



***High-Burnup Used Fuel  
Demonstration Workshop Report***

***August 22-23, 2012  
Idaho Falls, Idaho***

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## ACRONYMS

BRC	Blue Ribbon Commission
DOE	Department of Energy
DOE-NE	Department of Energy Office of Nuclear Energy
EPRI	Electric Power Research Institute
HBU	high burnup
FY	fiscal year
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
LINE	Leadership in Nuclear Energy
LLNL	Lawrence Livermore National Laboratory
NEI	Nuclear Energy Institute
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PEP	Project Execution Plan
PNNL	Pacific Northwest National Laboratory
SNL	Sandia National Laboratories
SRS	Savannah River Site
TAN	Test Area North
UFD	used fuel disposition
UNF	used nuclear fuel

# High-Burnup Used Fuel Demonstration Workshop Report August 22-23, 2012

The High-Burnup (HBU) Used Fuel Demonstration Workshop was held August 22-23, 2012 in Idaho Falls, Idaho, at the Shilo Inn. The event was hosted by the Idaho National Laboratory (INL).

## **August 22, 2012**

### **1. WELCOME (John Grossenbacher, INL)**

INL Director Admiral John Grossenbacher welcomed the group. He noted that the group included representatives from Nuclear Regulatory Commission (NRC); Department of Energy (DOE); the nuclear energy industry, including companies and the Nuclear Energy Institute (NEI) and the Electric Power Research Institute (EPRI); government-owned contractor-operated laboratories of DOE including Sandia National Laboratory (SNL), Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory (PNNL), Savannah River Site (SRS), INL, and Lawrence Livermore National Laboratory (LLNL); and universities.

Grossenbacher commented that the location was good for this workshop. He identified the role of INL as an integrator of technical capabilities. INL also maintains fuel, including Navy used nuclear fuel (UNF), providing INL with significant experience with the storage of UNF. He asked the group to think about the technical issues of what needs to be done and also identify the roles that the different entities should play. What is important for the success of the enterprise?

Grossenbacher also discussed the ongoing debate in Idaho over the role the state plays in nuclear energy. He noted that there are burdens and benefits of nuclear energy. A commission has been formed to explore options and engage in the broad discussion of how the state can deal with this issue.

### **2. THE ROLE OF THE IDAHO NATIONAL LABORATORY AND USED NUCLEAR FUEL (Dave Hill, INL)**

Dave Hill, INL Deputy Laboratory Director for Science and Technology, provided information about INL. He identified INL capabilities for nuclear research. Nearly any type of research can be conducted at the laboratory. A key issue is whether commercial UNF is limited or banned from coming into Idaho. Hill reviewed the background and requirements of the Settlement Agreement between DOE, the Navy, and the State of Idaho for UNF. The Settlement Agreement was conditioned on the availability of Yucca Mountain as a geologic repository for high-level waste (including UNF) by 2035. The Settlement Agreement initially allowed commercial spent fuel on a case-by-case basis upon approval from the state. It was subsequently modified to allow INL to receive up to 400 Kg heavy metal each year for research before State approval is needed. Hill addressed the Idaho Governor's recent formation of the Leadership in Nuclear Energy (LINE) Commission to identify at the state level what Idaho can do to promote the future of nuclear energy in Idaho. He described the makeup of the commission and the proceedings to date. The LINE Commission is, in part, a result of the Blue Ribbon Commission (BRC) on America's Nuclear Future. The purpose of the commission is to open a politically centered debate over what the state could do. Hill then described the INL capabilities for management of UNF. Hill commented that states are going to have to engage on the subject; they can't leave it to particular communities, yet interested communities are needed.

Rod McCullum, NEI, asked about Yucca Mountain and the Navy's ability to reach agreement with the state regarding continued receipt. He asked what assurances the Navy had to provide to let the state know the UNF would be safe. Grossenbacher replied that he was not certain of any specific assurances, yet he noted a few items. There is not a great amount of Navy fuel; about 30 metric tons is received each year. The Navy demonstrates a great deal of control and accountability in its care of UNF. They do it very well and it is a national security matter. Hill noted that the Navy fuel is different. INL fuel is viewed with more suspicion. McCullum asked whether the issue has come up regarding bringing commercial UNF into the state for research and long-term storage. Hill replied that this is one of the central questions for the LINE Commission to address. One commission meeting was devoted to the debate over whether the Settlement Agreement is sacrosanct and should not be revised. Grossenbacher added he is pleased with this whole effort because it puts the burdens and benefits discussion on the table. The other thing it does is internally to Idaho, it helps people to understand that the Settlement Agreement is really not focused on UNF. The real focus is the waste that was disposed of at INL from Rocky Flats and the threat of Idaho becoming a de facto repository. People are now considering the risk is of buried waste versus stored UNF. Buried waste is the threat to the aquifer. For the first time, these questions are being addressed. The state is also realizing the realities of the leverage it has over the federal government. The Settlement Agreement allows continued shipments of DOE fuel from domestic and foreign research reactors and also the Navy fuel. These issues are beginning to be understood within the State. The political scars are big and real. However, all involved are reviewing the potential for partnering on these matters and trusting the federal government based on its record, not just its promises.

John Kessler, EPRI, noted that some of the proposals for this particular demonstration would involve bringing more UNF into the state than the current limit of 400 kg. Seeking approval to surpass that limit might involve its own issues. Hill noted that this is not a limit in the physical sense. If we have a need for research, the INL would approach the state for approval. INL cannot promise the state would agree but could promise we could have this discussion in a serious way. More clarity may be obtained after the LINE Commission finishes its work. In follow up, Kessler asked when the discussion on this type of proposal would take place. The LINE report is to be delivered by January 1, 2013. Would a decision be expected by late 2013 on whether this would be approved? Hill noted that there is no restriction on bringing up this discussion before the LINE Commission report is issued. It will help frame the Commission's recommendations. It would be nice if the Governor could indicate in his State of the State address in January how he is reacting to the recommendations. Hill would like to provide a date but that is difficult to predict.

Steve Nesbit, Duke Energy, stated that what we are talking about is having one or more casks of commercial UNF transported to Idaho for research. Has this proposal been broached with the Commission in terms of the types of activities INL would like to pursue? Grossenbacher replied that the specific question had not been brought up. There has been a lot of discussion on interim storage. Independent of the LINE Commission, he emphasized that INL would pursue this under the terms of the Settlement Agreement as it now provides. Nesbit commented that we have to do something, we cannot wait. We have to do it somewhere and there is a lot of impetus for that to be Idaho. We need to know if this is feasible. This should be brought up to the Commission. Grossenbacher committed to making sure that if the group would like its input to be brought to the Commission, INL certainly could do this.

Kessler addressed timing. In terms of considering funding to modify the building to accommodate a cask, we may need state approval soon enough to support the project getting into the DOE funding cycle. Hill commented that many of the activities can proceed in parallel. A technical path forward is always needed, with the political constraints to be factored in. Hill stated that the discussion on acceptability of the project could begin today. Absent a reasonable prospect of this project, DOE may not be interested. This project may be subject to the capital acquisition process. Grossenbacher noted that the concerns over state approval are valid, and that is a big question. However, we will never know until we ask. He

described the example of the process between the State and INL for receipt of waste for treatment at INL as long as it is treated and leaves the State within specified time limits. The process of working with the State is straightforward. Hill also noted that outside of INL there is interest in counties hosting independent UNF storage sites. People have actually bought land for this purpose. So the discussion is broader than INL. Because of the history this is an important issue, but because there is a framework in the Settlement Agreement, there is a way to conduct the debate.

Paul Murray, AREVA, asked if other DOE facilities have indicated they are interested in hosting a demonstration – how will DOE decide where to host it? William Boyle, DOE, noted that politics are important, as well as the technical issues. His guess is that the final decision will be guided by political considerations that will be resolved at political levels. If multiple sites come forward for consideration, they will be considered. Hill commented that part of the purpose of the LINE Commission is to educate the political elite that the state does not hold the trump card.

Craig Seamon, NAC International, noted that the Settlement Agreement currently requires the waste to be removed by a certain date. How is INL handling this? Hill replied that as materials are received, INL works to ensure the materials leave the site within the designated timeframes. This includes things such as shipments to the Waste Isolation Pilot Plant. Grossenbacher noted that the used fuel and stored calcine will not be removed from Idaho by 2035 because there will be no place for it to go. The state may consider meeting with DOE to negotiate a new date. The other issue is regional equity. If you look at where the reactors are across the country are located and where UNF is located, it's in the east. For this part of the country, nuclear energy means the mess at Hanford and claims of downwinders from nuclear weapons. The region asks why it should deal with the burdens of nuclear energy.

Jim Tulenko, University of Florida, noted that there are 20 states out there in which the amount of fuel in storage makes the test look trivial. Maybe a commercial site would be the likely place for such an experiment. Hill noted that INL has UNF as well.

McCullum, NEI, asked to what extent the recent court decision vacating the waste confidence rule affects the LINE commission deliberations. Grossenbacher responded that this action has been noted and it emphasizes the need to address the problem. McCullum noted that if INL were to build an interim storage facility, the licensing would be dependent on the waste confidence rule. This raises the question whether NRC would regulate the facility or whether it would be regulated under DOE authority.

### **3. WORKSHOP OVERVIEW (Steve Marschman, INL)**

Steve Marschman provided an overview of the workshop. An attendee list is provided in Appendix A. Kessler asked Marschman what he desired as an outcome of the meeting. Marschman replied that DOE has asked INL to lead a project to look at attaining data for storage confirmation purposes. Some other projects are also being funded such as a test in a hot cell. As we look at those needs, we want to integrate them into a program so that each customer's needs may be taken care of properly. What we have not yet achieved is an understanding of the requirement for the demonstration – what is to be done and when. As a project execution plan is prepared for the demonstration, the options for meeting the requirements will be addressed. We are looking for consensus on requirements – what data are needed, how the data will be collected, etc. When we think about a timeline for a demonstration, there is not a lot of time before decisions must be made on what goes into a cask. We need to close on some issues and identify issues that need to be resolved in order to implement the demonstration. This will be a major project and a successful strategy is needed to bring it about.

McCullum agreed that a success strategy is absolutely needed. Industry wants a clear path forward for when the demonstration is needed and what will be covered. Failure is not an option. The right people are

in the room to get a path forward defined and commitments made to work on the steps. Marschman noted that the INL sense of time is different from industry. The pace of government may create some tension. However, INL will try to explain the limitations clearly so that ways to work more quickly can be pursued. A strong plan with clear deliverables is needed.

Rob Howard, ORNL, asked what the format is for articulating and documenting the requirements. Marschman replied that they will be captured in a Project Execution Plan (PEP). The PEP will be reviewed by DOE and industry. We will follow that process for each part of the project as it develops. The initial PEP is due in 6 months.

Richard Williams, CWI, noted that the demonstration is to establish the means to an end. He asked if the end goal had been defined. The demonstration that was done at INL's Test Area North (TAN) confirmed that the data obtained in the laboratory and from calculations matched with the actual conditions. Relicensing of facilities is based on these tests. Marschman commented that now utilities are raising the burnup of the fuel and allowing it to stay in the core longer. This increases the stress and strain on the fuel. This project is to demonstrate safe storage of this UNF. Another issue is how long it must be stored, then how will it be handled and moved at the end of the storage period. Laboratory testing and other testing will also be needed over time. It was explained that this concept started with the extended storage demonstration program.

Seamon asked about the existing capabilities of the laboratory now to do work such as handling and testing of PINs and fuel assemblies. He would like an understanding of the current infrastructure and what would need to be built. This question was deferred because the program will be nationwide and will use the resources of all the national laboratories. Campaigns for work will be planned based on the requirements for the demonstration.

McCullum addressed the question of the objective of the test. He emphasized that the issue is waste confidence. The recent court action puts a lot of focus on dry storage and this demonstration in order to re-establish waste confidence.

#### **4. USED FUEL DISPOSITION (UFD) CAMPAIGN UPDATE (Ken Sorenson, SNL)**

Ken Sorenson, SNL, provided an update on the UFD campaign. Tulenko asked if DOE was focusing any efforts on looking at monitoring and inspection of dry storage. Sorenson responded that there are tasks to begin looking at this. This effort is just starting and needs some careful consideration. McCullum asked about the funding in the four control accounts used to manage the technical work and what the picture is for Fiscal Year (FY) 2013. Boyle replied that there is some uncertainty regarding FY 2013 but planning is beginning. Storage and transportation has a little over \$9M in funding planned for all five accounts, broken down as follows:

1. Experiments	\$4.0M
2. Analysis	\$1.6M
3. Transportation	\$1.8M
4. Field demonstration	\$1.6M
5. Security	\$0.2M.

The major focus is on the experimental activities.

## **5. PLANNING FOR A HIGH-BURNUP FUEL DEMONSTRATION**

Perspectives from NRC, industry, and the research community were provided for planning the criteria and approach for a HBU fuel demonstration.

### **5.1 Nuclear Regulatory Commission Expectations for a High-Burnup Fuel Demonstration (Bob Einziger, NRC)**

Bob Einziger, NRC, provided a discussion of the HBU Fuel Demonstration. (He spoke from notes and did not use a viewgraph presentation.) He provided background on the initial demonstration started in Idaho in the mid-1980s. Due to the goals of the demonstration, there was no characterization of the fuel. The other problem with that demonstration was that the records had expired and could not be found. This led to lesson number one: keep good records.

Around the mid-1980s, NRC and EPRI decided to open a cask that had been storing fuel. Funding was pulled together, a cask was chosen, the cask was opened in the TAN facility, and some fuel rods were taken to Argonne National Laboratory-West and to Argonne National Laboratory-East for examination. The conclusion was that the fuel was good for at least 100 years. Later, an effort was initiated to evaluate a demonstration for HBU fuel, but the demonstration was never started. The issue regarding extended storage of fuel then arose. The decision was made that a 300-year period should be used for the purposes of evaluating data and predicting changes. This does not mean licensing will be for 300 years. NRC also raised the question of evaluating HBU fuels for interim storage, not necessarily extended storage. DOE began reviewing this question and determined that a demonstration would be appropriate.

The HBU demonstration program addresses the actions needed to monitor cask performance and monitor cask conditions. There are a lot of ways to address these issues. One approach is a split demonstration where the fuel is evaluated separately over a period of time independent of the storage cask. However, if the objective is to support current storage, this approach may not be suitable. For current storage, it is known that there may be things happening with HBU fuel that are different from other fuel. There is no substitute for confirming performance against laboratory data. This project is intended to support approval of casks for storage and for renewal. This is to be a confirmation of what is expected, because there is always a chance that something unexpected is going on. This is needed as one way to support license extension. The timeline for this demonstration is key. There are currently several facilities that have been storing HBU fuel for at least 4 years. Data is needed when the 20-year relicensing period comes up. NRC would like the demonstration to involve fuel rods with burnups as great as 55 and a diversity of cladding types and different structures (e.g., Westinghouse's ZIRLO™, AREVA's M5™, and Zry-4) although it may not be possible to get all into one cask. As far as atmosphere, between 1 and 5 atmospheres backpressure under dry conditions would be preferred. A drying procedure is recommended in the NRC Standard Review Plan. As far as temperature, a maximum cladding temp during drying of around 400°C would be preferred, and the demonstration should follow temperature profiles during normal operating conditions.

Past projects did not have the monitoring needed to help with evaluating results. It is almost an imperative to monitor temperature within the cask as temperature indicates degradation. Monitoring of Kr 85 for the first 50 years is good to indicate if rods are failing. Nitrogen and oxygen should be monitored to see if radiolysis is going on; if water is being generated, hydrogen should be measured for flammability. Optional monitors would be accelerometers on the fuel. Einziger noted that most monitoring does not require actual contact with the fuel, but accelerometers would. He thought it would be ideal if a package

could be dropped into a canister that would generate the data needed for monitoring. This could be compared with what can be obtained through feed through. He emphasized that time is of the essence. Demonstrations should not be delayed to develop monitoring techniques. If you are monitoring throughout, the data can be used immediately in licensing. You do not have to wait until the time period for the demonstration has ended. There must be some way to monitor periodically.

Einziger discussed temperature monitoring because of the importance temperature plays in many of the mechanical properties of the materials involved. One question is hydride reorientation. He explained that during fuel drying the cask internals are allowed to reach 400°C. Zirconium hydrides that formed during reactor service can dissolve and the hydrogen goes back into solution in the clad. As the fuel cools, the hydrogen solubility in the clad drops and the hydrogen bonds with zirconium, precipitating as new zirconium hydrides. These new hydrides, which are brittle, will precipitate preferentially with the residual stress gradient in the clad. Thus, the new hydrides can be oriented across the width of the clad and this results in a weaker fuel clad. Therefore, you want to monitor to determine the hot area in the cask to determine where the effect of reorientation could be the greatest. The other important part is fuel rod examination. It would be ideal to pull some rods out of the assemblies before they are put into a storage cask to characterize them for their initial condition prior to storage. At some point, you are going to want to take some rods out of the assembly that has been dry-stored and compare those to the fuel that was examined in its initial state. Einziger raised the question whether the assembly needs to be kept dry. He is not convinced that the assembly would have to be kept dry. There is always the potential that an assembly would have to be put back into a pool.

## **5.2 Industry's Perspective on the Need for a Demonstration (Rod McCullum, NEI)**

Rod McCullum provided a presentation on the industry perspective on the need for a demonstration. He commented that Einziger had done an excellent job of laying out what needed to be addressed in a demonstration. He emphasized that a demonstration is needed to address waste confidence. No licensing or renewals can take place until this issue is resolved. This must be solved from a technical basis. This demonstration is our first opportunity to move forward. Consolidated storage is a priority for industry, but nothing can be done until waste confidence is resolved. He also emphasized that data must be gleaned from real world situations, not just from laboratories. The public will understand data from actual casks instead of data from labs. He believes NRC must demonstrate that waste can be stored for at least 60 years. He believes just looking out 20 years will not be sufficient. McCullum commented that he was optimistic that DOE could undertake this demonstration within a time frame that meets the nuclear community's needs.

Adam Levin, Exelon, clarified that the waste confidence rule and the ruling by the NRC may allow renewals that are underway to proceed but that new renewal requests will be affected. Nesbit commented that his company (Duke Energy) has 12 operating reactors. They have five Independent Fuel Storage Facility Installations and are planning to develop a sixth. He agreed with McCullum's comments. When operating reactors, there are questions whether a shutdown is needed. A unit threat team is formed to solve the problem, bringing in resources from across the company. Industry does not debate what path to take. It takes multiple paths to solve the problem as quickly as possible. The issue before the group is to solve an industry-wide threat and the appropriate gravity needs to be brought to the problem. The resources of the DOE Office of Nuclear Energy (NE) should be brought to bear on this issue. He feels like this point is not appreciated by the entire group. Over the course of the day he hopes the group can agree on the urgency and come together.

### 5.3 Critical Data to Obtain from a Demonstration (Brady Hanson, PNNL)

Brady Hanson, PNNL, provided a presentation on critical data to obtain from a HBU used fuel demonstration. He is seeking to obtain the minimum data versus what is “nice to have”, how to obtain the data, and impacts of non prototypic activities for data collection. The main advantage of a demonstration is that it allows evaluation of combined effects, and things may be observed that were not observed during separate effects tests. The desire is to establish a long-term test platform that will run for decades. The main purpose of the demonstration is public confidence. There is also a secondary reason of exploring the potential for improvements in monitoring and detection systems. The most important aspect is to look at what is on the inside – fuel, cladding, hardware. Items such as baskets and canisters will be given secondary priority because the different cask manufacturers have different designs.

Hanson reviewed the technical data gaps that had been coordinated and compiled by Kessler. On the question of temperature measurements, Nesbit noted that the question is whether you need measurements to validate thermal models or to understand temperatures across the fuel. Hanson noted that the goal of validating thermal models is to develop integrated models for degraded material properties. This is not the goal of the demonstration. There is a need to understand exactly how the fuel performs in the long term if it must be re-wet. Hanson explained that the preference is to open a canister in dry conditions. Nesbit differed in that the demonstration program is needed to look at the fuel dry without re-wetting. If you want to do subsequent analysis that demonstrates down the road the you can get by with wetting the material as you examine it, then that is okay; but to take the best shot and do it right from a public acceptance aspect, you need to do this right and do it right the first time. However, you don’t need to spend all your money up front on a facility; you need to concentrate on having a demonstration program in place. Hanson agreed. Marschman noted that the plan would evaluate a scenario that would start at a facility where fuel is opened under water after 15 years, then other casks could be opened at different times after different durations. The concern is that a demonstration is started and funding for a facility cannot be identified. Nesbit replied that a worst-case scenario is that you cannot open under dry conditions; however, if you have the demo program underway, then you can deal with this because the program is already moving along. His concern is there will be a facility with no work done.

Kessler noted that the approach could be simplified a bit. For example, he identified that there would be certain data that could not be recovered within 10 years. These needs would be identified and then plans should be made for continuing to meet the needs.

Sorenson commented that they are sensitive to not letting the “ideal” derail getting work accomplished. Perhaps the sister rod approach is the way to go. You have sister rods in a hot cell so that other questions can be answered down the road. We don’t want to put a lot of investment into a demonstration and not get useful data.

An attendee clarified that in the fuel category dealing with fuel swelling and hydride buildup, these are issues akin to what other researchers refer to as stress effects. These may be combined. Another attendee asked if canister issues would be part of the demonstration. Hanson replied that because the different vendors have different designs, it is difficult to evaluate. They plan to defer to the groups that are looking at the outside of the canisters. Kessler noted that there were many studies regarding the canisters. Since this issue is being considered separately, it would not be part of the demonstration.

An attendee noted that a requirement of inspections must also be addressed. Inspections will be part of an aging management program required for relicensing.

Hanson raised the question on the length of time for the demonstration. Once it starts, how long should it keep going? Einziger commented – you should look for creep in this demonstration. Some are convinced creep is an issue. With respect to oxidation, you are not going to take a rod and stick a hole in it for this demo, but if by chance, there are a few breached rods that go into the demo that is good because it gives us more data. Einziger felt it was not out of the question to include a failed rod in the test. If you have the attitude you must have failed rods, then you have to look at the operational problems you may have with a utility in doing that. There is a trade off in terms of operations. Kessler felt it was a bad idea to include a failed rod. You will not be able to determine what fission gas is coming from the failed rod versus the other rods. Einziger contested this point. He felt that if a rod had failed, the fission gas would have been dissipated. Kessler also noted that the rods would be stored in helium. Einziger stated that that if there is water in the canister, radiolysis may lead to oxygen. Einziger also stated that failed rods were generally not managed differently.

Nesbit summarized that the best approach was to look at normal conditions including intact fuel. A good robust program moving forward is needed without a lot of permutations. Einziger agreed that failed rods could make interpretation of results a bit more difficult, but failed rods could be managed. Nesbit emphasized that the standard practice is to load intact fuel.

The question was asked what regulatory hurdle we were trying to get over with the demonstration. Jim Rubenstone, NRC, clarified how the information needs were identified in the report. The overall regulatory gap is that the requirements say a container must satisfy safety functions. The safety analysis must specify how these functions are being met. This information is fairly straight forward.

Hanson identified that canisters and containers data were in the ‘nice to have’ category. Einziger commented that the priority might be even lower than that. He summarized past work that indicated that particular technical issues only apply to particular absorbers.

It was noted that the past evaluation considered the external temperature not the internal temperature. Hanson clarified that there were sensors in the earlier study. However, he noted that the focus would be internal. One commenter noted that the material properties cladding can drive the thermal issues, which may be the “tail of the dog.” This has changed a little with HBU but you are still dealing with the loading temperatures. You still have the same physical actors and attributes. One way you can look at that is solubility limits in the hydrogen in the cladding. If there is a difference in hydrogen solubility it may be more important than a small difference in temperature.

Einziger asked about differences and difficulties in taking a gross temperature instead of temperatures at a specific location. Tom Danner, NAC International, noted that the loading would be done under 30 feet of water, and the finer the detail needed, the more difficult it would be.

Tulenko noted that he had data from past work looking at horizontal and vertical configurations to show the inherent effects and heat transfer mechanisms of convective and irradiative cooling. Kessler noted that there is an advantage of having thermocouples in locations other than the guide tubes. Carl Beyer, PNNL, noted when you attach a thermocouple to a heat source that affects temperature. Einziger commented that the process NRC went through to set an assumption of 400°C as a temperature was based on a conservative approach.

Hanson asked the group for input related to radial temperature distribution and approaches. He commented that the thermocouples may not last very long. Boyle commented that he questioned why we would expect them to fail; he felt they have been more long lived in other tests.

Nesbit noted that it might not be practical to get too much definition up front from the group. Hanson noted that Marschman's job is to prepare a plan that will state what INL wants to get out of the demonstration. Marschman commented that we may want 50 thermocouples but if we are constrained by the vent holes, we must take that into consideration. The design that can be licensed may influence the demonstration. Einziger stated that Argonne wrote a report that looked at monitoring the inside of the cask with various devices. There were some novel techniques for temperature measurement.

Initial condition of fuel – do we have enough data on that? How does crud affect the fuel? If we need to stop to get these issues factored in, this may delay the time. Another issue is the universality of the model we will use. Hanson questioned if we are going to allow for different codes or lock into one code. Harold Adkins, PNNL, noted that multiple codes are used. He noted that the COBRA code is available but not user friendly. He reviewed other codes that may be more useful. He emphasized that if you do the analysis properly, you should end up with consistent results. What could be addressed is the question whether the variance between the different codes is understood.

Hanson addressed monitoring and measurement. Allan Wertsching, INL, identified that in addition to pressure changes you would want to understand the gas content to understand what is contributing to pressure changes. Phil Winston, INL, commented that the casks sitting on the pad that are part of the original program are monitored for temperature and pressure, and some are sampled every 2 years. Typical frequency is 5 years; they look at 10 years for some. The samples have not been of such a large volume that gas needed to be replenished. The canisters are backfilled with nitrogen. If you are sampling Kr and Xe, based on decay you can estimate burn up level. Sean McDevitt, Texas A&M, identified that they are working on sensors that could be used in a demonstration. On gas monitoring, they are brainstorming how to accomplish this. This is important but a strategy needs to be developed.

Hanson raised the question of what is required to replace a component. Kessler stated that what we need in terms of temperature distribution and temporal changes, we need to know what portion of the cladding will get over 400°C, and how rods react when pressurized during drying. This up-front data will give information on stresses in cladding that could lead to hydride accumulation over time. Then we can wait for some period of time. The same applies to gas sampling. If you are concerned about adequacy of drying, conduct gas sampling more frequently up front to determine if water is forming again.

Nesbit commented that you want temperature while you are doing something in the initial stages; then you want to know temperature once the cask reaches steady state. The data are used to evaluate codes not satisfy safety criteria. Einziger disagrees a bit. He feels at this meeting we should focus on what questions need to be answered and what questions need to be further evaluated by design teams to see if they are important to answer. The important thing from this meeting is identification of the questions not the answers. Hanson requested the larger group to assist in the process.

Hanson commented the group should identify issues that can be addressed during a separate effects type test and those to be addressed through a demonstration.

Kessler suggested the questions are whether we should wait for a better thermocouple or should we plan to use what we have. These are the types of questions we should be addressing. McCullum suggests moving forward without waiting for a 'better thermocouple.' Hanson emphasized that we need to identify what is to come from the demonstration.

Winston suggested that a group could be formed to design a straw man approach to the problem and the minimum design criteria needed to address the needs. McCullum suggested that EPRI has some funding for conceptual design. He asked if EPRI might take this issue on. Kessler noted that EPRI would certainly like input and feedback in establishing conceptual design, so the groups may have mutual purposes.

McCullum asked if EPRI could assist. Kessler agreed that EPRI could take the slides and prepare feedback on the conceptual demonstration design.

Einzigler noted that a significant effort with data gathering may not be needed to support the demonstration. McCullum agreed and commented that there is a supply of fuel and claddings to start with. Once this is started there is time to decide what data on the cladding is needed.

Sorenson asked if the list developed by Hanson was kicked up a level, would all the different cladding and varieties be needed or could the demonstration start with just a few cladding types. Einzigler felt this was a question of needs versus desires. If more cladding types are available, it would be desirable to include them but not necessarily required. There will be some limitations if you don't plan to design a special basket. You may have to make tradeoffs and work with the candidate fuels you can get. Nesbit identified that the current candidates did present a wide range of materials. He commented on the question of what data on burn up properties, etc. was really available. He suggested sitting down with the vendors to obtain more information.

Hanson identified that the question with cladding is the differences in temperatures of the HBU fuel. We want to confirm that our predictions about the cladding are correct. McCullum asked if fuel was available that could provide a 10- to 15-year study. Nesbit noted that this would take about 400 years. He described the differences in temperature across a canister that may be experienced. Hanson noted that we need to study the hot part and study it as it cools. He noted that with reactors, the ends cool rapidly down to the temperature differences you are looking for.

Kessler commented that the purpose of the demonstration is to look at how performance lines up with the model. No one is going into the test with the idea it will produce statistical data. It is a test to show that what we thought would happen did happen. So he sees little need for many separate tests.

Hanson identified a question of timing. We will use the demo to confirm what we have developed through other means. Tim Morrison, Xcel, reiterated the urgency. They have an application for relicensing pending now. One of the contentions to the licensing is expected to deal with HBU fuel, and they will be addressing it. Nesbit stated that the concern about instrumentation should not delay the project. Fancy instrumentation is not needed. We can't get into the process of gathering data down the road unless we start.

McCullum noted the demonstration is the first building block. If the studies find things that need to be known, we can do other demos. We should get started with real time data on the HBU fuel that is in storage now. That will not be the only demonstration. We have utilities ready to load a suitable population of fuel that is 4 to 9 years old. Morrison commented that his company has an inventory of fuel that could be used. Tulenko noted that we should think about this problem in a phased approach that can be adapted. The first thing you do is the most simple thing. Get one loaded up with a couple of temperature probes to get started. You can learn from that. Don't assume that one cask will do everything you need. Hanson commented that this information helps provide the technical justification for the approach of multiple casks.

Levin summarized that the best interests of the utilities today is to get a demonstration started. NRC is looking for the basis upon which they can conclude with reasonable assurance that the casks can be relicensed for another 40 years. The best thing to do is to move forward and reach the 10 year time to open a cask as soon as possible. The industry understands that the demonstration will go longer than that, but action within a shorter time frame is needed. He wants to be able to show the stakeholders that the fuel will not fall apart when the cask is opened. In the best interests of the utility, get the demo started so the cask can be opened in 10 years.

Marschman commented that there are objectives of addressing waste confidence and also understanding the end state on a long-term basis. Therefore, a two-pronged approach may be needed. It will be important to address the immediate issue of waste confidence with urgency. But it is also important to ensure the safety of casks in general over the long term. McCullum commented that the study of low burnup fuel was based on fuel that no one selected. However, it gave NRC the confidence that it low burnup could be stored safely. He emphasized the need for early success.

Sorenson noted the group is approaching consensus on a strategy that starts immediately with a demonstration of what is needed to address waste confidence and also looks to the longer term question of continued performance. He brought up the possibility that sister assemblies might be useful in implementing the strategy.

## ***August 23, 2012***

### **6. SUMMARY OF PREVIOUS DAY, INCLUDING TOUR OF IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER USED NUCLEAR FUEL MANAGEMENT CAPABILITIES (Carl Beyer, PNNL)**

Carl Beyer, PNNL, provided a summary of the previous day's discussion. He noted Hill's discussion of the Settlement Agreement and the process for receiving UNF for research purposes under the Settlement Agreement. He noted that after Grossenbacher's explanation of the LINE Commission and its need to understand the potential for receiving materials for a demonstration, Marschman agreed to provide information to the Grossenbacher for the LINE Commission.

Beyer summarized the points raised by Einziger, which included the specific aspects that could be included in a demonstration. McCullum noted that the key issue to resolve is the NRC waste confidence rule.

There was discussion on whether failed rods should be included in the casks. The general consensus was that this might skew the results or make it difficult to remove the fuel, and that this should not be considered early on. Whether the thermocouples should be located in the guide tubes or along the fuel rod was discussed. It seemed that because the cask would be opened under water, it may be most efficient to place the thermocouples within the guide tubes and not try to handle the fuel.

The group discussed the use of sister rods and seemed to be in agreement that this is desirable. EPRI has agreed to assist in development of conceptual design based on the principles that are developed in this workshop.

In terms of schedule, there is an urgency to begin with a demonstration as soon as possible due to recent actions on the NRC waste confidence rule.

Marschman provided a summary of the tour and the potential to use the facilities at the Idaho Nuclear Technology and Engineering Center (INTEC) for the demonstration. Marschman related that the facility would need some modifications to do the work, but it is encouraging to see that it might work, and it will be pursued.

## **7. DEPARTMENT OF ENERGY ACTION TO SUPPORT A DEMONSTRATION (Steve Marschman, INL)**

Steve Marschman provided a presentation on DOE's actions in support of a HBU fuel storage and confirmatory data demonstration project.

Randy Bohachek, INL, provided a description of how the project will be organized, managed, and controlled. Nuclear safety and quality assurance will be significant issues.

Kessler asked how long it would take before the facility is up and ready to go. Marschman replied that he wants to get started as soon as possible, potentially in parallel with development of the PEP. Marschman observed that good planning up front is the best way to increase the chance of success. The risk is too high not to do rigorous project management and careful planning.

Sorenson observed that it seems the demonstration will take place in Idaho. He asked how this proposal will be integrated with other industry proposals. Marschman replied that the plan is to come up with a viable strategy to implement a demonstration. That might end up being at a commercial site, allowing time for examination facilities to be readied. There are other proposals to move fuel as soon as possible so that post-irradiation examination can be conducted. Marschman's intent is to pursue near-term activities immediately.

Ned Larson, DOE, commented that DOE had looked at whether it had the staff to be the integrator for the project, and it did not, therefore, DOE turned to Idaho for the role of integrator. That is what Idaho has been tasked with. Bohachek noted that the location for a facility will be developed as part of the alternatives evaluation for the project.

Rubenstein observed that NRC has two roles, which may conflict. First, NRC wants the demonstration to take place. Second, NRC will be asked to license facilities. Therefore, NRC must be careful in terms of the extent of guidance it provides on the types of demonstrations needed. The question came up whether NRC would regulate a facility located on DOE land. It was agreed that NRC could regulate a facility at INL, but that this is not a current requirement.

Adkins asked what the timeline was for the demonstration. Marschman stated the plan will be submitted in January 2013 for review and comment. From there the decision will be up to DOE to implement. His hope is that the project will initiate in April 2013. One proposal involves loading fuel in a cask by 2015. INL could try to run this faster.

McCullum stated that from an industry perspective, the facility should be NRC licensed. NRC will be the ultimate regulator and customer for the data to be gathered. It is of critical importance that the loading of the cask at a utility site proceeds independently of development of the facility that would ultimately receive it. Requirements for the facility should not flow back into the cask. The project should accommodate the two elements proceeding independently. Marschman noted that DOE does have the quality assurance needed to satisfy NRC requirement. However, if it would ease project acceptance, perhaps NRC licensing should be considered. Bohachek confirmed that activities such as data acquisition could be initiated immediately. Einziger identified that other demonstrations have been conducted under DOE authority. NRC is most interested in data that is applicable to the situation, and that has been controlled and collected under a quality assurance program. He also stated that NRC is not dependent on this demonstration. It is the industry that is coming in with applications that could use this information to strengthen their case and achieve their desired outcome. The role of NRC is of evaluating the data that is provided so NRC can make its own interpretation of the data. Kessler echoed Einziger's comments. NRC has evaluated a wealth of data collected by facilities that were not NRC licensed. This was the process for

low burnup fuel. NRC is aware of what data are collected well and what are not. Kessler commented that he was pleased to see that the UFD Campaign plans to do separate effects tests on two rods. He asked if this was funded and what specifically was planned for separate effects testing. Marschman replied that in FY 2013, the campaign has committed to finding the remaining funding needed for the test and to begin looking for fuel. If fuel is located, INL will pursue obtaining it for the test. Marschman has budgeted about \$0.9M for the activity.

Larson clarified that the \$1.6M for laboratory activity is not the only funding. There is also about \$2M for non-laboratory funding. He feels that we are well positioned for funding the effort. Sorenson commented that there are other pockets of funding available that could be combined.

Hanson noted that it would be ideal if a sister assembly could be a part of the small-scale test to support the same approach in the larger demonstration. Hanson asked the group to think about how INL could get the assembly for a small-scale test as soon as possible. Marschman noted that there might be some issues to be resolved for transport of the materials to INL.

Morrison asked what entity will be responsible for collecting and analyzing the data. Marschman replied that the project will be an INL project and INL will lead the data collection and analysis. It is desired that the reports have multiple authors representing multiple organizations and contain integrated input.

McCullum asked the industry representatives about their ability to provide sister rods early in the project. Tom Brookmire, Dominion, noted that this was planned as part of their proposal. This will involve reviewing the certifications for the transfer casks, making sure the vendors are available, preparing non-disclosures and other issues. Industry commented that the beauty of a phased approach is that things do not have to happen all at once. The fuel can be removed and the transfer can take place when INL is ready to receive it. Morrison agreed that they could also perform this. He noted that the fuel belongs to Westinghouse, who will have to be involved.

Keith Waldrop, EPRI, identified the biggest risk of the project coming to sustained completion is funding. How can we ensure funding will be there for the long term? Marschman agreed that funding is always a project risk. Part of what he is hoping is that INL as lead laboratory can accommodate such long-range projects. The INL has long-range projects now, such as facilities management and security. This could be placed within the facility management program to ensure it is sustained. An alternative would be to work with a particular office to make sure its long term funding strategy includes the project. Larson noted that it is a fact that DOE cannot commit to funds beyond what Congress appropriates, but DOE tries to do what it can in terms of planning.

McCullum noted that the funding issues provide further support for keeping the project on two tracks. We need both a research facility and cask loading. Institutional momentum may increase this way. Pete Lyons supports this strategy. His organization has been working with DOE-NE to complete action items and move forward in cooperation to get this project off and running. The cask loading piece may not cost that much money and it will get the momentum going. The real costs will be in the facility. The INTEC facility looks good but it will require significant investment. McCullum commented that support for this project at the top of DOE is extremely strong, and given the waste confidence issue, it will get stronger.

Einzigler asked if there was a way DOE could pull the BRC recommendations into this effort. The industry has not dealt with storage after transportation. If this is the type of thing that will be happening in 20 years, it needs to be considered. Einzigler asked if there is funding for this. Boyle said that DOE is looking at the possibility of interim storage from a technical matter. In the near term, to do anything other than load a cask at a utility may not be feasible. One alternative may be to load and store the cask at a utility and leave it there until something becomes available. McCullum noted that the BRC identified

things that DOE can do right away. He felt there was a direct tie between the BRC recommendations and this work. DOE clarified that there was no separate source of funding for the BRC. Work to implement the recommendations will come from the DOE-NE budget.

Hanson asked Kessler and McCullum to provide assistance in engaging the fuel vendors. Attendees noted that the vendors are reluctant to release data but are willing to allow the rods to be evaluated. One issue will be if proprietary data related to the fuel is needed to collect sufficient data. Extensive vendor involvement may complicate things. McCullum believes there may be ways to involve fuel vendors. He agreed to reinvigorate a group of fuel vendors if it will be useful at some point. One attendee noted that in his experience the best way to involve the vendors is to pay them. McCullum clarified that the vendor group was working on the understanding that DOE would purchase data that it required.

## **8. DEMONSTRATION LOGISTICS ISSUES (John Kessler, EPRI)**

John Kessler, EPRI, provided a presentation on logistics issues for a demonstration.

Einzig discussed the conditions of the rods that would be used in a demonstration. He had been thinking about loading fuel that has a breach of a type that would normally be allowed. There was a concern that if a breached rod were included, then it would be difficult if a breach occurs during storage to understand what has happened. Morrison noted that the license for Prairie Island does not allow loading of damaged rods.

Sorenson brought up the issue of re-wetting as something that needs to be considered in the demonstration. Beyer added hydrogen level. This may be related to how burn up is achieved. Charles Park, INL, noted that instrumentation could also affect representativeness. NRC brought up the question whether temperatures have been over predicted. If we assume cladding is at a certain temperature and it has certain effects on cladding, are we being too conservative? Perhaps two phases are needed. Go through the prototypic drying process of 30 minutes and take temperatures, then let the fuel stay in the vacuum until it reaches 400°C. It was noted that transient phases can be modeled and that there is confidence in the best estimate code. Marschman noted that during the drying process, the temperature might fall as the vacuum is pulled off. A participant also noted that you may have internal convection. Kessler clarified that we have models to predict what happens to fuel, and this approach may provide a benchmark to assess whether we are over predicting. The demonstration will need to identify the temperature after drying. Waldrop noted there is a period of time after draining and before vacuum drying when temperature reaches 1,000°C. There is a tech spec to inject helium into the cask so that the maximum cladding temperature is not exceeded. Danner noted that each of the designs will perform a bit differently. For example, a horizontal design will be different from a vertical design. You will get different conduction and irradiation profiles. With some designs the center of the basket will be the hottest location. He believes that the temperatures may be conservative by 50°F. Yueh-Kan Shih, Transnuclear, commented that they seek at least a 30 to 45° margin. Basically, if you have a number of assemblies, you will get close to the limit. For a prototype cask, it will be very difficult to load every rod at the temperature of 400°C. Kessler responded that when we select fuel we want a best estimate of how it will perform, not a conservative estimate. It was agreed that the wrinkles need to be ironed out prior to the testing.

Danner asked whether it was important to have the instrumentation working for a long period of time. He felt that as long as data were collected up front and the method was validated, would monitoring over time really be needed? Einzig commented that there is a continuing need to validate the model and see whether any unexpected changes occur. There may also be a desire to confirm temperatures at the lower end.

On the question of replacing thermocouples as part of the demonstration, Harris Greenberg, LLNL, commented that this is a research experiment. The need for replacement should be expected. If the cask is designed with ports that allow you to maintain the sensors you can account for minor differences in the configuration with an actual storage cask. That would provide the advantage of a single system that has components that can be replaced and recalibrated. Kessler noted that this would affect the lid design, but it is something that should be considered.

Brookmire noted that there is a cask that has a direct monitored location for a pressurized area. The question of replacing a thermocouple mid test would be a challenge, but it could be done.

David Stahl asked that if after 10 years we replace helium with nitrogen, would we be able to look at cooling. Waldrop noted that this could affect logistics. It may not be in line with the normal operations under a tech spec.

Danner addressed whether transport would be available for a HBU fuel assembly. There is a cask that would work but it would have to be relicensed for this fuel. Shih noted that Transnuclear has the approvals to transport a full assembly. This may need to be reviewed further.

McCullum emphasized that the demonstration should be for both transportation and storage as part of showing that fuel can be moved to storage. Williams also noted that there is an option of moving the assemblies and then doing the drying.

Participants clarified that regarding the prototypic nature of the demonstration, real data from real fuel using a real cask is best.

Brookmire noted that any efforts to reopen a cask may have to be done at the facility in order to meet requirements about an inadvertent release. Winston noted that when a cask is sampled at INL, there is a monitoring system to detect contamination. Brookmire noted that if opening were to be done at a pad, this would need to be addressed as part of the licensing because the necessary equipment to prevent a release would be needed. Marschman agreed that it would be a significant effort to open a cask on the pad. Stahl noted that in the past a canister type filter had been used. The group agreed this is still an approach. Waldrop noted that this could be done; it would require changes to licensing.

Rubestone, NRC, asked if there is a way to get information without taking gas samples. Marschman felt this may have been done at Hanford and is a way to reduce sampling frequency.

Shih commented that leak tightness would be important for the test. Einziger noted that an accelerometer would be useful to have in the cask for the time when it must be moved.

The group discussed how to address a test looking for the effects of swelling or creep due to stress. It was felt this would be a long-term effort.

The critical path item identified by Einziger is to determine how many rods are needed to be put aside. Questions of specific characterization needs or data needs may evolve. Another participant noted that the cost of the demonstration will be important; therefore, costs for the demonstration activities must be capable of being estimated. There are combinations of fuel that could be evaluated – and symmetry must be maintained. Therefore, it will likely be either 4 or 8; 8 are preferred.

In terms of the duration of the demonstration, Marschman noted that the longer the test goes on, the more useful it will be to confirming the models that are being developed for predictive behavior.

Shih noted that if information on the mechanical properties of the restrains could be gathered that would be informative.

An attendee offered a demonstration strategy. Metallurgically, we know what fuel is subject to high degradation, creep, etc., so if we use this fuel in our demonstration, then it will be easy to persuade NRC regarding the other fuels. Stahl cautioned that unexpected results may be encountered and this may not be desired. Waldrop noted that perhaps the work that pushes the margin may be better suited to a separate effects test. The demonstration should address expected conditions, not worse case conditions.

## **9. REGULATORY PROCESS (David Pstrak, NRC)**

David Pstrak, Branch Chief with NRC, provided a presentation on the NRC regulatory process for licensing a demonstration. The purpose of the presentation was to provide information and introduce the group to the process. For the NRC, the number one goal is safety. As activities are planned for fuel examination or handling, the role of NRC is to make sure it is done safely. NRC is not striving for perfection but is requiring reasonable assurance of safety.

There are two options for licensing a storage facility – a site specific and a general license. Pstrak noted that there would be public involvement and meetings or hearings for National Environmental Policy Act and for the licensing action. These would be separate processes. He recommended that applicants take advantage of pre-application meetings to help resolve issues and clarify the process. Regarding timing or schedule for the license for this demonstration, no priority has yet been identified for this effort.

There are also two options for certification of the transportation – a general certification and a special packaging authorization. Stahl asked if licensing could proceed concurrently for a cask that would be used for transportation and storage. Pstrak replied that this would involve two separate reviews because of the two different objectives of the licensing. A general certification has a set process and criteria, but a special packaging authorization can involve appropriate compensatory measures. It is up to the applicant to suggest these measures. NRC emphasized that if DOE is considering a special package route, they should let NRC know as soon as possible. Marschman brought up the question of whether a drop test was required. This would be a consideration of the licensing process.

Pstrak noted that he was recommending early involvement with NRC because the license may apply to the entire demonstration process even if transport to a receiving facility does not take place for some time. The storage at the plant would be addressed in the license.

Pstrak noted that NRC might be open to a dual licensing process for a dual use cask. It is up to industry to propose how this can be done and why it is a good idea. Pstrak noted that Mike Waters, NRC, is the point of contact to initiate a meeting on the demonstration. Once notified, Waters will formulate a review team. It remains to be seen whether NRC will have this as a priority, as it may compete with the needs of other licensees. Pstrak recognized that decision-makers may decide to assign this demonstration a priority.

Marschman asked a hypothetical question – if DOE approached NRC about using a TN-32 cask loaded with suitable fuel for the demonstration, could they ship it under the existing certification? Pstrak indicated that may be a reasonable approach; DOE would have to prove that the cask would not leak due to any penetrations. Marschman asked if a drop test would be required during transport. Shih commented that once you remove the instrumentation used during storage and seal the cask, you redesign the cover to make it protective in the event of a drop. Pstrak agreed if you have a way of capping off the means of penetration and putting a cask into its transportation configuration, a successful shipment can be made. Marschman noted that this process may be critical path. Discussions with NRC will be needed in order to convince DOE that the license can be successfully pursued. Whether you ship right away or later, this will

affect the approach. Morrison noted that Xcel has gone through the process of licensing a package for transport. It is a question of working with the reconfigured lid. Marschman commented that he needs the detailed strategy to make sure these issues can be worked out. Waldrop indicated that vendors can work with us because they have experience, and we need to work with NRC to license both. An attendee noted that meetings with NRC are public meetings and cautioned the group about this. He also noted that there are costs associated with the licensing application. NRC charges for its review. However, there is a provision for NRC to waive fees although it is unprecedented and does not appear to be intended for a demonstration. This would need to be carefully assessed.

McCullum commented that this discussion reinforces the strategy of starting with a licensed design instead of trying to get a new design licensed right off. Also, he recommends that the group take full advantage of pre-application meetings and that they hold them as early as possible.

Beyer asked if there has been approval for shipment of HBU fuel at the assembly level. Einziger noted that the casks at the orphan sites are licensed for transportation as well as storage. The Holtec HI-STAR 180 has been licensed for transportation of HBU fuel. NRC indicated this is not a new process. A lot of issues can be cleared up in pre-application meetings. Einziger reminded the group it is ultimately the applicant's responsibility to demonstrate it meets the regulations. He strongly recommended use of the pre-application process and a good strong initial application built upon the results of the pre-application meetings. Normally systems with penetrations are not allowed on the road, but there are ways to handle this. There should be no need for monitoring while the cask is on the road. He identified the NRC has four levels of priority. Safety issues have high priority. Applications needed by the federal government also have priority.

Sorenson noted that one of the objectives of the UFD program is to support the technical basis for transport of HBU fuel. He asked whether NRC is considering proprietary data when it is certifying casks for transport. Einziger replied there are various levels of HBU fuel. Most of the casks that are licensed for storage now are for HBU fuel that barely gets over the levels. He is not aware of the details that went into the certification. There is a certain amount of information in the Safety Analysis Report that is proprietary. Usually an application will have a proprietary and a non-proprietary version. The NRC is working on one such application at this time. The applicant must request that information be designated proprietary and this is an NRC determination.

Morrison added that the pre-application submittal meeting is important, but once the application is accepted, the post-application acceptance meeting that takes place prior to NRC beginning its detailed review is also very important. It is critical to work with the NRC project manager and the review team throughout the process. Pstrak noted that NRC has been working to improve its process, and he appreciated the feedback that this is effective.

Stahl noted that we have been discussing additional penetrations to the lid. He asked if we use the same design with the same existing penetrations whether this would require a license amendment. Pstrak replied that the consideration would be whether this would affect the functionality of the cask. Morrison noted that there is a process under NRC regulations (Part 72, Section 48) that allows you to proceed without a license amendment. This is the responsibility of the certificate holder. Einziger commented that this group knows what analysis and process is best to follow. Stahl asked whether vendors had been successful in using the 72.48 process. Einziger replied that he could only think of two times where a licensee had invoked 72.48 and it was questioned by NRC. In general, if there is a safety issue, the 72.48 approach will not work. Shih pointed out that Transnuclear had 8 criteria it applied to evaluate whether it would go through that approach. Then, they hold a meeting with NRC to go through its justification for why it is going that route. He emphasized that there is no need for continuous monitoring during transport. It can be removed prior to transport and then replaced. Morrison noted you can put lids on the

penetrations and verify it meets leak testing prior to transport. The number of penetrations may also be a factor. The key point is the life cycle design of the system to make sure that transport requirements are addressed during design. Marschman agreed that there was an important lesson that the NRC must be included as an active participant in the process from a regulatory perspective. This adds an additional element of the need to consider the regulatory side actively during the planning process. Rubenstone pointed out that the vendors will also be an excellent sounding board and resource.

## **10. VULNERABILITIES AND UNCERTAINTIES (Ken Sorenson, SNL)**

Ken Sorenson provided a presentation summarizing the vulnerabilities and uncertainties related to the demonstration. McCullum commented he would like to walk away from the meeting with some milestones and commitments to continue the work of the group on the demonstration. He feels a lot of progress has been made and wants to nail down what will happen next. The group decided to document its actions and commitments before concluding the workshop. Sorenson agreed that an update at the next EPRI ESCP meeting in December would be great. Kessler agreed that this should be scheduled.

McCullum commented on the issue of re-wetting. He feels there is not yet consensus on whether this needs to be included in a demonstration. He thinks if we start with an objective of not re-wetting, we can go this route and consider at a later date if we must go to opening in a pool. He asked if the group could agree on this approach. Levin commented that he still had concerns about re-wetting and whether this might adversely affect the data. Marschman noted that dry is the priority. Wet should be the worst case where it is used because it is the only option at that time to get the data needed. Therefore, the group was in consensus that dry storage and opening of a cask would be assumed for the demonstration.

## **11. MEETING SUMMARY AND ACTION ITEMS**

Marschman brought up the question about whether a communication vehicle should be established to allow more frequent exchange of information. Einziger asked if EPRI could assist with the communications. Waldrop noted there is an FTP site already set up for the Extended Storage Collaboration Program and that a separate folder could be established for this effort. Melissa Bates, DOE-Idaho, commented that she would like to coordinate this on her end to make sure this approach is consistent with INL being the technical integrator. Marschman also mentioned a concern about not wanting to disqualify any vendor from participating in the demonstration. Bates mentioned the possibility of preparing a regular status update to be distributed to industry. McCullum agreed that a weekly report would be beneficial. Since he is the trade association representing all participants, it is entirely appropriate for him to take approved communications and distribute them to the broader industry. He can also assist with passing questions back, although he understands not all questions may be answered. DOE-Idaho supported using this process to distribute information. NEI agreed to send out information via e-mail and to use the EPRI website for documents. The advantage of this approach is it helps keep industry tied in.

Action: NEI to distribute information on project weekly via e-mail. EPRI will maintain information of the demonstration on its ftp site.

McCullum then asked for dates to be established for when the questions would be answered from the presentations and when information on these issues could be exchanged. The goal is to reach closure on the technical issues quickly. The group agreed to submit responses to the questions by October 12, 2012.

Action: The project team to provide responses to EPRI's questions raised in Kessler presentation. EPRI to provide answers to project team to their questions. Responses due October 12. Closure on the answers

to be reached by November 2. If there are topical areas where consensus is not achieved, a group will be assigned to resolve the issues.

On timing, Einziger pointed out that there is timing related to identifying the fuel and other considerations related to transport and storage. He recommended that a schedule be developed for review.

Action: INL to prepare and distribute a preliminary schedule for the demonstration.

Rubenstein reiterated that NRC is wearing two hats here. As things get closer to licensing or certification, NRC will have to step back. NRC will carry out the process here in an absolutely transparent fashion and formality may be required at some times.

Rubenstein suggested that the group needs to move into the down-select mode. The sooner consensus can be reached on what options to choose and what priority to place on actions, the sooner the group can get things done. The idea of mini-demonstrations in controlled environments in hot cells may be a good way to get rapid results and to explore specific questions. McCullum agreed and expressed hope that the process the group is going to follow will support rapid down-selection. Marschman noted that INL has begun developing the criteria for a down select and an alternatives analysis.

Shih commented that it has a cask that is licensed for up to 62 gigawatt-days per metric ton.

Marschman committed to making the presentations available to workshop attendees.

Action: Marschman will provide the workshop presentations to the attendees.

## High-Burnup Used Fuel Demonstration Workshop Attendee List

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