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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

158th MEETING

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WEDNESDAY

MARCH 16, 2005

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ROCKVILLE, MARYLAND

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The Advisory Committee met at 1:00 p.m. in Room T-2B3 of the Nuclear Regulatory Commission, Two White Flint North, 11545 Rockville Pike, Dr. Michael T. Ryan, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

MICHAEL T. RYAN Chairman
ALLEN G. CROFF Vice Chairman
JAMES CLARKE Member
WILLIAM J. HINZE Member
RUTH F. WEINER Member

ACNW STAFF PRESENT:

Neil M. Coleman
John Flack
Latif Hamdan
John T. Larkins
Michael Lee
Richard K. Major
Michael L. Scott

NRC STAFF PRESENT:

Charlotte Abrams
Jennifer Davis
Matt Blevins
Ralph Cady
Yawar H. Faraz
Scott Flanders
Dan Gillen
Joe Gitter
Paul Harris
Charlie Miller
Thomas J. Nicholson
Bob Pearson
Bill Reamer
Andrew Schwartzman
Jack Strosnider

ALSO PRESENT FROM FDA:

Adion Chinkuyu

Craig Daughtry

Timothy Gish, via teleconference

Andrey Guber

Yakov Pachepsky

I N D E X

P R O C E E D I N G S

(1:01 p.m.)

CHAIRMAN RYAN: We'll come to order please. This is the second day of the 158th Meeting of the Advisory Committee on Nuclear Waste.

My name is Michael Ryan, Chairman of the ACNW. The other members of the Committee present are Allen Croff, Vice Chair, and Ruth Weiner, Jim Clarke, and William Hinze.

During the meeting today, the Committee will hear from the NRC's Office of Research and the Department of Agriculture research staff on field studies to test and evaluate groundwater recharge estimation techniques, methods, and their uncertainties.

You'll be briefed by the Director of the Office of Nuclear Material Safety and Safeguards on recent activities of interest to the Committee.

And we will receive a briefing by an NMSS representative on the status of the license application for the proposed gas centrifuge and uranium enrichment facility in Piketon, Ohio.

After these presentations, we'll discuss potential or proposed ACNW letter reports.

John? Sharon Steele is not here so I will ask that John Flack will the Designated Federal Official for today's initial session.

MR. FLACK: Will do.

CHAIRMAN RYAN: Okay, thank you.

The meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions. Should anyone wish to address the Committee, please make your wishes known to one of the Committee's staff.

It is requested that speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so that they can be readily heard.

It is also requested that if you have cell phones or pagers, kindly turn them off or place them in a mute mode.

Thank you very much.

And with that, we'll proceed.

MEMBER CLARKE: Okay, as Dr. Ryan said, this first set of presentations will update us on field techniques for estimating groundwater recharge and also evaluating model abstractions, work that the

Office of Nuclear Regulatory Research is doing with the Agricultural Research Service and others.

And I'm pleased to introduce Dr. Tom Nicholson to you who will get us started. And, Tom, if you could introduce your colleagues as well.

DR. NICHOLSON: Thank you very much, Dr. Clarke.

I'd like to introduce to my left, your right, Craig Daughtry, who is a Research Agronomist with the United States Department of Agriculture, Agriculture Research Service.

Next to him is Dr. Yakov Pachepsky, a Soil Scientist also with the Agriculture Research Service.

Sitting at the table a colleague of mine, Ralph Cady, who is involved in the project, raise your hand, Adion Chinkuyu, he's also with Agriculture Research Service, Andrey Guber, with the Agriculture Research Service. And behind him, Adam Schwartzman, also from the Office of Research, who has been doing field work with the Agriculture Research Service.

Well, today we'd like to give you just a very brief series of presentations on estimating groundwater recharge and evaluating model abstraction techniques.

The two projects are through interagency agreements with the United States Department of Agriculture's Agriculture Research Service. The first project, estimating groundwater recharge using state-of-the-art methods and techniques, started about five years ago with Jim Starr and Dennis Timlin, also with Agriculture Research Service.

We started on a much smaller scale at the corn plot scale. Then we moved to lysimeter. Today we'll be talking about the watershed scale.

Also we have a separate interagency agreement with Dr. Yakov Pachepsky and Rien Van Genuchten looking at model abstraction techniques for estimating water flux and transport in soils.

The research that we're going to be talking about today supports work on looking at infiltration and groundwater recharge estimates.

We're looking at very realistic evidence-based research based on field data to support the NRC staff evaluations of infiltration recharge. These are extremely important parameters in estimating radionuclide leaching and transport in the performance assessment models being used by the staff primarily for decommissioning but for other applications as well.

One of the motivating factors for the

research was to look at the variety of methods used to estimate water flux rates and look at them from the standpoint of what is realistic and can we say something about whether they're conservative or not. In the past, people looked at a percentage of annual rainfall and they used annual infiltration.

Here we are looking at event-based. So it could be a day or a day and a half recharge event. How could we estimate in a more realistic sense infiltration and groundwater recharge?

Yakov Pachepsky will talk about his model extraction technique. This work is to provide a methodology for the staff to assess simplifying assumptions in the performance assessment models to assure that the features, events, and processes relevant for that site are incorporated in estimating water flux and transport. And this is primarily in soils, primarily in the unsaturated zone but also if at the water table aquifer.

Also this work, by being realistic and being very much based on field evidence, is to look at uncertainties. We're looking at conceptual model uncertainty and parameter uncertainty. And Yakov Pachepsky will talk about that in some detail.

And finally, we're very pleased that we

have this cooperative agreement with the United States Department of Agriculture because the field studies at Beltsville are very expensive. And we're able to utilize them for a relatively small investment.

They provide us with a highly-detailed database. The one the Tim Gish, who is on the phone, who will be making the next presentation, who is also from the Agriculture Research Service, he and Craig Daughtry have been doing this for many years. And they have very detailed databases.

Often the data is on a ten-minute basis and so therefore there is intensive data availability to look at the methods both from the standpoint of infiltration and groundwater recharge but also looking at model abstraction techniques.

This viewgraph is just to give you a sense of where we may apply these with regard to complex conceptual models. This is an example of an engineered system in the subsurface and how the environmental system may impact on it. So, therefore, you could have a variety of infiltration and groundwater recharge events. You could have failure of the engineered system due to that and preferential flow.

And Tim will tell us an example at his

Beltsville site where they have identified preferential flow in hydrologically-active zones. And so, therefore, the conceptualization is evolving in a more realistic sense.

As I said before, Tim will give our first presentation. They are evaluating monitoring approaches for capturing both short-term and long-term recharge over a variety of spatial scales. This, as I said before, is very relevant to decommissioning. Their site is 21 hectares in size. And they have sub-watersheds A through D, which are approximately four hectares in size.

And as I said before, they have data over a long time period on a ten-minute basis. This work builds on earlier work by Jim Starr and Dennis Timlin. And you have copies of their NUREG reports.

The other talk will by Yakov Pachepsky. He will illustrate the model abstraction techniques and show how a systematic methodology can help reduce model complexity such as the early one I showed while still maintaining the validity of the simulation results. They are relevant with regard to flux and transport.

He also will give field examples showing the range of simplified models that are appropriate for site-specific data relevant to water flux.

So with that, Craig and Tim, if you could scoot over here and make the next presentation? Thank you.

MR. GISH: So are you ready for me Craig?

DR. NICHOLSON: Just a second. Okay, the first tree graph is up, Tim.

MR. GISH: Okay. First off, I want to thank Tom for the invitation. And I'm sorry I could not be there in person. And I appreciate some of my colleagues willing to be there and answer some of the questions.

One thing that's very important to note here is that the Nuclear Regulatory Commission has done a lot of excellent work on the plot lysimeter scale. But as they start going to larger scales of observation, i.e., those that are associated with their Nuclear Regulatory waste decommissioning sites, they need to start accounting for complex flow processes, hydrologically active areas, and subsurface flow pathways.

And so that's what my focus is going to be. And I want to acknowledge some of my colleagues and some of the information they have given me will be in this presentation. Craig Daughtry is there representing me. Charlie Walthall, also from USDA, of course Ralph Cady and Tom Nicholson from NRC, Samuel Kung from the University of Wisconsin, Madison Campus.

Adion Chinkuyu is actually a visiting scientist with us, actually on loan from the University of California. And then Paul Houser who, until the last couple of weeks, was actually the division head at the Hydrologic Branch at NASA.

Next slide. On the outline, you'll notice there are a number of things we're going to try to cover in this talk and I have a number of slides so I'll be going fairly quickly. But I think you all have hard copies and so you can go back and look at these. And if worse comes to worst, you can contact me personally.

The first four objectives essentially are going to give us a good insight as to the kinds of things that are taking place at the OPE3 research site. Also some significance and some data sets that are available.

And then what will happen is we're going to -- after we give you an overview of what's taking place out there, we're also going to talk about some recent advancement in fluid dynamics and some work that's actually been done where actually subsurface fluxes were actually monitored.

And then we're going to actually use some of that information to help us understand how to identify hydrologically-active zones at the scale of observation that you folks are interested, i.e., around, you know, 21 hectares.

There will be a little brief discussion of how these data sets would be very useful for the model abstraction technique and then there are some sources I've listed.

Next slide. Optimizing Production Inputs for Economic and Environmental Enhancement is a mouthful. That's what OPE3 stands for. There's been a recent in-depth outside review just actually held last week. And one of the overriding recommendations was is that we have a sexier title. And so that may be changing in the near future. But right now and for the publications we have out, this is its title.

What I want you to see from this three-dimensional representation of the OPE3 site is roughly an idea of what the topography is. The z-axis has been amplified a little bit just so you could see some of it.

The important thing to take out of this is that it is essentially hydrologically bounded. The top part of the production area actually is the high point of the region locally for water flow. And it all drains through the fields to this riparian area which contains a first-order stream. And being a first-order stream means the stream actually starts there due to the site.

And so what we have are fluxes we can actually measure that go into the site and then we actually measure fluxes coming out. And so that's a very important aspect of the site.

Next slide. This research site is actually an international project that involves a number of scientists which we'll talk about in a few seconds. It has some major components that we're trying to resolve. One of them is actually measuring fluxes.

Right now there are good methods for measuring surface runoff fluxes and volatilization fluxes. But there's actually no good protocol for measuring or monitoring a subsurface flux.

Typically people take samples and measure water table highs and try to infer what the processes are that got the compound there. But there's very little monitoring -- that actually you have a flux that you are actually monitoring. We're trying to actually develop protocols to do that.

And then we're interested in how those fluxes interact and have an impact on the wooded, riparian wetland area and first-order stream.

In addition to this, we have a lot of remote sensing activity on this site. And so we'd like to develop products and techniques for evaluating and managing spatial variability.

And the last aspect is we hope in the long term, sometime in the future, to actually do an economic-environmental tradeoff analysis.

Next slide. Water and energy balance, of course, are very important for us to quantify here. And the larger picture here that you see contains a couple of towers. The large tower in the middle is actually a very detailed to complete energy balance system.

So we're measuring things there like three-dimensional wind speed profiles. And, of course, there's also temperature profiles and relative humidity profiles. And then we have heat fluxes that go into the system.

So we actually have the energy balance -- we've got it completely monitored out there. We have a couple of med stations but this is the detailed one.

And that allows us to quantify the water energy actually coming in.

In the picture on the right, if it is now phased in, is me holding a moisture capacitive probe now. Tim Starr has actually done a lot of work with this and some of the reg reports that you folks have. And we use this same system out in our site.

What's also quite interesting about it is we have all these inputs coming in but we can also evaluate a profile and we have approximately 256 sensors out in the field on probes like the one you see me holding. This one is actually holding seven sensors. But we actually activate those sensors every ten minutes, 24 hours a day, 365 days a year. And essentially it gives us a motion picture profile of the surface and the subsurface water dynamics.

What's also very interesting to note is that we have about -- a little over 13 million soil moisture observations every year. So we can link that detailed soil moisture dynamic information into the energy balance system.

Also on this slide there's a small tower in front of the energy balance system. And that's actually something for measuring output. That's actually a pesticide flux tower. And we usually have a couple of those out there to essentially measure the volatilization aspects.

Next slide. There's a number of other outputs as well. You can see surface runoff processes and groundwater monitoring that is taking place out there as well as some information in the riparian area for water table and the upwelling zones and tree sap flow sensors. And then also we have five weirs that are actually in this first-order stream. They're in the riparian area which, again, allows us to calculate these fluxes exiting the system.

Next slide. One thing that is also quite critical is that even though we have a lot of detailed information about processes, we also have a very unique ability to quantify what is happening on the subsurface.

On the left, you will see a graph that contains the depth to the subsurface restricting layer. The green areas are roughly three to three and a half meters below the soil surface where water is being restricted in those areas. And then it gets all the way to about a meter below the soil surface on this side.

And what happens we can take the special relationships of the depths to the restricting layer, do some modeling, and actually determine where the water -- how it is exiting the site.

And you can see on the right-hand side here, those are actually the identification of the subsurface flow pathways. Now this is done primarily with ground-penetrating radar data, of which we have over 40 kilometers' worth of data and we also have this very detailed digital elevation map.

So we take those and use that in the GIS framework to actually quantify the subsurface flow pathways. Essentially there are arteries and veins which essentially water converges to and then flows subsurface out of the site.

Now even though it looks like it occupies a great deal of the site, these arteries and veins, the fact is is that they actually comprise probably less than one percent of the available pore space. So they are difficult to actually quantify. And that's very important if we're going to know how or where to monitor.

Next slide. In addition to some of these things I've already mentioned, this is an international activity. Dr. Daughtry can talk more about this if you're interested. But we have over 63 scientists involved from federal agencies and universities across the United States and also industry. And there are some industries and universities outside the U.S. who are also involved in the site.

And everybody brings their own money. There's no funds on the site. Essentially if they want to work with us and use the infrastructure, they have to bring their own money and work accordingly.

Next slide. The next three slides have some selected OPE3 data collection activities. I'm not going to go through all these because there's a lot of verbiage. And I've already mentioned some things already like, you know, this 13 million-plus soil moisture observations.

But I wanted to let you know that there are some other data sets which are probably applicable to some of the things that NRC is interested in. For example, all the data when we collect samples, we have a kinematic GPS system which allows us to have an accuracy of looking at samples one centimeter in the x- or y-axis and two centimeters in the z-axis.

We also have, besides the ground penetrating radar info, a great deal of electromagnetic induction data that we have on the site. And we also have some well data and a great deal of soils data.

Next slide. On this slide, I'd like you to focus on Item No. II, Production Fields - Remote Sensing Imagery. In addition to the amount of data that we're collecting at this site, it is probably the most heavily -- probably the highest density of instrumentation of any research site probably anywhere in the world.

We also have a tremendous amount of remote sensing activities taking place. And Craig Daughtry, this was one of his fortes so he could talk to you a lot about these various platforms, whether they be high-altitude aircraft and various satellites.

But there's a lot of linkage here with NASA and industry so that we could actually use the information that we have to develop surrogate indicators of various processes and use that to address the questions that relate to either production or environment issues.

And then on the third slide of the data collection activities is just a listing of some of the things that are taking place in the riparian wetlands, which is also germane to NRC.

Next slide. The nice thing about this, we have this detailed amount of information of the subsurface process and the instrumentation that we have on the production fields themselves. It allows us to cover three very critical areas. The first one is to actually look at surface and subsurface interactions.

There are very few places in the world today that actually have the ability to look at subsurface interactions. And there is no place that has the detail that we do to evaluate that. So this is very unique in that we've got that information already here.

Secondly, we have enough information that is being gathered on various spatial and temporal domains that we can actually look at the interaction of variable climate on heterogeneous soil on a scale that's germane to agricultural production or, in this case, some of your decommissioning sites.

And then obviously one thing we're also very interested in is to evaluate protocols as to where and when to sample and how to interpret those data sets.

Next slide. Now I'm going to take just a quick run through some recent advancements in fluid dynamics. It's nice to kind of stay on the cutting edge of what is taking place in the research community. And I want to actually present some information to you folks that helps you understand the need to measure a flux and what those new flux protocols are actually telling us with regard to chemical transport through soils.

Next slide. For many years, people, when they were evaluating a worst-case scenario, and this includes me and many of my colleagues, we made a number of assumptions regarding how chemicals would move through soil partly because we didn't know where water was flowing.

And we just had to take samplers and randomly locate them and then collect them frequently. And we had to -- we didn't know that there was any fingering effect that we could actually account for or monitor. So we generally had to assume a piston flow process, which essentially negates any dispersion.

In order to have the fastest possible transport time, we thought that saturated hydraulic conductivities would be a good way to go. And then we generally lump in some kind of linear absorption process and also other process that might describe its degradation. This is true for radioactive nuclides as well as maybe pesticides.

Next slide. Now the problem is is that a lot of the information was gathered using concentration data and not flux data. And so I have a little slide here just to kind of bring home the message of how critical the surface runoff processes actually are. And also the need to measure flux.

If I'm going to measure a surface runoff process, just taking a sample, for example, out of this flume and measuring concentration, it doesn't tell me a whole lot about the relevance of what's going on in the field because all I have are concentrations.

I don't know whether it was a lot of water associated with that concentration I'm analyzing or if there was a very small flow associated with it. So it's important that you have both the water flow data as well as the chemical composition.

But once you have the chemical composition and the volume of water flow, then what happens is you could actually determine a flux. And once you get that done, you can actually calculate a relevance, i.e., what percentage of water have I applied that is actually moving to the soil system, in this case, the surface runoff process.

In the field -- next slide -- piston flow is not the normal flow process that we see. Whenever there is actual rain events or irrigation taking place, we have a tendency to have these little fingers that flow throughout the field.

The question is is what is the flow rate associated with some of those flow pathways. And they're very difficult to quantify. In this case, that little black circle that's underneath the major flow line was actually just me trying to simulate that I got lucky and I actually had a sampler located right below a flow pathway.

But even if I did have that in the field, you'd have a number of other areas where there wasn't directly a flow pathway. And so you would say well, how do I interpret this data? And so just concentration data itself makes it very difficult to interpret this kind of phenomenon.

Next slide. What's good, though, is that recently there's been some flux experiments that they've conducted and recently published. One, this really comes from a publication in 2000 by Dr. Kung, and what happens is -- I'm not going to go through a lot of detail here but this actually says a couple of things.

The take-home message here, and we see it from both the uniform silt loam, which is actually --

that's where it was conducted at West Lafayette at Purdue and the one on the right is actually an experiment that was conducted at Cornell under a little more complex soil profile, but we see a couple of things which are universally true. And that seems to be that the travel times to groundwater become shorter as the soil water content increases.

In other words, the system is becoming hydrologically active. And when it becomes hydrologically active, these fingering processes or these veins or arteries, which are draining the soil system, become very active. And they conduct a great deal of water much faster than we would normally anticipate.

In fact, the second issue is knowing that if we use saturated hydraulic conductivities, what happens is we wouldn't expect the compounds, in this case tracers that we were putting on the field, to reach one meter in less than two days. And yet, these breakthrough curves show that the compounds were getting there in anywhere from four hours to 12 minutes.

And so the idea of saturated conductivities and piston flow approximations don't seem to work very well, especially when there's any precipitation or irrigation event that is actually occurring out in the field.

Next slide.

MEMBER HINZE: Excuse me. But what's the reason for that? What's the cause of these shorter travel times?

MR. GISH: What happens is there's those arteries and veins which I showed on a lateral component but there is a vertical component that also takes place.

And what happens, you have -- when you're looking at saturated hydraulic connectivity, you are usually assuming all the porous media is available for flow. And there's a lot of variability in your hydraulic connectivity data. You may get coefficients of variation, at least I've seen them, of anywhere from 100 to 400 percent as far as spatial variability of hydraulic connectivity data.

So it is where you sampled, how well you sampled. There is also pore continuity it's associated with here. And the transit times, essentially these arteries and veins become saturated but they are probably less than one percent of the available pore space.

So it's going to be very difficult to get a saturated hydraulic connectivity for those areas which are actually conducting most of the fluid when you an irrigation event taking place.

MEMBER HINZE: So there are horizontal as well as vertical?

MR. GISH: Yes, yes there are. The last slide and this one are actually dealing mainly with vertical but I'm going to show you some horizontal ones in a few minutes.

Am I clear on that? Is that okay?

DR. NICHOLSON: Yes.

MR. GISH: Okay. I'll go on then.

This is another curve that essentially says the same thing. Obviously the other two curves were associated with some work that was done in Purdue and Cornell. And this one was actually done at Madison, Wisconsin that I did and reported last year in the literature.

And essentially what we're looking at is the same field site but using this flux protocol that Sam Kung developed. And what happens is I'm putting on two mobile tracers. And I've got it plotted as the mass of the compound that I'm recovering versus what was applied as a function of total amount of water applied. So even though I have two different irrigation rates, I'm essentially eliminating that because I'm just plotting this as a function of how much water was applied.

And as you see, the breakthrough curves are vastly different between the two. And if you look at it fairly closely, you can see that after about 150 millimeters of water has come out, that breakthrough curve that's associated with the little irrigation event, here 0.89 millimeters per hour, we only have about two percent of the compound leaving the top meter after 150 millimeters of water relative to essentially 40 percent that was coming out at that irrigation rate of 4.1 millimeters per hour.

So even though the same amount of water was applied, we see a vast difference in the transport times. So again, this is associated with hydrologic active zones within the soil system itself.

Next slide. And so what that means is that some of the flux data that has been developed over the last couple of years -- this flux protocol has only been available for the last couple of years -- the idea of piston flow probably isn't a very good one.

Saturated conductivity seems to have some problems. And when it comes to linear absorption and degradation of half-lives, that could also be a problem because it could be that the water velocity is so high in these veins and arteries that the residence time for the chemical really can't be absorbed. And, of course, obviously that would also change your anticipation of half-lives if it moves down there much faster.

Next slide. This slide I put the reference down at the bottom to -- it's not listed out on the end as far as my data sources -- you may want to make that note -- in part because it was just accepted last month. And this is going to be published in the Soil Science Society of America Journal.

But what I wanted to point out here was that when we look at this fingering phenomenon that takes place, it's been very difficult for people to have reproducible results because they didn't know where the samplers were actually going to be placed. And if you till a field, that changes things. And so it was very for them to actually calculate a flux.

And what happens with this flux protocol that Dr. Kung had developed, we actually show that it is reproducible. Here you'll look and you'll see a blue and a green line. Those are actually data sets of two fluorobenzoic acids that were applied to a field on two different years. And so we can actually see that this protocol, when you're actually measuring a flux, actually is reproducible.

Now the area that we're looking at here is about 80 square meters. But we get nice reproducible data that also helps us then understand those kinds of features that we need to be concerned with that might influence chemical transport vertically.

Next slide. So now we're going to talk about some applications to the OPE3 site.

Next slide. Again, here is the subsurface flow pathways. And we're talking about some relevance of them very quickly. And you'll notice that I've included a color infrared image on the upper right-hand here.

These flow pathways again occupy a small area of the field. But they also seem to be going to or draining these areas that have higher biomass. The darker red areas are areas within the field that have a higher biomass as a color infrared image.

And what happens is the bottom right figure here is actually some soil moisture data. There's thousands and thousands of data points. And those aren't actually line, those are actually data points because we have this real time process.

And what it is telling us is we have this lateral movement of water moving through the field. And so we have this kind of like a two-dimensional aspect that you can see from these graphs. However, there's also a third dimension to these.

Let's go to the next slide. And that is when we look at these small pathways, not all of them have the same shape, and form, and size. And so some of them actually conduct a great deal more water than others.

The graph on the bottom is actually water table heights through one of these flow pathways. And it consistently has at least a meter of water flowing through that lense out into the riparian area. And typically that one also has the highest concentrations of nitrate and pesticides in it which means that that one would have a much higher flux than any of the other two.

Next slide. Now this slide it's going to say well, so we have that -- this neural network essentially that goes through the fields but it has a vertical component.

And what I've done here is shown that you can see underneath the large corn plant, there's a small distance between the top of the soil surface and the top of this water table. So there could be capillary action of water that actually feed water and nutrients to that area during an average or dry year.

Whereas opposed to its farther down gradient you can see in a smaller corn plant and that's because there is a larger distance between this cascading subsurface water flow pathway and the plant. So it doesn't have nearly the benefit of subsurface water and nutrients. And so its corn growth is actually stunted relative to the other.

Well, what's interesting about this then is we would expect a three-dimensional flow system then that is interacting with plants that could actually be a useful tool then in evaluating through surrogate indicators where these flow pathways actually are.

Next slide. And it would suggest that if you look at some of the variable patterns of crop growth, that we could maybe develop this indicator. And what we have here is 1998 to 2000 various pieces of information which allows us to look at the spatial variability of crop growth. And if we use just the `99 and 2000 data to develop an indicator, which is what I'm going to do here, and then I'm going to use that data to actually predict yields in 1998.

And what that index essentially looks like, it's an algorithm that uses some normalized yield data and some climate data. It uses the most dramatically different years but it actually gives me a dimensionalist parameter which we call the surrogate moisture response index to help me quantify spatially those areas that are being influenced by the subsurface flow processes.

In the next graph what's going to happen is I'm going to relate this spatial distribution of this SMRI to actual yield data for a different year, in this case 1998.

Next slide. And this one is entitled now Extending SMRI, Comparison with 1998 Corn Grain Yield Data. And you can see this nice linear relationship here where we have the dots representing the yield for 1998 with standard deviations. Then on the x-axis, we have the soil moisture response index.

The arrows on the right-hand side essentially tell us how much of the field is being comprised by that data so you can see that within the green lines, for example, 65 percent of product field is described by that very linear region.

So it seems that we may actually start to be able to -- start to have the capacity to look at various other tools as an indicator of these flow pathways.

Craig Daughtry could also identify that we have a lot of remote sensing activities that are also associated with this.

Next slide. That takes us to our data resource model abstraction. What happens is that because we have this closed system, we have fluxes that are usually monitored going in and fluxes of the standard protocols that are exiting the site.

And with this tremendous amount of data on the inside, various state-of-the-art kind of data set that is being acquired, we can actually look at the data and average it over large time periods and have very simplistic conceptualization of how water is going in, like just simple mass balance protocols.

Or else we can get progressively more complex and look at the models themselves and also how you interpret the data and become increasingly more complex to see if we can improve the ability to quantify these output fluxes. And then to model them appropriately and see what the uncertainty is associated with those.

And, of course, we have the ability to

look at some very dynamic processes since we have good climate data and soils data being collected at about ten-minute intervals. And we're also developing protocols for looking at some fluxes.

And, of course, this is very important because if we have fluxes, as I mentioned earlier, with reproducible results, it will really dramatically reduce some of our uncertainties.

Next slide. Very close to the end here. And what I've done here is actually showing you an experiment we did this last November with NRC. And this actually uses some information we have from the OPE3 site and some of this basic information that we've gotten from our field studies at Cornell, Purdue, and Madison, Wisconsin.

And we developed a protocol for measuring a flux in the field itself. This graph on the right is essentially that, it's the cumulative bromide leached as a percent of bromide applied. And the blue line is the actual flux data.

And what we could see is that it's moving out very quickly even though the water was only applied at, I think, 4.1 millimeters per hour. The breakthrough curve is taking place much faster than we would have expected it to.

And I put a red line in there so you can get an idea of what the matrix flow processes would be.

What is also very important to note is that we got over 98 percent of the tracer that was applied was recovered, which is very good. In most transport studies, you're lucky to get, you know, 30 or 40 percent.

And that's why they're generally not reported in the literature is because they don't have good mass bounces. But here with this technique, an extension of what is similar to what Sam Kung has done, we've actually 98 percent of the compound back.

So I have now some data sources that I've listed for you that you could use. Like I said, there's one that's not listed here but it's actually listed at the bottom of one of the graphs.

And I think you very much for your time. And that's it.

DR. NICHOLSON: Thank you. Thank you very much, Tim.

MR. GISH: Do you have any questions?

MEMBER CLARKE: Shall we take some questions now for Tim? Bill?

MEMBER HINZE: Well, I'm very impressed

with the work. That goes without saying.

I'm just wondering about the applicability of this in a broad sense. And that leads me to the question of what is the origin of these preferential pathways? And how universal is that origin?

DR. NICHOLSON: Tim, do you want to answer that?

MR. GISH: Okay. I think I can capture part of that. I'm still on a lot of meds back here. So hopefully I'll make some sense out of this.

As far as the applicability, the preferential flow processes, there have been a number of studies done throughout the world on trying to identify that. And most of them were dye studies. And in most of the dye studies they've been doing, regardless of the water input rates, they seem to have noticed that as long as water is being put in the system, these preferential flow processes are dominant.

And you have -- people talk about the vertical component now. And you have a number of reasons for that. You have flow instabilities. You also have void route channels that are responsible for that. You also have layered systems, a funnel flow kind of a process, which essentially can make the water converge to a small point.

And unfortunately, it's very common. And that's one reason I think when they try to do saturated hydraulic connectivity values, they have so much uncertainty because every once in a while they may hit one of those channels and then they end up with coefficients of variation of like I said between 1 and 400 percent. And then they try and interpret that.

And how do they use such large coefficients of variation to describe chemical transport on a larger scale? And it's virtually impossible.

And so what happens is you actually have to know where and how to sample. Well, the vertical component is very tough. And I'll be more than happy to talk, some other time probably, about the protocol that Sam Kung developed and why it shows to be working and in what way we rigged that to extend to our field site. But actually it allows us to capture both the matric and preferential flow processes.

As far as the horizontal one is concerned, what happens is is that through time, there's various layers of soil horizons that are formed in the field. And these ecological processes form layers of accumulated clay, for example, like clay lenses, and they have a topography to them. Sometimes it might be due to, you know, massive rain events that took place that deposited a lot of clay there or actually came through the clay.

And so what happens is you have essentially this subsurface stratigraphy that vary spatially a great deal. Ib our site, you know the soil isn't that great. We have a fairly large range in elevation. And if I was to plot that up on a smaller scale, you could actually see this undulating surface that is taking place there.

Well, what happens is whenever water hits that, that restricting layer due these ecological processes either to a clay lense forming or some real dense horizon, water flow is restricted and starts to move laterally. And in that past, it's been essentially impossible to find out where those things were taking place.

But we've actually refined some of GPR data to identify these flow pathways. Unfortunately, these flow pathways, even though they can be identified with the ground-penetrating radar data, they only can be identified using GPR if you have probably a loam or a courser textured soil like a sand or a sandy loam. And if it is a finer textured soil, the GPR doesn't work nearly as well.

And that's one reason why we're -- even though we understand the processes will remain the same. And what we're trying to do is link up with various remote sensing activities to try and see if there is landscape and sensors that we can use to help us refine where these flow pathways are occurring.

MEMBER HINZE: Can I follow up there?

DR. NICHOLSON: Sure, go ahead.

MEMBER HINZE: Do I understand then that these are predicated on the basis of hydrologic properties of the subsurface materials?

MR. GISH: Yes.

MEMBER HINZE: But there are additional factors as well?

MR. GISH: No, that's essentially -- it's the soil --

MEMBER HINZE: Okay.

MR. GISH: -- forming processes.

MEMBER HINZE: So it's --

MR. GISH: So there are actually features that you should be able to quantify.

MEMBER HINZE: Okay. You have excruciating detail in these subsurface flow patterns.

I'm curious. It isn't clear to me -- I must have missed it in your presentation -- just how do you get that kind of resolution?

MR. GISH: What happens we actually -- when we're doing the GPR data, what happens is we have two scales of ground-penetrating radar that we actually pass through the site. But before we even did that, we put two calibration sites up. One in one of the coarser-textured areas at the OPE3 site. And one in the finer textured.

And then we buried a series of metal plates at various steps. And we actually tested a number of antennae at various frequencies to see what gave us the best resolution and depth penetration.

Obviously the higher the frequency, the lower the depth penetration. And we wanted to go far enough to where we could actually see what was going on. So we actually had to bury plates for that calibration.

And then what happens is for us it was about 150 megahertz. And then what we did is we had two scales. One of them was a large scale where we had transects that went over the whole site every 25 meters. And then what happens is the computer picked 44 25 by 25 meter blocks where we did an essentially continuous measurement of GPR over that entire block. So we had very, very intense small-scale GPR data as well as this large-scale data.

And that allowed us then to then look at how the depth of this restricting layer changed with scale essentially. And one of the papers I've listed there, that's, I think, in 2004 -- no, I guess it's not listed there at all -- sorry about that -- there's one paper that we published I guess about 2003 that dealt with the GPR technique.

And what happens is for us we noticed that the variagram that describes the spatial relationship of the depth of this restricting layer didn't change much for us after four hectares. And from four hectares to 21 hectares, we had the same variagram.

And since we had essentially -- we never had anywhere in the field where you had to go more than maybe a couple of meters to get a data point, we can actually do a pretty good job of covering the whole site.

It took a long time to analyze the data because like I said, there was over 40 kilometers of GPR data there. So it's very extensive.

It's something that farmers can't afford to do. And that's why surrogate indicators of the flow pathways are so important to evaluate because no one is going to be able to use GPR in a realistic sense to evaluate subsurface processes.

MEMBER HINZE: If I may, let me ask one last question. We're interested in climate change and we're interested in recharge under periglacial conditions. What does your work tell us about the recharge to the subsurface under periglacial conditions? Or even in higher mountain areas where there's frozen ground?

MR. GISH: Yes, I'm not really hearing the question real well. Craig, can you continue through that?

MEMBER HINZE: Well, I'm asking under -- can you extrapolate your work to periglacial conditions? To frozen ground on an intermittent basis through the year? And the implications of that?

MR. GISH: I'd be real hesitant to do that.

(Laughter.)

MEMBER HINZE: I don't blame you.

MR. GISH: Yes, that's something I'd have to think a little bit more about.

MEMBER HINZE: Okay.

MR. GISH: I don't know if I feel

comfortable.

MEMBER HINZE: Thank you very much. Thank you.

MR. GISH: Sorry.

MEMBER WEINER: This is Ruth Weiner. I was wondering since I live in the desert and I'm familiar with places where the soil is not only unsaturated, it's enormously unsaturated. It's very dry.

How applicable are your OPE3 results to a place like say Hanford?

MR. GISH: Okay. I think that's very appropriate.

Actually I think that one of the things the basic research studies tell us -- maybe I should address that first -- is that when there is a lot of water coming around, like anywhere east of the Rockies where you start to get a lot more water than the arid West, the hydrologic areas become very critical in evaluating the transit time of compounds.

But at the same time, if you are very arid and you're very dry and you don't get a whole lot of water, then they're not going to really be very important because there's just not going to be enough water there to make things hydrologically active.

MEMBER WEINER: Good.

MR. GISH: And so in really dry areas, it's just probably not going to be nearly as big an issue. So I think most of this work is going to be relevant to flow processes that we'll be concerned with probably east of the Rockies would be my guess.

MEMBER WEINER: That's very helpful. I have a slight follow-up question. And that is one of the things that we have, in fact, observed in the subsurface at a place like Hanford is adsorption on to the soil, chem adsorption. And I notice that you have rejected the notion of linear absorption isotherm.

Can you draw any conclusions or any extrapolation to what happens when you do have adsorption in the subsurface soils?

MR. GISH: Yes, the adsorption processes are very chemical dependent. Some things have a high affinity for organic materials where other things which are permanently charged molecules have a much higher affinity for quiet fraction. And I think that's what you're talking about.

And what happens is that can really slow down transport dramatically. But if there is water moving through the soil system and you have this fingering process, there's a fair amount of that compound which can be bypassed. But a lot of it depends on how many of these arteries or veins are actually moving through the soil system.

Like one thing I didn't mention was that I gave you the -- I showed you a graph that showed how the transit time from the surface to one meter decreased as the system became wetter, and wetter, and wetter for the Purdue and also for Cornell site.

What's interesting is that if you actually look at relevance, which you can if you have a flux, we found out at the Purdue site that there was a compound that took four hours to start to get down there.

Even though it's very fast relative to two days, the relevance was we only got six percent of that tracer in the three centimeters of water that were applied to the soil surface. Whereas when the system was hydrologically active, what happened is we actually got 20 percent of the applied compound with a little over one centimeter of water that was applied to the soil surface. So now that's Purdue.

But now if you go to Cornell, it seems they have fewer flow pathways because even though you have the same timing that seems to take place as far as the transit time reducing, I think the rates go from six percent for the first tracer, just like it did at Purdue, but then it only goes up to eight percent at the end. And so apparently that one has fewer flow pathways.

So that goes back again then to the features of the soil, you know, whether it be connectivity measurements that we could link up to it or it has yet to be determined. But there's something about that soil that is different.

And so when we start talking about adsorption processes for the subsurface, one of the questions that comes up was how many flow pathways does it have in a vertical component? The only way to determine that is actually to have a flux experiment.

And that way you can actually determine relevance because it may be that yes, there's a fast-moving compound but the fact is it could have -- it's a very small fraction and so the retardation factors that you might use might be very applicable. And that has yet to be determined.

MEMBER WEINER: Thank you.

MEMBER CLARKE: Allen? Anything?

(No response.)

MEMBER CLARKE: Mike?

CHAIRMAN RYAN: Yes. This is Mike Ryan.

Thanks for being with us today.

I'm trying to think about how this applies to decommissioning sites or other evaluations. Could you give me a couple of examples?

I'm thinking about -- one of the questions in my mind is that this type of flow, is it fairly common? Is it expected at most every site? Or are there sites where you're going to get a more uniform flow? Or a less complex, near-surface system?

Could you give us some perspective on where this obviously detailed and very good research fits in?

MR. GISH: I'm not hearing real well.

DR. NICHOLSON: Okay. Before you answer, Tim, Mark, do you want to comment? Mark Thaggard is the person we're doing this research for. He's in NMSS. Mark?

MR. THAGGARD: Well, I think we need to look at it from a broader perspective. I mean I think there are two main issues here.

One is what are the dimensions we should be looking at in our analysis? Most of the analysis we do look at one-dimensional flow vertically. And so I think this may point to some issue as to whether or not we should be looking at two dimensions versus one dimension. So I don't think we need to look at it for a specific site but maybe some of the broader application.

But the other issue is what time scale should we look at in terms of trying to come up with infiltration rates? I mean I think Dr. Weiner brought up the issue about Hanford.

And a lot of the sites that you may have out in the West where you've got very low precipitation rate, you know, somebody may be tempted to look at the infiltration rate trying to come up with it over a long time period like over an annual basis or something like that where you're going to get -- that would tell you that you would get no flux.

But if you were looking at a much shorter time scale, you would actually see that you could get some flux. So I think we're looking at it more from a broader application in terms of how we should be -- some of the issues we should be looking at in terms of doing our analysis.

I mean we could get into some of the specific sites. I mean I see some of these issues popping up in some of the sites, like some of the weir work that we're doing. But I'm looking at it more from a broader perspective.

DR. NICHOLSON: The two things that I'm learning from this project is first of all where to look and how to look is extremely important.

And if a site, and I'm sure all sites have complexities, the question is how relevant are these complexities to water flux and transport, if they occur, if there are, for instance in a clay, if you have a fractured clay, a weathered fractured clay like a site up in New York State, then you'd want to ask the question how important is that fracture pattern in the clay and does it give rise to both a vertical and horizontal preferential flow?

If that's the case, then obviously you want to monitor to capture the significance of that event and process.

Similarly, Tim was commenting, and I showed an earlier viewgraph of the Hanford tanks, you know in the subsurface, there may be things on the East Coast -- they often talk about fragipans. Out West it may be caliche layers.

There may be some natural soil morphological textural class that says, in effect, there is some perching unit or some restricting layer that gets the water to move a certain distance. And then it slows down. It may then concentrate, funnel, and move preferentially if there is a fracture or some vertical pathway.

And so the question you have to go back and ask yourself is okay, how do I both characterize the site and, if necessary, monitor to understand if those features and processes do occur? And how important are they are in modeling.

And, of course, Yakov will be talking next about how to look at model abstraction techniques. When is it all right to simply? And when isn't it all right to simply? Because through those simplifications, you may ignore significant features, events, and processes. And also in ignoring those, you're creating large uncertainties.

And one of the things that Tim did mention is that he's getting a much better understanding now of conceptualization of water flow and transport in these heterogeneous, complex sites.

So should we move on to Yakov?

CHAIRMAN RYAN: Yes, just another comment, though.

DR. NICHOLSON: Okay.

CHAIRMAN RYAN: And again I appreciate both answers, all the above. It gives me kind of a framework to think about it. I think about other generalizations, too, like, for example, if you plunk in a sampling, well, how do you know where you are? So there's lots of other interesting questions that factor into that general category. So that's helpful.

And I guess I was anticipating what's coming up next in terms of when is a simplification okay and when not. So on we go.

Thank you.

DR. NICHOLSON: Okay.

MR. GISH: Tom?

DR. NICHOLSON: Yes?

MR. GISH: When you're done there, can you give me a call?

DR. NICHOLSON: Yes.

MR. GISH: A call back?

DR. NICHOLSON: I'll definitely give you a call.

MR. GISH: Okay. Do you want me on the phone still? Or should I just --

CHAIRMAN RYAN: You know we might have some general questions. If it's okay, if he doesn't mind staying, that would be great.

MR. GISH: I'm sorry?

DR. NICHOLSON: He would like you to stay on the line.

CHAIRMAN RYAN: If you don't mind staying.

MR. GISH: Okay. Sure, sure.

DR. NICHOLSON: Okay.

Jim?

MEMBER CLARKE: Yes, let's just take one or maybe two more questions and then move on to Yakov.

DR. NICHOLSON: Okay.

MR. HAMDAN: Yes, Tim, my name is Latif Hamdan. I don't think I know you.

But there are many things that I understood from your presentation. But there are some things that I did not quite understand.

One thing I don't understand is the title of the presentation on Slide 3. You are talking about optimizing the production inputs for economic and environmental enhancement.

And just so that I may understand, can you tell us when you have optimization, you usually have an objective function. Can you tell us what the objective function is? And then what variables you are controlling in order for you to get, you know, the optimal for the object function that you have?

If you explain that maybe I'll have some more insights.

MR. GISH: Okay. Maybe I need to rephrase the question. You want to know what processes, what we're holding constant in order to develop techniques to optimize? Is that your question?

MR. HAMDAN: First of all, I want to make sure that you are optimizing but really the question is what is the objective function in this case?

MR. GISH: Okay. Well, I'm not -- I'm still -- I think we've got semantics here. I'm not really -- people look at objective functions differently so I guess I'm not really sure what the question is still. I'm sorry.

DR. NICHOLSON: Tim, we'll let Craig try to answer the question. Craig?

MR. GISH: Okay.

MR. DAUGHTRY: We're trying to look at several different agriculture production systems and whether we're using uniform application rates of chemical fertilizers, using our best management practices, or uniform applications of animal manures, or site specific applications of chemical fertilizers.

And what we're using is yield as one of our factors, grain yields. We're also looking at -- not just at the economic impacts but also some of the environmental consequences. And we're trying to kind of balance for different production systems here is what it amounts to.

I don't think we actually have a real good optimization scheme there. We're essentially evaluating three different management scenarios.

MR. GISH: Maybe I could add one thing to this, too. You know there's a couple of things that we are trying to look at. And Craig was talking about yields. But we're also looking at inputs.

And so, for example, on one of the watersheds, it's what we typically refer to as a site-specific application practice. And what happens there is on that particular site, we are using a knowledge of the subsurface flow pathways and various soils maps and things like that and past history and yields to actually develop an algorithm to tell us how much nitrogen to apply.

And one of the big factors there is these subsurface flow pathways. And what happens is -- is Craig will have to correct me on this -- but I think we've applied about what, about 60 percent of what we are everywhere else for nitrogen, is that about right Craig?

MR. DAUGHTRY: Yes, that's correct.

MR. GISH: And yet the yields are the same. In fact, even one year it was higher than the others which we don't understand that one. But we're actually able to with the knowledge that we have here of the hydrology, we're actually able to minimize inputs and have the same output, i.e., the same yields, no detrimental impact on yields.

So it allows us to actually use that information to optimize the inputs. So that might come in to one of your functions as well.

MEMBER CLARKE: Okay. Thanks, Tim. I think we really need to keep moving.

DR. NICHOLSON: Okay.

MEMBER CLARKE: We need to stay on schedule.

So, Yakov, please.

DR. NICHOLSON: Yakov?

DR. PACHEPSKY: Thanks for this opportunity to present these results and this project. It's a collaborative work with Ralph Cady, Tom Nicholson from the Nuclear Regulatory Commission, and a group of people from UC-Riverside. And two of us are from USDA/ARS.

The outline of the talk is why we'll be doing this and a little bit about the review of the model abstraction techniques. Then a few case studies for soil-water flow in a humid region. And what did we learn so far.

Why should we be looking at model abstraction? There are three reasons for that. We have increasing evidence that we may have multiple models with similar accuracy. The reason is that the complexity of the flow and transport pathways that we saw in the previous talk and they're easily perceived but they're very difficult to represent in mathematical terms without making strong assumptions.

Always there are assumptions. And it leads the result that there may be several models with completely different conceptual representation of this complex subsurface process which will give you the same accuracy. And this is something which is observed in many modeling field applications.

In hydrology, it's just a change of paradigm. But in other fields, the existence of the models which have very different complexity and strikingly different complexity and similar accuracy. It's almost commonplace. You can find it in marine biology, in population ecology, in economic projections, in weather, in many fields where modeling is applied.

And of course there is increasing evidence that the difficulties in populating and writing complex models are mounting. And sometimes they become basically unsurmountable.

Well, if it looks like the complexity of the model is not inexorably linked to its accuracy, then we might look for the simplification of the models.

Where does this term come from essentially? The model abstraction is a methodology for reducing complexity of simulation model while maintaining validity of this model. With respect to the question that this model is used to address, the logic behind this that there may be reasons or rationales to simplify.

Mostly there are three groups of them probably. One of them is contextual or regulatory limitations. There may be limitations in data resources or other resources. And also there may be a quest for the transparency.

The limitations in terms of the regulatory or contextual limitations, they basically mean that you have relayed the model not in terms of all things that it predicts but in terms of some things which are of interest for the specific application or specific judgment.

Then the limitations in resources usually often mean that it's a method of populating a model that you have problems with. And the transparency, of course, it's the method of communication.

So how can you communicate your model so that the people who will decide on the results will actually understand what are you doing?

Why this process may be important and useful for this Agency? First of all, the simplified models reflect the essential components and processes of complex natural systems. So then your user is focused on the most important component or processes. And therefore in the site investigation and data collection, they also omit -- can omit insensitive processes.

The simplified models are easier to understand and communicate. They are easier to run, test, compare, and verify. And also if the model abstraction is done in a systematic and comprehensive manner, if you formalize a process to allow a simplified model to be justified from the proper date for a specific site.

And this work is done in Agricultural Soil Service so this type of work is also important for our purposes. One of the reasons is that the models in our Agency are actual tools to integrate the knowledge, accumulate it in research, and deliver it to the end users. It's essentially a way to package knowledge.

And in this case, the simpler models are easier to understand and to communicate. There is a steep learning curve which sometimes we really need to avoid or want to avoid.

It relates parameters to the publicly-available databases. And simple models are easier to run.

So there is a lot of overlap between the two interests. And that's why this project is done with this interagency agreement.

And I must say that there was a systematic research on the model abstraction. It probably started in the early `80s. And people in different fields of modeling application, they were doing this.

This is the most probably comprehensive scheme which was done in the Department of Defense with their battlefield simulations.

They identified basically three big groups of modeling techniques -- model abstraction techniques, I'm sorry, the model boundary modification, the model behavior modification, model form modification. And actually I'm not going to go into these details because it's really a rich field.

What we did actually we tried to see what kind of model abstraction or model simplification techniques are available for today to be used in flow and transport. Essentially it was a big review. We didn't invent anything by ourselves.

We were looking at simplifications by the number of processes which are considered explicitly, process descriptions, spatial discretization or scale, if you wish, temporal scale, the number of measurements needed to estimate parameters of the models, computation speed, and also data pre-processing and post-processing, which sometimes takes up to 80 percent of the whole effort on modeling.

We found numerous techniques that are applicable and have been applied to flow and transport in variably situated soils and rocks. This is just an example from many but it's a graphical example so I kind of brought it here.

We are looking at using the predefined hierarchy of models. And this is the way how the subsurface material or media is schematized for simulation purposes.

The most complex is when they have discrete fracture with matrix. And then a little bit small -- simpler, sorry, if you have discrete fractures without matrix. And then you have the dual permeability systems with matric and fracture.

An even simpler way to look at it is just dual porosity and matrix and fracture. Then you may have equivalent matrix and fracture, which is even simpler, single continuum, and finally the water budget. It's like a bucket with which you pour water and if there's too much water, it flows out.

So the complexity goes in this direction. Model abstraction will go in opposite direction. The question will be okay, at which stage we can stop simplifying and still be able to represent the main features of what we see?

I think I'll spend most of my time just telling about this model abstraction case study. What we wanted to do, we wanted to understand how model abstraction can effect assessment of contaminant transport or migration if you wish at a relatively humid site where transport may be effected by the presence of soil macropores and related preferential flow phenomenon.

This is the general layout of the site. The site was selected in Belgium. And the reason we actually selected this one was that we wanted to have an exhaustive database so that there would be no question of absence of data for any complexity of model which is applicable here.

So what happened here there was a trench dug about an eight-meter trench and about a meter and a half deep. And sensors were placed along this trench in 12 positions at five soil depths. And sensors were to measure the soil water content, soil matrix pressure, so the driving force of the water flow, the solute concentrations, temperature, and -- yes, that was basically the sensors were doing that.

So all this set up was based on this loam soil which became a silty loam at the depth. And the grass actually was removed and the gravel was put on the top so that the influence of the plants was excluded for these experiments. And those Swedish boxes were sending continuously the information to the central site.

We also put there -- not we, the people who were doing this -- they put passive capillary lysimeters. It's a new family of devices which are very useful because they actually allow to measure fluxes. The problem of the Anser-Torwegge zone, which we are actually focusing here, is that it's very difficult to measure flux, water or chemical.

You can measure concentrations, no problem. Flux is a difficulty. It's not the case in groundwater. But it is the case here.

So this family of passive capillary lysimeters now we have commercial production of them here in the United States. The Pacific Northwest National Lab designed them.

But what it is essentially it's a plate at which you have weaks. And those weaks would support the same type of tension to soil water as soil supports. And, therefore, the fluxes which are collected here in these plates, they're comparable with the fluxes we are having in soil.

And this is just the laboratory situation when they were actually assembled. And then they were put into the soil so we actually could measure fluxes.

So this is an overview of the database which was collected during 384 days. The variables were water content, concentrations, soil pressure, and temperature, fluxes, and, of course, rainfall. So we have over 400,000 measurements.

So this is the example of soil water dynamics over one month. So this is the trench. And the distance along the trench. This is the depth.

And this simple animation shows that we

have an extremely complex system there which nevertheless has some persistence in it so that the places where they are staying wet, places which are staying dry. The flow of events are changing this but at the same time, there is some kind of continuity.

So now I'm going through several snapshots of the data. This is the precipitation which basically shows that it was a wet year. And it was a wet year even for Belgium. So it was real wet. This event was the record for 65 years.

Altogether there was about 100 centimeters of cumulative rainfall. It's not what you can have where you live.

I just wanted to show the soil water fluxes because this is unique information when you actually can have flux, not the concentration.

And this is done at 15 centimeters with this passive lysimeter. This is 55 centimeters with this passive lysimeter. And this was computed using the methodology developed in ARS at BNNL that got work together. So we had these fluxes at three depths.

So the model abstraction is a simplification with preserving validity with respect to the question to be addressed. So what is the question?

We wanted to estimate the cumulative fluxes, water fluxes at capillary sampler depth over four drying-wetting cycles. So there was the first one, the second one, third one, and fourth one. So it's the wetting phases. And then it dries.

This is the water content at 15 centimeters which basically shows well how the soil water dynamics was developing.

This is a 3D picture which would show how actually we designed this model abstraction. The arrows here will show the simplification. So we had the process description abstraction when we had this Richards equation, which is the continuous description of soil water flow. And we also had the simpler one with just the water budget.

In terms of the parameter source abstraction, we were moving from the inverse modeling, which needs the exhaustive dense field data to fine tune the model, to the laboratory measurements where they have one field campaign and then laboratory measurements of hydraulic properties of soil or sediment.

And finally to the pedotransfer functions which are essentially the empirical equations to estimate soil hydraulic properties relevant to the transport from basic soil properties which are available let's say from soil survey like soil texture, organic matter, bog density.

And finally we put here the soil material abstraction so we were looking at the layered soil and single soil material. So three directions of simplification.

So we used the publicly-available software here for the both of them. And each of those figures shows 50 Monte Carlo simulations to estimate uncertainty. The reason is that if you want to have anything telling us about the risks and about the statistical differences about probabilistic pressures or thresholds, then we need to do the Monte Carlo simulations which were done.

And now I'm going to go through two examples of steps, actual steps that were done everywhere here. But one step was here. We were doing the inverse modeling from the complex model, which is Richards equation to the water budget model, which is a simple one.

This is water content at two depths. Symbols are data, lines are simulations. And if you look at this picture, there's no surprise. The more complex model does a much better job in reproducing the water dynamics if you compare this one with one or this one with this one.

The surprise comes when we are trying to look at the fluxes. And fluxes, that's what we are interested in. That was pulled as a question for the model abstraction. And realistically if you want to know how a chemical moves, you need to know fluxes.

The red here is this mechanistic model. And it does an extremely poor job in estimating fluxes at all depths. This is one to one line. And the simple water budget model does well whereas the mechanistic model just fails.

There is some reason for that. The reason is that the mechanistic model is fitted to the water content data. So what it wants, it wants to fit water content data and to do this, it says okay you need to have surface runoff in this case. And then it gives you this a great fit.

Actually there was no surface runoff observed on the site at all. So the water budget model, which does require any runoff, it gives a fairly decent answer. Besides, what it does it helps you in terms of the sanity check. You actually can see what you're more complex model is doing and whether it's doing anything weird.

Another example from the parameter source abstraction is this pedotransfer function thing. When we go from the parameters estimated in the laboratory to the parameters estimated from basic soil properties, which is essentially a free ride, you don't measure anything. You have basic soil properties and then you just estimate parameters.

So what is done here is we use this ensemble parameter prediction which is -- ensemble modeling is very common in meteorology and later it comes to other fields.

So we didn't use always one pedotransfer function, which is often done and is completely wrong because there is no way to prove that the empirical equation which pedotransfer function is, developed at some site, will work at another site.

But if you use the ensemble of them, and the ensemble here was collected from -- this one was done in Australia, this one in the United States, this one in Hungary, this one in France, this one in Scandinavia, so using ensemble removes outliers and gives you a realistic envelope.

And this actually is shown here. The dots are field data. And the pedotransfer functions don't really fit them but what they create, they create a fairly reasonable uncertainty envelope in which we can then use Monte Carlo simulations to see what kind of spread we can have.

And this is the error in terms of the water contents. And this is the probability. So it's the probability solution and errors. This is the laboratory data which are presumably more precise. And this is the pedotransfer functions. Then symbol of pedotransfer functions which gave much smaller errors.

So in this case, simplification actually also gives you a gain because you still have an idea about the possibility in the result but at the same time, you have a better representation of the outcome.

And in terms of the fluxes which we are interested again, both models perform the same. There is no difference, statistical difference in the results of more complex or less complex model.

So what did we learn so far? First, that there is a wide variety of efficient model abstraction techniques that may be applied to containment hydrology problems. And people are actually applying them so it's not something which just sits on the shelf and waits to be applied. Here and there we see applications.

The model abstraction should be performed in the uncertainty context. What essentially it means that we need to have probabilistic simulations, Monte Carlo-type simulations. And then actually we can compare models and prove that the simplification is possible.

The issue of this conservatism versus realism, which pops up here and there, well our approach to conservatism must not invalidate abstraction. The observable metrics still have reproduced with a simple model. It is clear.

Results underscore the importance of the question to be addressed in applying the model abstraction process. The question we kind of put forth was flux. And we saw that if the model is fit to the other variables which are easier to get, like water contents, we may have the completely wrong answer.

Model abstraction results indicate the pitfalls that may occur when following inverse modeling. And inverse modeling becomes more and more popular. So we actually will see more and more of it. The more parameters that are there, the more difficult to understand their physical meaning though.

Now the simple water budget model, it

worked no worse than the mechanistic flow model with respect to water fluxes at the coarse-time scales. Actually it worked no worse at the fine-time scales, too.

So the issue of time scale, we didn't include it directly in this talk but we checked time scales and we are getting the same results.

Laboratory-measured hydraulic properties, we are not superior to the pedotransfer function properties when considering uncertainty. And the spectrum of pedotransfer function gave a good presentation of uncertainty in hydraulic properties.

I didn't talk here about one more approach that we tried using neural networks to mimic the formulas of the complex model but it is a promising direction of model abstraction, metamodeling, so that's one more thing which actually can be used.

And then what we think, at least what we understand, who should know about this? Well, probably the licensing staff. And there are questions do models submitted to support licensing actions adequately represent the site? And do the investigation adequately characterize the important features, events, or process for the site?

And managers, if there are requests for

additional information, do they target the sensitive site parameters? And then the licensees, can the site be adequately represented by a simple model that is easy to understand and communicate to people who are -- we'll decide on that.

Thank you for your attention.

DR. NICHOLSON: Thank you.

MEMBER CLARKE: I think we have time for a few questions. Bill?

MEMBER HINZE: Let me ask you. What we've seen here is at the most a three meter depth. We saw that on the Beltsville site. And you've been showing us a half a meter or so. So we're looking at the A and B zone, I assume. Do you still use that terminology in soils? A and B zones and so forth?

DR. PACHEPSKY: Not that I know of but --

MEMBER HINZE: Okay. Well, my soils course was unfortunately 40 years ago.

What happens at depth? How does all of this modulate with depth?

DR. PACHEPSKY: From what we know, soft sediments behave more or less the same way. You may have scale events so that --

MEMBER HINZE: Unconsolidated materials?

DR. PACHEPSKY: Yes.

MEMBER HINZE: Granular materials and silt-size fraction and up?

DR. PACHEPSKY: Yes.

MEMBER HINZE: Okay.

DR. PACHEPSKY: You may have scale events. Essentially you may have the increase in dispersion of material and increased dispersion of fluxes just because a particle which enters this media experiences more and more heterogeneity as it goes along the pathway. So you may have more dispersion.

But mechanisms, from what we know, are essentially the same.

MEMBER HINZE: Essentially the same? As long as you have those unconsolidated sediments.

DR. PACHEPSKY: Unconsolidated --

MEMBER HINZE: Because that's very important in terms of investigating the flow characteristics at depth which often are quite important in terms of the sites that the NRC has in lock.

DR. PACHEPSKY: Yes.

MEMBER HINZE: Let me ask you another question if I might, Yakov. I see processes being coupled all the time and -- within the earth -- and I'm wondering how much your abstracted models take into account the coupling of processes and parameters that I know must be going on in this zone that you're looking at? How do you take those into account? And are there feedback loops on them and so forth? Where do you get into that?

DR. PACHEPSKY: The issue is to have main feedbacks included, preserved. There are things which we cannot remove.

The simple example actually was given by Tim in the previous talk so I just want to refer to it. He was talking that okay, if you have these preferential pathways, then our knowledge about the chemical absorption or equilibrium may not work because the transport is so fast that no interaction may occur.

MEMBER HINZE: Yes.

DR. PACHEPSKY: So these type of things have to be listed and essentially taken into account. This is something we cannot avoid.

So even in simplification of the water transport in the simplest way, when we're going to this bucket model, so we have the transporting part and the non-transporting part.

We need to make sure the kinetics of the chemical equilibrium have to be preserved. This is something which we cannot throw out.

But there are things which may be not important. For example, the explicit description of preferential pathways, which we could see in the previous talk, they may be not important because we are actually not -- we may not be interested in pinpointing them physically but we may be interested in knowing how they work, what's the function of them.

So we may be interested in function. And we may kind of omit description of structure. So we may have --

MEMBER HINZE: Thank you very much. I could follow up that. But please, go ahead.

MEMBER CLARKE: Okay. Allen?

VICE CHAIRMAN CROFF: Let me try something. I don't know if this will make sense or not. But what I think I'm hearing is research that leads to a lot of -- I'll call it lessons learned or insights maybe as to how the licensing staff or an applicant should or should not do their -- I'll call it performance or hydrological modeling. But it's very complicated. There's a lot of things being considered going on here.

Do you somehow distill the key insights and lessons at various intervals, continuously in some kind of a form?

DR. NICHOLSON: Yes. There are a couple things that I probably should make a little clearer.

First of all, the work that Yakov is doing for us, we first wanted -- we asked the question everybody talks about model abstraction. But most people don't understand it can be done in a systematic way.

We've gone -- and as Yakov says, we've gone to the literature. We've seen what the Department of Defense and other people have done with regard to model abstraction.

He's applied it to a small scale trench study in Belgium with exhaustive detailed data. Yakov, Adion, and Andrey are now modeling the OPE3 site that Tim Gish talked about earlier. By doing that, we are then imparting these insights to the licensing staff.

Last June, we took the licensing staff out to the Beltsville site. They walked the site. They saw all the sensors, the technology. Yakov and Tim gave presentations last summer. Yakov came into our training center last summer and went through this.

Yes, we are taking into account the insights. Some of the ideas is do you have to do detailed, three-dimensional, highly detailed real time modeling? And the answer is no. You may not have to.

If you don't want to do the detailed, incredibly exhaustive mechanistic models like he was describing using HYDRUS, then what other approaches could be warranted that would be just as accurate and would comply with your knowledge?

And so a water balance approach that Yakov was describing developed at PNNL, by Glenn and his colleagues, can work just as well.

So we are learning from his application two field sites that have incredible detailed data to understand how much uncertainty are you imparting by simplifying and using much simpler models. And that's what we're trying to accomplish here.

VICE CHAIRMAN CROFF: Okay. Thanks.

CHAIRMAN RYAN: Jim, just a quick comment and to sum up on that point, Tom, you know this is exciting to me because it's a very systematic way to look at a long-standing question I've had for a long time which is when am I done --

MEMBER CLARKE: Yes.

CHAIRMAN RYAN: -- on modeling? And I think is a real approach to getting at that.

Yakov, you answered many of my questions in your presentations. So thank you for a very informative set of talks. It was great -- great information and it's clearly going to be, you know, powerful.

Now that being said, what's the next step? Where do you go from this level of research? Are you going to look at different sites? Or different kinds of geohydrologic regimes? Or what's next?

DR. NICHOLSON: Well, one of the things that Yakov has pointed out in his talk that we're learning from is you may not have to do the incredible detailed site investigations that a lot of people thought. And so, therefore, we're looking at these publicly-available databases.

He mentioned Rawls and Brackenseik developed over at Beltsville. But throughout the world, people are developing this soil textural-based databases. They're an excellent place to begin to populate your models to do primary estimation. So that's the first issue.

So we want to impart to the staff this knowledge of how to populate models. He mentioned inverse modeling. The PES code, developed by John Daughtry in Australia and other people, they think that that has to be used. And it becomes very difficult because you have the detailed field data to use those inverse models to come up with parameters.

Now Mary Hill and other people are a very strong advocate of those. And I didn't want to get into too much detail. But Yakov every month participates with us on a Working Group II on Uncertainty. It's part of the MOU we've talked to you about before.

So there is a very interesting dynamic going on in the technical community that we have people from the USGS, EPA, all the federal agencies, about nine of us now. And Yakov every month brings these lessons to us and tells us what he's doing.

The answer to your question is yes. We do want to move on to other sites. You mentioned the Hanford site. Phil Meyer and Shlomo Newman, who talked last year that you people were impressed with their uncertainty analysis, they're communicating with Yakov. They're going to be modeling the 300 area at Hanford. So we can bring that information in to bear.

So yes we do want to move forward with this. But the most important thing is to help people like Mark Thaggard, our users, to bring these insights so we always have training courses here for the staff and, when possible, have field trips also.

So hopefully that answers your question.

CHAIRMAN RYAN: Yes, that's very important. We'd like to track along with you at appropriate intervals when we could have these kinds of informative updates.

DR. NICHOLSON: Okay.

CHAIRMAN RYAN: But it seems clear to us that as in the past that this research is very much aimed at supporting staff decision making and in making it in a risk-informed and highly-qualified way.

So congratulations and thanks for being here.

DR. NICHOLSON: Thank you.

MEMBER CLARKE: Let me turn it back to you.

MEMBER WEINER: And my questions were already answered by Tom. Thank you.

MEMBER CLARKE: Okay, great.

DR. NICHOLSON: Thank you.

MEMBER WEINER: Before I even asked.

CHAIRMAN RYAN: With that being said, if there are no other questions from staff or comments -- Neil? Yes?

MR. COLEMAN: Very good presentations. Here you're looking at characterizing natural sites albeit agricultural sites that do have an upper disturbed zone from plowing and tilling.

Is one of the outcomes of this research going to be insights for the design of artificial covers say for low-level waste sites where you have a certain amount of control over the layering and types of materials that will be used?

DR. PACHEPSKY: Frankly, we didn't look at it. I would think that some issues definitely are the same. Not everything because here we don't have any control.

But the issues of selecting the important processes to look at, using genetic information, using information from other -- experience from other sites so that you don't lose anything here, they stay.

Models definitely will stay because it's the same set of models which is used with artificial soils that are used here. And actually Andrey Guber who is working on this project, his previous project was with the artificial soil layers on the sports fields though.

So I think it's not directed to that. But there are useful things. That's my impression.

DR. NICHOLSON: To answer your question, Neil, Jake Phillip at our branch has a interagency agreement with the Army Corps of Engineers. And one of their consultants, Craig Benson from the University of Wisconsin at Madison, recently came in and gave us a lecture on looking at clay covers and things of that nature.

So we can, at another time, talk to you about that. But we have the viewgraphs.

The answer to your question in a very short way is yes. It is extremely important how you create these composite covers and the layering, the soil cover, all those issues.

So the work that we talked about with Gish, Tim Gish, the antecedent moisturing condition is extremely important. The layering is extremely important. The thickness, the role of the vegetation, all that becomes extremely important.

And how you go about modeling it is a question that Craig Benson and other people have asked with regard to simple water budget models may be just as appropriate as detailed mechanistic because you can't find the parameters to populate it without doing detailed monitoring.

MR. COLEMAN: So is there any cross-pollination between these projects, to use an agricultural term?

DR. NICHOLSON: Yes. It isn't -- it's through a group called the -- there's a technical advisory group that the NRC staff has formed. It's the Groundwater and Performance Monitoring Technical Advisory Group in which Research and NMSS staff meet on a regular basis.

And a lot of people in the audience here are from that group because we wanted them to take advantage of hearing these two gentlemen talk. And we are communicating back and forth between other contractors, the Corps of Engineers, or wherever.

CHAIRMAN RYAN: Thanks, Neil.

We'll probably need to end our discussion there as we've got to set up for the next presentation. And stick to our schedule.

Again, gentlemen, thank you very much. It was a very informative session. And we'll look to see you again in the future.

Thank you very much.

(Whereupon, the foregoing matter went off the record at 2:38 p.m. and went back on the record at 2:43 p.m.)

CHAIRMAN RYAN: All right. If we could ask everybody to take their seats, we will reconvene, please. Our next presentation is the NMSS Office

Director semi-annual briefing. Jack Strosnider is here with his staff. I'll let him do the introductions and lead us into the discussion. Welcome and thanks for being with us.

MR. STROSNIDER: Okay. Thank you. I appreciate the opportunity to be here today.

9) NMSS OFFICE DIRECTOR SEMI-ANNUAL BRIEFING

MR. STROSNIDER: As you indicated, I brought some help along. At the table with me, I've got Bill Reamer. He's the Director of the Division of High-Level Waste Repository Safety. Charlie Miller at the end down there is the Director of Division of Industrial Medical Nuclear Safety. We've got Paul Harris, Section Chief in the Spent Fuel Projects Office; and Scott Flanders, who is Branch Chief in the Division of Waste Management and Environmental Protection; and Bob Pierson, Director of Fuel Cycle Safety and Safeguards.

What I am hoping to do today as much as the presentation is to walk us through some of the areas in which these have expressed interest in and that we have interest in and we can have whatever dialogue you're looking for in those areas.

The subjects or the areas that I want to cover, I want to do a little follow-up on some meetings that NMSS management had with Dr. Ryan and John Larkins and ACNW staff. We want to talk about status of some specific issues that we got feedback you're interested in. I want to cover some of the new program development since our last meeting. And then I want to touch on some highlights of the February 15th waste and March 7th materials briefings that we gave to the Commission.

Before I start on those, though, I just wanted to say something about our relationship and our interactions and the value of that. And basically I want to acknowledge the value.

I think historically ACNW and NMSS have had a very good working relationship. We're looking forward with the new members to continuing that. I know since I have taken over as office director now almost about ten months ago, that was one of my high priorities. I know that Mike as chairman shares that. We have been reading periodically. I'll talk a little more about that.

We think it's important that the staff acknowledge ACNW's role in providing the Commission independent and objective input and advice on their actions. And we do recognize that.

It's important also, though, that we

recognize the need to support you in that effort. We want to do that. We want to make sure that we get the right information to you in the right time frame so that you can use that in fulfilling your mission.

I think a good example of that came up in your briefing this morning when Commissioner Merrifield talked about disposition of solid waste and anything to make sure you were able to provide them timely input. We need to communicate and coordinate on those sorts of activities.

Having said that, recognizing your role and the importance of our supporting it, I want to point out that we get a lot back in return, too. So it's not that unselfish because I think the technical insights and the other insights that you provide in our meetings with you and the feedback you give us helped improve the technical quality of our products and our programs. And so we highly value that. We think it really adds a lot to the programs, and we appreciate that.

So, having said that, I think one of the important things in maintaining this sort of cooperation and helping each other out is communications. And I think it's important both in our planning -- I'll talk a little bit more about that

-- and in our presentations when we meet with you that we give you clear information.

In that regard, if I could go to the first slide? We have started some periodic meetings. I want to talk about this, the importance of the communication.

I mentioned that Dr. Ryan met with myself and Margaret Federline, the Deputy Director in NMSS; our staff; and ACNW staff. We have had several of those meetings now. Those are extremely important in terms of our sharing information in terms of what you're interested in and what we think is important also to keep you filled in on.

So we have been doing that. And what we agreed to at our last meeting on that subject, which was February 22nd, was that we would do that quarterly. I think in terms of follow-up actions, that that is one of the most important things that we need to maintain.

There are weekly meetings of staff occurring. Sam Jones from NMSS meets with Sharon Steele and Mike Lee of ACNW staff. I think at least I can tell you Sam is doing a good job keeping us informed of what information is coming to him in terms of your interest and needs.

So I think we've got a good conduit there to get that information to us and are encouraged to use that. So we've got those weekly meetings plus the quarterly meetings and then planning meetings and, of course, whatever we need to get together.

So my main message coming out of this is that I think those meetings are extremely important. And as far as follow-up actions, we just need to keep those going.

We get into specific discussions there about technical issues and also planning the calendar, agreed to work with this, put together the six-month rolling calendar now. And, actually, I guess we've got an annual but a six-month rolling that helps us plan our interactions.

When I look at -- another thing that we talked about at the last meeting was some thought on our part of integrating the activities we have with your Committee into our operating plans.

Our operating plans are what drive some of our day-to-day activities. They feed into our performance and strategic plans. And so we're looking at that possibility. It hasn't actually happened yet across the board, but it would help and perhaps improve connectivity and make sure that we keep things tracked properly.

The most important issues on NMSS' plate that ACNW can help with, what I wanted to point to here was the list of issues that we presented at the Commission briefings on waste and materials. And we can make those available to you, but there's a pretty long list there.

And it includes things such as waste incidental reprocessing; the potential high-level waste repository, including Part 63; decommissioning of complex sites; ICRP recommendations; fuel cycle facilities, such as mixed oxide, where you have already had the work with ACRS and you have looked at that.

Those areas that we identified to the Commission, those are things that we expect to be bringing up to them in the next 12 to 18 months. I think it's very important that we look through those lists and make sure that where there's appropriate interaction, that we have that.

And I think if you compare that list with what is in your action plan and if you compare it with what is in our rolling six-month calendar, I think you will see a pretty good correlation now. But I think that is what needs to drive our interactions.

So I would suggest that we use those planning meetings and calendar to plan consistent with Commission priorities and the ACNW action plan our activities there.

Now, there were some specific activities that -- let's see -- you had expressed interest in - wait a minute -- some specific activities that you had expressed interest in that I wanted to cover briefly today. Those included the package performance study, decommissioning guidance, the West Valley working group, and disposition of solid waste.

We start off with the package performance study. I would just in a very brief summary point out that the SRM on December 10th, the Commission directed that a demonstration test should be conducted consisting of a simulated crossing with a train traveling at appropriate speed and colliding with the transportation cask.

The staff is preparing -- and I would point out Research has the lead on this, but we coordinate very, very closely with them, obviously through our Spent Fuels Projects Office and the rest of our NMSS.

There is a paper being prepared for the Commission, which would go up, providing the details of that, resources, et cetera. And that should be going up shortly.

Another part of the staff requirements memorandum received indicated that we should use some of the foreign tests that have been done, in Germany, in particular, to look to see what sort of scaling activities our scaling analysis might be able to do with that. So that is another part of what is being looked at.

So basically in terms of status, that paper is being developed, but at this point I wanted to know if there is some other specific interest or questions you had on that. We've got people here I think could address that.

CHAIRMAN RYAN: Questions, Ruth?

MEMBER WEINER: We are also -- in fact, I have been tasked to prepare a white paper on transportation. And my question is difficult to formulate.

When your recommendation went up to the Commission on this demonstration test, ACNW was informed basically after the fact. We were told this is what is going to go to the Commission, and that is that and "Here. You can know about it."

What do you envision ACNW's involvement in this to be? Are we going to be simply told after the fact: a) we're going to use a European test or whatever or will you come to us with a draft? I'm just curious as to since there was relatively little in the past or at least in that iteration, what do you envision the future involvement to be?

MR. STROSNIDER: I guess what I would suggest -- and I don't know if we have a representative from Research here or not, but at least what I would point out is that at least the discussion, the interaction with the Commission thus far has really been in defining almost, if you will, philosophically what kind of test needs to be done here. And, you know, there has been a lot of interaction on that point. I would almost look at that as a policy issue in terms of here's the type of test that the Commission is interested in.

Now, when we get into the actual design and the conduct of that test and the analyses and the results and the implications, that is where I would expect that we would have interaction with the Committee in terms of getting your insights in terms of how that is actually conducted and evaluated.

Rob, I don't know if you want to add anything to that.

MR. LEE: I don't have anything more to add besides reflecting the fact that we are going off of proposals in the industry to design us a test at a fixed price cost that they will deliver to us. And the Chairman will have an opportunity to approve that package.

CHAIRMAN RYAN: I'm sorry? The bid package you mean?

MR. LEE: Yes, the bid package. And when that package comes in, I don't know what the schedule is for external involvement. But I hear what your question is. And I will see if I can get back to you on that.

MEMBER WEINER: If I could just follow up? We, the Committee, wrote a letter to the Commission regarding this test and suggesting that from what we knew at that time, we could not see any new technical information that would be developed from that test.

I would be very interested to know what new information NMSS thinks will be developed from that test. I think that that is something that the Committee is quite interested in.

We may have written our letter on the basis of insufficient information from you all. I mean, I'm just guessing. But I think that any new technical information insights or other insights that you hope to gain from this test would be of great interest to us.

CHAIRMAN RYAN: Jack, I think if we're involved on the front end of the various steps, whether it's the bid package or not, I don't know. If that's the right one, that may be more of a business question than a technical scope. Maybe there is a technical scope.

But as we can get involved on the front end of those activities moving forward, I think that's where perhaps all of you could at least confirm what you have done or maybe add value or get you to think about different questions.

So as your schedule firms up and I think as you have indicated, Jack, you're going to see about letting the ACNW's participation into your schedule as well through the activities and the planning you discussed. I think that would be a great way to get in on the front end.

I do recognize that -- and I think this is Ruth's point that a test has been decided in terms of at least the philosophy. I think that's probably a good word for it. And you're now about the business of turning that into a technical program. I think at that step, that's where we maybe add some value. And we look forward to that.

MR. STROSNIDER: And I would agree that there can be value added in terms of what are the objectives, you know, the technical objectives of that test, what sort of information do we expect to get out of it, how would we analyze it.

My understanding is there is some blind analyses being planned and that sort of thing. And we could discuss how those things are going to go forward.

MEMBER WEINER: Thank you.

MR. STROSNIDER: Good. The second subject on decommissioning guidance, there I wanted to indicate we are having a workshop on April 20 through 21st. And I understand that the Committee -- I don't know if it's everybody but at least some members of the Committee plan on attending that.

CHAIRMAN RYAN: Well, let me clarify for the benefit of those who hadn't heard that thought. We had actually decided that it would be helpful for us to observe as observers, not necessarily having our own independent meeting but observing your workshop, rather than do two things.

One is it gives us a chance to hear public input that you might get during that meeting. And, second, it's very economical that you don't have to exercise the same people giving the same kinds of presentations to us.

So we have committed two days of our meeting during that week to actually be attendees and observers at your meeting. If we can work that out, that would be great.

MR. STROSNIDER: And we really appreciate that. We appreciate the efficiency in terms of the impact on staff. And I think it will be interesting and good to hear firsthand some of the stakeholder interest. And, you know, we would expect to get into a fairly detailed level on a lot of the technical issues associated with this.

CHAIRMAN RYAN: And we just want to take advantage of that.

MR. STROSNIDER: From a bigger picture, this is part of our commitment to continuous improvement in terms of looking at our processes, our regulatory processes, and the technical aspects of this and making sure we have clear communication with the industry on what their issues are and how we expect to do this. It helps us to make a better quality product and make it more efficient. So we appreciate your participation in that.

We will as a result of that meeting be working on revising or developing staff guidance with a summary of the significant issues. And we will provide that to ACNW. We're looking at trying to do that by sometime in May for the June meeting so that you'll have the benefit of having been at the workshop, see what comes out of it in terms of guidance, and then have a meeting where we can discuss what the product is there.

Scott or anybody from --

MR. GILLEN: Dan Gillen, Decommissioning Deputy Director.

Jack characterized that very well. ACNW is well-aware of our process right now. Robert Johnson has been working closely with Rich Major. And we've got your participation plan for the workshop. And then following that, we will be providing you with guidance summaries end of May for the sole purpose of you then having your own working group session to address the guidance that we're planning in those LTR analysis issues.

CHAIRMAN RYAN: Great.

MR. GILLEN: Is that consistent with everything that you understand?

CHAIRMAN RYAN: Absolutely. Yes, that is right on target. And it's nice when a plan comes together.

MR. GILLEN: Very good. Thank you.

MR. STROSNIDER: Thanks, Dan.

The next subject was the West Valley working group. And DOE is developing an environmental impact statement and decommissioning plan to support cleanup of the West Valley site. You have expressed interest in seeing that, and we would welcome any feedback or suggestions that you have on that.

Scott, do we have anything on the schedule?

MR. FLANDERS: The last information I heard in terms of schedule is that DOE intended to provide a draft environmental impact statement to the NRC for cooperating agency review sometime in the August time frame.

And then I guess there would be some follow-on discussions with ACNW following the staff's opportunity to review that draft environmental impact statement. Is that consistent with --

CHAIRMAN RYAN: Yes. I think through no fault of anybody on the staff, of course, the schedule for the EIS has slipped some from our expectations some time ago.

In our Commission briefing this morning, we mentioned that we were interested in the West Valley. And I believe it's Commissioner Merrifield or, actually, McGaffigan both that said, "Well, that certainly is a complex site." And he suggested that we maybe visit with you on other opportunities for us to get involved in decommissioning case studies.

Commissioner Merrifield, in particular, suggested the ACNW could be helpful at perhaps looking at several and then trying to extract lessons learned, the patterns or trends in other kinds of sites.

So I don't know what the answer is, but I offer that question to you in terms of our setting priorities. Perhaps we ought to at least examine that question, think about where the schedule for West Valley might actually come along, and perhaps make a higher priority for other things that might be a little bit more valuable to you in the shorter term.

MR. STROSNIDER: We may want to shift to some other sites, say, that are coming up sooner.

CHAIRMAN RYAN: And, again, there was that exact point. He said, you know, they're actively working on lots of sites now and maybe looking at those would add some value in a more timely way now, rather than wait for West Valley. So we're sure open to that suggestion and would be happy to work with you on shifting that around a bit.

DR. LARKINS: Mike?

CHAIRMAN RYAN: Yes, sir?

DR. LARKINS: I sort of got the impression that the commissioner was saying that maybe some lessons learned from sites that are being closed or decommissioned, like one in New Jersey and Pennsylvania.

And if the staff had some lessons learned from those, maybe we could discuss that and there would be some value. We could sort of use that as a platform to move on to the more complex sites.

CHAIRMAN RYAN: Yes. And, again, I think he had mentioned the couple of sites that, Dan, I think you had mentioned to us previously in your presentation a couple of months ago. So I just wanted to give you that feedback from the Commission briefing.

MR. GILLEN: Yes. The lessons learned aspect is coming from a lot of different angles now. You know, it was certainly made clear to me in the last annual briefing I did for the Commission in October that that was something on their mind. And previous to that, it's already been something on our program's mind.

Lessons learned can come in many forms. It's how can we improve our process. What are the lessons we have learned to improve our process? It can be one of the technical aspects of decommissioning that the existing decommissioning sites are learning that they can apply or other sites can use that are either going to be entering decommissioning soon or even new facilities being built for future decommissioning.

So all of those things are on the Commission's mind, particularly Commissioner Merrifield. He's made it clear to me through that. I read the transcript from the ACNW briefing he gave. And I'm certainly aware.

One major aspect of our two-day meeting is to just get feedback. We have a panel set up specifically to address lessons learned from various members of stakeholders that are involved in decommissioning.

So yes, we're working definitely down in that lane.

CHAIRMAN RYAN: Just as a follow-on, Dan, we've thought about -- and this is speculative not knowing exactly how your two-day meeting will provide information. You know, we could have a follow-on working group as the ACNW to address information gaps or other areas or our forward-looking look after your two-day meeting.

So I just wanted to open that door that maybe we can make an adjustment there and be more timely and on point with what is current on your plate.

MR. STROSNIDER: Yes. And I think it is important that we look at this lessons learned area, if you will, from a more generic, from a broader point of view. As you pointed out the notion, you can look at some specific sites, but the intent is really to pull out of that some things that could be applied generically.

You know, at least part of what I think Commissioner Merrifield's message is is we won't see a whole lot of reactors given license renewal. You know there may be a hiatus. And it might be a long time before people get back to doing this again. And we want to make sure that they don't have to reinvent the wheel.

So I think, yes, it's an important area for us to follow up on and we can look at what sites might be most useful to look at and follow up from the workshop.

CHAIRMAN RYAN: And just thinking out loud for a second, I'm sure that some sites have gone well, as planned, on budget. Some sites have been over schedule, over budget. And it would be kind of interesting to explore why it went well or why it went away and from the schedule and budget, those kinds of things. And you can start to get a plan and dive into those details.

MR. STROSNIDER: Yes. And I'd just note on that, I think it's sort of interesting. We did put out -- we have two regulatory information summaries that were put out in the last couple of years on what I characterize as lessons learned in terms of what operating facilities need to be thinking about and doing while they're operating so that they'll be prepared for decommissioning.

CHAIRMAN RYAN: Yes.

MR. STROSNIDER: And I thought there were some interesting insights in that. And then you've got the lessons learned from the actual process itself, which we have captured.

CHAIRMAN RYAN: Okay.

MR. STROSNIDER: So good. Another area

that you had expressed interest in was the disposition of solid materials rulemaking and that there's a lot of things coming together right now in terms of completing the environmental impact study and pulling that package together.

The current schedule is to get the package up to the Commission this month. And, as was noted this morning, we need to make sure that we've got the interaction set up to provide you the information on that so that you can fulfill your role in advising the Commission.

I don't know if there are any other questions.

CHAIRMAN RYAN: We'll be ready.

MR. STROSNIDER: Okay. Then in terms of new programmatic developments, if I could have the --

DR. LARKINS: Can I ask a question on that?

CHAIRMAN RYAN: Yes, please?

MR. STROSNIDER: Yes.

DR. LARKINS: When is the best time you're thinking of proposed rule for disposition of solid material? Is it after Commission comments or during Commission review or once it's been issued for comment? I'm just trying to get a feel for what you're thinking.

MR. MILLER: This is Charlie Miller.

John, I think what we have arranged is that the paper will go up to the Commission. And then when the paper is put out for public comment, what we're looking from the Committee for at that point in time is to review and provide advice with regard to public comments received, disposition, and what recommendations should be made with regard to a final rulemaking.

DR. LARKINS: Okay. So that would be sometime towards the latter part of the year, it sounds like.

MR. MILLER: Charlotte, do you know the timing on that? This is Charlotte Abrams from my staff, who is following this extremely closely.

MS. ABRAMS: Too closely. It goes to the Commission, as Charlie said, the end of this month. We don't have any idea how long the Commission would keep it. It's a pretty extensive document with the EIS.

And so the timing for when it would go out for public comments, your guess is as good as mine. I guess approximately two months maybe. And then it would be out for public comment, 90 days. So we're talking several months.

DR. LARKINS: Okay. Thanks, Charlotte.

MR. MILLER: What I think that would allow you to do is you can become more familiar with what the Commission has put out for public comment during a 90-day period.

And then when the public comments come back, I think it might help us hit the ground running with regard to trying to schedule something to have a fruitful discussion on what we get back.

CHAIRMAN RYAN: That would be appreciated because from the sound of the documents, it's a pretty good homework problem to read through. So anything that will get us a lot more contemporaneous with decision-making steps, that would be helpful.

DR. LARKINS: Okay.

MR. STROSNIDER: With regard to some subjects that have come up since the last meeting with the Committee, the first bullet there on plans for responding to the State of Nevada query on the waste confidence rulemaking, as you are aware, I would think, we did receive a query from the State of Nevada on that subject. It's being reviewed right now by the Office of General Counsel.

I really can't add a whole lot to that

until they complete their review and provide us some guidance on what the next steps are. But depending on where that goes, obviously we would be very interested in staying informed and engaged in that.

DR. LARKINS: Jack?

MR. STROSNIDER: Yes?

DR. LARKINS: I guess that could be handled in several ways. I mean, it could be handled by the Commission or General Counsel or assigned to the staff in terms of making a decision or finding on --

MR. STROSNIDER: Yes. I think there are a number of options. And, like I said, that OGC review will provide some guidance on how to deal with the question.

DR. LARKINS: So it may or may not actually come back to the staff. Right. I just wanted to clarify that.

CHAIRMAN RYAN: I appreciate that. Thank you.

MR. STROSNIDER: With regard to DOE's progress in revising plans for submission of the Yucca Mountain license application, I think if you have followed the press in some of our management meetings with them, they have indicated that they plan to be ready to submit an application by December of '05, but they haven't actually committed to submitting it then.

There are a number of uncertainties, which everybody is aware of, with regard to certification and the licensing support network and development of the revised EPA standard. So I think they're waiting to see how all of that comes together, but that is the best information we have at this point.

I don't know if there are any questions on that, but related to that, the next bullet on the current plans for the high-level waste time period of compliance, it's our understanding -- and, again, follow this in the media -- that EPA has indicated a proposed revised standard sometime this summer. They're looking at several different options that are being discussed.

We're following that closely because our Part 63 will need to be revised to reflect what is in the EPA standards and certainly engaging in that.

CHAIRMAN RYAN: I think we're on the same page there as well. We're continuing with our pre-LA periodic reviews on various topical area with DOE. Carol Hanlon from DOE is here and helps us plan those sessions.

So we're going to continue on, at least

for the next few months, in prelicensing kinds of reviews, much like the working groups and other activities we have had up to now. And we are in the exact same place in terms of understanding what EPA is going to do in time of compliance

We have refreshed ourselves, thanks to Bill Hinze, who has returned to the Committee, because has been involved in many of the time-of-compliance issues, gave us a briefing of those letters and the past letters on the subject.

So we're hoping to be prepared and ready to support whatever comes forward that we need to deal with on time of compliance.

MR. STROSNIDER: Good. And I think your comments also go directly to the last bullet in terms of some of the preapplication activities. We do want to update you on the igneous activities, what we are doing there. And so we'll just need to work out the logistics of how we can provide that information.

CHAIRMAN RYAN: Actually, our subcommittee is going to the center in San Antonio for a visit. And the igneous work at the center is on the top of our list. As we come back from that visit and we get a report from the subcommittee on their findings and work at the center over that visit, we'll I'm sure work with staff on what is the appropriate next step to bring that to the table here.

DR. LARKINS: Yes. I was just going to say that I would think that after today's briefing, the Committee would want to try to go back and address some of those issues that came up before the end of the fiscal year --

CHAIRMAN RYAN: Yes.

DR. LARKINS: -- on igneous activity. So it would be good to have maybe dialogue with the NRC and DOE prior to that time.

CHAIRMAN RYAN: Yes, I agree.

MR. STROSNIDER: Okay. We'll move on to some highlights from the Commission briefing, NMSS Commission briefing, on waste and materials.

We received the staff requirements memorandum on waste materials. We are still waiting for that. But a couple of the things that were in the waste at least, we were asked to provide a response on our approach to the waste incidental reprocessing. And we have a paper in development on that which will describe our plans, technical reviews, how we're going to go at that technically.

And also one of the things they wanted us to address is the process. And we heard the emphasis again this morning on making this an open process in terms of how we come forward with the review.

So that paper is under development. And we're working with ACNW staff and tentatively scheduling a meeting in July to go over that. So I don't know if there are any other questions on where we're at on WIR or that planning.

CHAIRMAN RYAN: No. I think we have a good plan forward there.

MR. STROSNIDER: Okay. We're also preparing a paper in response to the staff requirements memorandum on our possible involvement in the development of the DOE environmental impact statement on greater-than-Class C waste. And this is a question of whether we are a cooperating or commenting agency and the pros and cons. So we're working that paper.

So those were some of the other areas in terms of emerging low-level waste. Over the next 12 to 18 months, GAO is expected to complete its study: storage of low-level waste. And that could point to a need for greater NRC involvement in this area.

We expect also that there could be some further congressional hearings on the recommendations that arose from GAO in the 2004 report and also from the hearings that have happened, that have taken place. There could be some issues coming out of that.

One of the things that came up at the hearing was the possibility for NRC to collect information with regard to low-level waste, you know, how much that needs to be stored.

There was also a recommendation at one of the hearings about the build of a low-level waste disposal facility on federal land. This is coming out of the GAO recommendations, I believe.

So those are some things that we need to keep an eye on, recognizing, of course, that Barnwell plan to no longer accept compact waste in 2008. And that could create some issues. And it was discussed at this morning's briefing. So this is an area that we need to stay closely in touch with as it evolves.

CHAIRMAN RYAN: In fact, in our agenda this week, we're going to take up a list of topical areas in the low-level waste arena that we're going to aim at a white paper that we would gather information and look at issues and try and sort that out.

The interesting thing I think I pointed out at the briefing this morning to the Commission was that low-level waste is not just low-level waste disposal. Those definitions touch lots of other issues, whether it's decommissioning or WIR or other areas. So we need to think about that.

So we're just trying to get our own thoughts organized and well-structured so we can participate in a meaningful way.

DR. LARKINS: Mike, I think it might be worthwhile, just reflecting on the comments this morning from Commissioner McGaffigan and Lyons and Jaczko that there are a lot of potential obstacles to getting any type of real reform in the low-level waste area. It would be good to maybe have a dialogue or exchange with the staff on this Committee's white paper at some point.

CHAIRMAN RYAN: Absolutely. No. I think that's very much a two-way street. We've looked to give you our white paper at several stages along its development so that we're developing our thoughts collectively with you, rather than as a separate activity.

Commissioner McGaffigan, in particular, identified that you may find as you explore that that you bump up against, I think he used the term, statutory barriers.

MR. FLANDERS: At least legal barriers.

CHAIRMAN RYAN: Legal barriers. Thank

you. And certainly that's true. Nonetheless, there may be a lot of fruitful work to do at different levels of advice.

For example, if a regulatory guide could interpret or solve a problem or help licensees or others deal with an issue in low-level waste, that's certainly an avenue to go forward and so forth.

We're not trying to recommend a solution, as I mentioned this morning. We're trying to explore carefully and systematically what the issues are so that as your thinking moves forward, we can all be educated with the same information and we're not crossing purposes.

DR. LARKINS: Yes. I wouldn't want to think the Committee might be going down a path which has some obvious pitfalls. And if the staff could point those out early on, it would be helpful with some issues.

MR. FLANDERS: I would just say that in April, Jim Kennedy and myself are supposed to come back and talk with the Committee. That may be an opportunity for us once you have the chance to think through some of the issues you want to address in the white paper and also gives us some time to think through some of the issues that we think may be useful and have a dialogue on those.

CHAIRMAN RYAN: Absolutely. And Jim was very helpful in our initial discussion of this topic last month. He sat through that session and was very helpful. So we've started it in a good way, and the point is well-taken.

DR. LARKINS: Can I go back on this greater than Class C waste EIS. Will the Committee get a chance to see that paper?

MR. FLANDERS: We haven't written a paper yet.

DR. LARKINS: Whenever.

MR. FLANDERS: Will the Committee get a chance to see that paper? At this point, the paper really is focused more on a policy issue. And the paper is going to focus on the issue of whether or not the NRC, the Commission, should serve as a cooperating agency in the preparation of the EIS or whether we should take a role more as a commenting agency.

So it's really a policy issue for the Commission to make a decision. And we're just going to lay out the pros and cons of selecting either side. So at this point it's not really getting --

DR. LARKINS: So you can wait and see what the Commission comes back with at that point. It may be better. Right, right.

MR. STROSNIDER: The last part on this slide, Part 61 and WIR, I guess there have been some discussions. In fact, there was some discussion this morning about risk-informing Part 61.

The thing I wanted to point out here is that with regard to waste incidental reprocessing, you know, we've begun some of those reviews under the Defense National Reauthorization Act.

And, as we discussed earlier, we will be meeting with you to talk about how we're doing those and the technical approaches that we're using. But we're not planning any modifications to Part 61 in order to support that. So they are somewhat separate activities in our mind.

CHAIRMAN RYAN: And I appreciate it from that perspective and agree with you, but it is interesting that definition of what is greater than Class C and so forth and some of the other issues. They do touch.

MR. STROSNIDER: As you say, there are a lot of cross-cutting issues here. Yes. So we agree with that, but I wanted to let you know how we're proceeding.

CHAIRMAN RYAN: Yes, yes. And we're on

track with it. I think, as Allen mentioned, our goal is to support your efforts in creating that standard review plan.

MR. STROSNIDER: Okay. The last slide -- and I guess it covers a couple, two pages here. Actually, this the rolling calendar we talked about and the activities we've gotten here.

I would note, I think -- I'm not sure it shows up on here; we had a little trouble getting this into the right format -- that our plans on the WIR working group don't show up on here, I don't believe, but that is something that is in the plan. It was just a formatting issue, I think, in terms of trying to get this to print out right.

I don't know if there are any comments or questions, but I wanted to just put that up there in case there is any discussion and interest in specific topics that are on there.

CHAIRMAN RYAN: No. I just want to give a word of thanks to Sam Jones for his ongoing interaction with the ACNW staff. It's extremely helpful for members to plan. I think it helps us in managing our resources. Hopefully it offers you the same efficiency that we're trying to do this in a way that's in your flow of work and it's not something that's burdensome or extra or out of step with your process.

So it seems to be working quite well. And we'll continue to move it long. So we appreciate it and appreciate Sam's insights to get along well.

MR. STROSNIDER: Yes. I think, as I stated at the beginning, we've got a good system for communicating. I think we've got some good tools that can help guide the interactions. And we want to make sure those work.

With that, I've got people here. I'd just ask if there are any questions or other topics that the Committee wanted to discuss.

CHAIRMAN RYAN: I'll start with Jim. Any questions or comments?

MEMBER CLARKE: Just one. You mentioned decommissioning and new guidance that is being developed in several areas, decommissioning. I think there are at least five, maybe nine. I don't recall the exact number.

Are there areas that you would suggest we focus on more than others? What are your thoughts on that?

MR. STROSNIDER: Dan, have you got some thoughts there on what would be the highest priority?

MR. GILLEN: Yes. Looking at the LTR analysis, which is the major piece of this, of the guidance changes, there were nine issues. And I think we have asked for assistance on what we consider maybe -- is it three or four, Robert? -- realistic scenarios and institutional controls; mixing, soil mixing. What am I leaving out?

Yes, yes. It's realistic scenarios is one issue. Institutional controls for restricted release sites is a second. And intentional soil mixing is the third. Those are the main three.

We have probably scheduled at the workshop to have six different breakout sessions. So our top six issues will be covered. So you could pick and choose, I guess.

CHAIRMAN RYAN: Well, and that's a good question to jump in here and say help us divide our time and interest among those working groups because we want to follow your priorities.

MR. GILLEN: I think Robert is working closely with you to do that.

CHAIRMAN RYAN: Right.

MR. GILLEN: And we will.

MR. STROSNIDER: We'll provide you some feedback on that.

CHAIRMAN RYAN: Great.

MEMBER CLARKE: Thank you.

CHAIRMAN RYAN: Ruth?

MEMBER WEINER: I've said my piece.

CHAIRMAN RYAN: Bill?

MEMBER HINZE: Just quickly. Regarding time of compliance and speaking with Ray Clarke at EPA, there has been some discussion about having some discussion meetings with various groups. And I understand they have had some with some affected parties.

Do you have any information on whether that is moving ahead? Can we expect to be involved with the EPA in their reaching their decision or will the NRC and the components of it be part and parcel of providing input to them?

MR. STROSNIDER: Yes. There have been some interagency meetings. And we have been trying to stay up to speed on their status and where they're at because we do have the obligation under law to modify ourselves.

So we have a need to understand where they're at and where they're headed on this so that we can plan and make our complementary rulemaking as effective and efficient as possible.

So we are having that kind of communication. And it's a routine part of the rulemaking process and something that we feel is important for us to be engaged in.

So that is happening. And I don't know if there is anything you would want to add, Bill.

MR. REAMER: Sure. The article in the paper last week indicated that they are aiming for a proposed rule in July. So that's pretty recent information that that is their track. That is the date they have been holding out for some time as the date for their proposed rule, in the July summer time frame.

EPA has an approach. They have the ball here. It's their standard that was invalidated. They have an approach to gather input from other federal agencies, from affected public interest groups, and perhaps other stakeholders as well. And I think they are obviously still doing that.

That's with the meeting that occurred last week we have an interest and we have to be consistent with. So we want to stay abreast of what they're doing and make sure we're ready to propose revisions to our standard that would be consistent with what they are proposing.

CHAIRMAN RYAN: Great.

MR. STROSNIDER: If I could add one thing, I think it is also very important to emphasize for all the stakeholders and public involved that as you go through the rulemaking process, the opportunity is there to engage in the rulemaking process, both on EPA and NRC.

And if you go back and look at the record from the first round of rulemaking, you know, there were public comments. And there were changes. You know, they were reviewed. And there were changes to those draft rules as they went through the process.

So that process is there. And I just wanted to make sure that everybody understands that because it's important that people understand they do have the opportunity. And that I believe is effective in influencing the outcome.

MEMBER HINZE: Thanks. If I may, one other question. One of the future NMSS activities that is listed here for May is the status of seismic design and basis at Yucca Mountain. I'm wondering if that also includes drift stability. Is that just a preclosure at the facilities or --

MR. REAMER: Can I get back to you on the scope of that? I'm inclined to think it's a preclosure, but I don't want to say for sure until I check. We'll give you an answer to that.

MEMBER HINZE: Right. We do have some interest on that. And any information you could provide to us, Bill, we would very much appreciate it. Thank you.

CHAIRMAN RYAN: All right, Bill. Thanks.

Allen? Again, I appreciate this update and our ongoing conversations. It's always great to have a meeting like this and say, "Well, there's no surprise. Nothing was brand new. And we're on track and well-planned for our upcoming interaction.

So thanks for this briefing. It's a chance for us to review our schedule and our activities and our plans in this public forum. So we appreciate you and your staff coming today, Jack. And thanks, everybody, for their participation. And we look forward to the good work ahead.

MR. STROSNIDER: Good. And we thank you for your time and your cooperation.

CHAIRMAN RYAN: Thank you very much.

We are scheduled to have a break. And we will resume at 4:00 o'clock, at which time we will hear a briefing on the USEC facility. Thanks very much. We'll go off the record until 4:00 o'clock.

(Whereupon, the foregoing matter went off the record at 3:31 p.m. and went back on the record at 4:02 p.m.)

CHAIRMAN RYAN: Back on the record. This briefing is going to be managed by Allen Croff, Vice Chair.

So, Allen, I'll turn the meeting over to you.

VICE CHAIRMAN CROFF: Okay. Thanks.

This briefing is a licensing status update concerning the USEC application up in Ohio. It's going to be given by Yawar Faraz -- I hope I pronounced that right -- a Senior Project Manager, Division of Fuel Cycle Safety and Safeguards in NMSS.

Proceed.

MR. FARAZ: Thanks.

10) STATUS OF NRC'S REVIEW OF USEC INC.'S LICENSE APPLICATION FOR A GAS CENTRIFUGE URANIUM ENRICHMENT FACILITY

MR. FARAZ: I'm the Project Manager for the USEC application that was submitted last August for a gas centrifuge enrichment facility. I work in the Division of Fuel Cycle Safety and Safeguards in NMSS. And, as was mentioned, I will be providing you a status of our licensing review that we are currently conducting for USEC's application.

This is going to be very similar to a presentation that Tim Johnson had given about six months or so ago on the LES application. We won't be discussing anything sensitive or classified in this meeting because it's a public meeting. And after I present an overall status of the project, Matt Blevins will provide you a status of NRC's environmental review that is also going on.

USEC Inc., or USEC, is proposing to enrich uranium using the gas centrifuge technology in a facility in Piketon, Ohio. The gas centrifuge process, as most of you already know, uses high-speed rotors to separate out the U-235 from the U-238 isotopes, the gas that uses UF_6. And they're proposing to enrich the uranium generally up to five percent, but the license that they're requesting is for ten percent in case in the future there is a need for high enrichments.

USEC will be setting up their facility at the Portsmouth gaseous diffusion plant site, which is in Piketon, in several existing buildings owned by DOE. USEC intends to lease them from DOE to house their American centrifuge plant.

The centrifuge machine looks fairly

simple, but it is a very intricate apparatus. It involves a casing, which is the outside shell. It's cylindrical in shape. And inside the casing, there is a rotor, which spins at a very, very high rate. The arrows that you see are the UF_6. And it's actually a countercurrent flow that is induced in the rotor while the rotor is spinning.

The spinning effect, what it does is it imparts centrifugal forces on the UF_6 that are inside the rotor. Since U-238 has a higher molecular weight, the U-238 F_6, it tends to move more to the wall.

And with this countercurrent flow that is induced within the rotor. More of the U-238 F_6 molecules tend to move up in the rotor. And there is a scoop at the top of the rotor where the U-238, primary U-238 F_6 molecules are withdrawn.

So the feed comes in somewhere in the middle. The tails or the depleted UF_6 is removed from the top. And the enriched UF_6, which is more U-235 F_6 molecules than the feed, that is withdrawn from the bottom, as is shown in this schematic.

You see a bearing. It is a magnetic bearing, but it's not completely magnetic. It's also mechanical. And there is a motor, electric motor, at the bottom of the centrifuge.

The principal hazards associated with the gas centrifuge enrichment facility that use UF_6 are primarily chemical. This involves soluble uranium, which is UF_6 in soluble form. It's very toxic to the kidneys. So exposure to soluble uranium is a chemical toxicity issue as well as the fact that when UF_6 is released and it comes in contact with moisture in the air, it forms HF, which is a very, very strong acid.

So that's primarily the hazard that exists at this facility. There's also a hazard of criticality, where enriched UF_6 is processed. I would say primarily areas where there is liquid UF_6 and solid UF_6 because you have to have it in solid form, enrichment in solid form, to have a criticality.

Now, unlike the gaseous diffusion plant that USEC also operates in Paducah, the feed and the draw stations at the gas centrifuge facility will not involve liquid UF_6. So they will not be liquefying UF_6, which means they will not be pressurizing UF_6 above atmospheric pressure to feed or to withdraw it from the gas case.

The gas centrifuge process uses very, very low pressures. Essentially the entire process is below atmospheric pressure, so in case there's a leak, you know, there's inflow, as opposed to outflow.

However, they do plan on using liquid UF_6 or liquefying UF_6 at the sampling and transfer stations. This is where they would sample UF_6. They need to have a homogenous sample. So they would be liquefying it for that purpose as well as to transfer it from one cylinder into another. So they would liquify that and then essentially drain the UF_6 into the other cylinders.

The advantage, the primary advantage, that a gas centrifuge facility has or a gaseous diffusion plant is that it uses about five percent of the electricity that a gaseous diffusion plant uses, which is extremely a major factor for why most organizations are trying to move into words gas centrifuge.

In fact, the only gaseous diffusion plants that are operating today are in France and the U.S. And Both France and the U.S. are moving towards centrifuge as well.

The technology, however, is highly classified, up to the secret, restricted data level. There's a lot of information associated with the technology that is classified.

MR. SCOTT: It's classified for proliferation concerns?

MR. FARAZ: Primarily, yes.

MR. SCOTT: Yes.

MR. FARAZ: Some of the unique requirements associated with licensing an enrichment facility are listed on this slide. It includes preparing an environmental impact statement, which we're doing right now. It involves a formal Subpart G hearing. So that is required, just as you would have for a nuclear power plant. And the hearing must be completed prior to issuance of a license.

It's a one-step licensing process, which means construction and operation at the same time. A pre-operation inspection is required. And liability insurance is also required.

The next six slides talk about the licensing status of where we stand in our review of the application. As I say, it was submitted last August. The Commission in October issued an order accepting the application for detailed review. And it also initiated, the Commission order also initiated, the hearing process.

It set a 30-month review schedule for the staff, which we intend to meet. The hearing would obviously cover safety, safeguards, and environmental issues.

We plan to complete our safety and

safeguards review in 18 months or less. So that would mean we would have the SER issued by this February or sooner.

The EIS we plan to issue in 18 months. So that will be in February of 2006. And then we anticipate the hearing board completing its hearing in eight months. So that will take us to October of '06. And then we anticipate the Commission taking four months to issuing its decision, which would take it to February of '07. So that's when the licensing decision would be made.

CHAIRMAN RYAN: Just a quick question, please, to clarify. If I read the dates right, you're simultaneously working on the SER and the EIS.

MR. FARAZ: That's correct.

CHAIRMAN RYAN: They are both due at the same time.

MR. FARAZ: That's correct.

CHAIRMAN RYAN: Okay. Thanks.

MR. FARAZ: Yes. In fact, I'm responsible for the SER, and Matt Blevins, who is in the Division of Waste Management, is managing the EIS.

CHAIRMAN RYAN: Okay. Thank you.

MR. FARAZ: We received two petitions for intervention on the February 28th deadline that was set by the Commission. One of the groups that petitioned the NRC has identified itself as PRESS. I guess there are local individuals involved in this. And there is a member of the public who has also petitioned the agency. He resides in New York City. That's his current address.

Some of the contentions that have been raised in these petitions are listed on this page: exemption on criticality monitoring, radiation work permits, UF_6 cylinder labeling, and the rest.

Some of the environmental contentions that they raise are on this page and include compliance with the National Historic Preservation Act, need for the facility for decommissioning funding, et cetera.

Now, the staff issued its request for additional information on the application and the ISA summary. So this would be a safety and safeguards review on February 7th of this year. USEC had responded to that RAI. We requested a one-month response. And they responded on March 9th.

The staff also issued an RAI on the environmental report -- this is associated with the EIS -- on February 23rd. And we issued a classified RAI on the FNMC plan, on the classified portion of the FNMC plan, on March 4th.

Most of the RAIs that we have issued to USEC are essentially clarifications that are needed, either in the application or in the response.

Now, concerning the ISA, which is the integrated safety analysis, USEC did not do a PRA. What they did do is a semi-quantitative risk index method, which is recommended by our SRP, standard review plan, NUREG-1520. This is primarily a method that's favored by most fuel cycle licensees and applicants.

Since DOE and NRC are the primary regulators at the Portsmouth site, Piketon site. In fact, we are also the primary regulators in the same building that USEC would be setting up the American centrifuge plant.

We decided to develop a memorandum of understanding with DOE to delineate each agency's roles and responsibilities in terms of regulatory oversight to make sure that there are no gaps and also to make sure that there is no dual regulation. So those are the two primary reasons why we are developing an MOU.

We had developed an MOU for the lead cascade facility, which is a pilot plant. We had approved that application in February of last year.

And USEC is proceeding to construct it, maybe operate it. So we are following the same kind of method and the same idea in developing this MOU.

They drafted MOU and provided it to DOE for comment last December. We expect DOE to provide its input to us on the MOU around April or May of this year. And then we intend to discuss the MOU with USEC in a public meeting later this summer.

Before I turn it over to Matt, are there any questions?

CHAIRMAN RYAN: I have one. Go ahead if you want to go first. I was curious. You made the comment in the ISA slide, number 12.

MR. FARAZ: Yes.

CHAIRMAN RYAN: Why is this method favored by licensees? Is it just because they're used to it?

MR. FARAZ: I think it's recommended in the SRP. So that they're essentially following that model, as recommended by the SRP, but I'm not sure if any -- there might be one or two licensees who might be doing PRAs for some processes. But generally they're not doing PRAs for the entire ISA.

CHAIRMAN RYAN: You know, with regard to the risk management questions, particularly Yucca Mountain, this Committee is on record many times, of course, focusing on PRAs as an approach to these kinds of evaluations.

It caught my ear that you said that licensees prefer this semi-quantitative approach, rather than a PRA. And I was just curious why they would prefer it, if they had done some assessment or analysis of this is better or that doesn't help us or this is adequate and for these reasons and so forth or is it just --

MR. FARAZ: Yes. It seems to be suitable for fuel cycle facilities because they tend to have a lot of accident sequences. And those accident sequences tend to be fairly simple.

So it's not as intricate as a nuclear power plant might be. You know, for example, it might involve an individual adding more liquid than he should in a container for a potential criticality accident. And then the controls might be fairly straightforward.

So these are accident sequences that can be analyzed in a fairly simple manner. So a semi-quantitative methods tends to be quite suitable.

CHAIRMAN RYAN: Well, in addition, I asked the question because of the accident in Japan several years ago is a human reliability factors issue, --

MR. FARAZ: Right.

CHAIRMAN RYAN: -- which is similar to a PRA. And I guess just recognizing that experience, which was a human error, I would wonder if it should be preferred or not.

I just throw that out as a question to think about. I know it's probably not something you can answer today, but I wonder if that's something to think about as an improvement to actually look at PRA as a preferred tool, rather than a semi-quantitative risk assessment method.

MR. FARAZ: Yes. Well, the semi-quantitative risk assessment also includes human error. So clearly that is included. It assigns it an index depending on how reliable that human action is. And clearly all of those actions have to be identified.

So something like what happened in Tokaimura if it had been done in an ISA, as our fuel cycle facilities are done, I don't think they would -- I mean, they would have recognized it and most probably have prevented an accident from occurring.

DR. LARKINS: Trying to follow up on that, this facility is similar to other centrifuge facilities that you have numbers related to reliability of certain processes?

MR. FARAZ: The process is fairly similar. In other words, you know, the UF_6, large quantities of UF_6 --

DR. LARKINS: I was thinking about it in the human error arena, where you can assess the likelihood of a particular process being carried out correctly.

MR. FARAZ: Yes, yes. And, in fact, it will be similar to the Urenco facilities that operated safely over the years. So yes.

DR. LARKINS: Okay. I guess I was just curious. I was looking on slide 10, where it talked about USEC's poor compliance history. How do you consider that in your human reliability estimates of factoring human factors?

MEMBER WEINER: That doesn't mean it happened.

DR. LARKINS: It doesn't mean it's real, right.

MR. FARAZ: That's right.

DR. LARKINS: I understand. Okay. Thank you.

VICE CHAIRMAN CROFF: If I may, I'd like to move on. And we'll listen to the rest of the presentation. And then we'll go around and do the usual questions. So we'll just have clarifications here in the middle.

Matt Blevins, I believe.

MR. BLEVINS: Yes.

VICE CHAIRMAN CROFF: Okay. Thank you.

MR. BLEVINS: I'm Matt Blevins, as Yawar said. I am with the Division of Waste Management and Environmental Protection. So we've got to throw that in there. We're actually assisting Fuel Cycle in this environmental review. It's sort of one of our tasks up there in DWMEP now.

In this first slide, I have just a flow diagram of the environmental review process. And we've just completed the scoping process. One of the things you'll note is we had sort of an extremely long scoping comment period. And that is sort of related to the ADAMS being taken down. So that was one of the hurdles we had to overcome so we could go back out and complete the scoping process.

So Yawar mentioned some of the deliverables we have had recently, the environmental RAIs. And then near term we'll have the scoping summary report, which will sort of discuss how we handle the scoping comments that were submitted by members of the public. We'll talk about some of those comments here in a second.

In terms of major deliverables, we have the draft environmental impact statement in July of this year. And we'll be going back out for public comments again. It's required by regulations. And then we'll issue the final EIS in February of 2006, as we previously talked about. And you sort of see how that feeds into the agency decision with the safety evaluation report.

Next slide, please. Some of the major scoping comments I've listed here on the slide. You'll see that if you look at Yawar's slide on the contentions, they're very similar. And that's primarily because the same group submitted most of the scoping comments and also submitted them as contentions.

So some of the bigger ones or the ones that were questioned more, you know, the need for the facility, historical and cultural resources, oddly enough, was one of the major scoping comments we received. We thought we were kind of out of it. I don't think we anticipated that based on the fact that it is an existing facility.

And then depleted uranium disposal, as you might have guessed, is another major scoping comment we got, much like with LES, and then some alternative site uses and some transportation ones. These were the major ones that we got.

Now, on the next slide, please. It's nothing that we weren't anticipating in the bigger picture. I mean, this slide here lists the typical resource areas we typically evaluate in an environmental impact statement. So I don't think there are any surprises from the scoping comments in what we are going to have to go out and evaluate.

So I'm not going to go through each of these. That's my big picture overview of where we are in the environmental review. So if you have any specific questions for me?

VICE CHAIRMAN CROFF: I'm just going to take the people here one at a time, let them do their thing. Ruth?

MEMBER WEINER: I have a number of questions. First of all, what are you going to do with the tails from the process, the depleted uranium hexachloride?

MR. BLEVINS: Well, they proposed what I think they called the plausible disposal strategy. Right now we're looking at different scenarios. And one of those scenarios is near-surface disposal. We haven't completed that analysis yet.

MEMBER WEINER: So at this point, you don't know what you are going to do with the tails?

CHAIRMAN RYAN: What they're going to do with it.

MEMBER WEINER: What they're going to do with the tails.

MR. BLEVINS: Yes. I think what they have said they are going to do is send them to the conversion facility that is going to be built there at Portsmouth. And then some of those programmatic EISes have talked about that it's acceptable to send it to either one of the disposal facilities out west.

MEMBER WEINER: Okay. So as U-02 or U-308?

MR. BLEVINS: U-3O8.

MEMBER WEINER: Yes. Okay. I noticed that you did not mention uranium fluorate as a health problem. You did mention HF, but when you release UF_6 to the air, you're also going to get basically oxidized UF_6. And that's nasty, pretty nasty, stuff also.

I don't think anybody would be around long enough to inhale or ingest enough uranium to cause any kidney damage. I think the HF is going to get them first.

MR. FARAZ: That's true, yes. If there is a large release and a person gets exposed to that release, clearly the HF will get there first. However, if you look at the smaller releases, the uranium kind of is a controlling factor, the soluble uranium is. In other words, the HF concentrations for the same amount of soluble uranium concentrations would be not as harmful.

MEMBER WEINER: But if you got something like a pinhole, the very small release, doesn't UF_6 at ambient temperatures solidify? I mean, it sublimes from the solid. Doesn't it close off its holes, the holes themselves, or would you get a hole so big that it wouldn't close up?

MR. FARAZ: The UF_6 would not solidify. I mean, not necessarily. It can remain as gas. If it's fairly cold, then yes, it would tend to solidify.

But if it's released as gas, it would rect with the water vapor and form U2F2, which is solid in particular form.

MEMBER WEINER: Yes. That's that fine powder that you get.

MR. FARAZ: Right. And that would tend to

--

MEMBER WEINER: You said you're using, you're not liquefying to transfer from one container to the other.

MR. FARAZ: They are proposing to liquefy --

MEMBER WEINER: They are?

MR. FARAZ: -- for transfer, yes.

MEMBER WEINER: -- proposing? So that the sublimation would be just for the centrifuge process itself?

MR. FARAZ: That's correct, yes.

MEMBER WEINER: Okay. I just have a couple of more. So you answered the waste question. Do you have any new ideas about transportation or are you going to use 48X and 48Y cylinders or do you know?

MR. FARAZ: I believe it's still -- well, for feed, --

MEMBER WEINER: Yes.

MR. FARAZ: -- it would be the 48s. And then for product, it will be the 30Bs.

MEMBER WEINER: I'm just curious. Why is the electrical usage so much less than for the gaseous diffusion process?

MR. FARAZ: The centrifuge machine itself is a lot more efficient than the gaseous diffusion. I mean, the centrifuge process, the enrichment factor, the theoretical enrichment factor is much, much higher than a gaseous diffusion.

So for a gaseous diffusion plant, if you need 100 stages, you may only need 10 or I'm just throwing that out in that example, but you need a lot fewer stages to get the same amount of enrichment than for a gaseous diffusion plant.

And clearly, you know, when you are considering Paducah running at 1,500 megawatts, 2,000 megawatts, you know, they are consuming a lot of power.

MEMBER WEINER: Yes.

MR. FARAZ: So it's a major savings.

MEMBER WEINER: Thanks. That's all I had.

VICE CHAIRMAN CROFF: Mike?

CHAIRMAN RYAN: One of the points -- I guess slide 9 is a good place to pick it up -- where enrichment is going up to ten percent. Currently folks are enriching up to what, three or four?

MR. FARAZ: Close to five.

CHAIRMAN RYAN: Close to five. So that's at least a doubling of enrichment. And again I come back to the PRA approach. Is that something that needs a systematic review? It just caught my attention that we're doubling enrichment. And how has that been evaluated?

MR. FARAZ: What USEC has done is they have evaluated their plant, their systems and all their equipment, at ten percent. So they're safe at ten percent. And they've assumed ten percent for all the entire process, even though they would be using, you know, going up to five percent or six percent.

CHAIRMAN RYAN: I think about that in terms of the normal process. I could understand how you could get to that. But what about accident scenarios and other kinds of off-normal circumstances? You know, again I'm just thinking out of the box here a little bit. Has that been analyzed? In a more rigorous PRA, you would approach all of that as well.

MR. FARAZ: Again, the ISA, the integrated safety analysis, assumes ten percent in the worst case.

CHAIRMAN RYAN: What if it's 11?

MR. FARAZ: What if it's --

CHAIRMAN RYAN: What if it's a little higher or a little lower? You know, I mean, that's the kind of thing where I would be more comfortable if there were some insight into what evaluating at ten exactly means. I mean, I understand the analytical calculational aspect, but I just wonder if that is sensitive to a particular parameter or difference.

Again, I'm sitting here because I don't know a lot about this particular technology, but I just question whether that needs more detail or not.

Yes? I'm sorry.

MR. SCOTT: I was just going to say from the standpoint of whether this has been done before, remember that the military has enriched to a whole lot more than ten percent.

CHAIRMAN RYAN: Oh, clearly. Absolutely. No. I understand that. But have they shared that criticality analysis with these folks?

MR. SCOTT: I doubt it.

CHAIRMAN RYAN: So that's a different world. Clearly that's true, but I just wonder in this configuration for the way they have designed it, as you say, they have analyzed it at ten, but are you satisfied that is enough?

MR. FARAZ: Well, USEC also operated the Portsmouth gaseous diffusion plant. And that was authorized to ten percent.

CHAIRMAN RYAN: Did they ever operate it at ten percent?

VICE CHAIRMAN CROFF: Portsmouth is operated all the way.

MR. FARAZ: It was operated, you know, up to, yes --

VICE CHAIRMAN CROFF: Ninety plus.

MR. SCOTT: Weren't the HTGRs also? The Fort St. Vrain thing? That was higher, I believe. Twenty maybe.

MR. FARAZ: Even though it wasn't USEC that was doing that, it was DOE and, you know, its contractor, but the facility that USEC operated was authorized at ten percent. And all of the analyses were upward ten percent.

CHAIRMAN RYAN: One of the areas where I think we might have interest -- I'm going to turn to this schedule slide -- is as the draft EIS becomes available, I think that's a point where the Committee might like to take a second look at the environmental impact statement and understand the whole system a little bit better and your analysis of the environmental impact statement.

VICE CHAIRMAN CROFF: And the SER?

MEMBER WEINER: And the SER.

CHAIRMAN RYAN: And the SER, yes, as well at that juncture in February of '06.

MR. FARAZ: Okay.

CHAIRMAN RYAN: That might be a place where we could put a mark to revisit this.

MR. FARAZ: So this is after those are published.

MR. BLEVINS: The final.

CHAIRMAN RYAN: No.

MR. FARAZ: No. The draft.

CHAIRMAN RYAN: The draft.

MR. FARAZ: After the reports are published.

MR. BLEVINS: The draft is this summer for the EIS.

CHAIRMAN RYAN: I'm sorry. You're right.

MR. GITTER: This is Joe Gitter, the Chief of the Special Projects Branch.

Because of the schedule on these projects, we are not planning to do a draft safety evaluation report.

CHAIRMAN RYAN: But they are going to go out for comment, public comment, or not?

MR. FARAZ: Not the SER.

MR. GITTER: Not the safety evaluation report.

CHAIRMAN RYAN: But the EIS is.

MR. GITTER: Yes. It's required to under NEPA.

CHAIRMAN RYAN: All right. I've got you. Well, at least at that point. The reason I ask that question is that a subcommittee of ACNW participated with ACRS on a MO_x and ended up raising an interesting and from the ACRS' point of view safety question, what if there's a disruption in waste outlet?

And I think that's an important question to valuate for any facility. If there's an interruption of a week, it's probably not a big deal. If it goes into months or years, then safety questions that could get raised might need to get addressed. So that's what we ended up offering as our part of the letter that the ACRS wrote on the MO_x facility. So it might be interesting for us to explore that question and the waste outlet question on this as well.

Thank you, Allen.

VICE CHAIRMAN CROFF: I want to follow up on something you brought up, the SER. From what I take out of this, there's not going to be a clean opportunity to review and comment on this before it goes final. Is that a fair understanding?

MR. FARAZ: That's correct.

MR. SCOTT: And I have to say from my

experience in NRR, that is absolutely normal. It's a different regulatory process.

VICE CHAIRMAN CROFF: Okay. All right.

CHAIRMAN RYAN: And, to be fair, Allen, perhaps the actual workings and the licensing of the facility, the machinery itself is a little bit out of our scope, but I think the environmental waste questions certainly are in our scope.

MR. GITTER: Yes. Our understanding was we were coming to you to present an informational briefing.

CHAIRMAN RYAN: That doesn't mean we can't ask questions, though.

MEMBER HINZE: Just a quick question. And I may be ahead of the game here, but the challenge in the water resources, is this a matter of an accident or is this a matter of the waste storage?

MR. BLEVINS: This is an issue with some of the past practices. I think some of the contentions are that some of the uranium has previously been released. And the argument is that they haven't reported it in a correct manner. That was my read of it.

MEMBER HINZE: Previously released as part of the operational --

MR. BLEVINS: From the gaseous diffusion facility.

MEMBER HINZE: From the gaseous diffusion facility.

MEMBER WEINER: From the facility, yes.

MEMBER HINZE: From the old facility.

MEMBER HINZE: Thank you.

VICE CHAIRMAN CROFF: Any more? Jim?

MEMBER CLARKE: I was just curious. I was at this facility I think a couple of years ago, just before they put the gaseous diffusion plant into a cold start status. It's not ready to shut down. It's ready to crank up again or at least it was at that time. And this I guess is intended to replace that.

MR. BLEVINS: That and Paducah as well, I believe, as part of the --

MEMBER CLARKE: And Paducah as well.

MR. BLEVINS: That's what they state in there. That's consistent with what --

MEMBER CLARKE: Are they using --

MR. BLEVINS: Yes.

MEMBER CLARKE: -- some of the same facilities?

MR. BLEVINS: I'm sorry?

MEMBER CLARKE: Using some of the same

facilities?

MR. BLEVINS: My understanding is some of the utility facilities, but in terms of the actual gaseous diffusion buildings --

MEMBER CLARKE: No. I know.

MR. BLEVINS: -- it's primarily located --

MEMBER CLARKE: No. That's a different deal.

MR. BLEVINS: Yes.

MEMBER CLARKE: Also, as I recall, they had a groundwater contamination plume, but I think it was trichloroethylene. I don't think it was uranium.

MR. FARAZ: It's still there.

MEMBER CLARKE: Okay. Thank you.

VICE CHAIRMAN CROFF: I've got a couple of questions, I guess. Could we go to page slide 9? I'd like to understand some of these contentions a little bit more. I'm not sure I understand what the technical issue is or what the issue is.

Criticality monitoring exemption. I take from this that USEC is asking for an exemption from some requirement. Is that --

MR. FARAZ: Yes. There's a requirement for fuel cycle facilities that they have criticality monitoring where they have enriched uranium. In the cylinder yards primarily, you know, which tend to be fairly large, that is one place that USEC would like not to have criticality monitors.

And we didn't grant them an exemption for the gaseous diffusion plants. So it will be a very similar type of operation, a very similar type of request.

VICE CHAIRMAN CROFF: Okay. On the enrichment authorization, Mike sort of started down this path. What are they assuming in their criticality analysis about the presence or absence of -- well, let me back up. I take it they are assuming they cannot get it in a liquid or a solid form in the plant, that USEC assumes this in their criticality analysis.

MR. FARAZ: That they cannot get uranium in solid form?

VICE CHAIRMAN CROFF: Yes.

MR. FARAZ: There are places where they will have uranium in solid form as well as liquid.

VICE CHAIRMAN CROFF: Okay. And in places where it isn't planned. Let me rephrase that.

MR. FARAZ: Okay. If there is a potential for the gas to convert into a solid, for instance, you know, if they get deposits within the facility, there is a potential for that, then they will assume that yes, they will have solid over that. And, you know, primary control tends to be moderation, control moderation, in those areas. Generally that's how they ensure.

VICE CHAIRMAN CROFF: And a broader question on the ten percent, if they begin making or enriching above five percent, it would seem it would have some implications for the rest of the fuel cycle, which is generally geared to five percent or less, has there been any assessment of sort of the implications to other facilities that might have to handle spent fuel from this or make fresh fuel or anything like that?

MR. GITTER: I'm sorry. Those facilities that have to be licensed separately for whatever enrichment was required for fuel. So, for example, if you had a requirement for 10-08 percent 235 fuel, the fuel manufacturer, we would have to do a review to ensure that they could manufacture that fuel at the higher enrichment.

VICE CHAIRMAN CROFF: But if they went in that direction at some point, this has significant implications for the rest of the fuel cycle. Maybe we would have to do some relicensing or maybe even redesign or whatever.

MR. GITTER: That's correct.

VICE CHAIRMAN CROFF: Okay. And on the bottom one here, the need for enriched feed at 3.9 percent, I don't understand, I guess, what's --

MR. FARAZ: Okay. The contention states that to be able to get 10 percent, you know, they have to feed at 3.9 percent. And they're basing that on the amount of tails that USEC has said it will generate.

So they use the tails amount. And then they estimated based on the quantity of tails that they're going to generate in 30 years of operation. It would mean that they need feed at 3.9 percent. So that's what they're contending.

VICE CHAIRMAN CROFF: Okay. So they would be buying 3.9 percent uranium from themselves or somebody else or running it through twice or --

MR. FARAZ: No. They would be feeding natural uranium primarily for that. This is a contention that we're reviewing.

VICE CHAIRMAN CROFF: I guess I still don't understand. You're going to have to try it again. I thought I understood you to say that for the USEC centrifuge plant to enrich to 10 percent, they would have to feed at 3.9.

MR. FARAZ: I believe they use ten percent and the amount of tails that they're going to generate because in the application, it says that they will generate so many tons of depleted uranium a year.

So they took that amount. And they put it in a formula, the enrichment formula. They assumed certain tails enrichment. And then they came up with 3.9 percent for feed.

MR. BLEVINS: That's the contention, but the actual proposal is to use --

MR. FARAZ: Natural, yes.

VICE CHAIRMAN CROFF: I see. Okay. Okay.

MR. FARAZ: These are just contentions that the --

VICE CHAIRMAN CROFF: USEC is not actually proposing this?

MR. FARAZ: No, no.

VICE CHAIRMAN CROFF: Okay. I thought they were objecting to USEC's proposal. That's where I went awry.

MR. FARAZ: No.

VICE CHAIRMAN CROFF: And, finally, I think on the waste issue, I'm assuming - well, are they producing any liquid waste from this facility or is it all solid?

MR. FARAZ: There will be liquid effluents.

VICE CHAIRMAN CROFF: There will be liquid effluents?

MR. FARAZ: Effluents, yes.

VICE CHAIRMAN CROFF: Okay. And their proposal is commercial disposal?

MR. FARAZ: For liquid effluents?

VICE CHAIRMAN CROFF: No. I'm sorry. Not for the effluents but for the solid waste, for low-level waste.

MR. FARAZ: Yes. Any solid low-level waste that they generate clearly would be commercial.

VICE CHAIRMAN CROFF: I mean, they're not giving it back to DOE?

MR. FARAZ: That's correct, yes.

VICE CHAIRMAN CROFF: And if I could stop there, does any staff have some question? Latif?

MR. HAMDAN: Yes. Actually, I have two comments. First of all, liquid waste, what are they proposing to dispose it in?

MR. FARAZ: The liquid waste would be effluents from their decontamination.

MR. HAMDAN: Right. Where would they

dispose it?

MR. FARAZ: This would go into the waste treatment facility. And from there, it will be discharged into the environment.

MR. HAMDAN: The other question, actually, the applicant's use of risk index method, as opposed to PRA, is mainly because NUREG-1520 recommends they use that method, right?

MR. FARAZ: That's correct, yes.

MR. HAMDAN: In other words, if they recommend some other method, the licensees would prefer that method.

MR. FARAZ: I'm not sure that would be true, but it just so happens that they're using the same methodology that 1520 --

MR. HAMDAN: Yes. I will mention this. The applicants prefer to go with that. This way the review would be easier, a lot more streamlined.

MR. FARAZ: There's probably some truth to that, yes.

MR. HAMDAN: Thanks.

VICE CHAIRMAN CROFF: Okay. John?

MR. FLACK: Yes. I would kind of follow up on this ISA. How does that enter into the decision-making process? I mean, you write about that in your SER. Does that support decisions? When you have health risks on that list, is that quantitative health risks or is that qualitative or how do you go about assessing those?

MR. FARAZ: Well, clearly we address -- you know, we look at the ISA, and we review it. What they submit to us is an ISA summary. Also, we go on site and look at their ISA and review the actual ISA documentation. And we look at the accident sequences. We look at their methodology and all of that. So clearly that goes into our decision-making process.

And the second part of the question was?

MR. FLACK: Well, no. I'm not even at that point. Looking at it for what? For what reason? I mean, are there some goals that you have assessed?

MR. GITTER: Yes, absolutely.

MR. FLACK: And then do you do important measures to find out if there are vulnerabilities that could be fixed at some reasonable cost or is it just based on some bottom line frequency number that you come up with?

MR. FARAZ: USEC is required to protect the workers, the public, and the environment. There are certain exposure doses, limits that are set. For instance, the workers should not be exposed to more than 100 rem, let's say.

MR. FLACK: With some probability.

MR. FARAZ: Yes, that is correct. The likelihood is also considered. So if they are in an accident sequence that results in exposure of greater than 100 rem, then they have to make that license sequence highly unlikely. And that has --

MR. FLACK: And that has a probability.

MR. FARAZ: There is a likelihood associated with it, yes.

MR. FLACK: Right, right. Yes.

MR. FARAZ: Yes. And there is highly unlikely, and there is also unlikely. So lesser impact accidents, they would have to make those unlikely. That's what the regulation says.

MR. GITTER: John, just to add to what you already said, we have performance requirements in Part 70. Part 70 is really call it a risk-informed performance-based rule. And if you look at Part 70, you will see a matrix in there.

And just as you all describe for high consequence events, it has to be shown to be highly unlikely. And, likewise for intermediate consequence events, it has to be shown to be unlikely.

Now, it's not a PRA method. And you're

not going to see that in fuel cycle facilities for a number of reasons. They're not reactors. You don't have a lot of the failure rate, meant time to repair sort of data.

And in the case of both USEC and LES, you're relying heavily on operating experience. You know, with a lot of the operations at the USEC facility, you had similar operations at the gaseous diffusion plant.

So you do have an operating experience you can rely on to assign meaningful frequency or come up with meaningful frequency information. But it really is frequencies and not probabilities. You're talking about a range of frequencies.

MR. FLACK: Probablistic frequency, actually.

MR. GITTER: Well, you could say that, yes.

MR. FLACK: But as in NEPRA and so on, you can always separate sequences and drive them as low as you want by adding more and more things to them.

MR. GITTER: Right.

MR. FLACK: So you have to be very careful on how you do that. And I guess when you do a PRA, you can do things like importance measures, look across sequences, and seeing how things could change. That's not one sequence but many sequences. But without a PRA, I don't know how you could do that using this method.

MR. GITTER: PRA is just one approach. It's a deductive approach. This approach looks at it differently, but it has concepts very similar to what a PRA would have. And you look at the unmitigated consequences. And if your consciences, for example, are high consequences, then you need to identify items relied on for safety to drive down the risk.

MR. FLACK: Thank you.

CHAIRMAN RYAN: I'm reminded by this last discussion of many of the same and similar comments that everybody talked about in the ACRS meeting on MO_x. And I want to add that, as we think about probablistic risk assessment from our perspective and hear about ISAs, we're not intending any criticism necessarily. We're just simply trying to understand differences and similarities.

And having sat through many, many hours of the ACRS asking similar questions, I'm reminded that we're as much of gaining information as well as trying to understand.

So I don't want you to take away thinking that this is a bad system, but it's not the system we're all as familiar with, either on the Yucca mountain site, for example, or in the reactor area.

MR. GITTER: I understand.

CHAIRMAN RYAN: So we appreciate your patience in helping us really appreciate some of the details. So again thank you.

DR. LARKINS: Yes. I was going to clarify something. To go back to the discussion on the schedule, so there would be an opportunity to provide some comments when it's in final, the SER and EIS? That's the current plan?

MR. GITTER: I'm sorry, John? Could you repeat that?

DR. LARKINS: I said there would be an opportunity when you finish the EIS and the SER to provide some comments or review?

MR. GITTER: Our plan for the final for the SER was to go ahead and issue a safety evaluation report without sending it out for comment.

DR. LARKINS: So you don't have any plans --

MR. GITTER: That's in order to meet the Commission's order for the 18-month technical review schedule.

DR. LARKINS: Okay. I thought we had discussed this before and it would be some opportunity for the committees to comment on it.

MR. GITTER: My understanding was the ACNW was going to receive an information briefing only. That was our understanding.

DR. LARKINS: Okay.

MS. DAVIS: This is Jennifer Davis. I'm the Chief of the Environmental and Low-Level Waste Section.

What we can do is go ahead and put you all on distribution for the draft EIS when that comes out in June. So that would be an opportunity, as Mike had suggested, to go ahead and comment in the early stages. But that is purely the environmental part.

DR. LARKINS: Thank you.

VICE CHAIRMAN CROFF: Any more questions?

(No response.)

VICE CHAIRMAN CROFF: Okay. Thanks for a very informative presentation, appreciate your time. And we'll look forward to this summer.

Back to you.

CHAIRMAN RYAN: Thank you, Allen.

We do have some other business to think about. So we'll continue on with our agenda. I don't know that we need to be on the record at this point. Can you advise me, John or --

MR. FLACK: No. I think you can stop recording.

CHAIRMAN RYAN: So we can stop the record for today here. Thank you very much. We're still in session, though, but thank you all for participating.

(Whereupon, at 4:54 p.m., the foregoing matter was adjourned.)