UNITED STATES OF AMERICA

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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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PUBLIC MEETING AND HEARING

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FRIDAY

OCTOBER 8, 2010

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The Board met in the Three Rivers Convention Center, 7016 W. Grandridge Boulevard, Kennewick, Washington, Peter S. Winokur, Chairman, presiding.

PRESENT:

PETER S. WINOKUR, Chairman
JESSIE H. ROBERSON, Vice Chair
JOSEPH F. BADER, Board Member

LARRY W. BROWN, Board Member
JOHN E. MANSFIELD, Board Member

STAFF PRESENT:

TIMOTHY DWYER, Technical Director
RICHARD AZZARO, General Counsel

PANEL MEMBERS PRESENT:

GREG ASHLEY, BNI
DAVID BROCKMAN, DOE-ORP
DONNA BUSCHE, URS
STACY CHARBONEAU, DOE-ORP

DAVID DICKEY, Consultant
INES TRIAY, DOE-EM
DALE KNUTSON, DOE-ORP

PANEL MEMBERS PRESENT (Cont'd):

DAVID S. KOSSON, CRESP

LONI M. PEURRUNG, PNNL

FRANK RUSSO, BNI

PAUL RUTLAND, WRPS

LEO SAIN, URS

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8:00 a.m.

CHAIRMAN WINOKUR: Good morning. My name is Peter Winokur. I am the Chairman of the Defense Nuclear Facilities Safety Board and I will preside over this public meeting and hearing.

At this time I would like to introduce my colleagues on the Safety Board. To my immediate left is Vice-Chairman Jessie Roberson and to her left is Mr. Larry Brown. On my right is Dr. John Mansfield and to his right is Mr. Joseph Bader. We five constitute the Board.

The Board's General Counsel, Richard Azzaro, is seated to my far left. The Board's Technical Director, Timothy Dwyer, is seated to my far right. Several members of our staff closely involved with oversight of the Department of Energy's defense nuclear facilities at Hanford are also present.

Today's meeting and hearing were

first publicly noticed in the Federal Register on July 26, 2010, and renoticed for a change of location on September 15, 2010. It is being held open to the public in accordance with the provisions of the Government in the Sunshine Act.

The hearing is being broadcast over the internet via video streaming; the link can be found on the Board's website. A video recording of the hearing will be made available on the Board's website as soon as possible after the hearing is concluded and will remain available for at least 60 days.

A verbatim written transcript, together with associated documents, will be available for viewing and copying in the Board's public reading room on the seventh floor of the Board's headquarters in Washington, D.C.

In accordance with the Board's practice and as stated in the Federal Register notice, we will welcome comments from interested members of the public at the conclusion of testimony for each of the three sessions comprising this public meeting and hearing.

A list of those speakers who have contacted the Board is posted at the entrance to this auditorium. We have listed the people in the order in which they have contacted us or, if possible, when they wish to speak. I will call the speakers in this order and ask that speakers state their name and title at the beginning of their presentation.

There is also a table at the entrance to this room with a sign-up sheet for members of the public who wish to make a presentation but did not have an opportunity to sign up previous to this time. They will follow those who have already registered with us in the order in which they have signed up.

In order to give everyone wishing to speak an equal opportunity, we ask presenters to limit their statements to five minutes. The Chair will then give consideration to additional comments should time permit.

Presentations should be limited to comments, technical information, or data concerning the subjects of this meeting and hearing. The Board members may question anyone making presentations to the extent deemed appropriate.

The record of this proceeding will remain open until November 7, 2010. The Board reserves the right to further schedule and regulate the course of this hearing, to recess, reconvene, postpone, or adjourn this meeting and hearing, and to otherwise exercise its authority under the Atomic Energy Act of 1954, as amended.

Now let me proceed to explain the Board's statutory authority for inquiring into the matters that are the subject of this public meeting and hearing. The Board's enabling statue, now in effect for more then twenty years, is found in the Atomic Energy Act beginning in September 2286 of Title 42.

One section of this defines the Board's role in the review of facility design and construction. I quote, "The Board shall review the design of a new Department of Energy defense nuclear facility before construction of such facility begins and shall recommend to the Secretary, within a reasonable time, such modifications of the design as the Board considers necessary to ensure adequate protection of public health and safety.

During the construction of any such facility, the Board shall periodically review and monitor the construction and shall submit to the Secretary, within a reasonable time, such recommendations relating to the construction of that facility as the Board considers necessary to ensure adequate protection of public health and safety.

An action of the Board, or a

failure to act, under this paragraph may not delay or prevent the Secretary of Energy from carrying out the construction of such a facility."

The hearing begun yesterday morning forms a part of the Board's continuing effort to fulfill this statutory charge with respect to the Waste Treatment and Immobilization Plant, also known as the Waste Treatment Plant. The record of the hearing, both oral and written, will be used by the Board to formulate recommendations to the Secretary of Energy for this critical project.

These recommendations may take the form of a formal Recommendation to the Secretary or may be transmitted to the Department through letters or informal exchanges between technical counterparts. The Board's oversight responsibilities continue through completion of construction, testing, operation, and eventual decommissioning of these facilities.

The Board's statutory charter is, like that given to other agencies operating under the Atomic Energy Act, the protection of the public health and safety, including safety of the workers.

In the case of the Waste Treatment Plant, however, this statutory charge is made more complex because proper construction and operation of the plant is critical in resolving the underlying health and safety problem, mainly the large volume of toxic and radioactive wastes now stored in underground tanks at Hanford.

Many of these tanks are already 67 years old, and would be almost 100 years old by the end of the projected treatment mission. Consequently, it is not enough, in this case, for the Board to focus solely on whether the construction of the Waste Treatment Plant will not suffer accidents harmful to workers or the public -- it must operate safely and effectively for many decades to remediate the safety hazard represented by tank waste.

The Board has, therefore, inquired into many issues that involve a mixture of accident risk and successful and efficient long-term operations.

At this time, I'd like to provide some additional background on the history of this project. The Hanford high-level waste tanks began receiving waste in the 1940s. As the initial single shell tanks were being constructed, they were designed for about a 20-year life.

Over the seven decades of operation of the tank farms, poor chemical and configuration control of the wastes has created a much more challenging problem for understanding the chemistry and properties of the waste, as well as getting them mobilized, than exists at other sites such as the Savannah River Site and the Idaho Cleanup Project.

Characterization of this waste

remains problematic. The first time that a single shell tank was suspected of leaking was in the mid-1950s. Many single-shell tanks have been proven leakers since then. The leakage exacerbates the need to get these wastes out of the tanks and in a stable form suitable for eventual disposal.

The Department of Energy's solution to removing and stabilizing the waste to reduce the current and future threats to health and safety is the Waste Treatment Plant.

The Waste Treatment Plant Project was initiated in the mid-1990s. This is a first of a kind project. The Board's formal oversight of the project began in earnest after a privatization effort was abandoned in 2002. The Board has been advising the Department about our concerns related to the design basis safety requirements and their potential impact on operational safety throughout the life of the project.

Since initiating the project, the Department has pursued internal and external reviews of the project, obtaining advice from experts in academia, the chemical and process industries, and its national laboratories to help inform the design, safe operation and performance of the plant over its projected 40-year operational life.

It is important to note that the Department undertook a significant redesign effort starting in 2009, even though the design of the plant was more than 70 percent complete. The redesign of the plant is now over 80 percent complete and construction of its pre-treatment facility is more than 30 percent complete.

Recently, the Department indicated to the Board that it is transitioning the Waste Treatment Plant project from a design and construction project to one of construction and commissioning. The Department has referred to this transition as "pivoting."

As such, the Department is planning to wrap up its design actions by establishing the final design criteria for the plant's structures, systems, and components. The pivot is intended to provide a defined path forward to finish the design of the systems and components that have not been finalized and to resolve any outstanding technical issues.

The Board is deeply concerned that the plant may be commissioned before several key technical issues are fully resolved. Once operational and exposed to radioactive waste, options for design changes in black and hot cells will be extremely limited, costly, and expose workers to hazardous situations. To the maximum extent possible, solutions must be accommodated before commissioning. A learn-as-we-go philosophy does not seem prudent for this facility.

Given that the project is now

pivoting, wrapping up design and focusing on commissioning, it is a crucial time to have DOE [Department of Energy] explain where they are, where they are going, what remains to be done, and in what time frame. Also, implicit in the Board's statutory mandate is keeping the public appropriately informed of issues affecting public health and safety. Those are the goals for these proceedings.

The proceedings began last month when DOE provided over two hundred pages of written answers to Board questions. These questions and answers are available on the Board's website and will become a part of the record of these proceedings. I want to take a moment to thank the Department for its timely response to these questions.

We began yesterday to explore some of these answers to gain a more complete understanding. However, because of the large volume of information that must be discussed, a lack of further inquiry in this hearing or in the near future should not necessarily be viewed as satisfaction on the part of the Board with either a previous written or verbal answer.

The Board noted in its transmittal of questions to DOE in August, 2010 that these questions should be viewed as a starting point for the discussions that will occur during this public meeting and hearing.

There are several areas of the Waste Treatment Plant design in which the Board has concerns with the safety and ultimate operation for the decades the plant must operate. These areas include:

The ability of the plant to adequately mix the wastes after they are transferred from the tank farms into the plant.

The hydrogen control strategy for dealing with the hydrogen gas that is inevitably generated by the high-level wastes.

The implementation of safety

controls necessary to implement the hydrogen control strategy.

The likelihood that limitations on the plant's operating envelope resulting from the performance of the plant's mixing systems will result in more demands on the tank farms to deliver waste that meets restrictive waste acceptance criteria or the need to provide alternative processing capability.

The third session of the Board's hearings -- this morning's session -- is going to concentrate on concerns with particular aspects of the revised safety design strategy. We are trying to understand the ability of the plant to safely, effectively, and efficiently process waste delivered from the tank farms so that it can be vitrified for eventual disposal.

This involves the treatment of waste that, by its very nature, generates a significant quantity of hydrogen gas. Hydrogen gas can, under the right circumstances, accumulate in process piping and become an explosion hazard, with the potential to seriously damage process piping.

In extreme cases, such explosions could breach the primary confinement boundary, resulting in a potential hazard to workers or even the public, and the potential interruption of waste processing for long periods. DOE has developed a hydrogen-in-pipes-and-ancillary-vessels, HPAV [hydrogen-in-pipes-and-ancillary-vessels], safety design that is intended to contain the effects of a hydrogen explosion in the piping system or, in extreme cases, actively prevent the hydrogen explosion. The design approach is new and, as of today, incomplete.

We have requested that the Department's expert in hydrogen explosions from academia participate in today's panel discussion. We had also invited the Team Leader from the HPAV Independent Review Team but he was not able to be with us today.

We have also asked for participation from project design personnel from Bechtel National, Incorporated, URS Corporation, as well as the Department's responsible personnel for managing the project.

That concludes my opening remarks. I will now ask my fellow Board members if they have opening remarks before we begin the testimony.

Hearing no such request, I would like to invite the Assistant Secretary of Energy for Environmental Management, the Honorable Ines Triay, to make some opening remarks.

DR. TRIAY: I appreciate the opportunity to be here these last two days to discuss our initiatives in assuring that we will define, construct, and commission the Waste Treatment and Immobilization Plant, WTP [Waste Treatment and Immobilization Plant], so that it can operate safely and reliably.

I would also like to introduce some of the senior safety leadership from the Department of Energy who have traveled to Washington State to support these discussions. Dr. Steve Krahn, to my right, is the Deputy Assistant Secretary for Safety and Security in the Office of Environmental Management.

Mr. Richard Lagdon, to my left, is the Chief of Nuclear Safety for the Department of Energy. The three of us represent 100 years of nuclear safety experience. Along with all of our work colleagues at the Waste Treatment Project we represent many hundreds of years of experience of technically complex and high-risk projects such as the Waste Treatment Plant and tank farms.

As owner and operator of multiple projects through the Department's complex overall our nuclear safety record has been exemplary. Our commitment to a safe, efficient, and effective Waste Treatment Plant is embodied by the three of us and our work colleagues in the Department.

Safe operations including safety of the public, safety of our workers, and protection of the environment are paramount to the Office of Environmental Management and have been the cornerstone of my career.

With respect to the Waste Treatment Plant you have heard the Deputy Secretary's and the Federal Project Director's experience and perspectives on the importance of this facility to fulfilling the Department's mission to safely treat the Hanford tank waste.

I also devote a great deal of my efforts to the Waste Treatment Plant and the Tank Waste Program. We have over 15 years of experience treating tank waste at the Savannah River site which contains twice the total radiation source than the Hanford tank farms.

High-level waste produces hydrogen which can be flammable or detonable in sufficient quantities so the Waste Treatment

Plant will be protected with active safety systems to ensure hazardous concentrations of gases don't accumulate.

Conditions can exist in the piping and inline components where the waste may remain stagnate. If a sufficient concentration of hydrogen were to accumulate and mixed with an oxidant and if an ignition source were present, the gas mixtures could ignite creating the postulated hydrogen event.

The piping in vessels that contain high-level waste, primarily in the pre-treatment and high-level waste facilities, are the primary boundaries for this waste. The Waste Treatment Plant contractor has developed the design criteria for the piping to prevent failures from perforations and detonations. The Department has reviewed and approved those criteria.

The project's design has always included elements of both active safety controls to prevent an HPAV event from occurring and passive safety features to assure piping integrity should an HPAV event occur with the ultimate goal of ensuring that the piping and inline component primary confinement boundaries are not breached by a postulated hydrogen event.

In April of 2006 the Department issued a Safety Evaluation Report that addressed criteria for HPAV events. In that safety evaluation report DOE approved a strategy that relied primarily on active controls to prevent HPAV events. However, the Safety Evaluation Report also included provisions for passive controls for piping.

At that time the BNI [Bechtel National Incorporated] had assessed that pipe sizes less than or equal to two inches in diameter could meet the passive design. The Safety Evaluation Report further stated that limited plastic behavior would be approved when qualified by a supporting risk assessment that should include a best estimate for the facility incorporating estimation of probability, location, and intensity of hydrogen events.

Interactions with the Board and staff at that time indicated agreement with this approach. In response to ongoing evaluation of hydrogen events, BNI began a testing program to evaluate the consequences of HPAV events on piping and complex component designs such as PUREX [Plutonium Uranium Extraction] connectors.

In 2009 the manager of the Office of River Protection initiated several independent reviews to determine whether the 2006 HPAV strategy both concerns from an operability standpoint and whether an alternative strategy could now be supported. As a result of the recommendations from those reviews, the Department directed the contractor to propose an HPAV strategy that is less dependent on active controls.

The Department directive for a

design with fewer HPAV active controls did not constitute a significant redesign effort as was mentioned in the opening remarks by the Board. In fact, the HPAV controls have always been an additive layer of controls that do not change the innate waste process design functions but add additional controls that could disrupt efficient operations and increase operational risk to plant availability and worker safety.

The contractor has recommended an approach that continues to rely on active and passive features but with a reduced number of active controls. The result in superior design will reduce exposure to workers, improve operational efficiency, thereby facilitating more expeditious completion of the tank waste mission and reduce risk of facility or system contamination.

The specifics of the design approach to protect against a postulated hydrogen events rely on passive engineer pipe component pressure boundary for piping up to four inch in diameter where it can be shown that the resulting loads on the piping and in like components meet the approved design criteria. Active controls where the postulated hydrogen events could cause the loads on piping and inline components to exceed acceptance criteria.

The design of piping systems in the Waste Treatment Plant ensures that an HPAV event in the piping will not adversely affect the ability of the piping on inline components to perform their intended safety function, will not render the piping inoperable, will not introduce additional hazardous risks to workers or have significant adverse impact on WTP operations thereby facilitating efficient plant operations.

In advancing the latest industry experience with risk analysis the project also completed evaluation of rigorous test programs and developed the HPAV quantitative risk analysis tool to organize application of the experimental results to specific pipe routes as required for ASME Code compliance [American Society of Mechanical Engineers]. The HPAV testing was conducted at the California Institute of Technology by Dr. Shepherd who is on the panel, and at Southwest Research Institute in San Antonio, Texas.

From these test programs the project has improved its understanding of HPAV phenomena which include improved understanding of gas phenomenology, validation that the stainless steel piping is robust relative to HPAV events, and that the piping shows minimal or no permanent deformation following repeated detonations, greater insight into the response of piping to high frequency oscillations, important design information regarding components, test data available to benchmark analytical models.

The QRA [Quantitative Risk Analysis] provides an extremely insightful tool from a safety perspective. The QRA employs a multi-functional team of design, operations, and safety personnel to analyze the potential for hydrogen events by reviewing the details of each path affected route and the number of times that route is expected to be used over the life of the plant, the normal and not normal operating conditions for each HPAV affected system using the structure analysis of the event fault tree.

The event and fault tree logic facilitates the review and response by looking at loss of power, component failures, operator errors, and other conditions that allow waste to remain stagnate for extended periods. This approach has been reviewed by the HPAV Independent Review Team which consisted of 12 independent experts with a combined industry experience of 450 years spanning the range of technical disciplines applicable to the HPAV strategy.

While Dr. Mattson is not able to

be here today to testify on the team's efforts due to a death in his immediate family, I will summarize the team's review. The HPAV Independent Review Team concluded that following implementation of the team's finding there is high confidence that the QRA approach is acceptable for the loads to be used in design and that there is low probability of exceeding either their frequency or their magnitude.

The best estimate of pipe stresses and strains computed from the defined loads in the manner proposed by BNI are not likely to be significantly exceeded. The combination of QRA load definitions, best estimate piping system response calculations, and conservative acceptance criteria developed pursuant to the piping code B31.3 provides a reasonable balance of probabilistic and deterministic elements appropriate for design of HPAV piping and components.

The net result of this approach to

design will be a low probability of pipe failure if hydrogen explosions occur. I considered this industry endorsement evidence that the Department has ensured that safety and quality of the WTP design for HPAV events.

We met with you on August 24th and September 24th to review the project's implementation plan for solving the Independent Review Team findings and recommendations. I endorse the project's plan and we are committed to continuing interactions with the Board and its staff as we implement the findings and recommendations and complete the designs.

We will ensure the inputs and assumptions of the QRA are adequately protected for the operational life of the facility. Finally, we will incorporate insights from the QRA application into our response to the Defense Nuclear Facility Safety Board Recommendation 2009-1 which pertains to the need for standards governing risk applications.

In closing, I would like to state that the evolution of the HPAV analysis and design criteria is part of the normal DOE process that may establish very conservative approaches in the early stages of design but changes to allow improvements to the plant's design and operation as design evolves and assessing to understand hazards is completed.

These efforts do not result in a significant redesign of the Waste Treatment Plant systems but improved design and operational efficiency and reduce risk in support of the WTP mission to process waste.

Finally, no design changes have been implemented using the HPAV analysis and design criteria and none will be made until the finding resolutions are reviewed by the Independent Review Team and are closed.

I would like to give the floor to Mr. Richard Lagdon who will address the last issue that we were discussing yesterday.

MR. LAGDON: Chairman Winokur, Members of the Board, and staff, I appreciate the opportunity to present for the record my statement regarding the use of deposition velocity at the Waste Treatment Plant. I would also like to thank Dr. Triay for recognizing my role in addressing this issue.

My position as the Chief of Nuclear Safety was created in response to Defense Nuclear Facility Safety Board Recommendation 2004-1. One of my responsibilities is to ensure safety is being appropriately addressed by the line. I take this responsibility very seriously.

MAX-2 Code Guidance was developed and accepted by the Defense Nuclear Facility Safety Board in 2004 as part of the Department's effort to improve the software quality assurance of software utilized in safety-related applications.

This guidance specified generic conservative values for use across the complex. These values were based on NRC [Nuclear Regulatory Commission] requirements with similar applicability for facilities operated by DOE.

When evaluating the conditions specific for the Waste Treatment Plant I reevaluated the technical basis contained in NRC regulations and standards. This evaluation was published in September 2009.

Because the evaluation continued to be challenged because of its use of 1 centimeter per second for deposition velocity, I solicited the independent technical review of a nationally recognized expert, Dr. John Tell, on the subject of atmospheric dispersion and modeling to review the issues and provide recommendations to the Department.

The question to be evaluated is the MAX-2 code as implemented based on documentation assuming 1 centimeter per second deposition velocity for particles sufficiently conservative for the Hanford site such that the target dose to the public is not underestimated at the 95 percentile level.

Dr. Tell concluded that the MAX-2 results and the analysis of the Waste Treatment Plant are conservative and meet the objectives of the assessment question.

CHAIRMAN WINOKUR: Excuse me, Mr. Lagdon. We are going to need to finish up your testimony here in the next couple of minutes.

MR. LAGDON: Yes, sir.

CHAIRMAN WINOKUR: I don't know if you have a lot to go.

MR. LAGDON: No, I've got one more paragraph, sir.

CHAIRMAN WINOKUR: Wonderful. Thank you.

MR. LAGDON: Okay. In reviewing the revised severity level calculations the impact on the analysis will not affect the design of WTP because of the small difference in the impacts using a more conservative number.

I will review this analysis with the Waste Treatment Plant safety analysis personnel in the near future and issue a revised technical paper reflecting the recommendations of an independent expert review. This will ensure that the Waste Treatment Plant is designed to the appropriate criteria and a conservative analysis exist such that the target dose to the public is not underestimated at the 95th percentile level.

DR. TRIAY: Chairman Winokur, Dr. Krahn will be submitting for the record our steps as the head of the Technical Authority Board to ensure compliance of the QRA process with 10 CFR 830 [Code of Federal Regulations].

CHAIRMAN WINOKUR: Thank you. I appreciate it. Thank you, Dr. Triay. Thank you Mr. Lagdon and Dr. Krahn.

The session will continue with testimony offered by members of the Board staff. I ask each staff member who offers testimony to begin by stating his name and position for the record.

MR. KASDORF: Good morning, Mr. Chairman, members of the Board. My name is Roy Kasdorf. With me are Mr. Steven Stokes and Mr. Scott Suffridge, staff leads for the Hydrogen Control and WTP. I am the lead for the Board's Nuclear Facility, Design, and Infrastructure group.

I am responsible for ensuring that the staff reviews of the design and construction of the Waste Treatment and Immobilization Plant are completed consistent with the Board's mission.

In this morning's meeting the Board is considering safety-related aspects of the pretreatment design and operations, specifically the safety design strategy for control of hydrogen. I will discuss the hazards presented by the hydrogen process vessels, piping and inline components and the Department of Energy's revised safety strategy to control this hazard.

As I've said in previous sessions, over the past eight years the Board's staff has been reviewing the pretreatment facility design and safety basis development. The staff recognizes that operation of the WTP is vital to the remediation of the Hanford site.

The WTP is the primary means for reducing the risk resulting from storage of high-level waste in Hanford's tanks. As such, the staff recognizes that the WTP must operate efficiently and safely over the entire duration of the multi-decade mission.

The staff concerns are fundamentally related to safety issues but many of the safety issues would also result in significant operational problems such as the build up of material in vessels, plugging or bursting pipes. Such operational problems would delay processing of Hanford tank waste. The Board believes that such a delay is a safety concern.

A little bit of background. Hydrogen gas is produced in all waste tanks depending on the amount of radiation present, hydrogen containing chemicals present, and the concentration of hydrogen scavengers. There are three distinct mechanisms that produce hydrogen gas from the tank waste; radiolysis, which is radiation interacting with molecules containing hydrogen breaking the chemical bonds to produce hydrogen gas. Radiolysis typically generates the largest amounts of hydrogen gas in WTP.

Thermolysis, which is the deformation of organic molecules containing hydrogen in the presence of radiation produces hydrogen gas. Due to the relatively low temperatures in WTP thermolysis is not a large contributor to the overall gas generation in WTP.

The third mechanism is corrosion of metal piping in vessels generates hydrogen but this will be insignificant in WTP due to the corrosion resistant materials used to make up the piping in vessels. In order for hydrogen gas to become an explosion hazard two other factors must also be present with the hydrogen; a source of oxygen and an ignition source.

There are two potential sources of gaseous oxygen in the Hanford's waste. First, oxygen can become entrained in the waste, for example from sparge that are used to mix some vessels. Second, oxygen can be present in the form of nitrous oxide, a gas produced in the waste from compounds containing nitrogen.

There are several potential ignition sourcing including mechanical components and compressive heating of the gas itself. Unfortunately, hydrogen gas has one of the lowest minimum ignition energies known which is why the control of ignition sources is rarely, if ever, relied upon as a control strategy for preventing hydrogen explosions.

DOE began the hydrogen design

effort in response to two explosion events at nuclear power stations in 2001, one in Japan, the other in Germany. DOE correctly recognized that there were some more potential explosion hazards associated with hydrogen and piping systems in WTP.

DOE's initial hydrogen control strategy was conservative and focused on preventing hydrogen explosions in vessels and explosions with the potential to deform piping. Ultimately DOE and BNI developed what the Board considered to be a conservative hydrogen and pipe safety design strategy.

In the Board's quarterly report to Congress dated October 17, 2007, the Board made the following observation: DOE has developed a conservative design criterion. The Board believes the design criterion is adequate for its intended purpose and the issue is considered resolved.

However, in early 2009 DOE formed a hydrogen and piping in ancillary vessels, an

HPAV, assessment team to evaluate the controls and design approach for the control of hydrogen in WTP. As discussed in previous sessions, this action was taken due to DOE's concern with complexity in the WTP.

On February 26, 2009 this team provided DOE with several recommendations that deviated significantly from the hydrogen control strategy considered acceptable by the Board in 2007. These recommendations are the basis for DOE's revised hydrogen and pipe safety design strategy.

The team's recommendations can be summarized as follows. First, DOE should reevaluate select assumptions and methods used in accident analysis. Second, DOE should separate the evaluation approach for the safety case and the mission case. The team judged that hydrogen explosions was primarily a mission case concerned with operational availability and that the safety concern was mitigated by the building and its confinement ventilation system.

Third, DOE should adopt a mission risk-based approach to evaluate the physical phenomena and potential consequences of hydrogen accumulation. Lastly, DOE should reduce the levels of conservatism in the evaluation methodology and structural acceptance criteria.

Subsequently, in its quarterly report to Congress dated June 22, 2009 the Board observed that there are several of these recommendations were inadequately supported. The prime example was the creation of a mission case to justify allowing hydrogen explosions that could result in breaching the primary confinement boundary. The Board emphasized that implementation of the recommendations would be detrimental to the safety of the facility.

Since then DOE has decided to pursue some but not all of the team's recommendations. DOE approved a revised design criteria on February 15th of this year that allowed hot cell piping to undergo permanent deformation, its bulge, due to an explosion but did not accept the primary boundary could rupture and did not allow permanent deformation of piping in the black cells.

The approved approach uses risk-based quantitative risk analysis, QRA, to calculate the frequency and severity of hydrogen explosions in each run of piping and then applies those predictions to design the piping and select the safety controls.

The staff believes that DOE's revised approach is more complex, less conservative, and reduces the margin of safety for the hot cell piping design compared to the original design approach adopted in 2007.

In its April 15, 2010 quarterly report to Congress the Board made the following observation. The Board is concerned that the design criteria lacks sufficient specificity to ensure that the design will maintain the integrity of the primary confinement boundary as intended by DOE Order 420.1, Facility Safety.

The primary issues were DOE invoked a provision in the code that permits the facility owner to approve alternative methods for piping system design. Although this latitude exists, the alternative methods must be consistent with DOE's directives for the design of defense nuclear facilities such as DOE Order 420.1.

The proposed strategy uses QRA to determine the peak pressure and the frequency of explosions. DOE has no standard governing the application of QRAs. BNI intends to test inline components, valves, and pumps that did not specify the specific methods or the criteria for the qualification.

DOE's justification for allowing permanent deformation is that operators can inspect the hot cell piping, observe leaks, and repair failed components. However, the facility design does not include the capability to readily detect an explosion. Further, repair or replacement of the piping could be time consuming, cause significant disruption of plant operations, and potentially result in considerable risk to workers performing the work.

In April 2010 BNI chartered the Hydrogen Pipes and Ancillary Vessels Independent Review Team, the HIRT. The HIRT's review was intended to provide added assurance that the criteria and the methodology used to design WTP to withstand the affects of postulated hydrogen explosions was technically defensible and conservative to ensure the safety and reliability of the WTP design.

At the time the HIRT conducted its review BNI had not completed the final design approach, the approach for qualifying inline components, or the QRA. Further, several key input documents reviewed by the HIRT were still in draft form.

On April 12, 2010 the HIRT issued its final report which identified 35 findings and 32 recommendations. The HIRT concluded that the design approach for hydrogen and piping components was acceptable provided BNI resolve the findings before implementing the revised approach.

The HIRT provided the recommendations as discretionary improvements that DOE and BNI should consider for making long-term improvements when using risk-formed approach design. DOE approved a closure plan to address both the findings and recommendations from the HIRT report on September 16, 2010.

The closure plan describes BNI's response to resolve each of the HIRT's findings, the process to be used to document the actions taken to respond to each finding, and the process to be used to communicate BNI's actions to the HIRT team for review and eventual closing of the findings.

The closure plan also identified which recommendations will be implemented by BNI and which will not. DOE and BNI have still not completed the final design method to implement the revised safety design strategy for HPAV. Further, several elements of the revised HPAV safety design strategy have never been completed.

I'm going to repeat that because it goes to the heart of the staff's concerns. There are several elements of the safety strategy that have never been completed and those are the methodology for the QRA, the requirements for qualification of inline components, and the final set of calculations supporting the design criteria.

BNI is still working to resolve findings from the HIRT and several of the findings are significant. The staff cannot complete its reviews of the HPAV safety design strategy until the methodology and the overall approach have been completed and examples of its use have been demonstrated.

There are three key aspects of the strategy that must be completed or resolved. Those are the QRA, development of the safety basis to implement the strategy and the resolution of the HIRT findings.

The staff is concerned that DOE's use of QRA, which is the most important aspect of the revised hydrogen in pipes strategy that remains to be completed. It is also the most novel element of the revised strategy in that DOE has never before attempted to use a probabalistic design tool like the QRA to design the primary confinement boundary for a nuclear facility.

BNI is using the QRA to predict both frequency and peak pressure of the range of potential hydrogen explosions in the WTP piping. This information is used to develop process piping response that is then compared to BNI's design criteria to determine if the piping can withstand the explosion.

For those cases in which the pipe is predicted to deform beyond the allowed criteria, the piping system is redesigned or an active control is determined to be necessary.

There are several noteworthy concerns regarding the use of QRA for the WTP. First, and I am repeating this, there are no DOE requirements to govern the use of QRA to ensure it is properly incorporated into the nuclear safety basis. Second, DOE's current safety-related orders and standards typically require the use of a deterministic approach to develop the nuclear safety basis.

Lastly, the assumptions used to develop the QRA fault trees and establish event frequencies and severities become part of the safety basis. These assumptions must, therefore, be protected in the same fashion as all other safety and design basis assumptions.

DOE requires that each nuclear

facility operate within the constraints formed by its safety and design basis. This ensures that each facility is operated safely. For WTP this means that the final documented safety analysis must incorporate each aspect of the QRA with the potential to impact the safety and design basis.

The staff believes that this will be a complicated undertaking made even more difficult by the fact that WTP is a one-of-a-kind facility. There are no DOE standards or requirements for the use of QRA nor expectations for controlling the assumptions from the QRA in the safety basis. It is not clear whether DOE intends to develop a set of order requirements and standards applicable to the use of QRA before allowing its use in the WTP.

BNI and its subcontractors must still complete the calculations and reports that form the design strategy. Many of these calculations will require review by the HIRT to determine whether their findings have been resolved.

DOE and BNI have developed a very aggressive schedule for resolution of the HIRT findings. It is not clear what involvement the HIRT has had in the proposed resolution of their findings. The staff believes that the actions needed to resolve many of the findings will require considerable effort and are technically difficult.

Several findings will likely require additional testing. The staff believes the following findings in particular will demand considerable effort and will be difficult to accomplish in the proposed schedule.

Finding 2.4, the need to consider plant level events in the QRA models, requires the QRA to be expanded to address plant-wide events that contribute to event duration. Finding 2.7, the enhanced treatment of phenological uncertainties addresses uncertainties regarding the gas pocket formation and hydrogen combustion.

Lastly, combining two findings, 3.6 and 3.7, regarding simulant selection for gas testing, the HIRT found that the simulant used to perform gas testing was not properly documented and that the range of yield stresses, one of the most important parameters used in gas testing and QRA calculations, must be revised or justified in the terms of expected behavior of the waste.

The staff believes that these latter two findings if not adequately addressed will prevent the QRA's use. The calculations to determine the bubble size form the basis for determining the frequency and severity of hydrogen explosions.

The staff does not believe that the simulant, Laponite, used by BNI to perform bubble tests, adequately represents the waste found in WTP and that additional testing is required to properly resolve these findings.

In its response to the HIRT finding BNI acknowledge that additional testing might be needed. However, DOE and BNI did not appear to have allotted the time needed to conduct the testing and adequately resolve the issue.

DOE is committed to resolve HIRT findings and plans to include HIRT members in the resolution process. The Board staff believe this is an important facet of finalizing the design basis for hydrogen controls.

That completes my prepared testimony and we would be happy to try to answer any Board questions.

CHAIRMAN WINOKUR: Thank you, Mr. Kasdorf.

Do Board members have any questions of the staff? If not, I would like to invite the panel of witnesses from the Department of Energy, its contractor organizations, and its experts to take their seats. I would like to introduce them.

Dr. Ines Triay is the Assistant Secretary of Energy for Environmental Management. Mr. David Brockman is the Manager of DOE's Office of River Protection. Mr. Knutson is the DOE Project Manager for the Waste Treatment Plant. Mr. Russo is the Bechtel Project Director for the Waste Treatment Plant.

Mr. Ashley is the Bechtel Engineering Director for the Waste Treatment Plant. Mr. Sain is the URS Executive Vice President for Performance Assurance and Operations. Ms. Busche is the URS Nuclear Safety Manager for the Waste Treatment Plant.

Dr. Joseph Shepherd is Professor of Aeronautics and Mechanical Engineering at the California Institute of Technology. He provided consulting experience to DOE on detonations and deformations.

Does any member of the panel wish to submit testimony at this time? We have a lot of material to cover at this hearing. The Board has chosen its panelists carefully and request that panelists alone answer questions that are directed to them to the best of their ability. If the panelists would like to take a question for the record, their answer to that question will be entered into the record of this hearing at a later time.

With that, we will begin the panel session with a question from Ms. Roberson.

VICE CHAIR ROBERSON: Good morning. My first question is to you, Mr. Ashley. Can you provide for us an estimate of a flammable gas that will evolve in the WTP on a daily basis and what fraction of that will be in piping and inline components?

MR. ASHLEY: We can provide that for the record but I cannot. In terms of total volume of flammable gas we do evaluate dependent upon the feed stream. It is very dependent upon the feed stream and it's very dependent upon the locations and the conditions and the temperature.

One thing that I would like to clarify in the previous testimony from Mr. Kasdorf, he indicated that the predominant mechanism for generation of the flammable hydrogen gas in the Waste Treatment Plant was radiolysis. In fact, the predominant mechanism is thermolysis on the side of the process where organics are present. That is an important clarification.

VICE CHAIR ROBERSON: Let me ask you the estimate that you will provide for the record that you are using in your design does it include both gases that are entrained in the waste when the waste enters the pipe and gas that is generated during the time that it's in the pipe?

MR. ASHLEY: Our estimates do include the total gases that are expected to be present in all phases of the process.

VICE CHAIR ROBERSON: So it does include entraining?

MR. ASHLEY: That's correct. It's the gases that are generated and the gases that are present inline, the gases that are generated and the gases that are present in the vessels.

VICE CHAIR ROBERSON: And how do you -- what is your basis for the amount of gas that is entrained? What is your basis of estimate for that?

MR. ASHLEY: The basis of estimate are correlations done from studies in the tank farms. There is a specific correlation that has been reviewed previously by the Defense Board staff. That hydrogen generation correlation is used in the Waste Treatment Plant.

VICE CHAIR ROBERSON: Okay. The assumed gas composition is based on inputs from the Hu correlation like the concentration for the Hu nuclei. Right?

MR. ASHLEY: The Hu correlation.

VICE CHAIR ROBERSON: Right, Hu.

I'm from Alabama. The HIRT recommended accounting for nitrogen gas and nitrous oxides as a function of waste processing. Will the project develop new correlations to account for the generation of nitrogen and nitrous oxide?

MR. ASHLEY: The nitrous is assumed. The most energetic of the potential hydrogen events is the combination of hydrogen with nitrous. The nitrogen is a diluent and the questions that were asked by the HIRT was the diluent actually could cause the generation or the creation of a larger bubble which could actually affect the characteristic, though a less energetic event could actually be a longer run-up to the event. In essence what that means is that the ultimate event could potentially be larger so that is being evaluated as part of response to the HPAV IRT [Hydrogen Pipes and Ancillary Vessels Independent Review Team] finding.

VICE CHAIR ROBERSON: Go ahead.

CHAIRMAN WINOKUR: I just want to go back to a previous question that Ms. Roberson asked. You are going to understand the amount of hydrogen both in entrainment into the vessels that's coming into the facility. Correct?

MR. ASHLEY: Correct.

CHAIRMAN WINOKUR: That will depend upon what's in the batch that's coming in to be processed.

MR. ASHLEY: That's correct.

CHAIRMAN WINOKUR: So consequently there is a need at the tank farms to be able to understand what is being delivered to the Waste Treatment Plant.

MR. ASHLEY: Correct.

CHAIRMAN WINOKUR: And how well can you determine that what's coming in in a given batch? What are you shooting for, five percent, 10 percent, 15 percent?

MR. ASHLEY: There is a requirement in ICD-19 [Interface Control

Document 19]. The batch is sampled. The batch is tested to determine what the hydrogen generation rate will be for the batch as it comes into the WTP. That then will be verified against the waste acceptance criteria that has been a control in the ICD-19 and remains a control in the ICD-19.

CHAIRMAN WINOKUR: So after this whole process is done you'll determine a waste acceptance criteria in terms of the hydrogen generate that you can tolerate in this QRA methodology and analysis?

MR. ASHLEY: No. If you think about it, what we are doing is a conservative analysis based on hydrogen generation rates. We don't intend to have a specific revaluation. It's an incoming waste acceptance.

It will be compared against the criteria that has been applied through the QRA. It is an acceptance criteria for the waste. It doesn't rely on getting that specific batch prepared, measuring the hydrogen generation rate, and then reanalyzing through a QRA.

It is done in advance. It is done based on conservative hydrogen generation rates through the QRA. The waste acceptance criteria will ensure that those requirements are not exceeded.

VICE CHAIR ROBERSON: Okay. I'm not sure I understood your response. Will you need new correlations or not?

MR. ASHLEY: We will not.

VICE CHAIR ROBERSON: Okay. Is the bubble logic currently used in the QRA a conservative estimate of the hydrogen in the pipe hazard?

MR. ASHLEY: The bubble logic and the way the bubbles are considered is conservative. There were questions that were asked through the HPAV IRT in terms of evaluating the radiology to determine if our experiments, in fact, provide those conservative representations. We are in the process of evaluating that but the way we treat the bubble and the shape of the bubble is conservative.

VICE CHAIR ROBERSON: Mr. Ashley, the testing conducted by your contractor used Laponite to develop the QRA. Right?

MR. ASHLEY: That's correct.

VICE CHAIR ROBERSON: The HIRT had two findings, F36 and F37 --

MR. ASHLEY: That's correct.

VICE CHAIR ROBERSON: -- that question the basis for the selection and suggested additional testing might be required. In your closure plan you indicate that the waste properties used in the QRA will be consistent with the documented properties for the route being evaluated.

MR. ASHLEY: That's correct.

VICE CHAIR ROBERSON: What is the source of the documented properties?

MR. ASHLEY: Once again, if you

look at the flow sheet, we have various stages. We have the received waste. We understand the radiological properties of the received waste. Then as we process the waste we have controls on how we process that waste.

As it transitions from, in effect, a Newtonian behavior to a non-Newtonian behavior after leach ultra-filtration, which is concentration and wash. The properties will be consistent in the route with the expected properties. The reason for Laponite is Laponite exhibits a non-Newtonian.

Another reason for the use of Laponite is very simple; it's clear. If you're measuring and trying to observe bubble formation, you need a clear simulant. If we went to a non-Newtonian simulant that was based on clays, for example, you couldn't observe bubble formation. It's very simple, the Laponite. It's a non-Newtonian fluid and it allows for observations that were necessary to measure bubble formation when gas is released.

VICE CHAIR ROBERSON: Is the 9805 report the same documented properties for mixing? Are the documented properties you're talking captured in the 9805 report?

MR. ASHLEY: The radiological properties are going to be dependent upon the system plan that's provided by the tank farm for each of the feeds that come in.

VICE CHAIR ROBERSON: Okay.

MR. ASHLEY: I received a note and I do need to clarify we do not estimate the dissolved or entrained hydrogen. We measure the gas that evolves from the waste.

VICE CHAIR ROBERSON: Okay.

MR. ASHLEY: I do want to clarify. I did misstate.

VICE CHAIR ROBERSON: Let me just ask you. With that in mind then, your estimate is conservative. How do you validate that conservatism with that correction in mind?

MR. ASHLEY: The conservatism in terms of the hydrogen generation rates have been evaluated relative to the correlation, the Hu correlation, and the processes of hydrogen generation to determine exactly what the margin is in our estimation of hydrogen generation versus what the expected is from both the hydrolytic and thermolytic reactions.

That was reviewed in substantial detail by one of the experts that was on the HPAV Independent Review Team also confirming the conservatism. In fact, in the HPAV one of the topical reports that's part of the HPAV IRT report it specifically plots that conservatism in the hydrogen generation rate versus what the expected actual generation rates are.

VICE CHAIR ROBERSON: Let me just make sure I don't stumble over this and make sure I understand. In your response to the Board and the response in the closure plan to the HIRTS issue the documented properties, as

I just understood you to say, will be the result of a flow sheet and testing provided by the tank farm.

MR. ASHLEY: Our flow sheet when I talk about the properties and how the properties of the waste stream change as they go through the WTP, the tank farm doesn't control that. The tank farm is controlling the properties of the waste as we receive it.

Once we start to process that waste through our leach ultra-filtration concentration and wash process those radiologic properties do change. In terms of bubble formation specifically depending upon if we're in the post-leach ultra-filtration, which is concentration and wash side, the radiological properties are non-Newtonian, or primarily non-Newtonian.

The Newtonian side obviously there is a different mechanism for the release of gas into those systems. The hold up of bubbles in a non-Newtonian slurry are different. As I stated, the use of the Laponite has non-Newtonian properties and that's why the experiments were done with Laponite.

VICE CHAIR ROBERSON: Okay. Maybe I'm just not communicating or maybe I don't understand what you're saying. You indicate that the waste properties used in the QRA will be consistent with the documented properties for the route being evaluated.

MR. ASHLEY: Correct.

VICE CHAIR ROBERSON: Okay. What are the properties and where are they coming from?

MR. ASHLEY: The properties are coming from our flow sheet. In other words, the non-Newtonian properties are the waste so post-leach we have a range of expected non-Newtonian properties from the sheer stress of 30 pascals to a viscosity of 30 centipoises down to a low range of properties that is more in the range of six pascals, six centipoises.

That is the range of expected properties on the non-Newtonian side of our process. That is important in terms of the generation of gas and the release of the bubbles within that slurry and how the bubbles form.

VICE CHAIR ROBERSON: So really we're talking the same properties we discussed at length in the mixing session yesterday?

MR. ASHLEY: That's correct. That's correct because, you know, our piping -- this is a batch process. Our piping transfers from one batch or one unit operation to the next.

As we concentrate slurries we are creating a non-Newtonian slurry. We transfer that non-Newtonian slurry down to the next unit operation in the process. Obviously the mixing system then has to deal with that waste that has those specific properties.

VICE CHAIR ROBERSON: Okay. Thank you.

CHAIRMAN WINOKUR: Let me understand something about what you just said about the mixers. One of things we didn't get much of an opportunity to discuss yesterday were these pump-out experiments that you had. A little bit we discussed it.

I think when you were doing the pump-outs you noticed that you had in the batches initially a lot of clearing of some of the heavier dense particles and the fissile materials and so on and so forth came out in like the first quarter batch. Right?

Can you account for that in the piping in terms of what's going into the piping in terms of hydrogen generation rates that you might be getting? You're not going to get a uniform feed from the vessels. You could get a very different kind of feed is what I heard yesterday. How do you account for that?

MR. ASHLEY: Once again, it is important to separate the size of the process.

What we talked about and what Dr. Dickey talked about, the tests that we ran were on the Newtonian mix. In effect, that's one of our most challenging vessels is what we call the HLP-22 [High-level Waste Lag Storage and Feed Blending Process System] vessel.

That's the feed receipt vessel. That comes in as a Newtonian mix. Non-Newtonian is similar to your paint. It's similar to ketchup. The Newtonian mix is basically particles in water or particles in a relatively low velocity fluid.

When we talked about the segregation of the fast settling particles and the distribution of those particles in that vessel with the larger, faster settling particles being more towards the bottom of the vessel, we're talking about these Newtonian vessels like HLP-22.

Now, as we move to the non-Newtonian side, and we did a much larger scale of non-Newtonian testing at PNNL [Pacific Northwest

National Lab] that was done in the '03 to '05 time frame to really look at what the best design for the mixing systems in non-Newtonian. Very different.

What you see is you see those vessels are more homogeneously mixed. Once we do shear the non-Newtonian fluids, though, there is the potential for larger or fast settling solids to settle. However, the properties of the non-Newtonian fluid which have essentially being plastic properties end up with apparent velocity that actually reduces the settling rate of those large particles.

We have evaluated that on the mixing side as well so that the behavior in the mixed vessels on the Newtonian side is different than the behavior of the vessels on the non-Newtonian side of the process.

CHAIRMAN WINOKUR: My question was really a lot simpler. Thank you. I just want to know -- I mean, you're mixing these things in the tanks and you just told me you measured the hydrogen gas to get a measure of what the hydrogen generation rate is going to be.

When you think about the tank farms you have to ask questions about how uniform is it the batch you're going to be sending over. Are you adequately mixing it in the tanks. Do you really have a representative sample. I'll put that aside for a second.

Now, you get into the vessels. We know that these vessels are not going to uniformly mix the waste. We know its stratified, especially for the denser and the fissile materials. When you start to transfer waste into pipes, you don't really have an average value of hydrogen generation weight going into those pipes. Do you? I mean, the generation rate could be more depending upon the batch you transfer or less. I'm just trying to get a sense if that's accounted for.

MR. ASHLEY: It's correct that the slurry content could change from the top of the vessel. As we start to transfer the fluid in the vessel it could change with a higher concentration of solids as we pump out the lower portion of the vessel actually, which is the first quarter batch that comes out. Then obviously a lower concentration of solids as we get to the top of the vessel.

I think what you find are the smaller particles tend to mix more completely. Even the denser smaller particles, a 10 micron particle of plutonian oxide we actually find mixes fairly well. Smaller particles tend to mix much better than the larger heavier particles as we talked about yesterday.

We believe there is sufficient conservatism in the HGR [Hydrogen Generation Rate] rates that that stratification that we expect in these vessels is accounted for.

CHAIRMAN WINOKUR: All right. That's what I was trying to get to. You're saying you've accounted for the fact that when each core -- when the batches are transferred there may be differences in hydrogen generation rate. That's accounted for and it's conservatively accounted for.

MR. ASHLEY: There could be differences. Just to give you also perspective, I'm being flooded with note cards --

VICE CHAIR ROBERSON: Must be a sign of something.

MR. ASHLEY: To give you a perspective, Ms. Roberson did ask what quantity of hydrogen are we talking about. We are talking about .1 milliliter of hydrogen per liter of waste per hour just to give you a perspective on quantity.

MEMBER BADER: Let me help you with this.

CHAIRMAN WINOKUR: Mr. Bader has a question.

MEMBER BADER: Mr. Ashley, you must be saying something highly controversial. Would you like to either call a friend or poll the audience?

MR. ASHLEY: These are my helpers. They are providing me information.

VICE CHAIR ROBERSON: Okay. Dr. Shepherd, thank you for joining us today. Welcome.

DR. SHEPHERD: Good morning.

VICE CHAIR ROBERSON: Good morning. You conducted a review of BNI's calculations and modeling of a gas explosion phenomena. What specific concerns or issues did you provide to the project or identify to the project?

DR. SHEPHERD: Thank you. Yes. I conducted many reviews of many documents. I actually anticipated this and tried to count them. I can't give you an accurate number. I think it was somewhere between the order of 50 and 100 documents. The number of formal reviews I submitted are somewhat smaller.

My concerns range all the way from details of symbols and equations to the overall approach to the analysis of how data is being used, how computer simulations have been validated. We spent substantial amount of time early in the program in looking at just what the approach was to analyzing explosions.

VICE CHAIR ROBERSON: I understand there is a broad range. For example, in a letter to DOE on March 27th of 2010 you raised a specific set of issues. Could you describe those specifically?

DR. SHEPHERD: That was dealing with some calculations that were ongoing. Those calculations are still ongoing. The issues there had to do with -- I believe what I need to do actually is look at what that was. I think that's in the book here.

VICE CHAIR ROBERSON: Absolutely.

CHAIRMAN WINOKUR: We would be happy to receive that for the record,.

DR. SHEPHERD: It's fairly straightforward so all I have to do is find my dog-eared corner here and then I can talk about that. Where did it go? I noticed that you had a special session section here just for me. So which question was that? Help me out here.

VICE CHAIR ROBERSON: It was March 27.

DR. SHEPHERD: Right. I guess what I would like to do is then respond to that for the record since I don't have it in front of me.

VICE CHAIR ROBERSON: Okay. We'll probably ask you questions from that since we've seen it but I think that is perfectly fine. Go ahead. Let me just ask you a few specific questions and I'm sure my colleagues will have others as well.

Dr. Shepherd, you reviewed the design criteria for the design of the piping and inline components potentially subjected to hydrogen explosions. Do you based upon your review believe that the criteria are adequate to protect ductile failure of a pipe in the case of inline component failure of the primary boundary?

DR. SHEPHERD: I think it's important here to distinguish that there are a number of different components in the WTP. There's piping.

VICE CHAIR ROBERSON: Um-hum.

DR. SHEPHERD: There are components such as valves and pumps and then there are pressure vessels. Which particular pieces are you referring to, Ms. Roberson?

VICE CHAIR ROBERSON: I'm asking you in your opinion do the criteria applied to inline components provide the same level of assurance as the piping design criteria?

DR. SHEPHERD: What I believe is that those criteria are appropriate. The ones that have been developed are broadly applicable to the entire facility, but particular cases need to be examined and that is something that I've encouraged the DOE to do. The most focus has been on piping to date and piping systems. I've encouraged the DOE to look at the components such as valves, pumps, so forth, separately. I know they have a separate program looking at the vessels.

VICE CHAIR ROBERSON: Okay. Let me ask you a connected similar question. In your opinion are the calculations and models used to predict a pipe's response to a gas explosion adequate for predicting plastic deformation in the piping system at WTP?

DR. SHEPHERD: My answer is a qualified yes because we always have to discuss what the extent of the plastic deformation is that is being considered and for modest amounts of plastic deformation the types that are being anticipated as being acceptable I believe that they are.

VICE CHAIR ROBERSON: Do you believe in your expert opinion that BNI's overall approach allows them to accurately predict the amount of plastic deformation?

DR. SHEPHERD: I think it's important to understand that we are not talking about making accurate predictions because we don't actually have inputs which would allow us to do that.

If we had a definite loading function and we said this is the loading function, I believe that the methods that they re developing are appropriate for that, although that has not been the focus of the program at this point to develop a highly accurate plastic deformation prediction tool, nor do I believe it's necessary to do so.

We are doing safety analysis and in safety analysis what you're concerned with is making sure that you have bounding calculations. I believe that they are developing methods which are appropriately bounding.

VICE CHAIR ROBERSON: Okay. Let me ask you, the members of HIRT, which I assume you've seen their report. I believe you provided insight.

DR. SHEPHERD: Yes.

VICE CHAIR ROBERSON: They observed that the design criteria applied to the piping system were adequate assuming that the inputs into the analysis, i.e., the outputs of the QRA, are accurate. Do you agree with that?

DR. SHEPHERD: Yes.

VICE CHAIR ROBERSON: I have just a couple of additional.

CHAIRMAN WINOKUR: Just give me an intuitive feel for things. I was a scientist once before I got on this Board and did experiments and things. How complicated a problem is this? How tough a problem is it to be able to -- you know, we have to figure out what's actually going on, figure out how these bubbles are formed, get an idea about detonation events. How hard a problem is this? Is this pretty well known in industry what we're doing here?

DR. SHEPHERD: You know, the

individual parts of it have been studied in great detail and so there are many folks who have made a living in academia and industry at looking at the various bits and pieces. So, for example, generation of gases due to radiolysis thermolysis; the motion of viscal elastic material and pipes; various aspects of deflagrations and detonations.

There are entire journal symposia devoted to these things. The subject of detonation inside of pipelines is something that I've been working on for the last 20 years. We have a substantial technical base on the individual aspects of this. What makes this problem interesting, difficult, and challenging is putting together a wide range of these things.

The modern kind of buzz word that folks use in the academic community is that it's a multi-physics problem. You have a lot of things going on at different scales with different physical phenomena. Putting those together in a way that it can be used as a design tool by an engineering firm, that's the thing that makes it challenging.

You're not going to hand a handful of scientific papers to the engineers and say, "Ah, there you go. Distill this with some down and get some simple rules out of it and you're done." What it takes doing is sorting through defining what are the most important phenomena that need to be addressed where you can live with uncertainties because you're always going to have uncertainties in a large complex system where you need to really sharpen up your tools and have an understanding.

The challenges have been to bring together all these desperate disciplines and also think about it in terms which are terms of safety. Quite frankly, the word risk is a very important word here assessing the risk. How do all of these different physical phenomena come into creating this thing that we call risk.

CHAIRMAN WINOKUR: Are you familiar with situations in industry where people have actually calculated what these probability distributions would be for the frequency and the magnitude of detonations in the kind of situation that we're dealing with here?

DR. SHEPHERD: Yes. The chemical industry, particularly the high hazard chemical industry that is involved with working with high-pressure ethylene. Generating polyethylene is a good example. That's an activity where you have potential explosive gases and very high pressure, complex petrochemical plants.

We had an example recently that happened in the Gulf of Mexico where we had a very serious accident that happened at Deep Water Horizon. There were accidents that have happened on off-shore dwelling platforms.

There was a very intensive effort that took place in looking at the platforms in the North Sea starting with the Piper Alpha explosion in the late 1980s. A very intensive effort in the European community of looking at siting high-hazard chemical plants in highly-populated areas.

Various organizations like TNO [Netherlands Organisation for Applied Scientific Research] in the Netherlands have played a very active role in that. In the chemical process industry, in fact, there is a whole groups of people. The Center for Chemical Process Safety is one of those. It comes out of the AIChE [American Institute of Chemical Engineers] that is involved with that.

CHAIRMAN WINOKUR: Do these applications allow defamations of the pipes? Is that a typical thing to do?

DR. SHEPHERD: One of the things that you have to decide is you have to decide how much you are going to place emphasis on your design case and what are going to be exceptions.

What are things that are going to be very unlikely things that are going to happen that you may wish to accommodate through plastic deformation. A very typical way to think about this kind of problem is risk is a combination of consequence and likelihood. At the same time many commercial organizations and also government organizations are thinking about containing cost.

Also the speed with which a plant can be designed Sometimes you find in that space of risk that there may be some very highly unlikely events. As long as the consequences of those are not too high, you might allow plastic deformation to occur.

CHAIRMAN WINOKUR: But they don't typically allow for plastic deformation? It's an incredible event you're telling me or an extremely unlikely event. Is that what I heard?

DR. SHEPHERD: So we have to be

careful about this because, in fact, plastic deformation is allowed routinely in certain types of motions within the piping code. Something to be clear about here is that plastic deformation is not a terrible thing and often you have to allow some amount of what is called small-scale yielding to occur.

Otherwise, it wouldn't be possible to put it together. It's a very large system with large dimensions. Everything is not going to fit quite right and you have thermal expansion when things move around.

If you have deformation that occurs through beam bendings, if you have a pipe and the pipe is being bent like a beam like this, you can accommodate plastic deformation and the piping code actually allows for some of that. The question really is what is the extent that you are going to allow.

I think as long as that extent does not affect your safety basis, I think it's perfectly okay to allow it as long as you are very carefully understanding what the basis is for the interest of that and that's where the QRA comes in.

CHAIRMAN WINOKUR: What is a typical extent and percent of deformation, for example, that you would allow?

DR. SHEPHERD: You can allow several percent deformation particularly in piping on a regular basis.

CHAIRMAN WINOKUR: Okay.

VICE CHAIR ROBERSON: I just have one more question for you, Dr. Shepherd.

DR. SHEPHERD: Yes.

VICE CHAIR ROBERSON: You also reviewed the testing program for Southwest Research. Did you raise any concerns about the quality of data utilized in that testing program?

DR. SHEPHERD: I had input into various aspects of that program. One of the things that I also did was review the data after it was generated. I did have some concerns. I think in all of these test programs that one of the things in my own program, and we do the same thing, we have to very carefully vet the data.

You have to understand is what we're looking at something that's physical or are there artifacts. One of the things to keep in mind is when you make measurements with gauges like strong gauges and you have very large strains so basically what you're doing is you've got a little piece of material that's glued onto your pipe and when the pipe moves, and the pipe is moving only really microns is what we're measuring, very small motions, but these are very sensitive gauges.

It's a beautiful little thing. When it's used properly it tells us what the strains are. When you start to get large strains, then the motion of that little glued on piece of foil is not necessarily going to follow the pipe.

Over time that connection, that

glued connection that we basically put on there with Super Glue, can become degraded so you have to be careful is that the signal that you're looking at really reflective of the actual strains inside of the material.

I had some concerns about some of the signals and they have addressed those. They have looked at those and they have done a careful examination of those. In fact, some of those strains are not going to be used in their evaluation of the data.

VICE CHAIR ROBERSON: You want to ask something else?

CHAIRMAN WINOKUR: Mr. Brown is going to have some questions but just before that one question from Mr. Bader.

MEMBER BADER: Dr. Shepherd, you were making comparisons to the chemical industry and drawing value from that. Are those facilities easily inspected for excessive deformation?

DR. SHEPHERD: Sometimes. Sometimes

you have components that are inaccessible. In those situations you usually create a different set of rules. For example, analogous to what you have, the difference between the hot cells and the black cells.

MEMBER BADER: Staying with the hot cells, how would you compare the assessability for inspection and repair in the hot cells with inspection and repair in assessable facilities in the chemical industry?

DR. SHEPHERD: Having never actually worked in a hot cell I guess I would have to defer with someone with more operating experience.

MEMBER BADER: Would you believe the presence of high radiation fields might inhibit that?

DR. SHEPHERD: Obviously you're not climbing down in there with a flashlight and a micrometer looking at it.

MEMBER BADER: Also you mentioned you're dealing with multi-physics problems, desperate disciplines, and trying to assess the overall risk. When you combine that with the concerns about doing inspection and repair in radiation fields, do you believe that would call for an extra measure of conservatism?

DR. SHEPHERD: I think that you have to weigh all of those things in deciding where you are going to come down in terms of how much conservatism you use.

MEMBER BADER: I'm asking for your opinion as to whether you believe an extra measure of conservatism would be a prudent thing to do.

DR. SHEPHERD: I think certainly we would all agree that when we treat these facilities with these special nuclear materials and the issues that you've raised and the other issues that we know exist here like criticality, certainly an extra measure of attention to these details is important.

MEMBER BADER: I think that was a yes. Is that correct?

DR. SHEPHERD: I believe it's important to pay very careful attention to all of these matters when you go through it.

MEMBER BADER: I'll take that as a yes. Thank you, Peter.

CHAIRMAN WINOKUR: Ms. Roberson.

VICE CHAIR ROBERSON: Okay. Thank you. Just two or three more questions, Mr. Chairman.

CHAIRMAN WINOKUR: Sure.

VICE CHAIR ROBERSON: Mr. Ashley, given that it is a complicated venture as described by Dr. Shepherd and evidenced by the HIRT review and the interaction between the project and the Board, not withstanding the Department's interest to develop this to further potential, broader use in the Department, and also given your concern and focus on schedule and cost control that you and Mr. Russo reminded us of a number of times yesterday, why has BNI proposed to the project, to the Department, to pursue this avenue rather than the better known and well established deterministic approach?

MR. ASHLEY: I need to start off and say because I believe this is the right design approach for this facility. The combination of the need to ensure safety and the need to ensure the operability of the facility results in having to take a novel approach for a very complex first-of-a-kind facility.

I have been involved in nuclear power facility design, nuclear design for my entire career. The situation that you have to address are what are the unique conditions, what are the unique hazards associated with each individual process or each individual design.

I believe that we have done that. This provides us the opportunity to work towards the best design for the facility. Our ultimate goal we are not just designing a facility and leave. I like to leave every facility knowing that I have left the operator with the best possible facility for them to complete their part of the mission. This is a methodology that we believe is very robust.

Assures that we have high confidence that we maintain the primary boundary of this piping so that it can fulfill the mission. We believe that this criteria is consistent with methodology that has been applied in the nuclear industry in the past.

VICE CHAIR ROBERSON: Thank you.

MR. RUSSO: Ms. Roberson, if I can add just something from my perspective. When I came on the project the second question I asked after I learned everything I could about mixing and M3 was the very question you asked.

Basically I was convinced after a great deal of discussion with Greg, and some with Dr. Shepherd and others, what Greg is saying is absolutely correct. Even though it's not necessarily the best thing for schedule, it is the best thing for the co-located worker.

Also, from the perspective of my experience in the chemical industry, although pleasure excursions here are not something that we would ever anticipate or desire or want, in the chemical industry the pressures and temperatures they operate at you see the results on the news sometimes when the entire facility and three miles around it are destroyed.

What I've seen the petrochemical industry particularly do is if they have a concern they go with much heavier wall pipe. When their piping runs where they think there can be some kind of pressure excursion and the shell job being a perfect example. That was a new technology.

Instead of coking, taking the carbon out of the bitumen they put hydrogen in so it was very highly explosive process if not controlled. I saw some of the heaviest wall thicknesses that I had ever seen on that project.

VICE CHAIR ROBERSON: Ms. Busche. So, Ms. Busche, in the response to the Board's questions, Question 5E, "Doe indicated that one aspect of the change in approach from the original HPAV design criteria to the new HPAV design criteria was to determine if the project can replace an active control or barrier with passive control or barrier." I'm assuming this is the preferred approach from a nuclear safety perspective. You prefer to have a passive control?

MS. BUSCHE: That is correct.

VICE CHAIR ROBERSON: Okay. My last question to you, Mr. Ashley, with this in mind you are using this tool to help you determine active and passive control, again, with consideration of the pressures of the project. When I look at this simply, why isn't increasing the pipe schedule an option?

MR. ASHLEY: It is.

VICE CHAIR ROBERSON: So what is the balance between doing that and utilizing this too? Where is that line? What is that decision process?

MR. ASHLEY: The criteria enables those decisions. For example, if the current anticipated design were what we call a Schedule 40 pipe, which is from a process standpoint is probably the minimum pipe size meaning wall thickness that we have on the project.

If the criteria as we went through the analysis and the postulated events -- and I call these postulated events. These are what we postulate might happen or could happen. If we are unable to meet the criteria for that Schedule 40 pipe, the engineer's first response could be to increase the schedule of the pipe to Schedule 80 pipe.

In the current project we have put the HPAV affected pipe, that's where we could potentially postulate an event in four inch and under pipe, though that pipe had been procured some years ago prior to the evolution of how we were going to address the HPAV phenomena. We put that on hold because what we don't want to do is install any of that pipe and preclude the opportunity to increase the schedule of the pipe.

There are limits. The pipe has to interface with other components like vessels. We could go to Schedule 160 but Schedule 160 decreases the internal flow area of the pipe and would require a more substantial redesign of mechanical systems, reevaluating flows and pressures, so there is a limit to the schedule of pipe that we could go to. But we will meet our criteria to assure that we protect the pressure boundary. If to do that requires the increase in pipe schedule, that's what will be done.

VICE CHAIR ROBERSON: What I just heard you say is you need this tool to tell you what pipe schedule to go to?

MR. ASHLEY: Design criteria very simply tells an engineer what material do I need to meet the design, what's the geometry of the material that I need to meet the design. That criteria drives the design.

What we establish as our acceptance criteria very much drives the design. The design, the selection of a pipe schedule, the routing of a pipe, how I support the pipe. That's all driven by an acceptance criteria which assures the performance of that system.

VICE CHAIR ROBERSON: Right. So you need this tool to inform you on pipe schedule selection?

MR. ASHLEY: I need the full sweep of tools which is design criteria, which is the code, which is material properties associated with the code. I need to know the load. As an engineer I need to know what is the load that pipe is going to see. In this case it's a pressure response.

Then I'm going to take that severity and frequency of that event and then I'm going to evaluate how my piping system and my inline components respond to that event. I'm going to determine what the stressors are in that pipe and in those components. I'm going to determine what the loads are on the supports. It's all part of the process of design.

VICE CHAIR ROBERSON: I'm going to let somebody else ask questions, Mr. Chairman.

MR. DEWEY: Ms. Roberson, if I could just follow up your question for a second. So, let me try and ask it a different way. You're going to use this tool and you're going to say this particular run of pipe that we're analyzing suffers three plastic deformations of less than 2.5 percent strain so that's acceptable.

MR. ASHLEY: No, that's not the way we do design. Okay. What we do is we have to start with what is the event that I'm designing for. Then I take that event and I analyze that system to see what that system's response is to that load. We don't assume that we are going to be at the high end of our acceptance criteria.

I could have an HPAV event, a series of HPAV events that could result in responses that are well below the yield of the material, that there is no plastic strains associated with that event. The criteria I must meet is I must be below my acceptance criteria.

MR. DEWEY: Which are?

MR. ASHLEY: My acceptance criteria in the hot cell is yield stress at .2 percent strain offset which is the elastic limit. That is defined as the elastic limit. In the hot cell --

MR. DEWEY: You said hot cell.

MR. ASHLEY: I'm sorry, black cell.

MR. DEWEY: Thank you.

MR. ASHLEY: Black cell. In the hot cell it's 3 percent strain. Now, I must meet the code so I must evaluate how many times that event could occur or is postulated to occur over the life of the facility because I must evaluate the cumulative effect of multiple events.

The rigor of this criteria is and the reason that we need an estimate of severity and frequency is I need to design for the potential for multiple events and assure that I maintain the pressure boundary of this piping of that primary boundary over the life of the facility.

MR. ASHLEY: Okay. And the "limit number of events" is?

MR. DEWEY: It's a detailed fatigue evaluation. We're limiting -- we believe an appropriate limit would be three events of the most severe event.

MR. ASHLEY: Okay. Let me try again. You have a piping run for which you have calculated that you will get, over the life, the 2.5 percent strain event three times and that would be acceptable but that will cause plastic deformation.

MR. DEWEY: That's correct.

MR. ASHLEY: Why, since you've already said, "We'll adjust pipe schedule based on what we need," why would you not just say, "We'll not allow plastic deformation at all. Go ahead and increase the pipe schedule?"

MR. DEWEY: It meets criteria. For the criteria we can maintain. If it were the current design of Schedule 40 that meets the criteria. That is allowable. It then becomes specific judgment as to whether I would want to increase the pipe schedule to Schedule 80 but our design will meet our established criteria.

MR. ASHLEY: And I'm still left with why. If you could do it and not have plastic deformation, why not?

MR. DEWEY: Would you take the same approach in normal operating pressure design for pipe that says I meet the code. I meet the code allowable for normal operating load. Why don't I just increase the pipe schedule to the next schedule. It's not the way you do design. You design to a criteria.

MR. ASHLEY: Correct. And in this case you set a criteria that allows plastic deformation.

MR. DEWEY: Correct.

CHAIRMAN WINOKUR: I have one more quick question and then we're going to Mr. Brown. That is when you have these plastic deformation events you talk about, what is the impact on the jumpers and other inline connectors that the Board has expressed a lot of concern about?

MR. ASHLEY: Inline components -- complex inline components are not qualified by analysis. They are not qualified to a strain criteria. They will be qualified by test. We did demonstration tests. Demonstration tests, not qualification tests.

In the experiments at Southwest Research on PUREX connectors, for example, we did see limited plastic deformation with a pressure reflected DDT [deflagration -to-detonation transition] during those tests. I want to put into perspective when we talk about three percent strain and people talk about bulging pipe, the PUREX connector -- we measured about 1.8 percent strain in the PUREX connector.

It's 53 thousandths of an inch diametrical. Visual inspection would be unlikely to identify that level of plastic strain. When you talk about bulging pipe, you are generally talking about strains in the range of 25, 30 percent. We're talking three percent plastic strain.

As Dr. Shepherd mentioned earlier, standard design in piping fittings acknowledges there is plastic strain during normal operating loads.

CHAIRMAN WINOKUR: I'll probably come back to this a little later. I want to go to Mr. Brown now.

MEMBER BROWN: Good morning. Thank

you all for being here. I'm going to continue the questions which will be primarily Mr. Ashley and Dr. Shepherd, although I do have to ask should I call you Dr. Shepherd, Professor Shepherd, Dean Shepherd? Do you have any other titles that I've missed?

DR. SHEPHERD: Just Joe.

(Laughter.)

MEMBER BROWN: That must be a California thing. I had the opportunity, this is kind of a side story, to be the driver for Condoleezza Rice when she went to meet Sandy Berger for the first time at the White House 10 years ago.

She had never met me before and so I helped her into the car and then I turned to her and I said, "Should I call you Provost or Dr. Rice or Professor Rice?" She said, "Just call me Condi." I guess that's a California thing. Just call me Joe.

My questions are primarily on the testing program. I just want to go through it. We've talked around about it but I would like to try to fill in the whole picture. Let me begin with Mr. Ashley.

We've talked about how Cal Tech and Dominion Engineering and Southwest Research were key elements of your testing program. Were there any other significant elements of the testing program?

MR. ASHLEY: No. Those were the primary elements.

MEMBER BROWN: Okay. Could you describe the scope of this testing program; what you are trying to achieve, what it involved, how long it's been going on.

MR. ASHLEY: My recollection, and Dr. Shepherd can correct me, I think it's been going on about five years. I think the initial testing that Dr. Shepherd began at Cal Tech was in 2005.

Some of the initial investigations were with fairly simple systems in Dr. Shepherd's laboratory looking at two-dimensional systems, not just straight runs of pipe, but bend systems and provided some of the very important foundational work early on in the program.

The testing at Southwest Research then advanced that testing to full-scale piping systems of more complex geometry including some demonstration tests for some inline components down at Southwest.

The role of Dominion Engineering in the overall program in effect is as the analyst because obviously Dr. Shepherd's work really focused very heavily on some fundamental phenomenology, what happens, how these events transition from deflagrations to detonations and responses.

Dominion's role was really establishing how are we going to take this data and this measured response data and develop analytical tools that would allow us to conservatively predict the responses of the piping systems to these postulated HPAV events.

If you think about Dominion, Dominion worked in taking some of Dr. Shepherd's data.

A lot of Dr. Shepherd's data worked taking Southwest Research data, and then really taking that data and developing analytical models that would assure that we could conservatively predict the responses that we were actually measuring in these piping systems in the laboratories and at the larger scale down at Southwest Research.

MEMBER BROWN: So what you're really looking at is the bounding cases for this rather than what all the possibilities are but basically the boundaries of the HPAV uncertainties?

MR. ASHLEY: Well, yes. Determination of uncertainty, how we would address uncertainties, how well the models can correlate. If the models don't correlate well, how would we have to address that. All the way through to how do we combine the stresses.

There's a whole lot of technology, a lot of important analytical methods in terms of how stresses actually combine, stresses along different axes in a pipe. How do they combine to result in strains in the pipe?

All of that was really part of this program is to be able to get to a criteria that provides us the high confidence that we could evaluate the responses of our piping systems to these HPAV events that we then could use for qualification.

MEMBER BROWN: Dr. Dickey yesterday talked about an unexpected result of, I guess, in your Newtonian vessels the stratification of the heavier particles and how those were dominantly taken out of the tank when you were pumping out. Have you had any similar surprises, if you will, in your HPAV program, things that you didn't expect?

MR. ASHLEY: If you look down at the

individual responses in a piping system, there were some responses that I think -- you know, we worked pretty closely with Dr. Shepherd, scratched our head, some things that we call high frequency oscillations. We saw those responses.

We tried to understand and make sure we understood what those were. Then we had to make sure that we could understand how we had to evaluate those and how we had to include those in the design process. Dr. Shepherd can speak to it.

He's probably seen in the lab those responses before but from the engineer standpoint those were responses that I would say we didn't anticipate but they were important to be evaluated and included in the overall design criteria.

MEMBER BROWN: Would you like to comment on that, Dr. Shepherd?

DR. SHEPHERD: Yes. So this is the kind of interesting, fun, academic part of it, although I think it perplexes sometimes the engineers how to handle these things. What we were confronted with when we came into this program is that the state-of-the-art in evaluating detonations and piping systems was pretty low. In fact, there was not really any agreed upon design methodology for this, a set of standardized loadings which you would use.

The engineering groups like Bechtel come about this from the point of view that this is a structural mechanics problem. If you'll tell me what the loading looks like, what the pressure is as a function of time inside of the pipe they have very highly developed methods to do structural analysis.

That's what Dominion is doing and what Greg was referring to with their analytical methods so they use these finite analysis tools to calculate the response of the piping and see if they can develop loading methods, loading descriptions for the different things that happen, deflagration, detonation, transition from deflagration to detonation.

What happen when the detonation goes around the bend in the pipe. What happens when it reflects off of the dead end. What happened when it goes through a T. These were the things that we actually did not have a good grasp on in 2005 when I got started on this program.

One of the things that this program has done is really significantly advance the state of the art in how to model all of these features and make reliable engineering predictions of the response of the pipe. Now, this is a problem which is a little different than what piping designers usually confront because the detonation waves move pretty fast.

They are moving at several thousand meters per second so they excite elastic waves in the piping that ordinarily are not part of piping design. Piping design is basically you have a piece of material and it might undergo seismic loading which has oscillations on the order of a few hertz or tens of hertz but you typically don't consider oscillations which could be hundreds of kilohertz which is what gets excited when the detonation wave moves through.

It's necessary to expand how you are thinking about this. It's necessary to understand how you are going to account for these things with your standard engineering tools. There's standard piping codes that they're using.

One of the things we had to do was develop methods for how do we prescribe what the forces are going to be in the standard piping code ME101 that Bechtel uses for doing their design. This is, as far as I know, the first time that this has really been done for detonations and we've come up with a set of prescriptions of how to do this.

We progressed from the point where we were absolutely ignorant about it to now we can make reasonably reliable predictions. We show that for fairly complex piping systems that incorporated the kinds of features that you have, not all of the features but most of the features; three dimensionality, bends, Ts, so forth, in my laboratory and at Southwest Research, piping systems that were -- in my lab it was 70 feet long.

At Southwest I think it was 200 feet long, and able to show by using this kind of breaking it down into components developing models for each of these individual parts, we can simulate the whole. In the process of doing that, some of these features like these high frequency oscillations, these are things that are kind of unusual creatures.

How well are we going to need to understand those to do the design? I think they are things that we don't have to understand particularly well because the other strains and stresses which we can reliably calculate, in fact, bound those things but they remain as something that we don't clearly understand.

MEMBER BROWN: Thank you. Mr. Ashley, what are the uncertainties that you are still trying to grapple with and resolve --

MR. ASHLEY: Well, I think --

MEMBER BROWN: -- related to the testing program?

MR. ASHLEY: Related to the testing program in terms of our ability to correlate our design models with testing, there really are not a substantial number of uncertainties. There were some HPAV Independent Review Team findings that required that we provide additional justification.

We had, I think, good discussions with their team, additional justification for how we combine some stresses. The data is available. We don't need additional data for that.

The uncertainties that we are still

addressing have to do with the questions that were asked with regard to other gases like nitrogen that could cause formation of larger bubbles.

What effect does that have on what we call our run-up links as we predict what the event is. I think Dr. Shepherd provided good insights on how to address that. There is data out there that helps support that. We are completing that work.

I think as Mr. Kasdorf mentioned in his testimony, the bubble formation and our confidence in our bubble formation models are conservative. There is some uncertainty there that we are addressing in two ways.

One of the beauties of the quantitative risk analysis is it allows you to address uncertainties. Also we are addressing those uncertainties specifically relative to the phenomenology because that bubble model is part of our quantitative risk analysis.

If you go through the HPAV

Independent Review Team model, I think the remaining uncertainties that we need to resolve before we can fully implement that are well documented. Our action plan actually to address those uncertainties is documented in our closure plan for those both on the finding side and the recommendation side.

MEMBER BROWN: Thank you, Mr. Ashley.

I've got a real void here in the middle of the panel. Most of my questions are really to Dr. Shepherd but I don't want to leave you out.

I would ask maybe, Mr. Knutson, how involved are you in this testing program and the direction of the testing program? Do you review the data that they're looking at and are there other questions that you've added or you expect -- I mean, are you actively involved in the direction of this testing?

MR. KNUTSON: I guess, first, thank you for pronouncing my name correctly. Second

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MEMBER BROWN: We're both Scandinavians.

MR. KNUTSON: -- the Department of Energy has technical experts that are part of our project team that are engaged with the testing plan. They do participate in understanding how these results are translated into the design. They are part of the review process from an assurance point of view.

We do make sure that we do keep the arm's length relationship between design authority responsibilities and design assurance responsibilities. Our job is to make sure that the process being followed is in conformance with the standards that we've expected and in conformance with the expectations for ultimate public safety.

MEMBER BROWN: Thank you.

Dr. Shepherd, I've got a bunch of questions here. I could talk to you forever, as you know.

DR. SHEPHERD: Okay. Well, we've got another hour.

(Laughter.)

MEMBER BROWN: The Chairman isn't going to give me a full hour so let me run through some things here if I can quickly. We read a lot of your stuff. I know it's probably dangerous quoting from somebody's email without their permission, but I have an email last November, November 2009, that I would quote. There are a couple of things you have at the end and I just wonder if you feel the same way at this time.

DR. SHEPHERD: What day was that?

MEMBER BROWN: November 13, 2009. You said, "The DNFSB [Defense Nuclear Facilities Safety Board] comments span the range from very minor to serious points with some miscommunication thrown in for good measure."

DR. SHEPHERD: Oh, boy.

MEMBER BROWN: "It is clear that

multiple reviewers were involved and some of these comments are superficial while others go to great depth and demonstrate understanding of the issues. However, by focusing on so much detail, I think the big picture may be missed.

The DNFSB really needs to give some priority and sense of importance so that the main points can be addressed. From my perspective the big issues are..." and you list three. I would be interested in your comments on these three big issues. "...separating design and safety analysis. This was the purpose of introducing QRA but the issues are still entangled." Do you have any --

DR. SHEPHERD: I would like to go a little bit into the background here. This is commenting on a document that had been produced which had a set of questions and comments about the approach at that time.

What I felt was oftentimes, and what

I see, and this is true not only of the Defense Board but many other regulatory boards, and it's perhaps just a fact of life, but the comments span a large spectrum and it's difficult to often get, I would say, a response that really helps the organization.

I mean, the goal of all of this is to help the organization to do its job in a way that's going to comply with regulations, going to make sure it's safe and it's being done in a way and, in this case, safety means it has to be done in an expedient fashion so we don't leave the waste sitting in the ground. That's been made clear.

My comments are really directed at the fact that when the project organization spends an inordinate amount of time responding to each little detail and goes through each one with almost equal importance, it really then obscures what the main issues are. That was really to the point of my comments here.

I felt they were really getting down

in the weeds and spending a lot of time thinking about the details. I'm trying to say, "Okay, guys. We need to step back a little bit and say what's really the major issues here." That's really the thrust of my comments.

MEMBER BROWN: Thank you. The second one was using test data and simulations to validate the proposed method of treating stress estimation from explosive loading.

DR. SHEPHERD: Right. So thinking about these big issues and then just backing up a little bit so I can clearly address each one of these separating design and safety analysis. This is a very important point that hasn't really been touched on much here. This may be more of my own opinion as a scientist and an engineer than it reflects how the project is approaching this.

I would like to point out that in most projects of this type you have a design which is driven by some fundamental requirements of the job that you're trying to do and then you have a set of safety analyses that you do which are something that exist separately to this.

This is something that has to be, I think, clearly seen. You use the piping code to do the design for your design basis. You have a lot of safety analyses that you do that consider all kinds of things. I always tells folks when I get involved in these things all things that are possible are not probable.

When you mix these things up and you start to say, well, I'm going to do design, for example, to resist as a standard case in each piece of pipe, in each component, a pressure reflected deflagration and detonation transition, you've really put yourself in a box that's extremely hard to get out of. I'm not sure if that makes any sense at all. That's what my comment one was about. You should not get these two things confused.

Now, number two, using test data in

simulations to validate the proposed method of treating stress estimation from explosive loading. One of the key things that we have to keep in mind here is that we have a complex state of stress in the piping. Piping codes, they are not like the 10 Commandments. All right? The piping code is a very big collection of prescriptions about how to do things and it gives you many different ways to do things.

One of the things that they tell you is you really need to, as a responsible engineer, figure out how you're going to treat complex situations where you have stresses in different directions -- in this case the stresses are time dependent -- and how you are going to combine those and then specify some criteria that say whether or not you are going to accept that level of combined stress. Now, that's not something that we have any rules about in the piping code.

One of the things that I think is

very important to do and that the project has recognized and the project has been engaged in for some time and isn't going to be completing -- they've committed to doing that as part of responding to the Independent Review Team's remarks -- is developing methods and validating for how you estimate the stresses and combine those.

MEMBER BROWN: Thank you. I appreciate the insight. That's what I'm looking for. I'm always looking out. I like to hear people looking back so I can validate what I'm doing. One of the things which I think you just explained but it's a quote out of a 2009 Journal of Pressure Vessel Technology that you wrote is that, "There is no provision within the ASME boiler and pressure vessel or piping codes for designing pressure vessels or piping to withstand gaseous detonations."

DR. SHEPHERD: That's correct. If you'll look you'll see that there is a short section with some recommendations about deflagrations. We now have a code case that is sort of a supplement to the code which describes how you handle having solid explosives inside of a containment vessel. This is something that, in fact, was done for the DOE for their testing facilities that they have at the national laboratories.

There is not any specific prescription about what you do when you have a detonation inside of a pipe or a vessel and so you have to rely on that part of the code that says that you need to get smart, qualified engineers and they need to use accepted methods and analyze that and come up with methods for then determining what the stresses and strains are.

That's really what we've been about here. I wrote that article a little while ago and if I'm going to write an update in that, I would include all of this new information we have. In fact, we're working with the ASME --

both the boiler and pressure vessel part and the piping part, to initiate a process, and it's quite a lengthy process with the ASME.

It's a pretty bureaucratic organization. Their engineers are very deliberate and conservative -- in developing a set of rules that would then allow for basically translating everything that we've learned here in this program plus additional knowledge and then we would have a prescription where people could go and look it up and say, "Okay, what do I do now? I've got a detonation. How should I estimate the stresses and the strains?"

MEMBER BROWN: How long does it typically take to get a code case through?

DR. SHEPHERD: The code case that I'm familiar with is the one that was done from impulsively loaded vessels and I think that took about seven years.

MEMBER BROWN: So it's not something done lightly.

DR. SHEPHERD: No.

MEMBER BROWN: Mr. Kasdorf talked briefly about Hamaoka and Brunsbuttel and the explosions that happened in those nuclear plants. The information I have says that the ductal pipe failures were estimated at somewhere between 123 and 127 percent of their normal dimensions but that was a different type of material.

DR. SHEPHERD: There were two different types of materials actually. I think a couple really key differences between those situations and the present one. In Hamaoka it was carbon steel and high-strength material and in Brunsbuttel it was stainless steel. The stainless is more similar to what we have here.

The other key thing is those systems were operating at very high pressures to start with and so if you look at the relative loading, that is the pressure that was produced, they believe, by the explosion compared to the onset of plastic deformation, those pressures were quite high in comparison to the pressures that we're considering even in the most extreme cases that we have, the so-called pressure reflected detonation cases.

Those would still be much lower. If, you fact, you look at the relative amounts of deformation, they would be much, much smaller here in the case of the WTP. I fact, they are so small you would never even consider fragmentation to be an issue in the WTP in comparison to that.

MEMBER BROWN: I think I've read that deflagrations you can expect possibly a ten-fold increase in the pressure and a detonation is 30-fold, something like that.

DR. SHEPHERD: It's good to think about it in very definite terms. For the hydrogen nitrous oxide system and we've been using a system with about 30 percent hydrogen as sort of the reference case. The pressure increase that you get for a detonation would be about 26 times and the pressure increase for a deflagration might be on the order of 10 to 12 times.

MEMBER BROWN: It's 12 times the original pressure?

DR. SHEPHERD: The original pressure.

MEMBER BROWN: -- going back to the nuclear power plants where they are operating at 1,600 PSI multiplied by 26 and you get a pretty significant --

DR. SHEPHERD: Exactly. Of course, in that case that was a hazard people have known about as long as we've been designing nuclear power plants and they simply didn't take care of the fact that they should have had a high-point vent there and they could have avoided that problem. That was the case where standard mitigating method could have been used to avoid that.

MEMBER BROWN: Thank you.

Mr. Ashley, we talked about what it

takes to get hydrogen deflagration or detonation. You need the hydrogen, you need the oxidizer, and you need the initiator. What do you use as the probability of initiation for hydrogen?

MR. ASHLEY: The probability of ignition we use is 1. What we assume is if the conditions exist, and this is through the QRA, through the use of the QRA if the conditions exist that could result in a deflagration or detonation, we assume that the ignition source is there.

MEMBER BROWN: Does that mean as soon as you get to a detonable quantity or you get the maximum detonable quantity and then you --

MR. ASHLEY: Based on the event under consideration we do not do like we did in the ice condensers where we have hydrogen igniters to make sure that we ignite before we get there. We assume that the bubble continues to accumulate so that we can be evaluating the condition that would provide the high severity of that specific event.

MEMBER BROWN: The HIRT team questioned whether this was necessary. Is that correct?

MR. ASHLEY: Well, this is a topic of a lot of discussion. Could there be through an expert elicitation process, poll a bunch of experts together that could provide a different -- rather than a probability of one could we develop some other probability distribution for ignition evaluating the specific sources of ignition?

I think as Dr. Shepherd said the condition in Brunsbuttel and in Japan were very high pressure, high temperature. Obviously we don't have that condition but there was a recommendation that we might evaluate something other than a probability of ignition of one.

In terms of looking at specific additional margin in our response to that recommendation as we are considering an expert elicitation but right now that is not a priority for us. Our priority will be using the design tool which assumes a probability of ignition of one.

MEMBER BROWN: Thank you.

MR. RUSSO: Just for comparison, if I may, our facility will run at about a maximum of 140 F temperature, 70 to 80 psi. The reactor, as you know, goes at about 500 to 600 F, 1200 to 1600 psi. I just wanted to provide that for context and the discussion.

MEMBER BROWN: Thank you, Mr. Russo.

The probability of ignition, Dr. Shepherd, is that a reasonable assumption that BNI is making? What was your opinion of the HIRT recommendations on that subject?

DR. SHEPHERD: My opinion is that we should reconsider the probability of ignition. If you look at what drives the QRA which, by the way, I believe is a very important tool for understanding what you need to be addressing in your safety analysis.

The probability of ignition in my laboratory is zero except when I push the button. If you have a piece of pipe that has no active components in it, catalytic materials, nothing is moving, it's just sitting there, to me it's not credible to be postulating that you have ignition taking place.

When you say that the ignition probability is one, you're doing something that is more than just conservative. You're basically throwing up your hands and saying, "I'm not going to try to seriously address this issue."

I think it's useful to look at what other organizations have done. I have encouraged the project all along to have a look at what the practices are in various other industries which have hazards. For example, inside of aircraft fuel tanks looking at what's been done at Sellafield.

We are now engaged in talking to Sellafield about their practices that they have there. They have, in fact, sponsored a great deal of work on ignition by impact and things of that nature. I think that whatever you can do in regard to understanding better and quantifying what the ignition sources are.

For example, I've never heard a substantive discussion about what actually the ignition sources would be other than just sort of a very rough evaluation that, "Oh, well, we might have some components that might generate some kind of electrical spark or else there might be some compressive ignition due to motion of material."

Outside of that I don't believe there has been any substantive evaluation of that and I think there are substantial gains that can be made.

CHAIRMAN WINOKUR: Okay. We are going to take a question from Dr. Mansfield and maybe one from Mr. Bader and we'll take a very brief break. We need to do that. Then we'll get back to Mr. Brown.

Outside of that I don't believe there has been any substantive evaluation of that and I think there are substantial gains that can be made.

CHAIRMAN WINOKUR: Okay. We are going to take a question from Dr. Mansfield and maybe one from Mr. Bader and we'll take a very brief break. We need to do that. Then we'll get back to Mr. Brown.

MEMBER MANSFIELD: Just a short intervention, Professor Shepherd. The gas company has pipes under a fraction of an inch of water pressure four feet underground, wet, no sparks, no nothing. And yet, they always assume a PLI of one. That's why they dig. The same is true of the space shuttle main engine testing facility.

Any leak of hydrogen at the West Palm Beach test facility is considered to have a PLI of one. Even though it's miles away from -- not miles but a long way from anything you and I would call emission facility. I really don't think it's a good idea to introduce PLIs of less than one in a facility that you can't even see.

DR. SHEPHERD: I think what you have to do is to look at the practices in a lot of industries. For example, industries that handle high-hazard flammable materials, flammable dust, flammable gases, liquids, and so on, there are standard electrical practices for minimizing the sources of invert ignition by any kind of accidental electrical discharge.

There's an entire industry that is devoted to this. There is an ATEC standard in Europe. There are EL standards here in the United States. As so one can make substantial efforts to ensure that there are no ignition sources present for a number of these types of ignition sources.

Some are things that you can always postulate and we are going to have difficulty ever ruling out, for example, catalytic materials inside of the piping systems, adiabatic surges.

I believe it behooves the project if we are going to turn over every rock and understand what are indeed the threats. Then we need to understand what is the realistic probability of ignition and that's something that I think ought to be included in the QRA.

CHAIRMAN WINOKUR: Mr. Bader.

MEMBER BADER: Mr. Ashley, all this discussion with Dr. Shepherd and yourself just continues to drive me in the direction of asking you a similar question to what I asked Dr. Shepherd. When you look at all these uncertainties, and I can reenumerate them but you've heard them before, and you've added a few more, doesn't this drive you in the direction of needing additional prudent levels of conservatism?

MR. ASHLEY: We believe that we do have prudent levels of conservatism. Certainly it's good to step back from this and understand really the two sides to the equation, the demand side and the capacity side.

The demand side is really governed by what we're doing through the quantitative risk analysis. What is the accumulation of hydrogen, what is the geometry of that accumulation of hydrogen, and what the resulting potential events could be. Even embedded in that methodology is conservatism.

The capacity side is very deterministic and conservative. If you look at the methodologies employed in combinations of stresses, look at the methodologies employed in the analysis to predict responses, and then look at the methodologies that are employed in determination of the material properties and the levels of stresses that are allowed. That is very deterministic and conservative.

We believe that though there are those uncertainties, and we acknowledge those uncertainties, and through the QRA we actually can evaluate the sensitivity to those uncertainties, we believe that what we have is what we termed in commercial nuclear high confidence, low probability of failure which is assuring that we maintain, even in these unlikely events, probability of ignition of one and even under these unlikely events we maintain the pressure boundary of the piping.

MEMBER BADER: Let me go to one other thing and I appreciated this comment that Dr. Shepherd made. He talked about getting lost in the weeds looking at all the small details. Wouldn't adding back even more conservatism allow you to get much less complex situation in determining the risk from hydrogen detonations --

MR. ASHLEY: Actually --

MEMBER BADER: -- which is going

back to where we were before.

MR. ASHLEY: Well, I think it's important when you talk about where we were before in the approval of the criteria in 2006.

There were basic assumptions that, in fact, we provided significantly more rigor that we believe is important in looking at potential, the possibility of multiple events and what affect those multiple events have on the systems in looking at components of stress that originally prior to doing all of the investigation testing and analysis that we may not have considered.

You can look at it and say there is a lot of complexity in the journey, a lot of moving parts. The intent is we have criteria now that is easily understood. It's not implemented by everyone. These are specialists that are implementing this criteria all the way from the organizations and the personnel that provide input to the

QRA; engineering, operations, and safety.

Even the analysts, back from the commercial nuclear days, you didn't give transient analysis of piping systems to any engineer. You didn't give class 1 analysis of piping systems to any engineer. Those were specialists. This criteria will be implemented by specialists. It's important.

MEMBER BADER: The last question before we break to Ms. Busche. Staying on this course to me means that there will have to be assumptions that are fairly complex, protected in the safety basis.

MS. BUSCHE: Correct. 3009 Appendix A would drive us there when I analyze this design tool like any other design tool.

MEMBER BADER: And that's going to be a more complex situation in the operation?

MS. BUSCHE: I don't think I can determine that yet but we will have to maintain it and establish programs that are different than what we would traditionally have today.

MEMBER BADER: If you see an occurrence in the plant during operation, wouldn't you have to then go back and challenge?

MS. BUSCHE: Yes.

MEMBER BADER: Thank you.

MR. ASHLEY: Mr. Bader, I do need to add to that. If you look at all of the parameters that are necessary or that are important in the PRA [Probabilistic Risk Analysis], many of these parameters are already protected. Maximum temperatures of systems, the hydrogen generation rates. Those are protected already.

If you look at many of the assumptions in the probability distributions those are protected by existing safety management programs. There are safety management programs that will be necessary for the plant.

We will need to review, and nuclear

safety will need to review, are there any additional assumptions that require protection. I think the thought that the QRA is creating a whole new set of protected assumptions, that's not true. That's not factual because a lot of the inputs are already protected design basis assumptions.

CHAIRMAN WINOKUR: All right. I think we're going to need to take a short break right now. It's only going to be two or three minutes and then we will pick up. Okay?

(Whereupon, at 10:26 a.m. the above-entitled matter went off the record and resumed at 10:30 a.m.)

CHAIRMAN WINOKUR: All right, we're going to reconvene. Please, I would like quiet in the room.

Mr. Brown, you can continue your questioning.

MEMBER BROWN: Thank you, Mr. Chairman.

Let's see. Dr. Shepherd, can you --

we had hoped Dr. Mattson could be here but he was unable to be here for significant personal reasons so I guess I have you to talk to about the HIRT team. Can you describe what your role was with the HIRT team or as an adjunct to the HIRT team?

DR. SHEPHERD: I wasn't a member of the team. I briefed them on my activities. They came to Cal Tech and I gave them presentations on our work. We had two test programs that were sponsored by the DOE in 2008, 2009, and 2010 so I talked about that work.

I gave them the results of that work, access to the web pages where the data is, access to the reports. Then I also engaged in discussions primarily with two of the review team members that were looking at gas phenomenology, that was Chickarelli and Lee.

I also engaged in some discussions with the group that was looking at structural response. I reviewed portions of the documents and provide comments to them. That was the extent of my involvement.

MEMBER BROWN: So you were brought in as an adviser. You haven't really been following the implementation of their findings or --

DR. SHEPHERD: Right. I should add to that no, I was involved in the discussion of the plan that was put together by the project to respond to the findings and so I have made comments on several of the areas and there were several of those areas where I felt that there should be responses that folded in some of my concerns that I have brought up in reviewing some of the other documentation. My comments have been noted and incorporated into that response plan.

CHAIRMAN WINOKUR: Okay, Mr. Brown. I hope we have one or two more and we might need to move on, please.

MEMBER BROWN: Okay. Just two more

questions.

CHAIRMAN WINOKUR: Great.

MEMBER BROWN: Maybe three. The HIRT team had recommended that BNI establish plastic collapse design margins by testing representative piping and components to failure or by analytical calculations. Do you have any comments on that recommendation?

DR. SHEPHERD: I think it's nuts.

MEMBER BROWN: Excuse me?

DR. SHEPHERD: I don't think it's rational to propose doing that. It doesn't make any sense. I mean, the kinds of loads that we're talking about to get to plastic collapse are so extraordinary and outside of anything that we would imagine that we have either tested or postulated that I don't know what value that would add to the program.

MEMBER BROWN: Thank you. The question for you, and then Mr. Ashley, basically the same question. What further tests or analysis do you consider important to the subject of hydrogen explosions in piping?

DR. SHEPHERD: Let's be clear. We're talking about HPAV here.

MEMBER BROWN: HPAV.

DR. SHEPHERD: Yes. I think one of the most important things we can do at this point is to complete the work that Bechtel has said that they are going to do, the project is going to do in regard to fleshing out the design rules and going through an example of that and making sure we have a very clear statement about how the stresses are going to be combined and have an end-to-end calculation for a model system that clearly explains to the designers about how to apply what has evolved into a fairly complex set of design rules that they will need to use to evaluate situations where you have detonations in piping.

I think that is the most important thing to do at this point is to make sure that's really very clearly all set out and worked through. In fact, this is a concern that I believe they have committed to responding to and I think that is the most important thing.

MEMBER BROWN: Thank you, Dr. Shepherd.

Mr. Ashley, would you care to comment on that?

MR. ASHLEY: The remaining testing that we must do is for component qualification. We're in the process of developing the test plans and acceptance criteria for qualification testing of components. Once again, though, that's very different than the testing that has been done over the past five years. This is, I would say, a different qualification for a different load, a different event, but it is similar to seismic qualification of components or environmental qualifications.

As we purchase a piece of equipment the requirement for testing whatever the safety function is for that component will be part of that procurement.

MEMBER BROWN: Thank you, Mr. Ashley.

Mr. Chairman, those are all my questions.

CHAIRMAN WINOKUR: Thank you, Mr. Brown.

Dr. Mansfield.

MEMBER MANSFIELD: First, I would like to go back to the last question that Ms. Roberson asked about who measures what, hydrogen, nitrogen, and where. It was unclear because, Mr. Ashley, you said we. I'm sure that was the corporate institutional we. What I want to ask about is when you have to know the hydrogen generation rate and the N2O generation rate -- the N2 generation rate in pipe, who collects that data, from what sample and where?

MR. ASHLEY: Okay. There will be a collection of that data. It is a requirement of the waste acceptance criteria so before a feed is set, it's sent to the WTP. That certification parameter will be collected.

MEMBER MANSFIELD: By the operators of the waste treatment plant?

MR. ASHLEY: I'm not -- it is in the waste acceptance criteria. In terms of specifically which organization, obviously at the time we're operating the operator will have to receive that certification of that sample before that feed is transmitted to the WTP. The tank farm.

MEMBER MANSFIELD: The tank farm. Okay. Is the hydrogen generation rate measured or is it a mass-weighted calculation based on the Hu result from a bunch of different batches that have been blended together.

MR. ASHLEY: It's measured.

MEMBER MANSFIELD: Measured. The same is true with the N2 and N2O?

MR. ASHLEY: There are a set of

gases and I don't have the ICD in front of me. There are a set of gases, hazardous gases that will have to be measured.

MEMBER MANSFIELD: Are those done in your laboratory facility at the WTP plant or a new facility or where?

MR. ASHLEY: I would have to defer that to --

MR. SAIN: 222S.

MEMBER MANSFIELD: Oh, 222S. Okay. Fine. Good.

The next few questions I have are based on DOE's answers to the Board's written questions from some time ago most of which are for you, Mr. Ashley, but there is a sprinkling for others. You have certainly heard from the Chairman that the operability of the plant is a safety issue. If you break the plant, safety suffers.

MR. ASHLEY: Yes.

MEMBER MANSFIELD: So, you are going to have to forgive us if we ask questions and expect you to have controls like on hydrogen of the most conservative type because of the fact of what might be a simple industrial problem is liable to be months or more of exposure to the tank waste. We are not letting up on that.

Mr. Knutson, when ORP [Office of River Protection] approved BNI's request to modify the design strategy for control of hydrogen in pipes you established multiple criteria for the magnitude of plastic strain, number of strain events, and things like that, to protect the primary boundary.

It's getting very complex and it's getting more so. You need now to watch over 30 parameters to make sure you have accurate values or accurate distributions for them as opposed to five parameters last year. Is this getting too complex for the owner of the plant to manage?

MR. KNUTSON: The assessment report that I mentioned in my opening remarks evaluated one of the areas which was how have we established expectations for safe performance and the ability to manage our ability, the Department of Energy's ability, to manage the evolution of responsibilities as we move forward.

The complexity of the controls and the assessments associated with those controls inside the Department of Energy has not increased. The assessment processes that are used to ensure that those controls are monitored and evaluated has not become more complex.

The relationship between WTP as a project and the Office of River Protection as a site office and authorization basis has got to continue to mature so that as this evolves we can continue to keep a pace with the evolution of the project.

All of that is an expected outcome of a project of this scale, a project of this size, moving from a design and construction activity to a commissioning and operations activity. Now, that is a standard and normal expectation associated with any major project evolving towards commissioning, especially one that's a non-reactor nuclear facility in the Department of Energy.

MEMBER MANSFIELD: But this complexity is going to continue into operation of the plant. You're going to have to continually review, it seems to me, the contractor's performance on protecting the safety base of many more variables than you're used to.

MR. KNUTSON: The normal practice, normal process of our mission-driven site office and Department of Energy activity is exactly that. We must stay a pace with the way the plant is evolving and we must remain cognizant of the way the safety basis is being implemented.

MEMBER MANSFIELD: I would have asked this question of Dr. Mattson, and I will eventually, but I'll ask it of you now in his absence. The output of a route-by-route calculation, QRA calculation, as I understand it in the ideal situation, probability density function for the strain in a pipe that can be compared with the ultimate strain to tell you whether you are close to failure or not. Correct?

MR. ASHLEY: I think as I said before, Dr. Mansfield, the QRA provides the demand side of the equation, not looking at the capacity side of the equation.

MEMBER MANSFIELD: You misunderstand me. If you want, you have a QRA for the demand side required to cause a certain strain that you have decided is either code limit or a limit established by the consensus of people looking at plastic deformation. I mean, there is a probability density function for something in this problem. That's the only thing I can see comes out of the QRA.

MR. ASHLEY: What comes out of the QRA really is the severity of the event and the frequency of the event. Then what we have --

MEMBER MANSFIELD: That's a probability density function.

MR. ASHLEY: That's correct. Then what we have to do with that is take those peak pressures, the severity of the event, and the number of times that event could occur and we evaluate that through the response predictions, the piping response predictions to compare that against our acceptable strains.

MEMBER MANSFIELD: Okay. You are trying to do this without, of course, code guidance along the lines that we mentioned just a few minutes ago. It seems to me that requires a burden of independent review on parameters and methods and probability density functions, gas pocket logic and things like that, that would normally not be the case.

There is no cookbook here. Somebody has got to look at your assumptions or calculations or determinations of what the probability density functions of various parameters in the expressions used through the gas pocket logic to the EPC [Engineering, Procurement and Construction], etc.

Unknown parameters that are not allutory parameters -- do you agree they are best treated as random variables as NUREG-1855 [Nuclear Regulatory Commission Regulation] recommends? There being no guidance from DOE on whether or not you should do this, do you believe that you have to -- that it's necessary to treat unknown variables as random variables for the purpose of doing these calculations?

MR. ASHLEY: Actually in one of the recommendations that came out of the HPAV Independent Review Team as we looked at the inputs to the PRA is that many of the inputs, as you remember, Dr. Mansfield, were point values.

I think when you were here in a smaller briefing I believe in March and we provided you a table of what the basis for the input values, one of the recommendations that came out of the Independent Review Team is obviously looking at those point values and many of those should be input as probability distribution functions. Right now we have 73 existing parameters and 35 of those are being converted to probability density functions.

As you mentioned, one important part of implementation of a PRA or a QRA is peer review. And as we've responded to the HPAV Independent Review Team findings are when the QRA when we have addressed the findings and those recommendations that we will address, we will submit the QRA to independent peer review, a peer review team of three.

One of the peer reviewers that actually DOE -- when DOE did their peer review out of Brookhaven one of those reviewers will be there. One of the members that was the PRA expert that was on the HPAV Independent Review Team and then there will be a third expert that will be called --

MEMBER MANSFIELD: By route?

MR. ASHLEY: -- that will be called in to review the PRA methodology.

MEMBER MANSFIELD: Methodology.

MR. ASHLEY: We will not have actually run the PRA until we get through the completion of the implementation of the findings, a resolution of the findings, complete the V&V [Verified and Validated] of the tool in accordance with the NQA1 requirements [Nuclear Quality Assurance] and the 414-1C requirements. It will then be ready for implementation, i.e., route by route taking the methodology and applying that methodology to the specific routes.

MEMBER MANSFIELD: And that would be the case for all situations where parameters can't be determined precisely and there is a good argument that they should be distributed.

MR. ASHLEY: That's correct. All of those probability distributions will be documented in terms of what is the basis of the selection of that probability distribution.

MEMBER MANSFIELD: And that's a promise?

MR. ASHLEY: That's correct.

MEMBER MANSFIELD: Ms. Busche, you're the only nuclear safety expert testifying today and you're a good one or otherwise we wouldn't have asked you here. Are these QRA results far enough along where you can conceive of how they can be used and protected in the safety basis for the plant?

MS. BUSCHE: I am comfortable with the construct of the tool, how it's been put together with the caveat of the changes that are being made. There are two primary input tables that I would initially focus on or we would initially focus on in our integrated safety reviews and those would be your basic event parameter tables and your event duration parameter tables.

We would need to make sure if you're using a frequency distribution or probability density, whatever terminology you are going to use, that we are consistent in the unmitigated accident analysis and what this tool would provide. Then we would make some determination on those inputs and assumptions and determine if they needed to be protected by TSRs [Technical Safety Requirement].

Many, as mentioned before, are being -- that parameter will have already been selected because of another potential upset in the plant. To understand the inputs and tanks, it's not mature enough along that I can make those determinations.

MEMBER MANSFIELD: In a nuclear power plant or in other chemical plants initiating events like that that can't be controlled, for instance, loss of offsite power and duration of offsite power, are mitigated by having enough electric power to protect the plant.

I raised questions yesterday about whether that is the case and whether it's wise. I just raised them again. I've never seen a plant this important and this expensive that wouldn't have -- was at the whim of nature and the utility company to protect it from further damage. Would you care to comment on that?

MR. ASHLEY: Yes. Obviously all of those would meet the requirements important to safety equipment that must be maintained from a nuclear standpoint in the loss of offsite power. Additional loads on a diesel are obviously evaluated as a risk decision.

That risk, as we've talked about, one of the important features of that is if we did not have those components available what would be the potential impact on the operation of the plant. I think you recognize that those components that are not important to safety you can't put everything on your emergency diesels.

In commercial nuclear days one of the last things we did is what are the essential loads because we have too many loads on our diesels. You can't have lighting on your diesels. You can't have some of the components because you are limited in terms of diesel loads.

One of the beauties of the QRA, though, is allowing us to make those types of decisions, providing that information that really allows us to evaluate the risk and make those decisions. Good examples are we are using very conservative assumptions in terms of loss of offsite power.

One of the parameters this facility has used is loss of off-site power for a thousand hours. It's a long time. Forty days with no power. There's a lot of action that could be taken during a 40-day period but there are conservative assumptions in terms of what those event probabilities are, what the distribution of those events are. Those are all essential elements to a PRA.

MEMBER MANSFIELD: But, for instance, on a thousand hour loss of offsite power it's probably due to some event that will take all the bridges down. If you were thinking of trucking in a diesel, you know, you don't have many options. Once you've built a plant, I think you have to consider that the options are totally limited.

Another argument for having everything reviewed, I'm reminded of the complex codes used for fire protection calculations. They are not only reviewed externally, they are reviewed on a national basis. There are whole code cases on how you calculate how fires spread in a building.

Your models for hydrogen generation and detonation deserve a level of review that's equally strong. Do you agree to that?

MR. ASHLEY: We believe we have subjected these models to very extensive independent review. This is the methodology even from the beginning with world renowned experts in the specific areas and specific disciplines including Dr. Shepherd's ongoing involvement and the 12 members of the HPAV Independent Review Team.

This has also gotten a lot of attention. Some of the documentation has been provided. I believe, Dr. Shepherd, that the 7-11 document has been provided to the Nuclear Regulatory Commission.

DR. SHEPHERD: I can comment on this a little bit. I was recently involved in review of advanced reactor design for licensing and they were attempting to do some evaluation of a situation where they had detonation in some piping and I got permission to transmit this document, this so-called 07-11 document, and I felt that would really substantially help the NRC and the industry out in doing that.

I agree with you that in the best of all worlds we would have a broad exposure and review and participation from many communities. This is a very specialized business. There's not really that many people who are working on the subject of detonations inside of pipes.

MEMBER MANSFIELD: There's not many people that are working with such consequences either.

DR. SHEPHERD: Well, that's right. It's a very small community. You could ask the National Academy of Sciences to be involved and so on but the difficulty is really in getting enough folks together and having a critical mass. Loss of life due to fire, I would point out, is something that is of much more substantial and broader interest to the society.

MEMBER MANSFIELD: But that is

until there is a radiation incident.

DR. SHEPHERD: I understand.

MEMBER MANSFIELD: On the question of unsteady expansion behind the detonation front, you are proposing to examine whether you can model this with a double exponential. The parameters in a double exponential would be what, would they be functions of time?

DR. SHEPHERD: What you're addressing is the empirical description that is being used for deflagration to detonation transition. I just want to make a distinction here, Dr. Mansfield, to be clear. When we treat propagating detonation waves we have a very sound basis to do this, the so-called Taylor's Altovich Model, and this comes from solving some gastronomic equations. That is something we have a very clear grasp on.

What is much more difficult to do is when we have transition from a deflagration to detonation we have a very transient event. The pressures that we get out of that are something that are different each time we do that experiment. What we strove to do in constructing a model pressure signal was to construct something that would bound the strains that were measured by calculated strains using that load input.

Those exponential functions currently the version of that that has been implemented today uses constants for those -- time constants -- but it has been proposed, particularly by the independent review team, that correlation be reexamined and potentially that those constants could be calculated so that they depend on other variables.

For example, the size of the gas pocket. They would not necessarily be time dependent. The time dependence would all be in the exponentials but the time constant itself would be depend upon the scale of the system.

I would point out, though, that on the other hand all that would do is provide a little bit more of a connection to the physics of the problem. I don't believe that the Independent Review Team felt that it would really necessarily change the answer in terms of what the peak strains were.

MEMBER MANSFIELD: Wouldn't it change the impulse?

DR. SHEPHERD: This is an interesting question. What happens in these problems is it's a kind of a mixed load. Both the peak pressure and the duration are important. Quite frankly it's an ad hoc correlation.

There's a lot not to like about it but what you really want to make sure that you do is that you bounded all of the data that you have and that's how it was selected. There's a lot of changes that can be made to that. There is not a unique way to prescribe it because it's not based on a detailed physical description.

MEMBER MANSFIELD: On the issue of

bends in elbows and asymmetry factors, the variables used to calculate asymmetry factors, or estimate asymmetry factors, are those going to be considered distributed because they are epistemically unknown or uncertain?

MR. ASHLEY: The asymmetry factor I can let Dr. Shepherd weigh in on that but asymmetry factors actually were developed from the correlations with the test.

MEMBER MANSFIELD: Okay. So those test results.

DR. SHEPHERD: Both test results and there are some very nice pencil and paper analysis. I'm patting myself on the back here. I wrote a whole report about it. It's basically the kind of analysis that you do just when you have a garden hose and you turn it on and it starts flopping around.

It's just momentum conservation. There's nothing all that fancy about it. That is pretty sound. I would say it's more than pretty sound. I would say it's one of the significant accomplishments we have is that we have a good method for calculating the forces on detonation.

MEMBER MANSFIELD: So you think those are quite precise?

DR. SHEPHERD: Yes. They are precise but underlying that is you have to say I have a detonation in this bend. That's what's imprecise.

DR. SHEPHERD: Of course but we know that's where all the --

MEMBER MANSFIELD: Right.

DR. SHEPHERD: There is no imprecision once you tell me I've got a detonation in the mixture with 45 percent hydrogen and nitrous oxide at 112 kPa and 50 degree C I can tell you what that force is within 10 percent.

MEMBER MANSFIELD: Mr. Ashley, in your operation frequency analysis calculations, I'm referring to the so-called 008 report, you use failure data above the means modes or error factors from Savannah River, from EG&G [Edgerton, Germeshausen, and Grier, Inc.], and apparently Bechtel has its own reliability, availability, maintainability, inspectability database.

What is the pedigree of those? Do they include or are they consistent with a very large database for industrial equipment that is maintained by NRC and NRC contractors and IEEE [Institute of Electrical and Electronics Engineers] gold book and things of that nature?

MR. ASHLEY: Yes. As we talked about a little bit earlier, Dr. Mansfield, in terms of the justification for all of the probability distributions that are being used in the QRA, in the quantitative risk analysis, there is a basis, the basis being a comparative basis back to substantiated information. If there is information that we need to use because, as you know, some of our equipment is unique, then there will be a basis provided that substantiates those distributions.

MEMBER MANSFIELD: Most of those distributions show up in the databases as a central value and error factors on each side.

MR. ASHLEY: Actually, one of the recommendations that came out of the HPAV IRT is a number of these distributions were modeled as triangular distributions. That presumes that you know a maximum and that you know a minimum.

MEMBER MANSFIELD: No. That's the precisely the answer I didn't want unless you prove to me that there is no possibility of an extreme event past where that triangle ends.

MR. ASHLEY: You didn't let me finish. Those are being changed.

MEMBER MANSFIELD: Okay.

MR. ASHLEY: Because we know that there is no finite maximum and minimum for many of those distributions. The original drafts of those distributions did indicate triangular distributions. As I said, that would presume that you know the maximum and the minimum. In a true probability distribution you know that you don't.

MEMBER MANSFIELD: If the data shows -- if the handbook data or the databases show central values plus error factors in either direction, that suggests to me that they came from log normal distributions because that's exactly the way to specify the standard deviations of a log normal distribution. Do you think that -- do you share the widespread prejudice that log normal distributions are in some sense natural for these complex phenomena that involve multiple parameters?

MR. ASHLEY: I can't say that I share that but, as I said, we will develop the distributions for those specific functions and those will be provided both for the peer review as well as will be open to anyone's review.

MEMBER MANSFIELD: You mentioned in response to our question on code cases for extending the BDOT 31 code to explosive events that it's not applicable. Is that really precise? The 300-C3 and 300-C5 are applicable but they don't solve your problem completely. Appendix P on deflagration loads, those are certainly applicable. Aren't they?

MR. ASHLEY: When we look at a submittal of a code case, obviously you have to step back and ask yourself the question what are you asking the code to rule on. As I think Dr. Shepherd indicated, B31 has established a subcommittee that is looking at development of a standard which is this is very much not taking existing code and asking the code for a ruling of -- your methodology for adapting the existing code.

You're not also asking for a code interpretation. This, in fact, is as the code prescribes, the engineers identified that there is a phenomena. There are loads. There is a condition not addressed by the code. The competent engineer as supported by the necessary expertise is developing that methodology within the framework of the code.

MEMBER MANSFIELD: After all, the static code was developed to -- there's some physics behind that. I mean, fiber bending strength and things like that. The approach to the Dinex vessel used a lot of physics about metals and things like that and presumably can serve as the basis for trying to extend that.

CHAIRMAN WINOKUR: Ms. Roberson has a question.

VICE CHAIR ROBERSON: Connecting to Mr. Mansfield's question. In response to question 5C, I'm going to ask you, Mr. Ashley, because you are identified as a primary author of the response, the question was identified, "Other defense nuclear facilities that allow gaseous deflagration, detonations in process piping..."

In your response you sited the Defense Waste Processing Facility in H-Canyons at Savannah River as having been evaluated to allow for gaseous deflagration, detonations, and process piping. Then you say the safety design strategies for these facilities haven't been provided as part of the response.

I guess the question is we're asking for the reference for those. We understand that they were reviewed to determine the probability and the capability of the as-built facilities to handle those following the two international events but we are not aware that was a goal in the design strategy so we are asking for references if you have any. That's one.

MR. ASHLEY: Yes. I think I would -- you know, those are other facilities, other DOE facilities that I would refer to DOE to be able to provide those. As the contractor, I wouldn't be the one to provide those but I would --

VICE CHAIR ROBERSON: Okay. That's one. Then the second question on the same response in regard to the Dinex facility which your response is clearly the Board does have a lot of knowledge about this. We understand for that facility they also developed and submitted a code case and they were very discrete on specific actions that resulted. You say you gained insights from that. What insights did you gain?

MR. ASHLEY: That's correct. Obviously one of the experts that has supported us was working at Los Alamos at the time and was actually one of the authors of the code case. He has been on our team since the beginning so obviously the insights that were gained through development of that code case, that individual was able to bring to bear to development of our criteria. That individual is Ed Rodriguez.

VICE CHAIR ROBERSON: Okay.

CHAIRMAN WINOKUR: Dr. Mansfield.

MEMBER MANSFIELD: I'm sorry to take so much time but I'm the guy who was assigned this stuff so I've got to do it. On the 021 report, the implementation of closure plan for the HIRT report, you mentioned that the inline component test plan is not completed and you've only done limited testing. Do you have a time line for that when you're going to have an inline component test plan?

MR. ASHLEY: Yes. We expect to have that test plan and test acceptance criteria, I believe, by the end of November, that time frame. We're working that obviously to support the project schedule for procurement. The nature of our procurement processes are long. We obviously will have to source the qualified lab to be able to do that testing.

There are a number of labs that are qualified to do that type of testing, not just going back to the one laboratory that we had used previously in our testing. We are moving on the schedule necessary.

I think it is important to point out though, that we did do demonstration testing, not qualification testing when we were doing the large scale testing down at Southwest. We believe that provides us the confidence that we will be able to procure equipment that will meet our requirements.

MEMBER MANSFIELD: I'm sorry to have passed you up, Secretary Triay. Does anything you heard here this morning communicate to you that it's pretty urgent that we get a risk policy with some direction to contractors on how to handle these issues?4

DR. TRIAY: I believe that is why I offered Dr. Krahn to come up yesterday. Let me just summarize perhaps in a little bit more detail the work that he is doing as the head of the Technical Authority Board.

The Environmental Management Program worked with the Board to promulgate some of the basic principles of Standard 1189 through the Technical Authority Board ahead of the formal policy of the Department because we had facilities that were in the design and were being built for tank waste across the complex.

I believe the Technical Authority Board can serve the same function for the waste treatment plant, the policy that I promulgated at the Environmental Management Program level through the Technical Authority Board.

MEMBER MANSFIELD: It seems to me you're the one most affected by the incomplete art of probabilistic safety assessment at DOE. Frankly, this needs a champion. You've heard today that many of the questions that we've had would have disappeared, would not have been here, if certain NUREGs had been accepted by the project at the start.

I mentioned 1855 which says that all epistemic variables should be considered candidates for being random variables. That's a very good thing to do and is widely done.

It was not done here until it was discovered late in the process.

I ask you to consider being the champion for accelerating and getting a DOE policy/directive/manual/whatever it takes to give Contract a head start on what they are really going to have to do about this.4

DR. TRIAY: As you know, we work very closely with HSS [Health, Safety, and Security]. Mr. Glenn Podonsky is a tireless worker when it comes to addressing issues of this nature. In order to establish the 2009-1 implementation plan we have established in the Department a risk working group. The QRA has been fully vetted with the risk working group.

The independent peer review that the risk working group charter on the QRA has given findings and conclusions to the HPAV Independent Review Team. The Secretary has stated in the implementation plan for Recommendation 2009-1 that when the Department used quantitative methods to inform safety analysis it did so in a manner that was consistent with accepted industry standards.

The Risk Working Group as a result have sponsored the QRA peer review that I was just referring to. I believe that the work of the technical authority board will serve to inform the ultimate addressing of Recommendation 2009-1 just like we did with the Standard 1189.

MEMBER MANSFIELD: I would just counsel you that there is more to QRA than Abelian algebra spreadsheets, etc., etc. It's all in the models. It's all in what physics you put into it and what uncertainty is in there. That's what there needs to be a policy on.

DR. TRIAY: As we have done before, we will have a wide guidance on the subject of the QRA and we will establish a pilot with NEM like I was discussing yesterday that will inform the work of the division.

I would also like to point out, Mr.

Mansfield, that very detailed level 3 PRAs are used in the commercial nuclear world and those analyses do not irrevocably lead to complex controls. I believe that we will satisfy the Board with respect to the QRA process.

We will establish clear guidelines for this, as well as other programs in the Department and in the Environmental Management Program moving forward. I do believe that this is going to be a very important tool in the nuclear world within the Department of Energy like it is already as a best industry practice.

MEMBER MANSFIELD: I just wanted to get that little lick in there.

Mr. Ashley, I want to quote something from the 021 report on page A-3. "The use of a relative probability among event sequences calculated with an ignition probability of one rather than an absolute value, for instance, 10 to the minus 5 as a threshold, will be less sensitive to model uncertainties." Can you tell me what that means?

MR. ASHLEY: What they means is if you look at certainly the preliminary results that we provided out of our quantitative risk analysis, and I think they have affectionately been referred to as the horse tails, it is pretty clear that once a bubble forms that is ignitable, that is combustible, the probability of ignition then equal to one is overriding in terms of that probability distribution.

The comment is that as we go into the sensitivity, as we develop the additional probability distributions, the feeling, the judgment is that may not significantly change the outcome of the analysis based on that one parameter which is not a distribution. It's a probability of one of ignition.

As we go through the sensitivities we may find as we go through those and development of the design tool, we may find that is an overriding parameter that drives the results.

MEMBER MANSFIELD: Thank you. I think I understand. On page A-5 in listing the plant level events, you have process pipe leaks and fires and floods and things. You don't explicitly have loss of offsite power, although it's mentioned at the bottom of A-4. Are you going to consider loss of offsite power in the distribution for repair time or restoration time as initiating events?

MR. ASHLEY: Yes.

MEMBER MANSFIELD: And distribute them?

MR. ASHLEY: Yes.

MEMBER MANSFIELD: Okay. Your response to finding 2-6 I find particularly heartening. You have committed yourself to include -- you're going to update the design tool to include distributed values in lieu of point values in all other instances except those where there is sparse data or not agreed upon among subject matter experts and be justified by industry experience. I think that is very helpful.

I just urge you there are ways of getting probability density functions when data is sparse and not agreed to as well, extreme value theory type thing. It's never a good idea to leave tails out. If they are going to hurt you in mono calculation, they are going to hurt you anyway so you don't want to eliminate it before you start.

MR. ASHLEY: Yes.

MEMBER MANSFIELD: Ms. Busche, could you ever handle a safety analysis that had a probability of ignition less than one? Would you know what to do with it?

MS. BUSCHE: The answer is yes, I could handle it. Right now with the current design I have no mechanism to actually write a meaningful control for that because I don't know what I don't know. It's a pretty complex design.

MEMBER MANSFIELD: It's complex enough that everybody that I know that runs into this problem controls it by having ventilation and igniters which is what you had in the original safety class design.

I've got a few things here. I'm almost finished here. On page A-10 you talked about a common relationship between the normalized run-up distance, cell size, and reaction zone length. Dr. Shepherd, can you tell me is this something new that I haven't heard of?

DR. SHEPHERD: This is a pretty arcane bit of physics but I guess we can talk about it. The situation we're talking about is we've got a section of pipe which is partially or totally filled with combustible gas. We're imagining we have a small ignition source at one end so we start with a flame.

Through the process of flame instability and generation of turbulence that flame accelerates and ultimately becomes a detonation. The distance that it requires for that to take place, that's the run-up length.

The question is we would like to be able to predict that because clearly if things don't transition to detonation, then detonation is not something we need to be considering in the safety analysis for that particular situation. We need to have some type of a correlation because this is not something that is simple to predict.

It involves turbulence, one of the last unsolved problems in classical physics. It's quite complex so we resort to doing experiments. The question is what would you correlate that with. What do we have in terms of dimensions.

We'll do a little dimensional analysis here in class so we can have the diameter of the pipe. We can have some characteristic measure of the chemical reaction length in the material. That's what this cell size is about. You take those three things and obviously there needs to be some functional relationship.

You have to do a little bit of thinking about that. There are some scientists who have worked in this area and they have thought about how that might work and that's what this is all about.

MEMBER MANSFIELD: It's much more clear when you describe it than it was on page 10.

DR. SHEPHERD: Yes.

MEMBER MANSFIELD: On page 11, I believe you're saying that you're going to generate distributed hydrogen generation rates -- will be developed. My question is when. Is there a program to come up with a PDF, probability density function, for gas generation rates?

MR. ASHLEY: Yes. That's one of the variables that previously was input as a point variable where we are in the process of generating probability distribution.

Dr. Mansfield, a couple of things that I need to clarify for the record. I think you probably just misspoke but the previous design did not have igniters in the WTP.

MEMBER MANSFIELD: Well, you potentially have mason iron and silver and waste. Those are --

DR. SHEPHERD: But the implemented control did not have igniters. We did have vents.

MEMBER MANSFIELD: You had purges.

DR. SHEPHERD: Purges and flushes but didn't have igniters.

MEMBER MANSFIELD: No, no. You don't. I should say there are ignition sources in that waste. It would be very hard for anybody to try to convince you that the waste mixture didn't have any nascent metals.

MS. BUSCHE: That is correct.

MR. ASHLEY: The other thing that I did misspeak earlier, the only WAC [Waste

Acceptance Criteria] requirement is a measurement of hydrogen. There are no other gases that are required to be measured in the WAC.

MEMBER MANSFIELD: So you're just going to assume that there's enough -- there are issues where -- I can think of batches where you would have very depleted nitrates and I don't --

MR. ASHLEY: We assume the oxidant. We assume the oxidant in the proportions so what we're interested in is the explosive gas, the hydrogen. We've evaluated that's the controlling mixture against the other gases, the methane.

MEMBER MANSFIELD: But then the nitrogen and the rest of the oxidant are diluting gases.

MR. ASHLEY: Yes. That's one of the HPAV independent review team findings that we have to address. As I said, those other gases cause a larger gas bubble which could change the dynamics.

MEMBER MANSFIELD: There were two areas in here where it was uncertain enough to me that I have to ask the question. This is do with finding 4-2. Is the ignition location distributed? The ignition source location.

MR. ASHLEY: The ignition source is assumed to be where the bubble occurs.

MEMBER MANSFIELD: Okay. It's in the worst spot in the bubble.

MR. ASHLEY: We actually -- the location at which it starts is stochastic. I think Dr. Shepherd can better speak to that but it is stochastic. It could occur anywhere in the bubble.

MEMBER MANSFIELD: Okay. It won't be at the worst possible spot at one end to give you maximum run-up or anything like that. It's going to be stochastically determined by whatever the bubble link has to be. We'll skip that, too.

I'm coming rapidly to the end and I

just want to ask Dr. Shepherd when the long-awaited tests on axial pulsing loading are going to be completed. Weren't you tasked by DOE to do some tests of axial loading?

DR. SHEPHERD: I'm a little mystified, Dr. Mansfield. What are you referring to precisely?

MEMBER MANSFIELD: I'm quoting from one of the thousands of pages of paper that Mr. Ashley gave me but I won't trouble you with this here. My last question is really an observation. I think it's a healthy rule in Monte Carlo calculations to run them uselessly long until you get a few outliers to understand what the world is really doing. You don't have to do that for every situation but I know people that have been caught because they haven't done that.

All right, Mr. Chairman.

CHAIRMAN WINOKUR: Thank you, Dr. Mansfield.

Mr. Bader.

MEMBER BADER: Before I start on the mainline of the questioning, I wanted to follow up on the QRA. I had a question for Dr. Triay. I'm looking at the peer review that was done of the QRA methodologies and one of the concluding sentences says, "Without further refinement of the modeling and treatment of uncertainty the WTP runs the risk of making inappropriate design decisions." I don't think that's anything you can let stand or anybody would want to leave standing. Could you address how that's being resolved, please?

DR. TRIAY: Yes. The HPAV Independent Review Team took all of the comments from the Risk Working Group sponsor, a peer review team, and have given us very specific recommendations and paths forward which we do intend to implement. As I have testified, until the HPAV Independent Review Team looks at how we are intending to close their issues, we're not pressing forward with a finalizing the changes in the design.

MEMBER BADER: Is this something that you would like to submit some additional material on later?

DR. TRIAY: We would be happy to submit for the record the statement of Dr. Krahn as well as a detailed explanation of how we are going to close the recommendations of the Independent Review Team.

MEMBER BADER: Thank you.

Ms. Busche, we are going to repeat some things, I think, that we touched on yesterday in the evening. I believe you agreed that the QRA design approach is a qualified safety basis tool, or is not yet a qualified safety basis tool. Is that correct?

MS. BUSCHE: Yes. Its primary purpose is a design tool and it is not -- I'm a little hesitant of the word qualified. The use and application of that design tool is not clearly established.

MEMBER BADER: Yes. It must meet

NQA-1 requirements under 414-1C.

MS. BUSCHE: Oh, yes.

MEMBER BADER: It has to be V&V. Is that correct?

MS. BUSCHE: Correct.

MEMBER BADER: Going from there I think we have discussed adequately the need to protect certain assumptions which you will have to determine as your analysis goes on.

MS. BUSCHE: Correct.

MEMBER BADER: And also calculated results.

MS. BUSCHE: Correct.

MEMBER BADER: I believe we also touched on whether or not you currently had enough information to do a plan to write the TSRs and LCOs [Limiting Condition of Operation] and I believe your answer was no you don't.

MS. BUSCHE: It's across the board. Yes, correct.

MEMBER BADER: I really have only

one major area of concern that we haven't addressed that comes out of all these things. I've been making a short list. We have as yet to be done large-scale testing, resolution of the HIRT findings, and then use of the QRA as a design tool, again a first-of-a-kind application.

Mr. Ashley, my understanding is that you are considering that the design is not complete until the safety basis is completed. Is that correct? In other words, you may find things as a result of developing the safety basis that impact your design.

MR. ASHLEY: The design criteria has been established. We obviously have to complete the development of the probability distribution and the VNV of the quantitative risk analysis we need to complete the calculations necessary to support the methodology. We have a schedule for completing that.

The criterion methodology at that

time will be complete for implementation. Now, the process of implementation, running the QRAs for each of the individual routes, running the piping analysis, along with completing the design is going to be the purchase of components that are qualified. That is a process.

What Ms. Busche is referring to are there going to be any additional inputs and assumptions used in the QRA that will then have to be protected as part of the safety basis of the facility.

MEMBER BADER: I'm not being clear. As a result of the large-scale testing as a result of implementing the HIRT findings and what comes out of the analysis of these findings, to me there is a real risk that you may find something that challenges a piece of your design and has to be incorporated.

MR. ASHLEY: Understand the design -- the changes in the design are not complete or they have not been started. I need to clarify there is no additional planned large-scale testing. These is component qualification testing.

MEMBER BADER: No, no. I'm going back to mixing.

MR. ASHLEY: Oh.

MEMBER BADER: I'm sorry. I'm not being clear enough. I'm looking at the whole project now and looking at the number of things that have to be addressed so large-scale testing of the pulse jet mixing. Then the HIRT findings have to be implemented, have to be addressed and the fixes implemented.

To me all these things you're going to find something in all of this that impacts your design. It's going to have to be reflected in Ms. Busche's safety analyses and work. Then your design is going to be impacted by what she finds. Is that correct?

MR. ASHLEY: Yes. That process between design and nuclear safety is an iterative process. Any design change is reviewed by nuclear safety to determine if we've introduced additional hazard. If we've introduced additional hazard, that has a potential iterative affect on design. That is the design process in the nuclear industry.

MEMBER BADER: What this takes me to is the concern that there will be pressure on your, Ms. Busche, to do your work. I think the pressure is going to come from unexpected sources. I mean, there is a real desire to finish this plant to get it up and running. Do you feel up to this working under this kind of pressure?

MS. BUSCHE: Yes.

MEMBER BADER: And that takes me really to my last question which is, Mr. Russo, I hope you are going to support Ms. Busche in what she needs to do and do it unequivocally, directly, and simply and that you are going to protect her.

MR. RUSSO: I think she will tell you that about seven months ago I met her outside of a meeting where there was that healthy tension between design and safety basis. I said, "Donna, I have your back."

MS. BUSCHE: That was a true story.

MEMBER BADER: I expect Mr. Knutson and Dr. Triay would support Mr. Russo in that.

MR. KNUTSON: Absolutely. Donna is an incredibly talented talent and incredibly important part of the project team.

DR. TRIAY: As you know we have a network of nuclear safety experts with the Environmental Management Program that work very closely together. Their leader is the Deputy Assistant Secretary for Safety and Operations Oversight. Our complete support is always given to that network of nuclear safety experts because of their excellent work have led to the Department having very robust nuclear safety record.

MR. SAIN: I would like to add that URS supports Donna fully with the stable of safety basis experts that we've got.

MEMBER BADER: Those are the answers I fully expected I would get but I wanted to ask to be sure. I'll ask Ms. Busche one final question and that is are you ready for the opportunity on a plant that's got a lot of first-of-a-kind things to have the first-of-a-kind safety basis for QRA?

MS. BUSCHE: Yes.

MEMBER BADER: I have no further questions, Mr. Chairman.

CHAIRMAN WINOKUR: Mr. Dwyer.

MR. DWYER: Just for clarification. Dr. Shepherd, in your response to question 12 that the Board received from DOE --

DR. SHEPHERD: Yes.

MR. DWYER: -- you indicated that you were not yet satisfied with, I guess, the resolution of some issues you raised with Dominion Engineering. Has there been any further development?

DR. SHEPHERD: Thanks for the opportunity. This goes to the question that

Ms. Roberson asked me at the beginning of the session. I have gone back and I've looked at the correspondence. I would like to say in general that I have been very satisfied with the responsiveness of both Bechtel and Dominion to my comments.

It often takes some time due to the complexity not only of the technical issues but the contracting to get those resolved. I have a long-term commitment to this project. I'm tenacious in getting my concerns addressed. There are some folks here in the audience who can attest to that.

In this particular case for this particular letter that I wrote on March 27th there were four documents that I reviewed. I have had discussions with Dominion staff and Bechtel about those. We have discussed a path forward that I believe will resolve my issues.

I think that they have been otherwise occupied in the last six months and have not gotten back to that but I have spoken with Craig Jones and Mike Wintick about it and there is a plan to have those addressed. I expect to be reviewing those documents this fall.

MR. DWYER: So the summary is you believe you have a path forward but resolution not yet achieved?

DR. SHEPHERD: Yes. That's right. I don't see any obstacles to resolving that. It's a matter of their returning a draft to me, my going through that discussing it with them resolving any remaining issues. That's typically the fashion in which this gets done.

MR. DWYER: That's all.

MEMBER BADER: Dave, did you want to make a comment?

MR. BROCKMAN: Yes. I just wanted to add to your concern that you posed to Ms. Busche. The authorization basis approval and the oversight of that and watching that is, you know, independent in my office. I can assure you we watch for that very closely and won't allow it.

MEMBER BADER: Thank you.

CHAIRMAN WINOKUR: I have a few questions. In the answers to the questions you talked about, I guess you used the words "readily accomplish repair" if there is a breach in piping in the hot cells. Can you give some insight into what that will involve and the time frames and depending on the kind of waste it is whether it's a slurry or some other type of waste.

MR. ASHLEY: To begin with, you know, I think it warrants addressing for the record some of the statements about the consequences and how catastrophic the consequences may be. I think it is important once again to reiterate that the piping is designed -- the piping and inline components will be designed to withstand these events.

Now, if you go to the extreme that the probabilities are never zero and if there were damage to a piping component that was in the hot cell, the expectation is that damage would result in a leak. Many of these components are not welded components, the jumpers. They are made to be replaceable. That equipment has to be remotable for repair and maintenance.

The expectation is that a repair or replacement would be similar to a repair or replacement necessary for normal plant maintenance. Part of our OR model is evaluating how long it takes if we have a pump failure, if we have a valve failure under any situation.

It could be just normal failure, wear failure, any other type of failure operations has looked at, what it would take under those normal service conditions to replace those components. The expectation is the causes of damage due to -- potential cause of damage due to a hydrogen event would be very similar.

CHAIRMAN WINOKUR: Does that include

the cleanup of the waste? How does that factor in in terms of what it would take to become operational again in that area.

MR. ASHLEY: I don't believe operations has developed all of the procedures necessary. There will be leaks in the cell. Jumpers will leak over the life of the facility. The cells are lined. The cells have sumps so they are designed to facilitate any necessary cleanup if there were a spill or a leak in the cell.

CHAIRMAN WINOKUR: Let's assume there was this leak or this serious leak. How long would it take to clean it up? What do you think?

MR. ASHLEY: I don't have that information. We can provide that for the record. I would need to consult with the operations folks.

CHAIRMAN WINOKUR: All right. I've gotten so few notes during this hearing but I did get one so I have a question for you, Dr.

Shepherd. Obviously there was work done in Southwest Research Institute and they developed the pressure time histories. Do you have any concerns about the studies that they performed whether they were valid or not?

DR. SHEPHERD: I believe their work is valid. I think there are particular details that we've discussed that need careful attention to but by and large it's valid.

CHAIRMAN WINOKUR: Okay. My final question is for you, Mr. Knutson. We barely met. We just heard throughout these discussions this morning that this design is not complete at this point so the question is how does DOE pivot the project when the design is not complete? What does that mean?

MR. KNUTSON: I think I talked about that a little bit yesterday. We've spent a lot of time talking about the pre-treat facility. There are five facilities in this project. The pre-treat facility is the one that we are reserving the most open schedule time to be able to respond to issues that may emerge from testing or QRA responses or even the development of the TSRs.

It's a very large project and there is an awful lot of that project that needs to be moving towards commissioning and start-up and that's what I mean by saying it's time to pivot.

There may be elements of the project that we need to take in all deliberate haste and ensure ourselves that the path forward is clear and within the expectations that we've set for performance on this project. That doesn't mean the rest of the project needs to stand still waiting for that.

CHAIRMAN WINOKUR: So the pivoting doesn't mean that you don't have a design effort going on still?

MR. KNUTSON: That's correct.

CHAIRMAN WINOKUR: Okay. Dr. Triay, is there anything you want to say about that?

DR. TRIAY: I completely agree with

what Mr. Knutson has said. We designed the concept of trying to ensure that the rest of the program was ready to feed the waste to the waste treatment plant, that the rest of the infrastructure was ready.

As a matter of fact, we assigned $300 million of Recovery Act monies to the tank farm infrastructure so that we could be ready for the commissioning and ultimate operations of the waste treatment plant. I believe that Mr. Knutson is correct that this is the appropriate time for that transition in the site office.

I believe that Mr. Brockman is of the same opinion. We will work very closely together to ensure that when this plant starts operating the rest of the infrastructure is ready to support its safe operations.

CHAIRMAN WINOKUR: Thank you. Do other Board members have questions?

VICE CHAIR ROBERSON: No.

CHAIRMAN WINOKUR: All right. I

want to thank our witnesses very much. This concludes the testimony from our staff as well as the Department and its contractors and their experts.

We will now call on members of the public who have signed up to speak. As I indicated earlier, I ask that each speaker limit remarks to about five minutes. If time permits, I will extend that time for additional comments.

The first person on the speaker list is Jen Gregory.

MS. GREGORY: Hello. I want to thank you for this opportunity to present public comments. My name is Jen Gregory and I work for Hanford Challenge, an organization that works in the public interest for a safe and robust cleanup at Hanford.

You know, I think public comments are particularly important when making assessments about actions that could result in increased risks. Deciding the safety tradeoffs for time, money, or other reasons is essentially a value judgement. I am hear today to say that as a member of the public I value erring on the side of safety.

To that end, I want to continue presenting Hanford Challenge questions that were interrupted yesterday. Why is a design that cannot prevent flammable gas explosions considered acceptable? There is a design solution that prevents these explosions but it is considered too expensive. Are explosions in a hazardous nuclear facility ever acceptable?

Why is a possibility of a nuclear criticality considered acceptable at the waste treatment plants? Internal documentation indicates that nuclear criticality could occur if the waste tanks are not adequately mixed and plutonium settles to the bottom of the tank.

Why has Bechtel proposed redefining firewalls in the facility as non-safety items to save on cost? What justification can there be besides money to propose such a move? Is DOE considering the implications a broken safety culture has on the safety of a waste treatment plant? How will concerns surface if employees who notice critical issues are afraid to raise their concerns?

Why did DOE suddenly approve the closure of technical issues after their own work plans concluded that it will take 18 months or more to resolve these issues? Is this approval related to the fact that the DOE had a legally binding tri-party agreement cleanup milestone to meet and that Bechtel had $6 million at risk if they didn't close a key technical issue M3 by June 30th?

Is DOE considering the impact of assigning one contractor to design and build the waste treatment plant and another contractor to operate the plant? Since Bechtel is not responsible for operating the plant, there is no contractual penalty if they build a plant that does not work.

For the first six years of design and construction of the waste treatment plant Bechtel lacked a vender quality assurance program. How can we assure that the quality of procured equipment and instruments is adequate without the necessary pedigree?

Would this facility even be considered for licensing by the Nuclear Regulatory Commission or denied due to its quality indeterminate state? Doesn't the public deserve a plant that meets the safety standards of an NRC licensed facility?

When the atmosphere has been poisoned by a history of reprisals against employees who raise concerns, the quality and safety of the plant will always remain indeterminate because important issues affecting future operations may not have been raised and addressed.

The waste treatment plant design, especially the strategy of pre-treatment of the waste, is in jeopardy of failure. Meeting deadlines to build a plant have overridden safety and design considerations for the operation phase. Thank you.

CHAIRMAN WINOKUR: Thank you, Ms. Gregory. Please submit those comments for the record.

The next speaker is Liz Madsen.

MS. MADSEN: Thank you for soliciting comments from the public on the issues that surround the design and construction of Hanford's waste treatment plant. My name is Liz Madsen and I work for Hanford Challenge. I am also the Vice Chair of the Public Involvement Committee of the Hanford Advisory Board.

I appreciate your effort to bring issues into the light and clarify the confusion that surrounds this much-delayed project. I am going to use the pronoun "we" today.

I believe in systems that hold us

accountable and believe that in the end as we age and die and the problems of Hanford go on, we all take some responsibility in our individual roles for shifting and changing and finding the best solutions to achieve a robust and complete cleanup.

A cornerstone of that cleanup is the waste treatment plant. Hanford brings with it incredible uncertainties. We have some records. We have some sampling data but often it is not enough information for actions and assessments that require a high degree of certainty.

Of importance to the waste treatment plant is our lack of knowledge about Hanford tank waste. Over the past few years I have seen over and over how a situation with high degrees of uncertainty results in pretending that everything is under control and a default position that when in doubt nothing is wrong.

As a member of the public I appreciate any effort to cultivate an environment of transparency and openness where expressing what we don't know is encouraged so that we can get to a place of knowing. Posturing confidence and knowledge wastes precious time and tends to take us further from robust solutions.

Yesterday a member of the DNFSB showed a pointed observation from the discussion defining how an issue can be closed when it is unresolved. What is closed is not closed. I wish it was not such a challenge to use clear language and say what we mean. I wish that profit and schedule were not such seductive factors in a game to make the right decision.

I am tired of seeing and hearing about plans for solutions that are not believable. I often think about the time frame of Hanford cleanup and long-term stewardship. When I look around this room I wonder who will still be working on this project in 10 years, 20 years? Where is the dedication to follow through and bring this painful process to fruition?

As one of the rare young people involved, it is disheartening to receive the message that everything is going to be fine and see so much evidence to the contrary. After 10 years no one in this room can honestly assure me that the waste treatment plant will operate safety and effectively.

Thankfully we are here in front of the DNFSB in an effort to publicly bring in some sunshine clarifying positions and finding truth in a situation that is so mired in complexity and confusion.

It is my hope that everyone involved is reminded frequently of the bigger picture. We are here to protect future generations. I want to tell my grandchildren a story that ends, "Despite all the problems that plagued Hanford, we worked together and successfully designed a plant that secured extremely dangerous waste in glass to protect you."

Thank you.

CHAIRMAN WINOKUR: Thank you, Ms. Madsen. Please submit that for the record.

I may pronounce this name wrong. John Stang.

MR. STANG: That is correct.

CHAIRMAN WINOKUR: It's not your name that's difficult. It's the handwriting.

MR. STANG: That's probably true. I'm a reporter from Seattle. I don't have any comments but I'm here to ask two questions of Mr. Bader if I may.

CHAIRMAN WINOKUR: No, I don't believe we are going to entertain questions at this point.

MR. STANG: Okay. I was told yesterday that this was the appropriate way to ask questions.

CHAIRMAN WINOKUR: No, I don't believe so. You'll have to put them on the record and we'll answer them. This is an informational meeting. The Board will not be taking questions.

MR. STANG: Okay. I don't understand.

CHAIRMAN WINOKUR: I'm sorry for the misunderstanding. Please just submit them for the record. We will get back to you.

MR. STANG: In writing?

CHAIRMAN WINOKUR: Yes.

MR. STANG: Okay.

CHAIRMAN WINOKUR: Thank you.

There are two more names on this list here and I have to just as a matter of protocol make sure that they are not present now, or wish to speak, that is. Susan Lekband and Allen Bolt. My apologies. There was a second page. Dick Dunning.

MR. DUNNING: Good morning, Mr. Chair. It's actually Dirk Dunning. Today I'm speaking entirely on behalf of myself. I'm a registered professional chemical engineer also trained in nuclear environmental control systems and several other fields of engineering.

I just wanted to make a couple of points. First I'll start by thanking you all, the Board and the staff, for your diligent work on all of this subject and all of the long hours I know that you've put in by the questions that you've asked. It's greatly appreciated.

I also want to thank you very much for your openness and transparencies in this entire process. It's greatly appreciated by all the citizens of the Northwest.

I would also echo Liz Madsen's final closing comment that though there are problems in building a facility of this complexity, and there will be more, and some of them will be really hoary, solving them is essential to getting this plant operating and getting this plant operating is essential for the Northwest. Whatever these problems are we need to find them and we need to resolve them. All of the help of everyone involved is essential in doing that.

In listening to the discussions there are a couple of points that I think could use some clarification. Back about 15 years ago or more as the Hanford tanks were going through what were called rollover events as gas was generated and the tanks would roll over the researchers involved calculated that the potential ignition energy was seven millijoules for those gases.

That's extremely low. As you're talking through the probabilities of ignition and whether it should be one or something else, with those kinds of energies I don't doubt that there is the potential for ignition wherever it is and that we don't know what that is.

Something else for people who are not from this region, and even for those here. Hanford and the Northwest is home to the Cascadia fault system off the Oregon/Washington coastline. This is a fault that is 1,000 kilometers long, about 100 miles offshore. About every 350 to 1,100 years it ruptures.

When it does that it ruptures with a 9.5 earthquake that goes on for about five-and-a-half minutes. The expectation from the studies is that if that event occurs at some time in the next 50 years, all of the bridges in western Washington and Oregon will collapse.

Transportation systems will be down. The major fuel transports out of Anacortis heading south through Washington state into Oregon will be disrupted for months at a time. There isn't going to be any easy recovery and there isn't going to be anybody coming to help in the real near term. We are all going to be on our own wherever we are in the region so I would be very careful about that.

Also, it's important in recognizing that those events principally people think about earthquakes as having the first two modes, the shear and compression waves, the P and the S waves. What is often forgotten is there are two other modes, the Love and Rayleigh waves.

Particularly in large subduction zone events the Love waves are important. Those waves are at lower frequency roughly with wave lengths comparable to the size of the facilities and vessels at Hanford. Those can cause somewhat different kind of responses. It changes the spectral response frequency and that's important in the analysis.

Those are the principal ones I just wanted to make sure you guys were aware of. Again, thank you for all of your diligent effort and work and keep it up.

CHAIRMAN WINOKUR: Thank you, Mr. Dunning.

Larry Felton. Mr. Felton. Mr. Felton is not present.

That concludes the public comment

portion of this hearing. I would now like to turn to the Board members to see if they have any closing comments.

MEMBER BROWN: No.

VICE CHAIR ROBERSON: No.

MEMBER MANSFIELD: No.

MEMBER BADER: No.

CHAIRMAN WINOKUR: I'm going to provide some very general closing comments and then I will close the meeting.

This public meeting and hearing dealt with public health and worker safety for the waste treatment plant at Hanford which is DOE's solution to cleaning up the toxic and radioactive waste in Hanford's tank farms.

The first session looked at the adequacy of pulse jet mixer vessels and implications for the waste acceptance criteria, the Board's safety concerns or criticality, hydrogen gas buildup, and PJM mixer overblows. The Board was pleased the Department has committed to accelerate large-scale testing of pulse jet mixer vessels beginning in 2012.

The Board also believes a hot pilot plan during plant operation also has high value.

During the second session on pre-treatment facility safety. The Board explored issues of complexity that drove a revised hydrogen strategy and its implications on the safety basis. The Board has always been supportive of more reduction but has concerns about severity level calculations dealing with sprays and leaks and deposition velocity.

The Board is concerned that the Department has chosen not to adopt a deposition velocity of 0.1 to 0.3 that the Department agrees is technically justified. The Board is concerned that the requirements on the tank farms to control, characterize, and deliver waste to the waste treatment plant will become increasingly complex if the waste treatment plant is required to tighten its waste acceptance criteria as it finalizes its design.

Today's final session of this public meeting and hearing explored the Department's hydrogen strategy for pipes and auxiliary vessels that employs a quantitative risk assessment methodology.

The Board is concerned that the QRA methodology may reduce the plant's margin of safety resulting from breaches in the primary confinement boundary in the hot cells which may require repairs that delay operations and expose workers to hazardous situations. The Board would like to thank all of the witnesses from the Department of Energy, its contractor organizations, and its technical experts who testified during these two days of public meetings and hearings.

I want to personally once again thank Dr. Triay. I want to thank all the folks at DOE and their team. I thought this was an excellent information exchange.

Obviously it's a very extensive record to review and I appreciate you all being here.

With that I am going to close this public meeting. The record of this meeting will be open until November 7, 2010. Thank you for coming.

(Whereupon, at 12:05 p.m. the hearing and meeting were adjourned.)

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