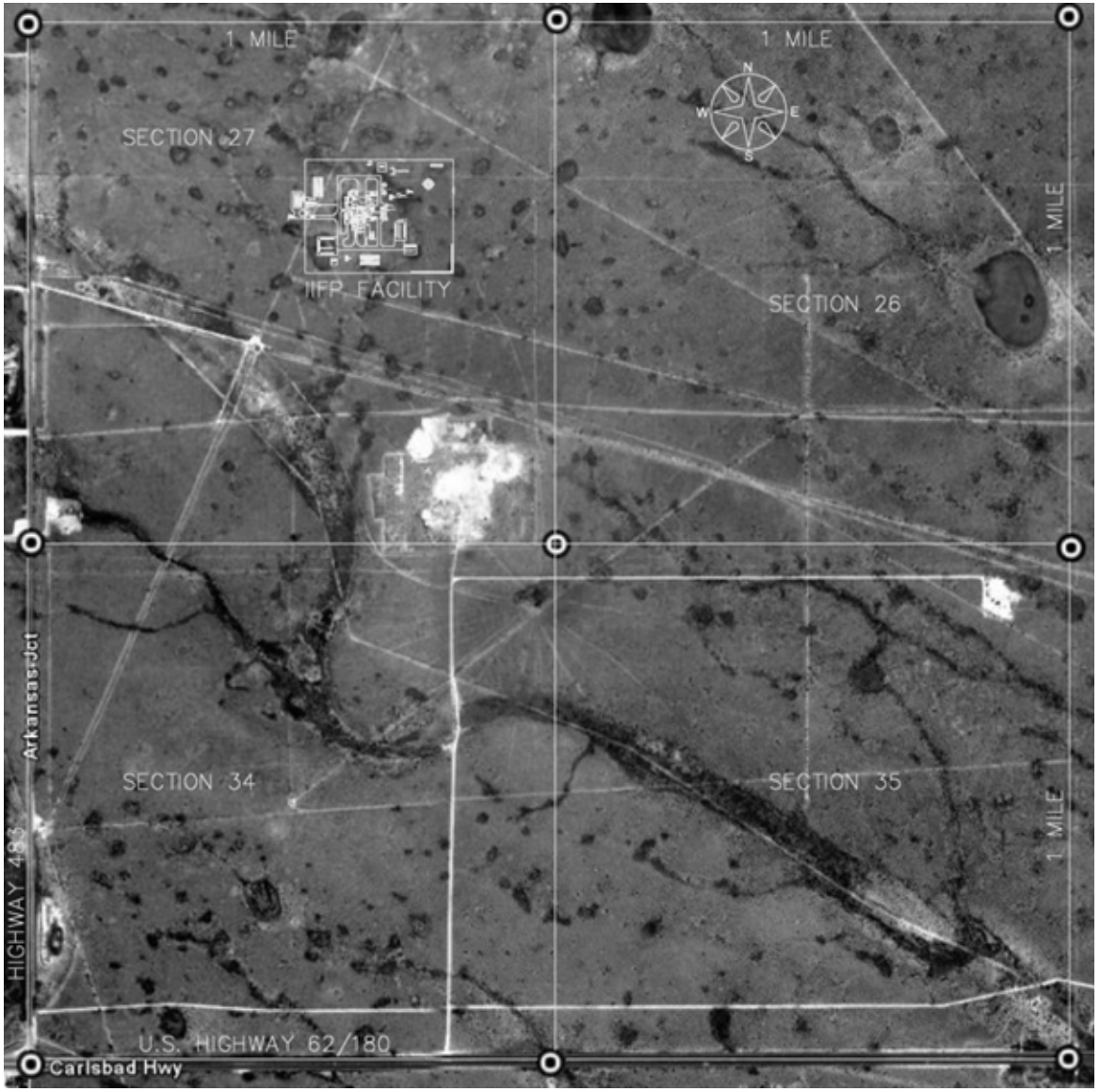
IIFP Footprint

IIFP Site within
640 Acre
Section 27



Impacts

Public Dose

- Uranium – Estimated Dose Modeling 3.1E-6 rem/year to MEI

Air Emissions

- Fluorine – Estimated Release Modeling ≈ 238 lb per year HF after treatment
- Compares to 222,000 lb in State of NM (2009 US EPA Toxic Release Inventory)

Water Usage

- Minimized by using process water recycling – estimate usage at less than 10,000 gallon per day.

Ground Water Protection

- Zero Discharge of Process Waters

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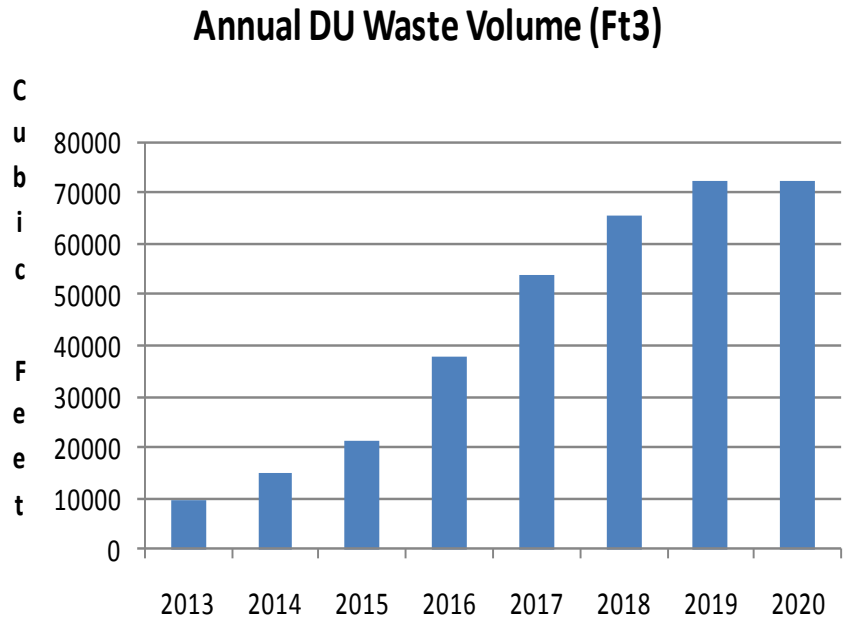
Depleted Uranium Oxide Waste Disposal

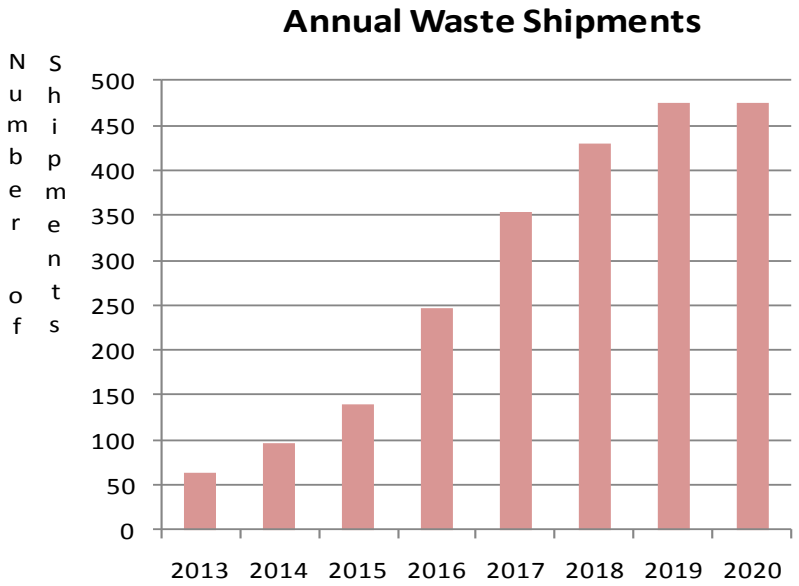
Rocky Mountain LLW Compact issued a declaratory order exempting DUF_6 as "waste" provided it is shipped to INIS for fluorine extraction

Uranium oxide waste is shipped to licensed disposal site(s)

Utah – Energy Solutions

Texas – WCS





NRC Licensing Process

Part 40 Source Material Facility

- Letter of Intent to license facility submitted April 2009
- License Application and Environmental Report Submitted December 30, 2009.
  - License prepared in accordance with Part 70 using the guidance from NUREG 1520 Rev 0.
  - Environmental Report prepared in accordance with NUREG-1748 *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs*
- NRC accepts License Application February 2010
- NRC Request For Additional Information (RAI) provided September and November 2010
- Responses to RAIs are complete

NMED Permitting

New Mexico Environmental Department

- Ground Water Discharge Permit – (storm water basins)
- Air Emissions Permit.
- Waste Water Treatment and Land Application Permits
- Hazardous Waste Generator Permit.
- Storm Water Discharge Permit (EPA)

Several face-to-face meetings with the various NMED Bureaus

Agreement with NMED:

- Limit quantity of uranium possessed on-site
- Limit time DUF_6 cylinders and full DU Oxide disposal containers remain on-site.
- Reporting and access to information agreements.

ISA Methodology

- Follows methodology specified in 10 CFR Part 70, Subpart H
  - Uses NUREG-1520 and NUREG-1513 as guides for format and content
  - FEP/DUF_6 De-conversion plant is considered a low-hazard nuclear facility
    - Primary hazards are from HF or HF reaction product resulting in chemical dose to workers and the public
    - No process related scenarios lead to intermediate or high radiological consequences to workers or the public

Key ISA Elements

- Hazard Identification
  - Identification, location, and inventory of hazards

- Hazard Screening
  - Identifies hazards that exceed low consequences
  - Excludes standard industrial hazards

- Process Hazards Analysis (PHA)
  - What if/checklist methodology
  - Identifies scenarios that can lead to intermediate or high consequences to workers and the public

PHA Example

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Scenario Number	What If…	Causes	Failure Frequency	Consequences	Consequence Category	Prevention Features	Mitigation Features	Comments
ID_xyz	Process gas flow valved to open system	Valve misalignment Valve leak	-1	Hazardous and radioactive gas released from containment	CD(W) = 3 CD(P) = 2 RD(W) = 1 RD(P) = 1 RD(E) = 1	Isolation valves prior to open system Blind flange on open system prior to maintenance Purge and evacuation pressure checks prior to maintenance	Facility structure limits offsite consequences Area hazardous gas and/or airborne radiation detection system and alarms	None

Consequence Types:	Consequence Receptors:	Consequence Severity Level:
RD = Radiological dose	W = Worker	1 = Low Consequences
CD = Chemical dose	P = Public	2 = Intermediate Consequences
Sol U = Soluble uranium uptake	Env = Environment	3 = High Consequences

I³

Likelihood Analysis

- Frequency of the initiating event
  - Frequency assignment is based on NUREG-1520 criteria
- Failure probability of prevention/protection features
  - Failure probability assignment is based on NUREG-1520 criteria (used conservative side of the numbers unless a basis otherwise)
- Failure duration was not used to determine likelihood
  - Nature of the process did not provide a need for duration credit

Likelihood Determination

- Used the Qualitative Likelihood Index method to determine likelihood category
  - Order of magnitude method as described in NUREG-1520, Rev 1 (page 3-AA-1 "Likelihood Definitions")

- Likelihood index value is determined by summing the Frequency Index and Failure Probability Index to get an overall likelihood index number "T"

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Consequence Analysis

- Consequence Receptors
  - Worker, public, and environment

- Consequence Severity Levels
  - Low Consequences = 1
  - Intermediate Consequences = 2
  - High Consequences = 3
    - Consequence level criteria is from 10 CFR 70.76

Items Relied On For Safety (IROFS)

- IROFS are the credited prevention/protection features or mitigation features that are relied upon to meet acceptable risk levels for accident scenarios
  - IROFS are identified and assigned as needed during the risk analysis
  - Credit for IROFS as prevention or mitigation is based on the type of IROFS (passive, active engineered, etc.) as described in NUREG-1520

Risk Determination

- Risk is determined by multiplying the likelihood category number by consequence category number to get a total risk index value
  - Risk index values of 4 or less meet the performance criteria in 10 CFR 70.61 and are acceptable
  - Risk index values greater that 4 require additional prevention/protection features and/or mitigation features to reduce the risk to an acceptable level

Risk Tables (Accident Sequences)

- Risk Tables were compiled to evaluate accidents that could result in intermediate or high consequences
  - Used the PHA as the starting point (initiating event, consequences, potential IROFS, etc.)
    - Refined initiating event frequencies and consequences prior to completing the risk tables
  - Consistent with the example in NUREG-1520 and implemented as applicable to the IIFP facility
    - NUREG-1520 example is more geared toward criticality safety scenarios

Risk Table Example

Accident Identifier	Initiating Event	Prevention IROFS 1	Prevention IROFS 2	Mitigation IROFS 3	U/C	Likelihood		Consequence		Risk Index	Comments and Recommendations
						Index	Category	Evaluation Number	Category		
XYZ	-1	XYZ-1	XYZ-2		U	-1	3	XYZ-EV-1	3	9	IROFS required
Process gas flow valved to open system	Valve misalignment Valve leaks through	Isolation valves	Blind flange on open system								
		-2	-2		C	-5	1		3	3	Acceptable Risk

NPH and External Events

- Some initiating events have low or no consequences
- Some initiating events are highly unlikely or not credible
- Design Basis Events
  - Followed guidance in NUREG-1520, Rev 1, Annex to Appendix A

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Conclusions

- Project is important to the nuclear Industry as it fills a “Void” in the Nuclear Fuel Cycle

- Environmental and Safety considerations have been given high priority

- Licensing process – Ahead of the curve for a Part 40 facility
  - Integrated Safety Analysis
  - Used NUREG 1520 Revision 1

I^3

INIS Fluorine Extraction and Depleted Uranium Deconversion Plant

May 25, 2010

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NRC Participants

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- Tom Hiltz –FCSS Deputy Division Director
- Dennis Morey – Licensing Branch Chief
- Matt Bartlett – Licensing Project Manager
- Yawar Faraz – Senior ISA Reviewer

Staff's Objectives

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- Information Briefing
- Discuss Review Process
- Role of Integrated Safety Analysis
- Review Status

Role of the Office of NMSS

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- Fuel Cycle Safety and Safeguards
- Single Contact with Applicant
- Oversee Safety Review
- Issue License

Licensing Process

Matt Bartlett, NRC
Licensing Project Manager

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Topics

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- Overview of Source Material Facilities
- Facility Hazards
- Regulatory Requirements
- ISA and Safety
- Status of the Review

Regulation of Conversion and Deconversion

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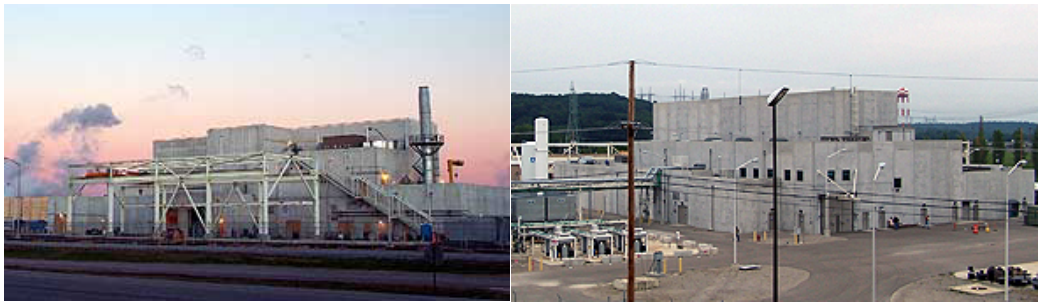
Agreement States

Department of Energy



Conversion

Deconversion

International Isotopes Inc.

Proposed Facility

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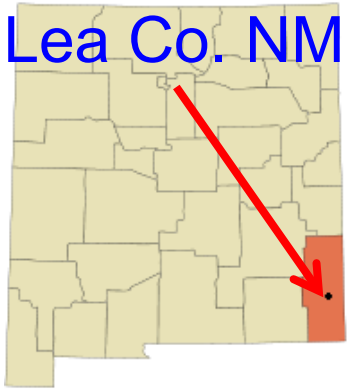
- Deconversion Facility near Hobbs, New Mexico

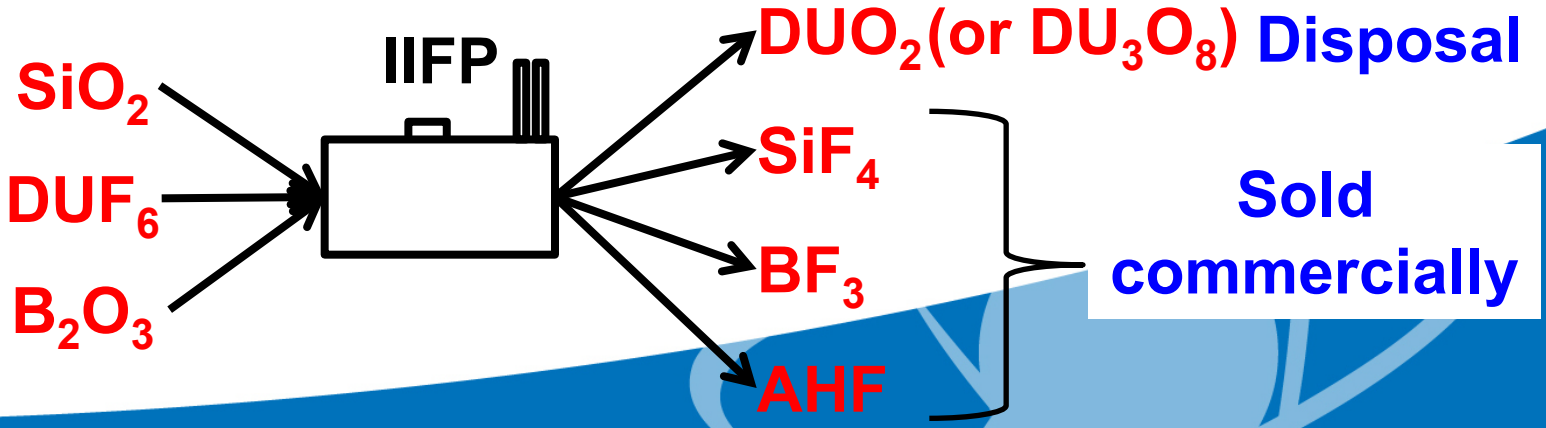
Name: International Isotopes Fluorine Products Inc.

Lea Co. NM



Site

Technology: Chemical Deconversion



Hazards

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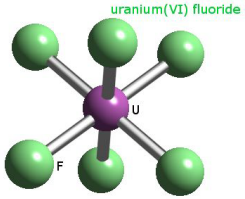
Process Tails from Enrichment Facilities

$$DUF_6 + H_2 \rightarrow DUF_4 + 2HF$$

$$DUF_4 + SiO_2 \rightarrow DUO_2 + SiF_4$$

Inventory of Chemicals

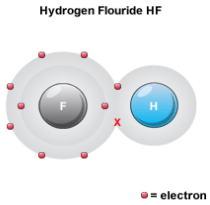
DUF_6 1.65 Mlbs



HF 31,000-80,000 lbs

SiF_4 8,000-14,400 lbs

BF_3 7,200-54,800 lbs



Chemicals from a Release

$$UF_6 + 2H_2O \rightarrow UO_2F_2 + 4HF$$

Key Regulatory Requirements

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		Similarities
Protect Environment	40.31(f)	70.21(f)
Decommissioning	40.31(i)	70.22(a)(9)
Emergency Plan	40.31(j)	70.22(i)
Qualified Staff	40.32(b)	70.22(a)(6)
Facilities and Procedures	40.32(c)	70.22(a)(8)
Health and Safety	40.32(d)	70.22(a)(7)
Physical Security	40.32(d)	70.22(h)

Integrated Safety Analysis

SRM to SECY-07-0146 – Part 70, Subpart H

Integrated Safety Analysis

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- Part 40 Proposed Rulemaking

  Incorporates ISA Similar to Part 70, Subpart H

  2000 kg or more of UF_6

  Licensed by the NRC

- Approved for Publication

  SRM to SECY-010-0128

  Published May 17, 2011

  Final rule by late 2012

Integrated Safety Analysis (continued)

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- ISA Summary
  - Identify Accident Sequences – over 100
  - Implement IROFS – around 40
  - Incorporate Management Measures
- Baseline Design Criteria
  - Minimum design requirements
  - Defense in Depth

Additional Requirements

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- Environmental Impact Statement

  Part 51.20(a)(1) … major federal action…

- Opportunity Hearing

  Part 2.105(d)(2) …request a hearing…

- Guidance/Standard Review Plan

  NUREG-1513 – Develop an ISA

  NUREG-1520 – Review an application

Standard Review Plan

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- Applicability

  Written for Part 70 Applied to Part 40

- Areas of Review

  General Information
  Organization and Administration
  ISA and Summary
  Radiation Protection
  Chemical Process Safety
  Fire Safety
  Emergency Management
  Environmental Protection
  Decommissioning
  Management Measures
  Appendixes

- Acceptance Criteria

"The reviewer should find the applicant's general information acceptable if it provides reasonable assurance that the acceptance criteria presented below are adequately addressed and satisfied."

Licensing – Review

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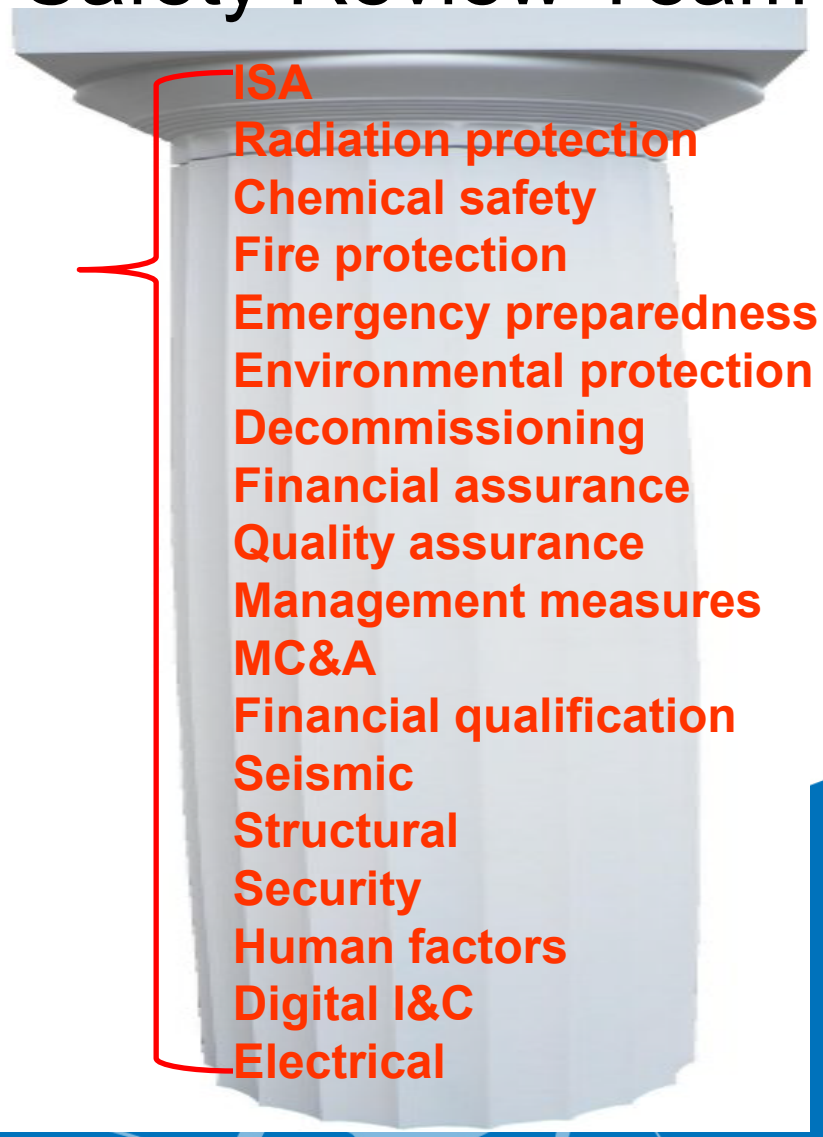
- Conducting the Review
- Requests for Additional Information – 174 RAIs
- Onsite Vertical Slice
- Updated Application



Licensing – Status

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Application	December 31, 2009	Completed
Acceptance Review	February 24, 2010	
Close Hearing Request	June 4, 2010	
RAI Responses	May, 2011	

Safety Evaluation Report	September 2011	Under Development
Draft EIS	November 2011	
Final EIS	May 2012	
License	June 2012	

Conclusions

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- **Regulations In Part 40**
- **Implement Part 70, Subpart H (ISA)**
- **Reviewed against Acceptance Criteria in NUREG-1520**

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RISK-INFORMING NUCLEAR MATERIALS

Dr. Susan E. Cooper & Dr. Julie Marble (RES/DRA/HFRB)
Dr. Bill Brown (Brookhaven National Laboratory)
Dr. Jeff Brewer (Sandia National Laboratory)

ACRS Radiation Protection and Nuclear Materials Subcommittee
May 25, 2011

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Presentation Outline

- Background on risk-informing nuclear materials
- Summary of early efforts to develop HRA capability
- Excerpts of recent work on:
  - Qualitative HRA for cask drops
  - HRA-informed tools for medical applications

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Background on risk-informing nuclear materials

- User Need (2003-003) from NMSS:
  - This User Need was provided to RES in order to develop HRA capability across NMSS as part of an overall effort to risk-inform NMSS.
  - Two Phases were identified:
    - Phase 1: Feasibility assessment for HRA capability
    - Phase 2: Development of HRA capability
- RES split the efforts into two parts:
  1. High-level waste, spent fuel handling, fuel cycle, etc.
  2. Medical and industrial applications of byproduct materials
- Phase 1 feasibility studies to identify NMSS needs were completed:
  1. BNL performed study for byproduct materials (2003)
  2. Study for high-level waste, fuel cycle, SFPO, & decommissioning was performed in-house by RES (2005)
- Phase 2 development:
  - BNL continued work on medical applications of byproduct materials
  - SNL began work on spent fuel handling

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Summary of efforts to develop HRA capability

- Spent fuel handling
  - Because the feasibility study did not identify an initial focus, interactions with staff identified priorities, e.g.,
    - Qualitative HRA for misloads and cask drops as initial priorities
    - Cask drops and HRA insights on potential human performance vulnerabilities in later investigations
- Medical applications of nuclear materials
  - Based on results of Phase 1 feasibility study and additional interactions with staff, the following was agreed upon:
    - Medical applications as an initial focus
    - While a variety of different HRA-informed products were identified, development of job aids and training are the top priorities
  - Staff interactions also helped to identify:
    - a list of human performance topics to focus on
    - Gamma Knife as “test bed”

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Excerpts: Qualitative HRA for cask drops

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Analysis Approach

- Gathered information
  - Subject matter experts
  - Reviewed reports and previous analyses
- Generated cask drop scenarios (using ATHEANA HRA method)
  - Hypothetical scenarios describing how and why cask drops may occur given current understandings of human performance
  - Identified unsafe actions, human failure events, contexts
- Generated recommendations for avoiding or mitigating cask drop human failure events

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Cask Types

- HI-STORM 100 System at Mark I Boiling Water Reactor
  - Uses the canister as the confinement boundary and uses a separate structure to provide shielding and thermal protection
  - Loaded canister must be transferred to the storage structure/container
- Transnuclear (TN)-40 at Pressurized Water Reactor
  - Uses a directly loaded, bolted-closure storage cask to provide confinement, shielding, and thermal protection
  - May be placed directly on the independent spent fuel storage installation

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Cask Drop Scenarios

- Scenarios constructed within NUREG/CR-7016 (TBD) for the following movements:
  - Cask movement from spent fuel pool to preparation area (HI-STORM 100 & TN-40)
  - Cask movement from preparation area to transfer pit (HI-STORM 100)
  - Multipurpose canister (MPC) movement from transfer cask down to storage cask (HI-STORM 100)
- Scenarios constructed within NUREG/CR-7017 (TBD) for additional movements
  - Before and during fuel loading
  - During MPC and transfer cask sealing operations
  - During storage cask movement from the transfer pit to the ISFSI pad
  - During cask monitoring and storage at the ISFSI

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Human Performance Vulnerabilities

1	Inadequate procedures	Omission of detail in procedures
2	Limited reliance on procedures	Many operations are skill-based and may not be guided by written procedures
3	Inapplicable procedures	Procedures don't apply to a unique or unusual situation (off-normal; emergency)
4	Inadequate training/experience	Individual & team factors (e.g., between plant personnel and temporary contractor personnel)
5	Communication difficulties	Noise, hand signals, confusion using RF headsets with many people
6	Limited indicators and job aids	Lack of engineered reference tools or administrative controls (variable execution of skills)
7	Visual challenges	Large distances, viewing casks in water, obstructions
8	Unchallenging activities	Slow-paced tasks, monotonous, easy to get distracted
9	Time pressure	Approaching outage can increase pressure

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Human Performance Vulnerabilities

10	Time of day & shift work challenges	Double shifts, variable shift schedules, filling in for sick colleagues
11	Inadequate verification	Incorrect “redundant” checking: common-mode failures, social shirking, overcompensation
12	Quality assurance problems	Structures, systems, components, materials, etc.
13	Decision making bias error	In particular: confirmation bias, loss aversion, overconfidence
14	Inadequate team coordination	Undesirable variability within and between teams, e.g., different assumptions for task execution
15	Improper or uneven task distribution	Missed opportunities for checking, workload imbalance
16	Large number of manual operations	More opportunities for unsafe actions and human failure events
17	Other ergonomic issues	Cramped work spaces, noise, hot or cold conditions, cumbersome clothing

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Conclusions

- Introduced the analysis process allowing development of:
  - Cask drop scenarios including unsafe actions and error-forcing contexts
  - Human performance vulnerabilities representing performance shaping factors and plant conditions that generate a condition that may contribute to human failure events
  - Illustrative guidance for avoiding or mitigating human performance vulnerabilities
- ATHEANA & Good Practices for HRA have proven valuable for uncovering the dynamic, contextual conditions influencing human performance in cask handling.
- It is possible to build a technical basis for potential improvements to procedures and practices involving Dry Cask Storage Operations (e.g., to avoid cask drops).
- This work forms a useful basis for potential future HRA/PRA Level 3 site-wide studies that include spent fuel handling in their scope.

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Excerpts:
HRA-informed tools for medical applications

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Aims and Approach

- Risk-inform byproduct-related tasks by:
  - Applying HRA perspective to materials issues
  - Focusing on qualitative insights from HRA
  - Providing technical basis for staff decisions
- How to provide this perspective?
  - Provide basic information on human performance and error
  - Provide relevant resources (i.e., filter literature and understanding in psychology, cognitive science, etc.)
- Specific implementation
  - Training (2008 materials are for 2 – 21/2 days)
  - Job Aid (mostly represents 2008 version; 1-2 slides based on upgrades to software and content made in 2010)

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HRA-INFORMED TRAINING

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General topics in HRA-Informed Training

Human Error in Medical Applications

What is Human Error

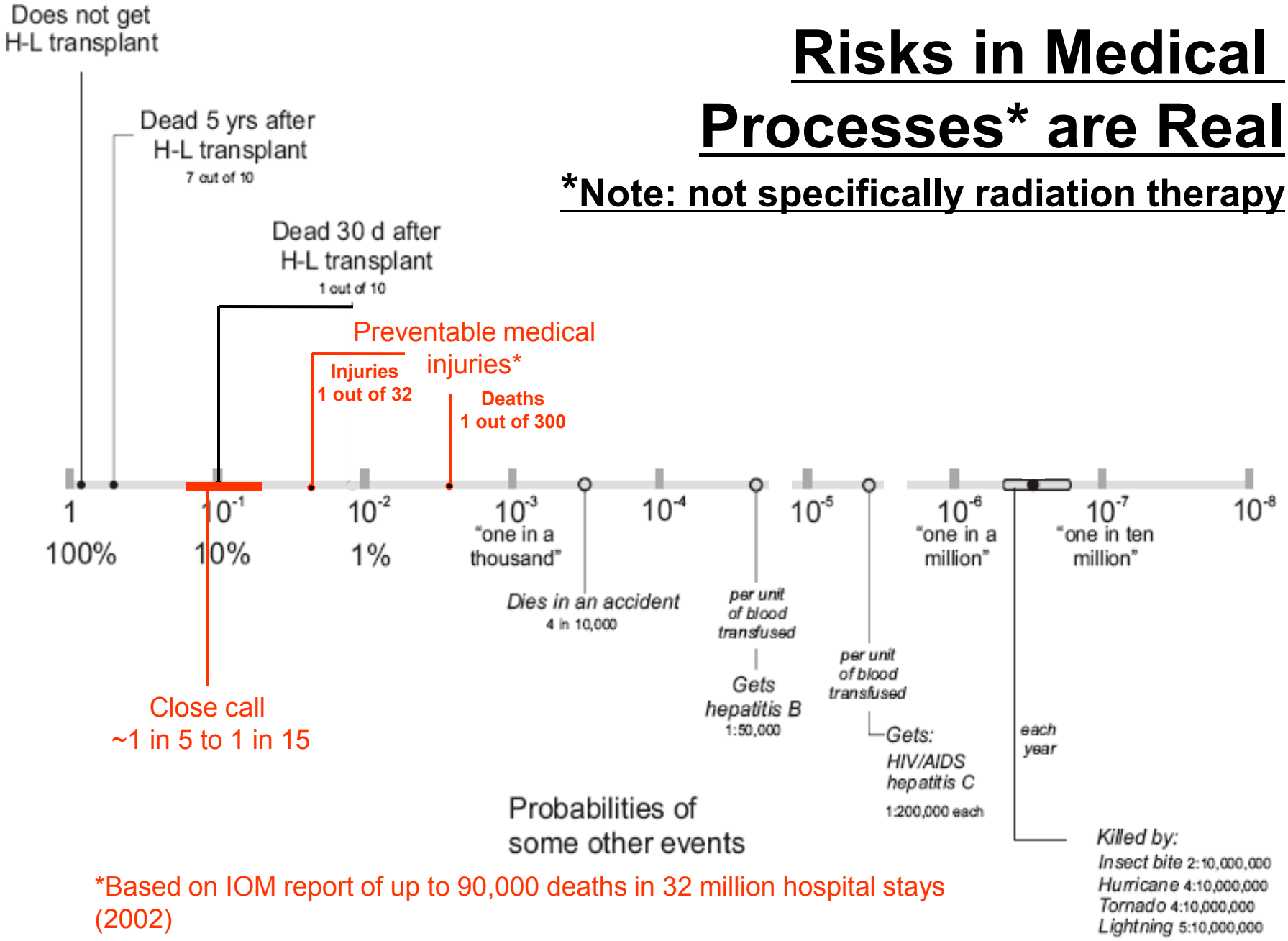
Error Mechanisms/Contexts

Current Thinking on Human Error

Event Analysis/Corrective Actions

Risks in Medical Processes* are Real

***Note: not specifically radiation therapy**



*Based on IOM report of up to 90,000 deaths in 32 million hospital stays (2002)

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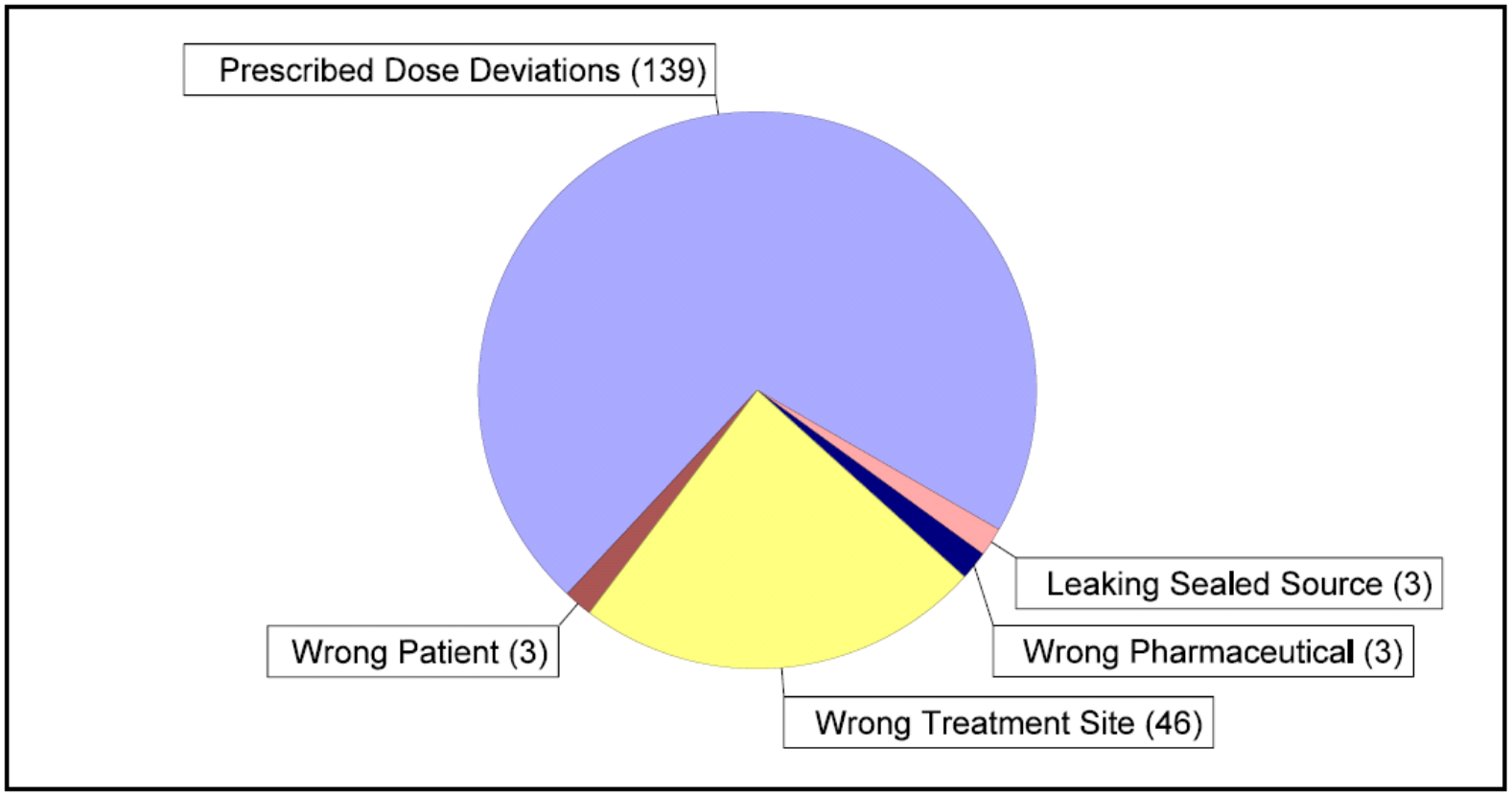
Types of Medical Events



Source: NMED 2nd Quarter Report FY2007 (last 16 quarters)

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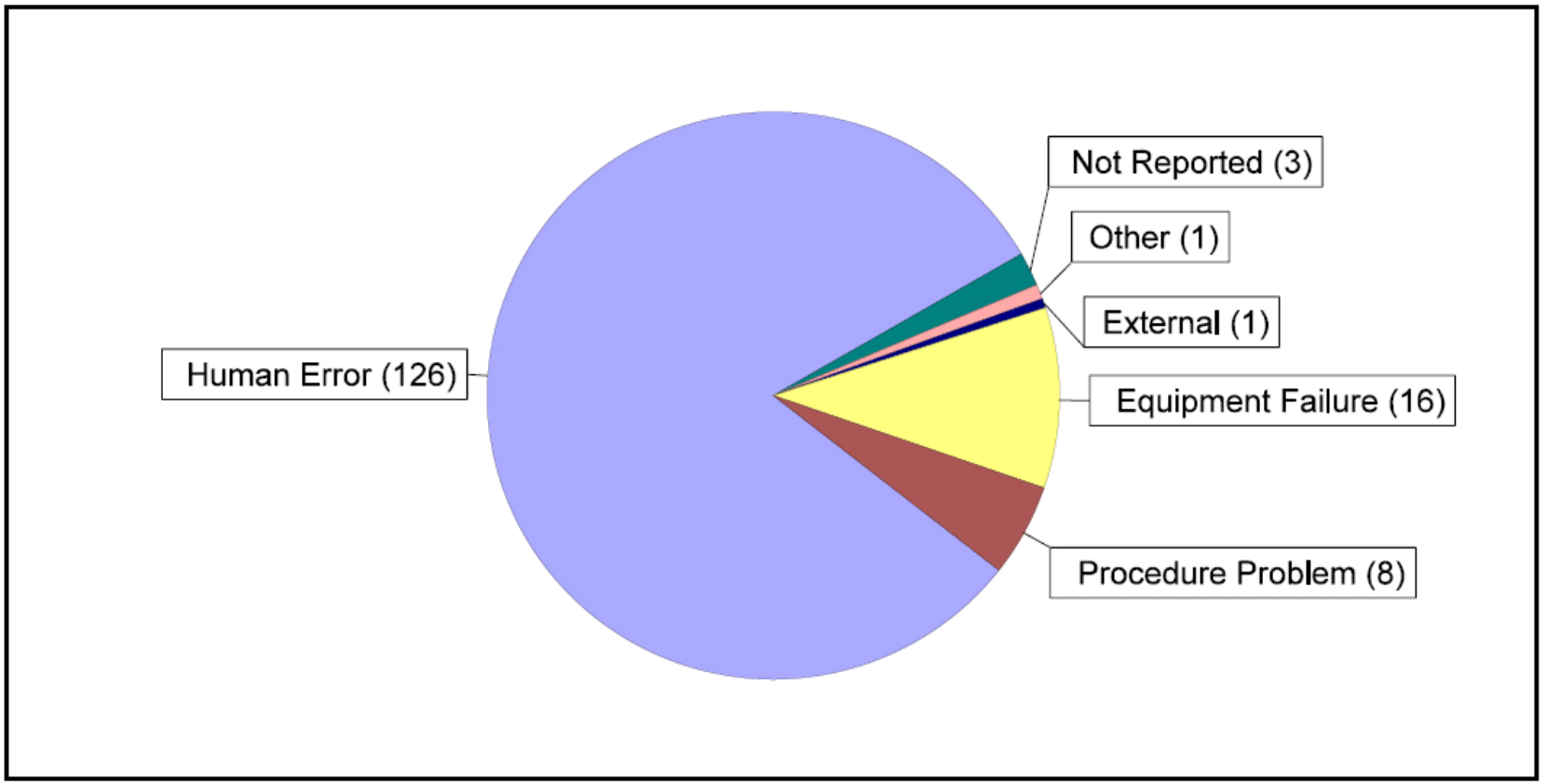
NMED Medical Event Causes



Source: NMED 2nd Quarter Report FY2007 (last 16 quarters

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Why do people make errors?

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Human error can be predicted because…

- People's behavior is almost always rational:
  - adaptive – i.e., goals are achieved
  - satisficing – i.e., adequate under the circumstances
- People's actions will tend to be:
  - practical
  - people do what "works"
  - economical
  - people act so as to conserve resources (physical & cognitive)

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Human error can be predicted because…

- People follow familiar paths
  - Maximize use of habits (good *and bad)*
  - Minimize 'cognitive strain'
- People use 'rapid pattern-matching' to detect and interpret faults and errors
  - Very effective at detecting most problems, but
  - Not very effective at detecting our own errors
- People also use…
  - shortcuts, heuristics, and expectation-driven actions
  - efficiency-thoroughness trade-offs

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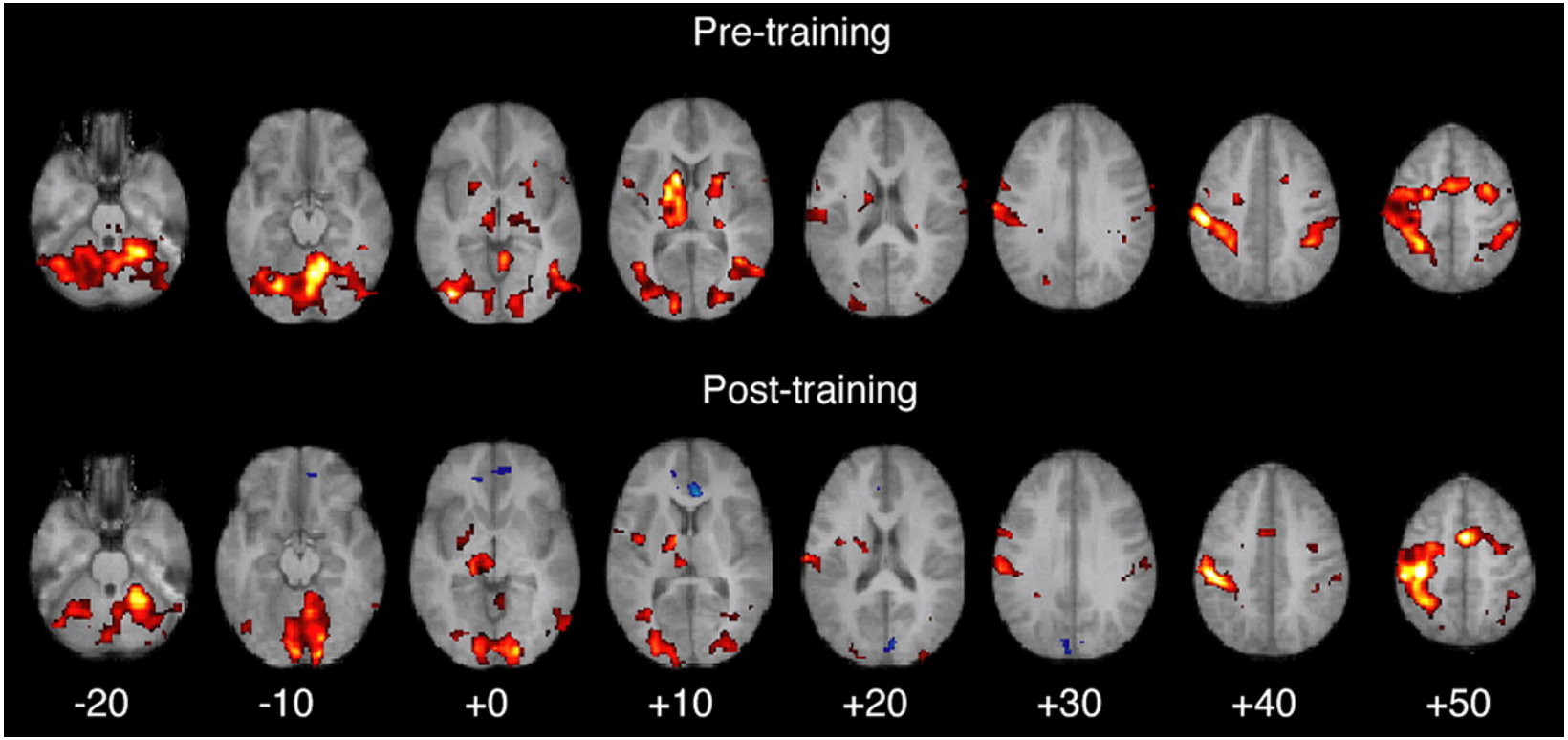
Practiced actions become 'automatic'…



…whether we want them to or not.

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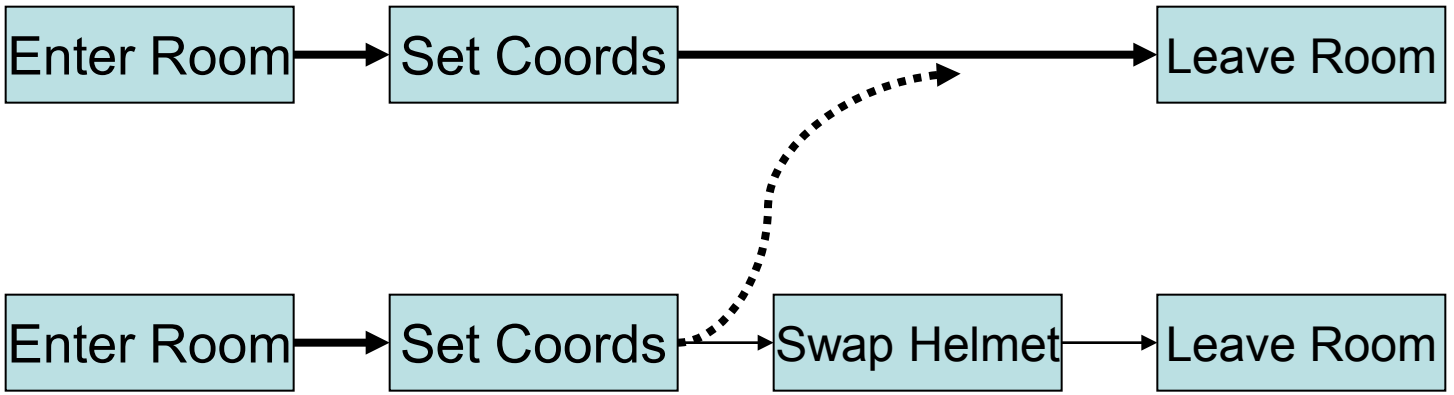
Failure to Change Collimator Helmet



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The Search for Root Causes

- The purpose of the root cause evaluation is to ensure fixes are put in place to eliminate or reduce the risks of repeat events
  - "What you look for is what you find" - WYLFIWYF
  - "What you find is what you fix" - WYFIWYF
    - Anticipating problems in license reviews & modifications
    - Reviewing corrective actions
    - Changes in regulations
- Most commonly cited causes in NMED:
  - Inattention to detail (~48%)
  - Failure to follow procedures (~26%)
- There are reasons for this
  - The nature of tasks
  - The nature of human behavior
- But these *do not fully explain* the events
  - The analysis is superficial
  - Corrective actions may be ineffective
- Example in backup slides

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HRA-INFORMED JOB AID

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Purpose of HRA-informed job aid for license reviewers

- To provide a basis for improving the understanding of human reliability issues in medical uses:
  - the human-related causes of risk-significant events
  - the effectiveness of proposed fixes
- To provide a basis for evaluating the potential for significant risks associated with human performance in new license applications or modifications
- In general, this can be termed '***sensemaking***' of events
  - 'Sensemaking' is a $64,000 term for simply making sense of things
  - But it includes some specific activities

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Develop "sensemaking" aids

- One-page summaries of human performance topics
  - Compact reference based on training material
- Prompt items to guide discovery of issues
  - Questions to ask about circumstances, characteristics
- Task breakdowns (annotated)
  - Detailed action sequences
  - Notes re: relevant events or human performance aspects
- Error discussions
  - Brief treatment of types of errors
  - Examples from events
- Error narratives
  - Excerpted from NMED records & human performance issues highlighted

Job aid is essentially a structured knowledge base of prioritized human performance issues, with multiple entry points & linkage to events (to illustrate importance of human performance issues with respect to frequency, recency, etc.)

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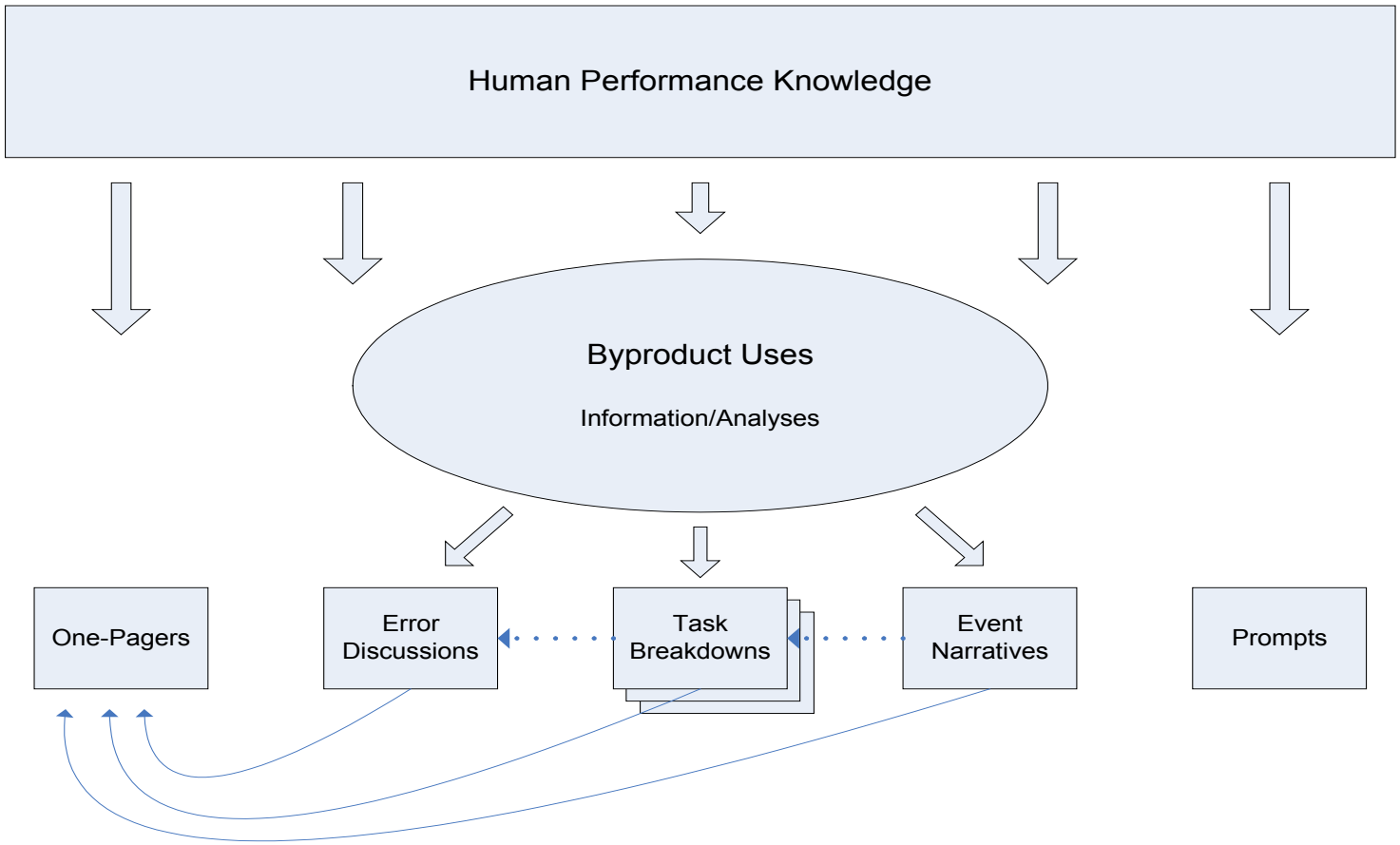
Creation of Job Aids and Knowledge Sources



About the Job Aid
Human Performance Job Aids Fo
Error Discussions
Event Narratives
Human Performance Topics
Task Breakdowns
Information Notices
HRA Resources

Human Performance Job Aids For Gamma Knife

Task Breakdowns

A gamma knife treatment is considered to consist of three phases:

- Imaging and Localization
- Treatment Planning
- Patient Positioning and Treatment

Each of these consists of many individual tasks, which are shown here in flowchart form. The task breakdowns are based on the risk analysis described in NUREG/CR-6323; the tasks should be viewed as generic. The actual steps carried out in using a gamma knife may differ owing to changes in technology and/or facility preferences.

The flowcharts can be shown annotated with either of two types of information. In the one view, the expertise and/or training required is shown to the right of each task; this information is taken from NUREG/CR-6323. In the other view, references to NMED reports are shown to the right of the tasks with which the events were associated.

Human Performance Topics

Brief summaries of human performance topics are given for reference. Among the topics are automation, types of errors, and staffing.

Error Discussions

The errors associated with reportable gamma knife events can be grouped into several categories.

Error Narratives

The narrative sections of selected NMED records for gamma knife events are shown. These are events involving human error; instances of hardware failure are not included. Below the narrative section are: a brief statement of the mishap and related circumstances, the pertinent human performance topic(s), and the corrective action proposed (if one was specified in the narrative).

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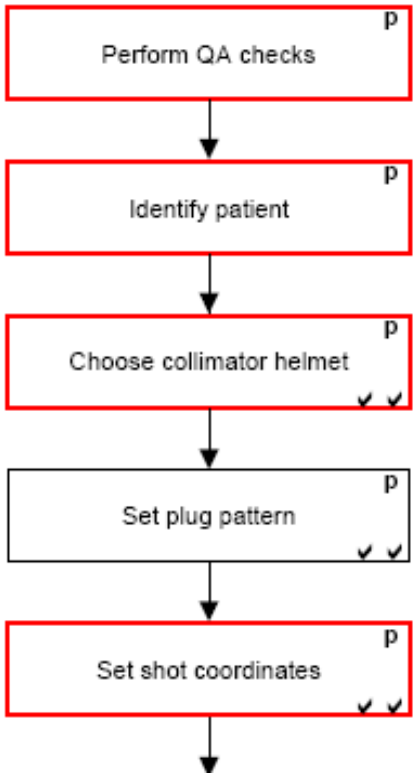
Example of an Annotated Task Breakdown

Toggle Annotation

Patient Positioning and Treatment



990097: incorrect system date
021005: system date reset during maintenance

000336: substituted other patient's treatment plan
010662: substituted other patient's treatment plan

951266: failed to change helmet
040125: neglected to change helmet

980646: y,z coordinates reversed
981167: y,z coordinates reversed
000615: y coordinate incorrect
000616: y,z coordinate error

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Example of an Event Narrative

000787

The licensee reported a medical event that occurred during the performance of a gamma stereotactic radiosurgery treatment for acoustic neuroma. The patient's treatment plan called for the administration of 1,200 cGy (rad) to a tumor volume in three shots. The first shot was delivered with the 8-mm collimated helmet and was to be followed by two shots with the 4-mm collimated helmet. When the coordinates of the second shot were being set, it was discovered that the z-coordinate of the first shot was 11-mm off of the target volume. It was determined that the x-coordinate was accidentally entered for the z-coordinate. The licensee determined that the positioning error resulted in the treatment of a small volume (0.58 cm3) of normal brain. The licensee stated that this area would have received some radiation exposure during the normal course of treatment, but not the 460 cGy (rad) that resulted from the positioning error. The patient and the patient's physician were immediately advised of the error. A new treatment plan was generated to account for the misplaced shot. The patient was then treated with the second and third shots (with the modified treatment times) and the physician added a fourth shot to ensure that the target area missed during the first shot was fully treated. The NRC contracted a medical consultant to review this event and the probable deterministic effects on the patient. The medical consultant concluded that this event is not expected to produce clinically identifiable adverse effects on the patient. This event was caused by the licensee's failure to follow their established Quality Management Plan (QMP) in that the licensee failed to verify that the treatment coordinates set on the patient's head-frame were the same as those established in the written treatment protocol. Corrective actions include 1) procedure modification to explicitly state that all team members must verify treatment coordinates and 2) conducting an in-service to re-familiarize the team members with the QMP and the revised procedure.

Error and Related Factors
x coord entered for z; discovered as second shot was being set up

Human Performance Topic(s)

Proposed Corrective Action
modify procedure 'to state that all team members must verify treatment coordinates'

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Example of a 'One Pager' – team performance

Staffing

Effects of Advanced Technology on Team Performance

Teams are often relied upon to support situation assessment, error detection and recovery in high-consequence activities. Coordination of the team members' work requires them to be aware of the each other's activities. Successful teams actively locate errors, question improper procedures, and monitor the status of others. In carrying out tasks, personnel convey, directly and indirectly, their intentions and actions to others. Computer-mediated tasks, especially those performed at individual workstations, may isolate users, making an individual's actions less visible to others, thus reducing team effectiveness.

It has been suggested that traditional work environments with conventional technologies have characteristics that contribute to team performance: horizon of observation, openness of tools, and openness of interaction.

- *Horizon of Observation* - This refers to the portion of the team task that can be seen or heard by each individual. It results from the arrangement of the work environment (e.g., proximity of team members) and is influenced by the openness of tools and interactions. By making portions of a task more observable, team members can monitor errors of intent and implementation, and determine when assistance might be helpful.

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BACKUP SLIDES

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Example: Beatson Oncology Centre, 2006

- Beatson Oncology Centre (BOC) major oncology treatment centre in Scotland
- Teletherapy event, but could happen with any modality controlled by computer
  - Varian Varis software (commonly used in rad therapy)
- 15 year old patient dosed in 19 fractions (20 prescribed) each with 58% overdose in January 2006
  - Died October 2006
- Step omitted from planning calculational process
  - Normalization step missed
    - Inattention to detail?
  - Step omitted from procedure
    - Inadequate procedure?
  - Not detected by checker
    - Inattention to detail?
  - Planner not qualified to perform this planning process
    - Violation of rules?

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However…

- Software newly upgraded for planning and treatment tools, to allow automatic transfer of data from planning to treatment program
  - Reduction in human errors expected because potential failure mode eliminated
    - Removed manual transcription of data from planning form to treatment software
    - Also expected to reduce costs by eliminating manual actions
      - Reduced treatment prep time estimated to save $35k for avg facility
    - No safety review of impact of changes
  - However because of complexity with this type of tumor, manual calculation of plan was required
    - Only ~6 out of ~5,000 new plans per year
  - Treatment planner omitted new unit conversion step
    - Not identified in procedures
      - Procedure not updated in many years
    - Not detected in reviews by senior planners
      - Planner was more familiar with overall plans like this

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And more…

- Beatson had ~40% shortage in treatment planning positions
  - Chronic shortage over many years
  - Not just funds
    - Few Med School graduates want to enter field
  - (US average estimated to be 18.9% shortage for typical Rad Onc Dept)
- Pressure from public for reducing waiting times for treatment
  - Oncology services being consolidated at BOC
  - Reported delays of up to13 weeks for lung cancer treatment
    - 20% avoidable death rate due to delay alleged
- No staff available to maintain infrastructure
  - Procedures
  - Training
  - Reviews of new software
- So “human error” causes (bad procedures, inattention, etc.) were symptoms of a **bigger problem**
  - “Fixing” them (e.g., discipline) would not improve things in reality
    - WYLFIWYF
    - WYFIWYF