AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

S. HRG. 108–384

OVERSIGHT OF DEPARTMENT OF ENERGY ACTIVITIES AT THE YUCCA MOUNTAIN SITE

HEARING

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

UNITED STATES SENATE

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

SPECIAL HEARING

MAY 28, 2003—LAS VEGAS, NV

Printed for the use of the Committee on Appropriations

Available via the World Wide Web: http://www.access.gpo.gov/congress/senate

U.S. GOVERNMENT PRINTING OFFICE

87–639 PDF WASHINGTON : 2004

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2250 Mail: Stop SSOP, Washington, DC 20402–0001

COMMITTEE ON APPROPRIATIONS

TED STEVENS, Alaska, *Chairman*

THAD COCHRAN, Mississippi
ARLEN SPECTER, Pennsylvania
PETE V. DOMENICI, New Mexico
CHRISTOPHER S. BOND, Missouri
MITCH McCONNELL, Kentucky
CONRAD BURNS, Montana
RICHARD C. SHELBY, Alabama
JUDD GREGG, New Hampshire
ROBERT F. BENNETT, Utah
BEN NIGHTHORSE CAMPBELL, Colorado
LARRY CRAIG, Idaho
KAY BAILEY HUTCHISON, Texas
MIKE DeWINE, Ohio
SAM BROWNBACK, Kansas

ROBERT C. BYRD, West Virginia
DANIEL K. INOUYE, Hawaii
ERNEST F. HOLLINGS, South Carolina
PATRICK J. LEAHY, Vermont
TOM HARKIN, Iowa
BARBARA A. MIKULSKI, Maryland
HARRY REID, Nevada
HERB KOHL, Wisconsin
PATTY MURRAY, Washington
BYRON L. DORGAN, North Dakota
DIANNE FEINSTEIN, California
RICHARD J. DURBIN, Illinois
TIM JOHNSON, South Dakota
MARY L. LANDRIEU, Louisiana

JAMES W. MORHARD, *Staff Director*
LISA SUTHERLAND, *Deputy Staff Director*
TERENCE E. SAUVAIN, *Minority Staff Director*

SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT

PETE V. DOMENICI, New Mexico, *Chairman*

THAD COCHRAN, Mississippi
MITCH McCONNELL, Kentucky
ROBERT F. BENNETT, Utah
CONRAD BURNS, Montana
LARRY CRAIG, Idaho
CHRISTOPHER S. BOND, Missouri
TED STEVENS, Alaska (ex officio)

HARRY REID, Nevada
ROBERT C. BYRD, West Virginia
ERNEST F. HOLLINGS, South Carolina
PATTY MURRAY, Washington
BYRON L. DORGAN, North Dakota
DIANNE FEINSTEIN, California

Professional Staff
CLAY SELL
TAMMY PERRIN
DREW WILLISON *(Minority)*
NANCY OLKEWICZ *(Minority)*

Administrative Support
ERIN McHALE

CONTENTS

	Page
Opening Statement of Senator Harry Reid	1
Statement of Senator John Ensign	3
Statement of Robin M. Nazzaro, Director, Natural Resources and Environment, General Accounting Office	7
Prepared Statement	8
History of Actions Taken to Correct Quality Assurance Problems	9
Status of DOE Efforts to Improve Quality Assurance	10
Preliminary Observations	11
Statement of Allison MacFarlane, Senior Research Associate, Massachusetts Institute of Technology	12
Prepared Statement	15
Brief Summary of Main Points	15
Politics and Science at Yucca Mountain	16
Unresolved Technical Issues at Yucca Mountain	17
Reason for Unresolved Issues	19
Lessons Learned	20
Statement of William L. Belke, Nuclear Regulatory Commission (Retired)	22
Prepared Statement	24
Additional Material Submitted Subsequent to Close of Hearing	39
Letter From Senator Pete V. Domenici	39
Response From Margaret S.Y. Chu	39

OVERSIGHT OF DEPARTMENT OF ENERGY ACTIVITIES AT THE YUCCA MOUNTAIN SITE

WEDNESDAY, MAY 28, 2003

U.S. SENATE,
SUBCOMMITTEE ON ENERGY AND WATER DEVELOPMENT,
COMMITTEE ON APPROPRIATIONS,
Las Vegas, NV.

The subcommittee met at 1:12 p.m., in the Commission Chambers, Clark County Government Building, 500 Grand Central Parkway, Las Vegas, Nevada, Hon. Harry Reid presiding.

Present: Senator Reid.

Also present: Senator Ensign.

OPENING STATEMENT OF SENATOR HARRY REID

Senator REID. The United States Senate Appropriations Committee and the Subcommittee on Energy and Water is called to order. The committee is meeting under the direction of Senator Pete Domenici, of New Mexico, and the ranking member, which is me. Senator Domenici has indicated that, with pleasure, he invited Senator Ensign, as I have, to participate in this most important hearing.

I would like to acknowledge the presence of the Attorney General of the State of Nevada, Brian Sandoval. General, would you stand, please?

General Sandoval runs the largest law firm in Nevada, about 150 lawyers. We are very glad that he has personally taken the time to attend this. There has been a seamless transition from Attorney General Del Papa to Sandoval, working with the Governor and doing all the legal work that is necessary in this most important project, the project being the legal efforts to do what is necessary to make sure all Nevada's interests are represented in the courts of this country in this Yucca Mountain Project.

I am also happy to recognize the County Commissioner, Myrna Williams.

Over the years, we have appreciated very much the support of the Clark County Commission. We have had good support from Washoe County and Clark County, the two counties that make up about 90 percent of the population of the State of Nevada, and we are grateful for that support that we have gotten.

I, first of all, want to thank the witnesses for appearing today in Las Vegas. Two of the witnesses had to travel a long distance to be here, and the third had to leave the golf course to come here.

I have been working on problems dealing with Yucca Mountain for more than two decades. Throughout all these years, I have seen

indications of problems with the program, and it seems that each time, no matter who is in the presidency, Democrat or Republican, the Department of Energy refuses to acknowledge the problems and presses forward like a runaway train. Somewhere in the bowels of the Department of Energy, there are people who never leave, and they continue their undying efforts to push this project that is flying.

For two decades, we have heard warnings throughout the Nation about the dangers of transporting nuclear waste across the country. Today's hearing is not going to deal simply with that. And it appears that each time a person raises their voice, the Department of Energy says the concerns are unfounded.

When I state that the Department of Energy's own analysis shows hundreds of thousands of truck shipments that would be needed to move the waste to Yucca Mountain, DOE simply says, "We will use rail." Well, we all know that we will never be able to build a rail spur in Nevada and in other parts of the country. It is too expensive, and it is certainly too risky.

When the General Accounting Office, responding to our request, warned that the Department of Energy, that their site recommendation was unfounded and premature, they pressed ahead anyway. They simply ignored the General Accounting Office's well-documented investigation.

Like an ostrich sticking its head in the sand, the Department of Energy just assumes ignoring these problems will make them go away. But it has not, and it will not.

From the scientific standpoint, we have seen clear evidence that the project will never meet the Department of Energy's own requirements for groundwater movement through the repository, among other things. Here, the DOE's response was simple, "Get rid of these requirements."

All of these events make it clear that the DOE is intent on pushing the project forward regardless of the risk it poses to the health and safety of Nevadans and the rest of the country. But all these actions by the DOE were just a drop in the bucket when compared to what I have seen in the last few months.

Some of you have read the news reports about retaliation against workers in the quality assurance program who have raised concerns about the credibility of the scientific and technical work being done there. As a result, Senator Ensign and I requested an investigation by the General Accounting Office into these problems. Several months later, more reports surfaced about quality assurance auditors finding additional problems with the quality of the Department of Energy's management of the program and, most disturbing, the apparent efforts to silence those witnesses. This represents a disturbing pattern at the project. Instead of addressing problems, the DOE seems more intent on investigating auditors for simply doing their jobs.

So today we hope to hear from a number of witness who have been involved in these incidents. Unfortunately—and I repeat, unfortunately—many of these witnesses were unwilling to come forward. We have two here who wanted to come and could not come. The DOE instructed a number of these witnesses not to appear today before the committee. And in a letter from Dr. Chu, who is

running the nuclear waste program, in her letter she said, "Well, he is not working at a job now that he would know anything about that." Of course, he was transferred, because of activities of the Department, from a job that he was responsible for quality assurance at Yucca Mountain.

But I would say to Dr. Chu, if these witnesses had nothing to offer, why not let them come forward and prove to the American people that they had nothing to offer? The DOE has so little regard for the quality of the work being done at Yucca Mountain that the DOE would rather silence than support their own employees. These are not disgruntled employees. These are people who support the project—I repeat, support the project—and simply want to make it better. They want the hundreds of millions, and arriving now at $7 billion, of taxpayers' money to be spent properly. These are brazen actions by a Federal agency that is about as annoying and as arrogant as I have ever experienced in my years of service in the Congress.

To those of you out there who have things to say about Yucca Mountain, I would hope that you will listen to this hearing and know what else needs to be said. I will do everything I can to stop the intimidation at the project so that your voices may be heard without fear that you and your families will be made to suffer for simply telling the truth.

I want to thank those of you who were able to testify today. We appreciate your not backing down in spite of the pressure that has been placed on you.

This project is out of control. It is a multi-billion-dollar boondoggle that is draining precious resources from our economy. At a time when the Federal Government is running record deficits and passing huge tax cuts, we need to stop wasting money on a project that will never succeed. Most important, we need to stop supporting a project that seeks to intimidate its own employees for telling the truth. These actions appear to be the desperate last efforts of a program that is failing under the weight of its own mismanagement and ineptitude.

So I hope today we can gain enough information to convince our colleagues in the United States Senate that the time has come to put an end to the fear and retaliation and put an end to the project.

Senator Ensign.

STATEMENT OF SENATOR JOHN ENSIGN

Senator ENSIGN. Thank you, Mr. Chairman. You are probably not used to being called Mr. Chairman, being in the minority now.

So I will give you the honor today, and thanks for——

Senator REID. But I have fond memories of being in the majority.

Senator ENSIGN. No, and I appreciate that, but I hope you stay in the minority.

It is great to be here with you, and I want to extend my thanks to Senator Domenici for allowing us to have this hearing out here and to you for calling this hearing.

I also want to welcome our witnesses. I am disappointed that we do not have all of the witnesses that we had hoped to have at this hearing today. There are real concerns that the Department of En-

ergy's fierce commitment to its schedule for submitting its application for an operating license to the Nuclear Regulatory Commission by 2004 and storing the Nation's nuclear waste in our backyard by 2010 has allowed an unrealistic time line to take precedence over quality control.

As the Nuclear Regulatory Commission management leader, John Greeves, noted, "quality is not being built into the project. The bottom line is that behavior and safety needs change. Right now, the schedule pressures are overrunning the quality".

Clearly, that is not acceptable. However, it is going to keep on happening unless we blow the whistle on the failures of the quality assurance program and the Department of Energy's efforts to silence the program's critics.

Our Nation and our State cannot allow the DOE to cut corners on the very program which has been set up to verify that all scientific data and engineering designs submitted to support a license for Yucca Mountain are accurate and reliable.

Senator Reid and I, as he mentioned, have asked the General Accounting Office to look into the problems DOE's quality assurance program is experiencing. We asked the GAO to answer three main questions. One, has the quality assurance program been effective in identifying and correcting quality deficiencies? Two, have the deficiencies affected the progress of the project? And, three, what efforts has DOE taken to strengthen the program's effectiveness. Hopefully, the GAO can shed some light on these matters today.

In addition, I am concerned that responsible workers who uncover problems with Yucca Mountain procedures are being retaliated against by DOE and its contractors. Just look at the recent case, where three out of the four members of a Yucca Mountain quality assurance review team, Don Harris, Lester Wagner, and George Harper, contractors for Navarro Research and Engineering, were reassigned after their audit resulted in a stop-work order. Unfortunately, this is an all-too-familiar story. It is reminiscent of the firing of Jim Matamo, another Navarro Yucca Mountain quality assurance reviewer. Of course, later the Labor Department determined he had been unfairly terminated. And let us not forget the case of Bob Clark, former director of the DOE Office of Quality Assurance, who was transferred after raising concerns about possible wrongdoing at the Yucca Project.

The two whistleblowers we invited to appear today, Bob Clark and Don Harris, declined to attend. I, personally, chalk that up to the fear of the DOE's and its contractors' culture of retaliation that these individuals have personally experienced.

I certainly believe that this hearing is an important endeavor, and I want to thank Senator Reid for holding it and for the witnesses for coming here to enlighten us. The importance of a rigorous quality assurance program should not be underestimated. If quality assurance is not in place, the NRC could and should reject the license applications on those grounds.

I thank you, Senator Reid, and look forward to hearing from our witnesses.

Senator REID. Senator, one of the things I forgot to mention to you is I had to get permission from my son to have this meeting here today.

Senator ENSIGN. Have you noticed also that the chairs in their hearing chambers are a lot nicer than the Senate's?

I think they have a lot more money than we do.

Senator REID. Yeah, I think that is probably true. I think the Attorney General should investigate that.

We have here a couple of vacant chairs, and it is difficult for me to understand how the Department of Energy could allow anything like this to happen. These are people who wanted to come and testify. They are afraid. And we will talk, just very briefly, about what these people would have said had they been able to be here. Now, keep in mind they wanted to come. And for various reasons, they did not come. The most important reason they did not come, they were afraid they would lose their jobs.

Robert Clark is someone who would provide a lot of information. He has talked to other people. The DOE sent a letter, as I indicated, saying that he had nothing to talk about because he no longer worked in the quality assurance program. This is outrageous, for lack of a better word to describe the activities of the Department of Energy. Mr. Clark no longer works in the quality assurance program because the DOE moved him to a new position. According to press accounts, Mr. Clark was told at the time, quote, to take one for the team.

I can imagine, after being told that, after hearing about the letter the DOE sent me, he would really be reluctant to come forward to testify. The DOE should be afraid of what he has to say.

But remember, this is an agency of the Federal Government. It is not an independent entity set up to freelance on anything they feel is important. Mr. Clark was a director of quality assurance for the Yucca Mountain Project for 4 years. He is a nationally recognized expert in quality assurance. As a leader of the quality assurance program, he told the DOE to shape their quality assurance program up. He would have forced the DOE to make too many commitments, I guess, to the NRC, the Nuclear Regulatory Commission, commitments that would slow down the project; therefore, they just moved him. They cannot allow anything to slow up this project, so they just simply, I repeat, moved him.

Since they moved him from quality assurance, not a single one of the problems that he flagged has been fixed, more problems have been created, more people have been harassed and intimidated, fewer people feel comfortable raising safety concerns. So it is no wonder DOE does not want to justify why they moved him.

I am disappointed that we could not hear Mr. Clark today. He would have shed a spotlight on the recurring quality assurance problems at Yucca Mountain. But most importantly, I am disappointed that we could not hear from Mr. Clark today, because what this says about Department of Energy concern for honesty, integrity, and fairness speaks in volumes.

In testifying, Mr. Clark would have testified about the quality of DOE's Yucca Mountain work. In not appearing, Mr. Clark's absence speaks volumes about an agency that is committed to pushing this project regardless of who gets fired or intimidated or how taxpayer dollars are wasted.

This project is no longer about quality assurance. It is about good, ethical, and safe Government that protects, above all, the

people who work for it and the people who it represents, the taxpayers of America.

Senator Ensign, would you tell us a little bit about the other vacant witness?

Senator ENSIGN. Yes. Donald Harris was another person that we wanted to hear from today. Unfortunately it appears his employer and the Department of Energy also would prefer him not to speak. Based on several recent news reports, it appears that he would have had a lot to offer to this hearing.

Donald Harris was reported to have been a member of an audit team that uncovered problems with the quality assurance program at Yucca Mountain. Based on his work, the Department of Energy issued a stop-work order, a rare occurrence, even at the Yucca Mountain Project. After completing the audit, we know that he was temporarily reassigned and taken off the audit teams. It seems that this is testimony that would be extremely relevant today, since we are not only trying to figure out what is going on with quality assurance, but also what is going on with the treatment of workers.

Donald and all the other auditors on his team were simply doing their jobs, and they were doing them well. Their job is precisely to find problems with quality assurance, raise them, and then have them corrected. Unfortunately, Donald's case seems to be one more example of the DOE spending more time trying to find out who raises concerns than actually trying to fix the problems raised in those concerns. Donald is one of many experienced auditors working on this project.

I am extremely disappointed he is not here today. The people of Nevada, the Department of Energy, and the Nation have missed a real opportunity to understand the problems with Yucca Mountain.

Mr. Chairman, I think that it cannot be emphasized enough that these are two witnesses who very much support the Yucca Mountain Project, and that is why their testimony would have been so valuable today, because no one could question their motives. So it is very disappointing that they were not able to testify today.

Thank you.

Senator REID. Ladies and gentlemen, we are going to have testimony from three witnesses at this time. Following the statements of the three witnesses, which will take about 10 minutes each, Senator Ensign and I will begin asking questions of the witnesses.

The first witness we are going to hear from today is from the General Accounting Office. A little background of the General Accounting Office, the General Accounting Office is the watchdog of Congress. It is an agency that is set up on a bipartisan basis, nonpartisan basis, to do investigations of what is going on in this country, whether it is something in the Defense Department, whether it is something in the Bureau of Land Management, or, as we are looking here, something within the Department of Energy. They are known worldwide for their astuteness and their approach to finding, without any political bias, a problem. And I have worked with them all these years and been terribly impressed.

Today, we are going to hear initially from Robin Nazzaro, who is the director of the Natural Resources Environmental Team at the United States General Accounting Office. She is currently the director, as I have indicated. She, for the past 10 years, has been

responsible for overseeing GAO's work assessing the results of the Federal Government's investment in Federal science and technology programs. She has been with the General Accounting Office since 1979. She has served as an assistant to the deputy director for planning and reporting. She has served as the division focal point for strategic planning and human resources. She has been educated at the University of Wisconsin. Among other honors from the General Accounting Office, she received the Controller General's meritorious service award for sustained leadership. She has received two Assistant Controller General's awards for exceptional contributions in strategic planning. So we are very fortunate to have her here today to give us the information that she has regarding Yucca Mountain.

Ms. Nazzaro.

STATEMENT OF ROBIN M. NAZZARO, DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, GENERAL ACCOUNTING OFFICE

Ms. NAZZARO. Thank you, Mr. Chairman. I am pleased to be here today to discuss the Department of Energy's quality assurance program for the Yucca Mountain Repository Project.

As you know, Yucca Mountain is intended to serve as the Nation's permanent repository for high-level nuclear waste. DOE is currently in the process——

Senator REID. Can everyone hear? No. So——

Ms. NAZZARO [continuing]. DOE is currently in the process of preparing an application to the Nuclear Regulatory Commission for authorization to construct the repository, which it expects to submit by December 2004. To ensure that DOE can safely design, construct, and operate the repository, NRC requires DOE to have a quality assurance program in place. This program is designed to include procedures to assure NRC that the information submitted is verifiable and well-documented. Audits and management reviews are also built into the program to monitor whether workers follow these procedures. In cases where the procedures have not been followed, DOE must develop and implement corrective actions and monitor their effectiveness.

In this context, you asked GAO to investigate the effectiveness of DOE's efforts to improve its quality assurance program. Although we are still in the early stages of our work, I am prepared today to provide the history of DOE's actions to correct quality assurance problems, the status of DOE's efforts to improve its quality assurance program, and our preliminary observations on the effect of the quality assurance problems on DOE's ability to successfully meet its 2004 milestone for submitting its application to NRC.

In summary, DOE's track record for correcting problems with its quality assurance program is less than favorable. Dating back to the late 1980's, NRC identified many concerns at Yucca Mountain. DOE was put on notice of these shortcomings, but the problems continued. As a result, NRC reported that it had no confidence that DOE's management plan for resolving quality assurance issues related to the design activities would work.

In the late 1990's, DOE's own audits at Yucca Mountain identified quality assurance problems in three areas: data sources, verification of scientific models, and software development. In re-

sponse to the issues raised in the audits, DOE issued a management plan in 1999 that prescribed remedies. However, model verification and software-development problems resurfaced again in 2001.

In July of 2002, DOE provided NRC with a revised plan to correct its quality assurance problems at Yucca Mountain, including the problems with scientific models and software codes. Because DOE is still in the process of implementing this plan, it is too early to determine whether these changes will be effective. However, notwithstanding these changes, in April 2003 DOE again found data-related problems similar to the data-verification problems identified back in 1998.

Whether DOE can correct its quality assurance problems in time to meet its 2004 milestone for submitting an application that NRC will accept is unclear. DOE's unsuccessful efforts to address recurring quality assurance problems, the identification of new problems since the issuance of this 2002 management-improvement plan, and NRC's recent comment that DOE's quality assurance program has yet to produce the outcomes necessary to ensure that this program meets NRC's requirements, do not instill much confidence that the quality assurance problems will soon be resolved. These problems could impede the licencing process, leading to time-consuming and expensive delays as the weaknesses are corrected, or ultimately prevent authorization to construct the repository. Moreover, continued reliance on data that are unreliable or inaccurate could lead to adverse health, safety, and environmental effects in the course of the 10,000-year licensing period.

However, now that the project has shifted from scientific investigation to preparing the application, DOE may now have the motivation and focus to correct recurring quality assurance problems given the integral role that quality assurance plays in the application process.

PREPARED STATEMENT

As we continue our investigation for you, we will further validate our observation and assess the effectiveness of DOE's efforts to improve its quality assurance program.

Thank you. That concludes my testimony. I would be pleased to respond to any questions you may have.

[The statement follows:]

PREPARED STATEMENT OF ROBIN M. NAZZARO

Senators Ensign and Reid, we are pleased to be here today to discuss the Department of Energy's (DOE) quality assurance program for the Yucca Mountain repository project. As you know, Yucca Mountain is intended to serve as the Nation's permanent repository for high-level nuclear waste. DOE is currently in the process of preparing an application to the Nuclear Regulatory Commission (NRC) for authorization to construct the repository, which it expects to submit by December 2004. To ensure that DOE can safely construct and operate the repository, NRC requires DOE to have a quality assurance program. The quality assurance program is designed to include procedures to assure NRC that the information submitted to it is verifiable and well documented. Audits and management reviews are also built into the program to monitor whether workers follow these procedures. In cases where they are not followed, DOE must develop and implement corrective actions and monitor their effectiveness. An ineffective quality assurance program could potentially impede the application process and could precipitate potentially adverse health, safety, and environmental effects.

In this context, you asked us to investigate the effectiveness of DOE's efforts to improve its quality assurance program. Although we are still in the early stages of our investigation, we are prepared today to provide: (1) the history of DOE's actions to correct quality assurance problems, (2) the status of DOE's efforts to improve the quality assurance program, and (3) preliminary observations on the effect of quality assurance problems on DOE's ability to successfully meet its 2004 milestone for submitting an application to NRC requesting authorization to construct the repository.

In summary:

—DOE's track record of correcting problems with its quality assurance program is less than favorable. Recurring problems have persisted in the program despite DOE's numerous attempts to correct them. DOE evaluations and NRC oversight activities have concluded that the program still falls short of expectations.

—DOE's 2002 quality assurance improvement plan represents the department's most recent attempt to correct quality assurance problems, including those involving scientific models and software codes that DOE will use to demonstrate the safety of the repository. Because DOE is still in the process of implementing this plan, it is too early to determine whether changes included in the plan will be effective. However, notwithstanding these changes, DOE has recently identified further quality assurance problems, including recurring problems with the data that will be used to support the NRC's decision on whether to authorize DOE to construct the repository.

—Based on previously identified weaknesses and recent indications of new problems, we are concerned that DOE's current efforts to improve its quality assurance program may not yield the results it hopes for. Our observation is further supported by NRC's recent comment that DOE's quality assurance program has yet to produce outcomes necessary to ensure that this program meets NRC requirements.

BACKGROUND

The Nuclear Waste Policy Act of 1982 was enacted to establish a comprehensive policy and program for the safe, permanent disposal of commercial spent fuel and other high-level radioactive wastes. DOE was directed in the act to, among other things, investigate potential sites for locating a repository. Amendments to the Act in 1987 directed DOE to consider only Yucca Mountain, Nevada, as a potential site for a repository. In 2002, the Congress approved the President's recommendation of Yucca Mountain as a suitable site for the development of a permanent high-level waste repository. The next step in the process is for DOE to submit an application to NRC for an authorization to construct the repository.

In order to ensure that the information submitted to NRC is verifiable and well documented, NRC requires nuclear facilities to develop a quality assurance program that includes a process to identify problems, develop corrective actions, and monitor the effectiveness of these actions. Among other things, such a quality assurance program is required to: (1) train personnel in quality assurance; (2) inspect activities that affect quality; (3) establish controls over testing programs and test equipment, such as ensuring that this equipment is properly calibrated; (4) establish and maintain records, including records documenting the qualifications of personnel performing repository work; and (5) verify compliance with the rules and procedures of the quality assurance program to determine the effectiveness of the program.

In carrying out its responsibility for the Yucca Mountain repository to meet the Environmental Protection Agency's (EPA) standards for protecting public health and safety, as well as its standards, NRC provides consultation and advice to DOE in the project's pre-application period. NRC officials are located onsite at the Yucca Mountain project office where they conduct daily oversight of project activities, including observing and commenting on DOE's quality assurance audits and preparing bi-monthly reports on the overall status of the program. Additionally, DOE and NRC hold quarterly quality assurance meetings and conduct exchanges between staff on technical issues.

HISTORY OF ACTIONS TAKEN TO CORRECT QUALITY ASSURANCE PROBLEMS

DOE's quality assurance problems at the Yucca Mountain repository site date back to the late 1980's. In a 1988 report, we identified significant problems with the quality assurance program, noting that it failed to meet NRC standards.[1] We found that NRC had identified many specific concerns from the oversight activities it had

[1] U.S. General Accounting Office, "Nuclear Waste: Repository Work Should Not Proceed Until Quality Assurance Is Adequate," GAO/RCED–88–159 (Washington, DC: Sept. 29, 1988).

performed at Yucca Mountain. For example, NRC noted that DOE's heavy reliance on contractors and its inadequate oversight of quality assurance activities would increase the likelihood that DOE might encounter quality-related problems. Furthermore, NRC said that the likelihood that the State of Nevada and others would contest the licensing proceedings increased the probability that DOE would have to defend its quality assurance program and the quality of the work performed. NRC noted that DOE's inability to properly defend its work could result in additional expense and time-consuming delays as program weaknesses are corrected. NRC also found that DOE staff and contractors exhibited negative attitudes toward the function of quality assurance, noting that participants appeared to lack a full appreciation for what it took to get a facility licensed by NRC.

DOE was put on notice of these shortcomings, but the problems continued. In its 1989 evaluation of DOE's Site Characterization Plan, NRC concluded that DOE and its key contractors had yet to develop and implement an acceptable quality assurance program. In March 1992, based on progress DOE had made in improving its quality assurance program, NRC allowed DOE to proceed with its site characterization work, noting that DOE had demonstrated its ability to evaluate and correct quality assurance program deficiencies. A year and a half later, however, NRC raised concerns with DOE about the acceptability of facility design activities requiring quality assurance. NRC reported that it had no confidence that DOE's management plan for resolving quality assurance issues related to the design activities would work because of DOE's and the site contractors' inability to effectively implement corrective actions in the past.

DOE renewed its efforts to correct problems with its quality assurance program starting in the late 1990's when its own audits at Yucca Mountain identified quality assurance problems in three areas: data sources, validation of scientific models, and software development. First, DOE could not ensure that all the data needed to support the scientific models could be tracked back to original sources or that the data had been properly collected. Second, DOE had no standardized process to develop the scientific models needed to simulate geological events. Finally, DOE had no process for ensuring that the software being developed to support the models would work. In response to the issues raised in the audits, DOE issued a management plan in 1999 that prescribed remedies. Following implementation of this plan, DOE considered the issues resolved.

Model validation and software development problems, however, resurfaced in 2001. New quality assurance audits found that project personnel had not followed the required procedures for model development and validation or established a timeline for completing the models. In addition, these audits identified that project personnel had not followed the software development process, prompting a prohibition on further software development without prior management approval. According to DOE, the significance of these new observations was compounded by their similarity to those problems previously identified.

STATUS OF DOE EFFORTS TO IMPROVE QUALITY ASSURANCE

In July 2002, DOE provided NRC with a revised plan to correct its quality assurance problems at Yucca Mountain, including the problems with scientific models and software codes. In constructing the plan, DOE conducted an in-depth study of Yucca Mountain's management and work environment. The plan outlined five key areas needing improvement. Specifically, it noted the need for:

—clarifying roles, responsibilities, accountability, and authority for DOE and contractor personnel,
—improving quality assurance processes and clarifying line management's quality responsibilities,
—improving DOE and contractor written procedures,
—implementing more effective and consistent corrective action plans to preclude recurring quality problems, and
—improving the work environment where employees can raise program concerns without fear of reprisal.

To fully address issues raised in the plan, DOE identified a total of 72 actions needed to correct the quality assurance program—35 to address the five key areas, 12 to address model development issues, and 25 to address software development issues. DOE recently reported that it had completed 41 of the 72 actions. The management plan also included performance measures to assess the effectiveness of the actions. DOE recently reported, however, that the Yucca Mountain project still lacks complete and useful performance measures and stated its intention to have the appropriate performance measures in place by September 2003.

Since DOE began to implement its latest improvement plan, new quality issues have emerged. In March 2003, DOE issued a "stop-work" order preventing further use of a procedure intended to help improve DOE and contractor quality assurance procedures. According to DOE, they cancelled the use of the procedure and reverted back to the existing procedure. In April 2003, DOE again found data-related problems similar to the data verification problems identified in 1998. For example, DOE found that, instead of verifying data back to appropriate sources, project scientists had been directed to reclassify the unverified data as "assumptions" which do not require verification.

At the April 2003 quality assurance meeting with NRC, DOE highlighted several recent improvements to the quality assurance program. These improvements included: (1) management changes with DOE's primary contractor at the site, including a new president and a new director of quality assurance, (2) increased line management involvement in quality assurance, and (3) the integration of quality engineers with DOE line employees. Despite this reported progress, an NRC official at the same meeting commented that the quality assurance program had still not produced the outcomes necessary to ensure the program is compliant with NRC requirements.

PRELIMINARY OBSERVATIONS

Whether DOE can correct its quality assurance problems in time to meet its milestone for submitting an application that is acceptable to NRC is not clear. DOE's unsuccessful efforts to address recurring quality assurance problems, the identification of new problems since the issuance of its 2002 improvement plan, and NRC's recent comment that DOE's quality assurance program has yet to produce outcomes necessary to ensure that this program meets NRC requirements do not instill much confidence that the quality assurance problems will soon be resolved. An ineffective quality assurance program could impede the application process, leading to time-consuming and expensive delays as weaknesses are corrected, or ultimately prevent DOE from receiving authorization to construct a repository. Moreover, continued reliance on data that are unverifiable and thus could be inaccurate could lead to adverse effects in the course of the 10,000-year period required by EPA's health and safety standards. At the same time, now that the project has shifted from scientific investigation to preparing an application, DOE may now have the proper motivation and focus to correct recurring quality assurance problems given the integral role that quality assurance plays in the application process.

As we continue our investigation, we will work to validate our observations and further assess the effectiveness of DOE's efforts to improve its quality assurance program.

Thank you, Senators Reid and Ensign. That concludes my testimony. I would be pleased to respond to any questions that you may have.

Senator REID. We are now going to hear from Dr. Allison MacFarlane, from the Massachusetts Institute of Technology.

Dr. MacFarlane is currently a senior research associate at MIT's security studies program. For the past 2 years, she has been a Social Science Research Council MacArthur Foundation fellow in International Peace and Security at the Belfer Center for Science and International Affairs at Harvard. She received her Ph.D. from MIT in 1992. She has traveled around our country considerably. She has been a professor of geology at George Mason University. She has been a scholar at Radcliffe College and Kennedy School Fellowship at Harvard. From 1997 through 1998, she was a science fellow at Stanford. And for the past 2 years, she has been serving on a National Academy of Science panel on spent-fuel standard and excess weapons-plutonium disposition. Her research focuses on the issues surrounding the management and disposal of high-level nuclear waste and fissile materials. We could not have anyone better qualified to testify at this hearing today than Dr. MacFarlane.

Dr. MacFarlane.

STATEMENT OF ALLISON MACFARLANE, SENIOR RESEARCH ASSOCIATE, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. MACFARLANE. Thank you, Mr. Chairman, Senator Ensign, ladies and gentlemen.

Senator REID. Turn your mike back on.

Dr. MACFARLANE. Aha, okay. Let me begin again. Technology defeats me, even though I am at MIT.

Mr. Chairman, Senator Ensign, ladies and gentlemen, I appreciate the opportunity to address the important issue of quality assurance in the siting and development of a nuclear-waste repository at Yucca Mountain in Nevada.

To understand quality assurance and the quality of science at Yucca Mountain, one must first understand what type of science is being produced there. I will discuss that, and then I will go on to discuss a selection of what I consider to be the significant, unresolved scientific issues that bear on the safety of the Yucca Mountain site as a nuclear-waste repository. I will conclude with some suggestions for improving the quality of the science.

The science done in support of siting a repository at Yucca Mountain has clearly been influenced by politics. The science produced by Department of Energy scientists or their contractors is requested by and evaluated by managers at DOE who must fulfill legal and regulatory obligations under the Nuclear Waste Policy Act and Nuclear Regulatory Commission and the Environmental Protection Agency rules. In this way, not only are the managers at DOE seeking particular knowledge, but the scientists themselves are required to gather data in a way that fulfills DOE's political obligations.

The products of scientific inquiry at Yucca Mountain are, for the most part, published as DOE reports without individual authors, and rarely does this data find its way into peer-reviewed publications. This is not to say that there is no peer review at DOE, but it is an internal matter; and, thus, the agency is in danger of appearing to review itself, which brings into question the quality of their research. Peer review works best when scientists outside a community review the research. DOE's science would appear less politicized overall if it were shown to pass muster with the larger scientific community.

Let me illustrate the influence of politics on Yucca Mountain science with a brief example. I argue that DOE has stressed some of the features of Yucca Mountain—in particular, its deep water table and aridity—as positive, without adequately exploring the negative aspects of these features.

DOE basically has a dry-is-good policy for Yucca Mountain, but Yucca Mountain is not really dry. A cubic meter of rock, on average, there contains 100 liters of water. And it turns out that the United States is the only country pursuing a policy of developing a repository above the water table. All other countries are looking to store their waste below the water table, which, in fact, is better for spent fuel. Spent fuel in the presence of air and moisture, the conditions that will be expected at Yucca Mountain, oxidizes or rusts like iron. But due to their focus on the dry-is-good policy, the DOE has not fully explored many of the important technical issues

associated with spent-fuel degradation in an oxidizing environment.

Spent-fuel degradation is just one of the scientific issues that remains unresolved but could affect the safety of a nuclear-waste repository at Yucca Mountain. Let me discuss a few others that I consider significant for repository performance.

First, DOE has underestimated, I would say, the future infiltration of water into the mountain from precipitation, because they have not adequately accounted for the effects on the climate of Southern Nevada from the extreme carbon-dioxide levels that the planet will likely experience in only a 100 years.

Second, DOE continues internal debates about the quality of chlorine-36 data and its impact on transport of water above the water table, while ignoring other significant unsaturated-zone issues. The hydrologic community, in general, accepts the chlorine-36 data and the current conceptual models of water transport in the unsaturated zone, but DOE is in the process of redoing the study and has done a poor job in doing so. Remaining open are questions of how fracture flow occurs in Yucca Mountain rock and which fractures are the ones that would actually flow.

Third, DOE is relying heavily on the performance of Alloy–22, a chromium-nickel molybdenum alloy, to provide at least 10,000 years of corrosion resistance for the waste packages. This reliance stems from 2 years' worth of corrosion studies in the laboratory. There are no natural analogs, no long-term studies, and little understanding about the very complex and poorly understood conditions that will evolve over time around the waste package. These conditions depend on interactions among the canister, the rock, the drip shield, other tunnel equipment, groundwater, heat, and radioactivity.

Fourth, in the past DOE assumed that radio nuclides like plutonium would move far from the repository because they are not soluble in water. But it turns out that plutonium can adhere to tiny particulate material called colloids and be transported long distances. We know this from evidence collected at the nearby Nevada test site. But very little work has been done at Yucca Mountain so we do not yet know what will form colloids in the repository—for instance, the waste, the rock, the microbes—how far they can travel, and how much material, like plutonium, would be available for transport.

Fifth, we know very little about how radio nuclides would be transported in the saturated zone below the water table, simply because we know very little about the saturated zone itself. This stems from the fact that there are not many test wells north of Route 95 and only one multi-well test location.

Sixth, and finally, the potential volcanism at Yucca Mountain remains a contentious issue, with the Nuclear Regulatory Commission arguing that there exists an order-of-magnitude-higher probability for volcanism at the repository than the Department of Energy.

Why do these issues remain, and why are there problems with the quality of science at Yucca Mountain? One explanation is, as I said earlier, that DOE has focused on some issues to the exclusion of others. Furthermore, the results of their performance as-

sessment show that the performance of the repository depends largely on the waste package and, therefore, does not encourage further exploration of the concerns of geology and geohydrology.

Another explanation lies in the quality assurance program itself. In some cases, the quality assurance program is a barrier to who can do science and what science can be used in the assessment of Yucca Mountain. One rule of the quality assurance program prevents DOE scientists from using data already published in the literature as primary data. Published data can only be used to corroborate DOE's own findings. Thus, even if work has already been peer reviewed by the scientific community, DOE requires that it collect its own version of the data for input into modeling studies. Furthermore, the process of actually using already-published data turns out to be an onerous task that few DOE scientists attempt. Thus, they are forced to repeat work already done.

Furthermore, the quality assurance program requires that laboratories that produce data to be used in the Yucca Mountain assessment be qualified by the Department of Energy before they are allowed to produce usable data. This is a costly and onerous task and limits the number of labs that can do analysis.

What can we do to address these issues? First, in terms of the quality assurance program, DOE should allow the free and easy use of peer-review data gathered by academic researchers. It should allow the use of laboratories that do not have the imprimatur of DOE's quality assurance program as long as they are respected within the academic community. It should continue to encourage DOE scientists to publish their work in academically peer-reviewed journals and, in fact, make it easier for them to do so by reducing the number of internal reviews required of the work. DOE scientists have begun to do this more over the last few years, and it is essential that they continue to do so to demonstrate the quality of the research.

DOE could improve the quality of science produced for its nuclear waste program by offering competitive grants to academic researchers to complete scientific analysis essential to the understanding of Yucca Mountain. In doing so, they must not control the interpretation of data. The Office of Civilian Radioactive Waste Management recently enacted a funding program aimed at supporting academic research on these issues.

It should be viewed as a start of a larger process. And DOE should allow an external panel of scientists selected in as apolitical fashion as possible—for example, by a group of members of the National Academy of Sciences or ranking members of national scientific organizations—to produce an independent review of the science done and to allow a mechanism for feedback within DOE.

PREPARED STATEMENT

Finally, DOE might benefit by comparing the expected performance of different existing waste repositories, such as the WIPP site in New Mexico and the sites selected by Finland and Sweden, to Yucca Mountain, instead of simply relying on their performance-assessment modeling to evaluate the Yucca Mountain site.

Thank you.

[The information follows:]

PREPARED STATEMENT OF ALLISON MACFARLANE

Mr. Chairman, distinguished senators, ladies and gentlemen, I appreciate the opportunity to address the important issue of quality assurance in the siting and development of a nuclear waste repository at Yucca Mountain, Nevada.

I am a Senior Research Associate at the Massachusetts Institute of Technology's Security Studies Program. I hold a Ph.D. (1992) in geology from the Earth, Atmospheric and Planetary Sciences Department at the Massachusetts Institute of Technology. I have been studying and writing about both the technical and policy issues associated with nuclear waste disposal at Yucca Mountain since 1996, and am currently co-director of the Yucca Mountain Project at MIT, an independent technical review of the science done in support of a repository at Yucca Mountain.

I have been asked to address issues of quality assurance at Yucca Mountain, issues of the quality of science done to characterize the site, and the long-term feasibility of the project. To understand quality assurance and the quality of the science at Yucca Mountain, one must first understand what type of science is being produced there. Then I will discuss a selection of what I consider to be the significant unresolved scientific issues that bear on the safety of the Yucca Mountain site as a nuclear waste repository. I will conclude with some suggestions for improving the quality of the science and the implications for the long-term feasibility of the project.

BRIEF SUMMARY OF MAIN POINTS

To understand the quality of science done that supports the siting of a repository at Yucca Mountain, it is important to evaluate both the qualitative and quantitative aspects of the science. First, the science done at Yucca Mountain is produced by scientists mindful of the political goals of the agencies they work for, and the work they produce is evaluated by managers trying to meet those goals. Furthermore, Yucca Mountain science has been largely published in gray literature, which limits scientific debate. Politics has even influenced the kind of questions asked in the technical analysis of Yucca Mountain. For instance, because the repository is to be located above the water in an arid region, it is considered "dry." The Department of Energy (DOE) and others have promoted the dryness as an advantage, though one can easily make a scientific argument that the opposite is true. More importantly, this focus on the positive aspects of a dry repository has caused DOE to overlook technical issues such as spent fuel oxidation, and they have left this issue largely unresolved.

In evaluating the scientific analysis done to support the Yucca Mountain site, it became clear that there are actually a number of unresolved technical issues that may affect the performance and therefore safety of the repository. These are issues of:

—surface infiltration rates based on climate change models,
—transport of water above the water table and the continuing debate over the meaning of chlorine-36 data,
—the durability of Alloy-22, which forms the basis for the resilience of the waste canister,
—colloidal-facilitated transport of radioactive materials like plutonium,
—transport of water and radionuclides in the unsaturated zone, and
—the potential effects of volcanism on the repository.

The reasons that these issues remain unresolved are multiple, and include those policies within DOE that lead to blind spots, such as the emphasis on "dry is good." The results of the total system performance assessment, used to evaluate the repository, de-emphasize geologic barriers and the need to understand them better. Finally, the Quality Assurance program itself limits both the data that DOE can use in its site evaluation and the people and laboratories qualified to collect such data.

In summary, I suggest that the quality of science can be improved by:

—adjusting the Quality Assurance program to allow the use of published data and laboratories that do not have DOE's approval,
—requiring DOE scientists to publish their work in peer-reviewed journals,
—providing competitive grants to academic scientists to address the unresolved scientific issues,
—allowing for completely independent scientific review of the work done by DOE in support of the Yucca Mountain site, and
—ensuring that performance assessment is not the only tool used to evaluate Yucca Mountain, but that a comparison of different waste sites (in the United States and in other countries) be completed.

POLITICS AND SCIENCE AT YUCCA MOUNTAIN

To understand the quality of science being produced to support the Yucca Mountain site, we must first understand the type of science being done. At Yucca Mountain, scientific knowledge addresses the policy question of whether the site is suitable for waste disposal. The knowledge itself is being used to predict the behavior of the repository over geologic time through complex computer modeling to determine whether members of the public could be at risk over that time. Most important for this hearing, the science produced at Yucca Mountain is being evaluated equally by scientific peers within the DOE and their managers, who are required to meet goals set by their agency.

It is the last point where politics appears to play a direct role in the knowledge produced. The scientists producing the knowledge to be used in nuclear waste policy must satisfy their managers at the DOE. And these managers, in turn, must fulfill legal and regulatory obligations under the Nuclear Waste Policy Act and Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA) rules. In this way, not only are the managers at DOE and its contractors seeking particular knowledge—politicized knowledge, if you will—but the scientists themselves are required to address questions, gather and interpret data in a way that fulfills DOE's political obligations.

The quality of science produced in the U.S. nuclear waste policy process can be difficult for scientists and others outside of the process to evaluate. Much of the scientific research produced at Yucca Mountain is published in the form of "gray" literature. Many of the DOE reports are unsigned—"authored" instead by the institution, not an individual. Such authorship obscures accountability and decreases scientific debate. In contrast, debate is often encouraged by scientific journals, which publish reviews of papers that take issue with the results or interpretations of data presented in previously published work. The scientists themselves carry out public debates in journals. In the case of the science produced at Yucca Mountain, the scientists who produced the knowledge are only rarely accountable to the larger scientific community. Furthermore, the results of this research are not widely distributed because of the difficulty of obtaining the reports. As DOE scientists themselves remarked in a 2001 National Academy of Sciences Report,

"It is important to note that the history of the characterization of Yucca Mountain cannot be accurately reconstructed solely on the basis of citable literature. To fully understand this history requires reference to unpublished draft reports, memoranda, and rough notes."

What constitutes peer review in the case of scientific knowledge produced for Yucca Mountain? All DOE contractors require that completed scientific research go through an in-house review that not only considers the quality of science done, but also the implications of making certain findings public. In this way, scientists are responsible to managers who may or may not be scientists themselves, but who have clear political agendas to meet the goals and requirements of the DOE, NRC, and EPA. Some peer review comes in the form of public hearings, though the impact of the feedback from public hearings and public comment is negligible. These public comment exercises appear to be more like "rituals" than serious venues to receive, process, and incorporate input from the public. Finally, some peer review comes from entities such as the National Academy of Science (when asked) and the Nuclear Waste Technical Review Board, whose influence depends on the members of the board and, since they are appointed by the President, is politicized. Peer review works best when scientists outside a community perform the review—as is done with work published in peer-reviewed journals. DOE's internal review process appears to be a community reviewing itself, and thus calls into question the quality of the work.

Now that we know that politics does indeed play a role in the science produced to uphold the Yucca Mountain site, we can ask the question, has politics limited some of the science done and the questions asked about the site? I would argue that the answer is yes. I will provide one example of such a bias.

The main technical reason DOE provides for regarding Yucca Mountain as particularly appropriate for nuclear waste disposal is the low water table, the thick unsaturated zone above the water table, and the arid location. The plan is to store waste above the water table in a dry region—a region where, it is hoped, conditions will remain dry due to the arid environment. Actually, this was not always the case. Initially, DOE considered using the saturated zone, below the water table, for waste disposal at Yucca Mountain but changed its mind, in part due to the discovery of the existence of rapid water transport in the saturated zone. The key to nuclear

waste disposal in the United States has become disposal of waste in a setting that minimizes contact with water. Put simply, the policy has become "dry is good."

Where does the dry is good policy come from? First of all, the unsaturated zone at Yucca Mountain is not really dry. On average, a cubic meter of repository rock contains about 100 liters of water. Second, although held up as a scientific criterion for nuclear waste repository siting, there is no scientific basis for using the unsaturated zone. In fact, most other countries, partly due to the geological or hydrological conditions, are planning to dispose of their nuclear waste in the saturated zone, below the water table. As long as an isolated saturated zone can be found that does not communicate with other aquifers, a saturated zone offers technical advantages, especially if most of the high-level waste is in the form of spent fuel (as will be the case for the United States). Reactor fuel is composed of uranium oxide, UO_2, which is stable and not prone to corrosion under reducing conditions, where little to no oxygen is present—conditions, in other words, that would be found in a wet environment. Oxidizing conditions (circulating air), like those expected at the Yucca Mountain repository, cause spent fuel to become unstable and break down, just as iron rusts in air. The breakdown of the spent fuel creates new minerals and increases the surface area over which any water present can act to remove radionuclides from the spent fuel. Sweden, for instance, plans to use copper as a canister material to encase spent fuel. Copper, as we know from its existence in nature, is highly resistant to oxidation and corrosion if it remains in a reducing environment. Thus, Sweden will considerably reduce the uncertainties in repository performance by emplacing its waste in a wet environment.

As a result of the focus on a dry repository, DOE has done insufficient analysis of issues associated with the rapid oxidation of spent fuel. This is an especially important technical issue because over 95 percent of the radioactivity in Yucca Mountain waste will result from spent fuel. Thus, once the waste package corrodes and the spent fuel is exposed to moisture and air in the drifts, based on studies of natural analogues, it will rapidly alter to new forms. DOE has a limited understanding of the spent fuel dissolution process due to a lack of thermodynamic and kinetic data. Furthermore, there is little information on whether the alteration products will retain radionuclides or release them to the environment.

UNRESOLVED TECHNICAL ISSUES AT YUCCA MOUNTAIN

Spent fuel oxidation represents one of the scientific issues that remains unresolved (and will likely remain so even after the DOE submits the license application), but could affect the performance of a nuclear waste repository at Yucca Mountain. There are a number of these issues, including surface infiltration, transport in the unsaturated zone, durability of waste package materials, the role of colloids in radionuclide transport, saturated zone transport, and volcanism.

Surface Infiltration

Assumptions about future infiltration of water into Yucca Mountain are based on predictions of climate change. Because the EPA requires compliance with their standards for 10,000 years, climate change predictions must attempt to cover this span of time. To do this, the DOE looked at the last 400,000 years (which encompasses the last 4 interglacial-glacial cycles) to predict wettest conditions that would be experienced over the next 10,000 years at Yucca Mountain. They saw at most a 5-fold increase in infiltration.

In fact, DOE may be underestimating climate effects because they have not adequately accounted for the effects of increasing CO_2 levels on climate warming. Over most of the Pleistocene, the last 2 million years, atmospheric CO_2 levels ranged between 200 ppm–280 ppm. Since the dawn of the industrial revolution they have risen to the present level of 365 ppm. The Intergovernmental Panel on Climate Change has predicted that by 2100, CO_2 levels will reach between 500 ppm–1,200 ppm. The last time CO_2 levels were in the 1,000's of ppm was in the Eocene, 50 million years ago. At that time, there were no polar ice caps and reptiles were found near the north pole. The climate was much wetter as well as being warmer, even in the Nevada region.

Although Nevada's climate will presumably not become tropical in the next few hundred years, clearly over the next 10,000 the impact on surface infiltration will be significant and most likely much more significant than a five-fold increase. Unfortunately, DOE has not yet completed the necessary analyses to really understand the potential impacts of anthropogenic climate change on the safety of a Yucca Mountain repository.

Transport in the Unsaturated Zone

Our understanding of how rapidly water is transported through the rock above the water table at Yucca Mountain has changed substantially over time. Initially, geohydrologists assumed water moved slowly along grain boundaries in the rock. Their models gave estimates of infiltration rates from less than 0.5 mm/year to 4 mm/year in 1980's. With the discovery of the presence of above-normal concentrations of the isotope chlorine-36 associated with fractures at the repository level in the mountain, DOE changed the old models. High-levels of the chlorine-36 isotope are attributed to atmospheric tests of nuclear weapons done in the 1950's. This material was carried in rain or snow to Yucca Mountain and then transported 1000 feet through the rock to the repository level within 50 years. Such rapid transport suggested the existence of fast transport pathways—most likely the fractures associated with the high level of chlorine-36. Thus, the current model of water transport in the unsaturated zone is a mix of fast and slow pathways with an average infiltration rate of 5–10 mm/year with some locations receiving up to 80 mm/year.

The academic hydrology community largely accepts the results of these studies on Yucca Mountain, but DOE does not. They are, in fact, in the process of redoing some of the original data collection on chlorine-36, but have not really addressed the problem properly—in fact, they have addressed it so improperly that one wonders what the Quality Assurance program is really all about, actually. For example, in one approach to redoing the original study, workers collected samples in the repository area, not at potential fast pathways, such as fractures, but instead at systematically fixed distances along the tunnel walls. These samples did not produce traces of bomb-pulse chlorine-36, but that would be expected—and was consistent with the earlier study. Furthermore, the sample preparation techniques that DOE used in this "redo" study were not the same as in the previous study—and therefore could not produce scientifically comparable results.

Although DOE has embarked on this costly effort to redo the previous study on transport pathways, it has neglected to address a number of important issues that bear directly on the safety and performance of the repository. DOE's current unsaturated zone models use steady-state precipitation conditions, but in fact water transport may instead be dominated by threshold events, such as thousand-year storms. Moreover, DOE still does not have good models of fracture flow, leaving open the questions of how much water could be carried in fractures and which fractures would flow.

Durability of Alloy-22

The canister or waste package that will contain the spent fuel and high-level waste will have two shells, an inner shell made of stainless steel and a 2 cm-thick outer shell constructed of a nickel-chromium-molybdenum alloy called Alloy-22. Current DOE modeling suggests that waste packages will contain waste for at least 30,000 years. But these results are based on large extrapolations of existing data. The current corrosion data for Alloy-22 is from a 2-year long study. This is then extrapolated out to tens of thousands of years.

The existing data suggests over the short-term that passive corrosion rates under stable conditions at Yucca Mountain would be less than 0.1mm/year. The assumption is that conditions will remain stable at Yucca Mountain. It is not clear how groundwater chemistry near the waste packages will evolve over time, although DOE is attempting to model this. Groundwater chemistry, including its composition, oxidation potential and pH (acidity/alkalinity) are dependent on temperature, which will definitely change over time, interactions between the waste package and surrounding rock, engineered items like drip shield, concrete struts, and local groundwater. Radiation will also affect the situation.

Other remaining uncertainties in the performance of the waste package are: (1) the potential for stress corrosion cracking at lid welds—the one certainly vulnerable location in the waste package design; (2) the temperature of the repository initially—a "hot" (above 100°C) design or a "cold" (below 85°C) design; (3) the effects on durability of the development of a mineral crust on the waste package; and (4) the effects of de-alloying on corrosion resistance. The fundamental problem in trying to predict the waste package's performance over geologic time periods is the absence of natural analogues for Alloy-22. The existence of natural analogues provide a basis for understanding the behavior of material over time under natural conditions. This is one reason why the Swedes will use copper to encase their waste packages—pure copper deposits exist in nature and provide hard evidence of the durability of copper in conditions expected in their repository locations.

Colloidal Transport of Radionuclides

Initially DOE scientists assumed that because long-lived hazardous radionuclides such as plutonium were relatively insoluble in water, they would not be transported any great distance from the repository. This assumption held until the 1990's, when DOE scientists found that species like plutonium have the potential to attach themselves to materials called colloids, inorganic or organic particles between 1–1,000 nanometers in size that remain suspended in groundwater and therefore are easily transported. Colloids can form from sediments, the surrounding rock, the waste package or the waste itself, or microbes in region.

Recently, colloids have been shown to facilitate the transport of radionuclides. Scientists from Lawrence Livermore National Laboratory found evidence for transport of radionuclides via colloids at Nevada Test Site. In particular, they found that colloids transported plutonium, cesium, cobalt, and europium 1.3 km from the location of a 1960's-era test.

Very little information has been collected on colloidal-assisted transport at Yucca Mountain. We still do not know the natural abundance of subsurface colloids at Yucca Mountain or what will form them. We do not know the long-term irreversibility of the radionuclides attaching to them. Finally, we do not know what concentrations of these radionuclides can be expected to be available for transport.

Transport in the Saturated Zone

Little detail is known about water flow in the saturated zone below the water table. In general, it is known that water flows to the southeast then south. The uppermost aquifer in volcanic rocks extends 10–15 kilometers south of Yucca Mountain and discharges into the alluvial sediments in Amargosa Valley. The upper aquifer has high permeability due to the existence of extensive fractures, but the permeability and fracture networks are not well quantified. Overall there is a significant lack of data on the subsurface geology, the water table configuration, general hydraulic parameters, and the division of flow between matrix and fractures. This is in large part due to a lack of boreholes and borehole data. Many of the existing boreholes are concentrated in the south, in the aquifer that exists in the alluvial sediments near Amargosa. Clearly, more boreholes are needed in the volcanic aquifer. Perhaps more important is the lack of multi-well test sites—at the moment there is only one site located to the east of Yucca Mountain. If DOE is to understand how radionuclides will be transported away from the site in the groundwater, it is essential that they complete this work.

Volcanism

Volcanism remains a controversial issue. Five Quaternary basaltic volcanoes lie within 20 kilometers of Yucca Mountain. The youngest volcanic cone in the region, about 80,000 years old, is the Lathrop Wells cone, located at the southern end of Yucca Mountain. The question that remains unresolved is whether a new volcanic center can form under Yucca Mountain. There are two potential scenarios: the first is an explosive eruption below the repository that would spew radioactive material into the atmosphere; the second is that magma does not vent but instead fills the open drifts. Associated with the hot magma would be corrosive gases. The combination of thermal effects and corrosion would rapidly degrade the waste packages and any waters associated with the magmatic activity could accelerate the transport of radioactive material into the accessible environment.

Currently the DOE and NRC do not agree on the probability of such an event occurring. DOE estimates that the probability of a volcanic event at Yucca Mountain over the next 10,000 years is 1 event in 20 million years to 1 event in 180 million years, while the NRC estimates the likelihood to be 1 event in 10 million to 1 event in 100 million years.

In addition to the probability of a volcanic event at Yucca Mountain, there are a few additional unresolved issues. The first is from "buried" basalts (from magnetic anomaly data), which suggest that the number of young events in the area could be larger than initially thought. If this is so, it increases the probability of a volcanic event at Yucca Mountain. Secondly, the methods by which DOE and NRC use tectonic models of origin of volcanic activity to estimate the probability of a future eruption differ. DOE only uses three models, weights them equally, and then takes the average. NRC looks at all possible models and asks whether any would result in violation of standards or regulations.

REASON FOR UNRESOLVED ISSUES

Why do these issues continue to remain unresolved? There are a number of reasons. Earlier I offered an explanation for DOE not yet resolving the spent fuel oxidation issue: because DOE is so focused on the "dry is good" policy that they have lost

sight of the negative aspects of a dry repository. Some of these issues have not received enough attention because DOE's performance assessment emphasizes the superior behavior of the waste package material (even in light of the question I raised above) over the geologic barriers to radionuclide release. According to the performance assessment results, over 99 percent of the site's capability to preserve waste isolation is due to the performance of its waste canisters over the 10,000 year compliance period; only 0.1 percent is contributed by the geology of the site.

Originally, geologic disposal was considered the best option for dealing with HLW because of the ability of the geologic environment to contain the waste for substantial periods. Engineered barriers such as the waste form and disposal casks were thought to be less reliable. DOE has now reversed its previous thinking, so that in performance assessment analyses, geologic barriers such as slow transport, retardation of radionuclides, and distance of the repository from aquifers have been replaced by a greater reliance on engineered barriers such as the waste package and drip shield. DOE's Supplemental Science and Performance Analyses of 2001 support this shift and show that for the Yucca Mountain site, if the waste package were omitted from the performance assessment model, the radiation dose to people living near the site would reach 500 mrem 2,000 years after repository closure. This dose would exceed the EPA standard of 15 mrem/year by more than an order of magnitude. When the waste package is included in the model, peak doses of 800 mrem/year are only reached 200,000 years after repository closure. Furthermore, DOE's analyses of the effects of individual barriers to radiation dispersal at Yucca Mountain suggest the same conclusions: the largest dose increases result from failure of the waste package itself, and not from increased water infiltration into the repository nor increased transport of radioactivity in the water table.

Another explanation for the unresolved issues lies in the Quality Assurance program itself. In some cases, the Quality Assurance program is a barrier to who can do science and what science can be used in the assessment of the Yucca Mountain site. One of the rules of the Quality Assurance program is that data already published in the literature cannot be sued as primary data and can only be used to corroborate DOE's own findings. Thus, even if the work has already been done by others and peer-reviewed by the larger scientific community, DOE requires that it collect its own version of the data to input into modeling studies. Furthermore, the process of actually using already-published data turns out to be an onerous task that few DOE scientists attempt. Thus, they are forced to repeat work already done. Furthermore, the Quality Assurance program requires that laboratories that produce data to be used in the Yucca Mountain assessment to be "qualified" by the DOE before they are allowed to produce usable data. This is a costly and onerous task and limits which labs can do analysis.

LESSONS LEARNED

What can we do to address the current issues? Clearly, it was a mistake for Congress to select only one site to characterize. In doing so, it put a great burden on the responsible Federal agencies and made it virtually impossible to delineate politics from science in the process. That said, what can the United States do given its current predicament? Most likely, it will continue on course, and only time will tell whether it will be a success. If the project is brought to a halt from public disapproval, lawsuits, or failure of the DOE to get an NRC license, there is no alternative plan, another legacy of the 1987 Nuclear Waste Policy Act Amendments. If that happens, the United States will not be the only country to experience a huge upheaval in its nuclear waste program: it will have good company with Canada, the United Kingdom, France, and Germany. All these countries had repository programs that they abandoned in the face of strong public protest. The United Kingdom and Canada have yet to deal with the issue, while France and Germany have revamped their repository programs, giving the public a greater hand in site selection. Germany's new program may provide some insights into how to proceed more fairly.

In Germany under the previous Christian Democrat government, they had selected the Gorleben site for a nuclear waste repository, in a strategy similar to that of the United States: decide on one site, do some scientific analysis to see if it is suitable, and do not involve the public in the decision. Under the new Social Democrat-Green government, they "threw out" the Gorleben site and began with a "white map" to re-examine the entire country for appropriate sites. The first "cut" at this project will only consider sites on the basis of scientific criteria, not political ones. The scientific criteria by which the site will be selected are divided into two steps—the first step using general scientific criteria, the second step using a weighting process that employs somewhat more detailed criteria. In contrast to the criteria

used initially in the U.S. site suitability procedure, these criteria are not set up to qualify or disqualify sites; they are all allowed, but weighted.

Once at least three sites have been identified as being technically suitable, then the public enters the site selection process. At this point citizens of the selected regions, who all along will have had access to the scientific process that occurred previously, will be able to vote on whether to allow the government to explore the proposed site. Their vote will also be informed by socio-economic studies of the positive and negative impacts of a waste repository on the region. Thus the German process may have a better chance than the American one at using a broader scientific view.

How does this apply to the current U.S. situation? First in terms of the Quality Assurance program, it could:

—allow the free and easy use of peer-reviewed data gathered by academic researchers,

—allow the use of laboratories that do not have the imprimatur of DOE's Quality Assurance program as long as they are respected within the academic community, and

—continue to encourage DOE scientists to publish their work in academically peer-reviewed journals and in fact make it easier for them to do so by reducing the number of internal reviews required of the work. DOE scientists have begun to do this more over the last few years. It is essential that they receive support to continue to do so to gain the support of the academic community.

DOE could improve the quality of science produced for its nuclear waste disposal program by:

—offering competitive grants to academic researchers to complete scientific analyses essential to the understanding of Yucca Mountain science. In doing so, they must not control the interpretation of data. The Office of Civilian Radioactive Waste Management has recently enacted a funding program aimed at supporting academic research on these issues. It should be viewed as a start of a larger process.

—allow an external panel of scientists, selected in as apolitical fashion as possible (for example, by a group of members of the National Academy of Sciences or ranking members of national scientific organizations), to produce an independent review of the science done—and allow a mechanism for feedback within DOE.

Finally, DOE might benefit by comparing the expected performance of different existing waste repository sites (such as the WIPP site in New Mexico and the sites selected by Finland and Sweden) to Yucca Mountain, instead of simply relying of their performance assessment modeling of Yucca Mountain.

Senator REID. Thank you very much, Dr. MacFarlane. By the way, I did not mention her Ph.D. is in geology.

We are now favored with the presence of William L. Belke, former senior Nuclear Regulatory Commission on-site representative of the Yucca Mountain Project. He retired from the Nuclear Regulatory Commission in 2002 after having worked for the agency for some 28 years.

Most recently, he served as a senior NRC on-site representative in Las Vegas. This position required interface and oversight of the Department of Energy and Department of Energy's contractors, including observing DOE audits, meetings with DOE staff, DOE contractors, and Nevada State and local Government officials.

Prior to working in Las Vegas, Mr. Belke had numerous quality assurance positions at the United States Atomic Energy Commission and the Nuclear Regulatory Commission. In particular, he developed and reviewed regulatory guides and standards for quality engineering practices relating to safety and health of the public for nuclear facilities. Mr. Belke also conducted field inspections and audits to evaluate and verify proper implementation of quality assurance programs at the Three Mile Island Nuclear Power Plant, Millstone Nuclear Power Plant, and the Tennessee Valley Authority nuclear facilities.

Prior to working for the NRC, Mr. Belke worked as a quality control specialist for Pratt and Whitney's jet-engine program. He was educated at Central Connecticut and State College in Connecticut, and his degree is in industrial technology.

Mr. Belke, please proceed.

STATEMENT OF WILLIAM L. BELKE, NUCLEAR REGULATORY COMMISSION (RETIRED)

Mr. BELKE. Thank you, Senator. Thank you for having me here. It is an honor and a privilege to be here.

There are handouts in the back of my testimony, so I will kind of just highlight it, with your permission——

Senator REID. We would like you to do that, please.

Mr. BELKE [continuing]. In the interest of time, yes, okay.

Page 1, I would like to emphasize what quality assurance, by definition, is. It is all those planned and systematic actions necessary to provide adequate confidence that an item will perform satisfactorily in service. It should be used as a valuable management tool, as a means of improving, not to say "I got you" all the time, and that is the way it has been used in the past. The Department of Energy has an excellent top-tier document called the Quality Assurance and Requirements document. That incorporates the appropriate quality assurance Code of Federal Regulations, the nuclear quality standards, and the NRC guidance.

You can have the best program described in place. But unless you implement it properly, you have breakdowns. This has repeatedly occurred with certain nuclear reactors. There is a big study out in the 1970's, after Three Mile Island, I believe it is new reg 1400, which showed the good plants and the bad plants and what quality is.

NRC, at this time—DOE, rather—is not a licensee and they are not subject to the NRC enforcement actions and/or penalties, civil penalties, like the reactors are. What NRC can do is look at anything anytime, and that is mandated by the Waste Policy Act and also the Code of Federal Regulations. If NRC notes deficiencies or inadequacies or shortcomings, they are documented and carried generally as an open item until DOE resolves them.

I have listed about nine of the significant deficiencies that have occurred over the past years that I was with the project, on page 2, and I do not have to go through them unless you have questions on them. I would be more than happy to answer that.

Senator REID. We will have some, so please proceed.

Mr. BELKE. Okay.

There have been several efforts and studies and independent assessments of why these things repeatedly occur, from DOE. And in part 63—this was a comment I had, ironically, when I was doing the regulations—but we found—and I will read this verbatim, "The QA staff of DOE and their contractors have been successful in identifying QA program deficiencies in the various participants' programs and, in many cases, highlighting the repetition of similar deficiencies. In the past, inadequate corrective action was taken, and the DOE organizations responsible for correcting deficiencies were not held accountable." As I said earlier, implementation again.

I find the DOE contractor QA personnel the finest I have ever encountered in all my years of quality assurance. They are very knowledgeable. They are very well educated, trained; and they do not surface Mickey Mouse deficiencies, or they only surface the major deficiencies.

What I would like to do is maybe offer, based on my background and experience with the program, is suggestions or observations that should be considered to improve this program. I think people should be held accountable for the activities they are performing. I do not see that, and I did not see it when I was with the project. I found schedules being met so people could obtain their bonuses or whatever reason, but it was trash on time. And it is obvious, from the deficiencies on the page 2, this occurs again and again and again.

Another thing was, recent DOE management stated in the March 24th, 2000, letter to its employees, in part, that, "It is a commitment to admit imperfections so that high-quality work can be achieved. As individuals, it is essential that we feel compelled not only to celebrate successes, but also reveal mistakes and issues in our work when they occur. The NRC needs to know that we can be trusted to do the job correctly, to admit when there are problems, and demonstrate our commitment to resolve issues."

I find this kind of a paradoxical statement because of the recent articles published in the media about retaliation taken against their employees. This is what is known as a chilling effect. It hurts the people, and it causes morale problems, and they are afraid. They become afraid of their jobs, their livelihoods. That, I think, should be changed. I do not believe that people should have fear of retaliation in their jobs.

And you mentioned earlier, Senator, about backing down. I smiled at that, because just before I left, I had an issue. I was investigated by the DOE Concerns Program and also the NRC Inspector General. I was totally innocent, and they proved me that I did nothing wrong and so forth like that. I wanted my name cleared. But, more so, I wanted the integrity of the office cleared. I did my utmost to keep that office very respected.

Well, long story short is, I got a letter issued to me where I was told to "suck it up." That was the word. But the letter actually said, "If you continue this, you will be issued a disciplinary action." And I retired shortly thereafter.

The third point, I think, is NRC management should be more proactive and pay attention to deficiencies as documented in the NRC On-site Licencing Representatives Report. That is issued every 2 months, and it is also on the Web site, the NRC Web site. And we discuss it—well, when I was working there, we discussed these problems every week on a team meeting on a conference call with Washington with the technical people and NRC management.

You can see, if you look at these reports, that the same deficiencies are carried again and again and again. And there was no action taken to help these, by my management. The only time they maybe get action, a lot of times, is if the State, Bob Loux's shop, writes a letter to the chairman and says, "Hey, what goes on here?" That is when they get action.

I think—a very important point is, I think upper-echelon management, the executive director, and maybe even the NRC commissioners should initiate action to have the NRC regional office participate in inspection activities on this site. NRC, as you may know, is the headquarters of the technical people. They do all the reviewing of the science and so forth. They are not inspectors. We have four regional offices. The regional officers that would fall under this project would be Region 4. The regional people are trained in inspection activities. They do the reactors, they do the fuel facilities. They are very, very good. And I think that would be of great assistance to this program. I understand—I do not have a copy of it with me, but I understand Representative Berkley wrote a letter requesting this to the chairman, which I think is an excellent idea.

Lastly, when I was there in the 7 years as an on-site representative, I had about over 25 allegations given to me. Some of them were slipped under the door; others came in and requested to remain anonymous. Many of these allegations were of significant nature. Good computer stuff and so forth. By my management's direction, I must turn these over to my management, and, in turn, my management turns them over to an allegation coordinator. In every one of these instances, the allegation coordinator and management gave them back to DOE and says, "You fix them." NRC does not have the authority. I grant you that. But they should be tracked and trended.

So essentially, these are the observations. I have no bridges to burn as a retiree or anything like that, no grudges. I think—for the betterment of the program, I think DOE should provide confidence not only to the NRC, but to all the affected units in the State of Nevada. I am a resident of the State of Nevada, and I think they owe it to us.

Things have to be done correctly. If you cannot—right now, they can come back and tell you, "Well, we are not loading fuel." That is true. There is no safety hazard at this point. If they ever get a license, there will be fuel. But right now I think they have got to prove, DOE has got to prove, that if—they have got to do the little things right. If they cannot do the little things right now, they are not going to do the big things right in the future.

PREPARED STATEMENT

If you need further information, I would—I saw those—I would suggest you contact the NRC, local NRC, on-site representative. They will be allowed to come and provide you maybe with an update of current activities. And I just think it is a shame that these people were not here to give some more different perspectives on it.

So I would be happy to answer any questions.

[The information follows:]

PREPARED STATEMENT OF WILLIAM L. BELKE

On behalf of the Senate's Energy and Water Subcommittee, I have been requested to provide written testimony regarding my observations and experiences during my involvement with the proposed high-level waste repository at Yucca Mountain. A copy of my professional qualifications are attached.

I plan to address primarily, the activities I was associated with up until my retirement in January 2002. Should this subcommittee seek updates of current activi-

ties from a regulatory aspect, I recommend contacting the appropriate local NRC Las Vegas On-Site representative(s) if NRC management permits them to be interviewed. The activities described below have been documented and should be a matter of public record. I am retired and have no grudges or bridges to burn and voluntarily wish to share my prior involvement with the Yucca Mountain Project from my perspective now, as a private citizen and resident of the State of Nevada.

From 1974–2002, I was employed by the U.S. Nuclear Regulatory Commission (NRC) in various functions pertaining to nuclear reactor inspections, quality assurance program reviews, research, and rule making. From 1987–2002, I was involved with the Yucca Mountain Project. From 1995–2002, I served as the Senior On-Site Licensing Representative in Las Vegas, NV. My primary functions were to observe and monitor ongoing quality assurance and engineering efforts conducted by the U.S. Department of Energy (DOE) and its contractors. The purpose of this monitoring was to gain confidence, that should DOE ever apply for a Construction Permit and ultimately a license, that sufficient activities had been conducted by DOE to demonstrate that an acceptable program is in place to protect the safety and health of the public for the citizens of Nevada. This includes developing a program to produce highly qualified data that will be defensible at any public adjudicary hearings.

Quality Assurance by definition, ". . . is all those planned and systematic actions necessary to provide adequate confidence that an item will perform satisfactory in service." Quality Assurance should be used as a valuable management tool to detect deficiencies, correct them to prevent recurrence, and thus, improve the overall integrity of the product or program. The Office of Civilian Radioactive Waste Management Quality Assurance Program Description and Requirements document is the top tier document reviewed and accepted by the NRC. It is an excellent document that incorporates the Code of Federal Regulations, National Standards, and NRC Regulatory guidance that DOE has committed to implement. Any entity can have the best Quality Assurance document plan in place, but if not implemented properly, the result is a breakdown of the program requirements. This has been demonstrated with several nuclear reactors resulting in reactor shutdowns and costly civil penalties and legal enforcement action by the NRC.

DOE at this time, is not a licensee and consequently, is not subject to NRC enforcement action and civil penalties. Presently, there is no high-level radioactive waste being stored at the site and no threat to the safety and health of the public. However, during the present site characterization phase, NRC by virtue of the Code of Regulations and the Nuclear Waste Policy Act, can observe and investigate DOE activities and provide input as to acceptability from a licensing perspective. Identified problems are documented and carried as "open items" until fully resolved.

Some examples of deficiencies/shortcomings that I have either witnessed or uncovered during my 15-year association with the Yucca Mountain Project are listed below. These deficiencies and others have also been documented in the U.S. NRC's On-Site Representative's bi-monthly report to NRC management (and distributed to affected Yucca Mountain participants) for appropriate management action as deemed necessary.

—Geological core in the late 1980's was determined to be unusable because of the lack of traceability/identification. The cost of this mishap exceeded a million dollars.

—Numerous errors in the design process necessitated initiating a 2-year corrective action program to correct and revise the design process.

—Software, modeling, computer program errors detected resulted in a multi-year corrective action program.

—Numerous and repetitive supplier deficiencies resulted in a project-wide review of all data to determine whether this was of sufficient pedigree to be used and entered into the database for potential site characterization and ultimate license application.

—Numerous and repetitive errors in scientific notebook entries resulted in a review of all project scientific notebooks and personnel training.

—Deficiencies were not being closed in a timely manner and were remained open for 2 to 3 to 4 years.

—Erroneous or questionable calculations found in final technical reports necessitated a multi-year corrective action program.

—Instances that certain personnel in technical positions did not appear to possess appropriate qualifications/expertise.

—Examples of NRC not always being told the total truth. There was an instance whereby I was admonished by NRC management and threatened with disciplinary action after two independent investigations determined I was totally innocent and that a DOE employee had not revealed the true story!!

Efforts have been attempted to determine why deficiencies such as noted above repeatedly occur. In the Part 63 of Title 10 of the Federal Code of Regulations, it is stated, "The QA staff of DOE and their contractors have been successful in identifying the QA program deficiencies in the various participants' programs and, in many cases, high-lighting the repetition of similar deficiencies. In the past, inadequate corrective action was taken, and the DOE organizations responsible for correcting deficiencies were not held accountable." As stated above, the problem is IMPLEMENTATION (emphasis added). In my 35-plus years involved in the field of quality assurance activities, I have never worked with such a highly qualified dedicated number of DOE contractors, employed to provide technical and quality assurance oversight to the Yucca Mountain Project to determine whether the quality assurance program requirements are being effectively implemented.

From my perspective in the involvement of the Yucca Mountain Project, I have observed repetitive recurrences of deficiencies with a questionable record of improvement. In summary, I conclude and/or offer the following suggestions that may improve or enhance the Yucca Mountain Project activities.

—People should be held accountable for the activities they are performing. Too often schedules are met and the net result is "Trash on time" with no penalties.

—Recent DOE management has stated in a March 24, 2003, letter to its employees in part, that, ". . . it is a commitment to admit imperfections so that high quality work can be achieved. As individuals, it is essential that we feel compelled not only to celebrate successes, but also reveal mistakes and issues in our work when they occur. The NRC needs to know, that we can be trusted to do the job correctly, to admit when there are problems and demonstrate our commitment to resolve the issues." I find this to be a paradox in light of recent articles reported in the media where employees surfaced problems and were admonished. This attitude causes a "chilling effect" and must be changed to improve the Yucca Mountain project, not dampen it. Personnel should not have fear of retaliation when they find a deficiency.

—NRC management should be more proactive and pay more attention to deficiencies as documented in the NRC On-Site Representative's bi-monthly report and also discussed at the weekly meetings between the NRC ON-Site Representatives and NRC management. As documented in the bi-monthly reports, many deficiencies are carried as open items for extended periods without any support from NRC management to initiate closure or until an outside unit (i.e., State of Nevada) writes a letter to the NRC Commissioners requesting action for closure.

—NRC upper tier management should consider action to have the NRC Regional Office to participate and be involved in providing a more structured inspection approach for Yucca Mountain. The NRC Regional Office personnel are specifically trained and qualified in inspection techniques as opposed the NRC Washington Headquarters personnel having the necessary expertise to review and evaluate the scientific aspects of site characterization.

—Reported allegations should be given more attention by both the NRC and DOE and taken more seriously for the purpose of improving the Yucca Mountain Project.

Briefly, these are my observations and insights during my employment in the Yucca Mountain Project and I will try to answer any questions this subcommittee may have. As stated above, there is at present, no radioactive waste being stored at Yucca Mountain and no danger to the health and safety of the public. However, at this time, DOE needs to provide confidence not only to the NRC but all affected units, that the little things can be done correctly and down the road, the big things will be done correctly. Again, for more accurate insight to current Yucca Mountain Project statue, I would recommend contacting appropriate NRC and DOE involved individuals.

Senator REID. We will proceed with some questions.

Now, as I understand, what you have told us is that if you have a game plan, to make it effective, you have to work the game plan. You just——

Mr. BELKE. Absolutely.

Senator REID [continuing]. Cannot have it on paper. I mean, you can have the greatest game plan that a coach puts forward in a championship game, but if his team does not execute that playbook, so to speak, it does not work——

Mr. BELKE. Absolutely.

Senator REID [continuing]. No matter how ingenious that playbook may have been. Is that not right?

Mr. BELKE. Yes.

Senator REID. And so what you have told us, in layman's terms, is that there is a good playbook out there, but it just needs to be implemented properly. Is that what you have said?

Mr. BELKE. Yes, sir.

Senator REID. And I am terribly disappointed. You know, there is a pattern here that is developed—"Take one for the team," "Suck it up"—as if we are dealing with something that is unimportant. You know, this is not building a freeway. This is building a nuclear repository that is supposed to be good for thousands of years. And it would seem to me that everyone would benefit with openness. But that has not been the story.

Dr. MacFarlane, there appears to be a persistent problem with political pressure affecting the work of the technical scientific staff at the project. Recent news reports focus primarily on problems with retaliation against quality assurance engineers and staff. It is my understanding that you have heard from scientists who have been pressured in their work. Is that true?

Dr. MACFARLANE. Yes, that is true.

Senator REID. Tell us a little bit about that.

Dr. MACFARLANE. It has to do with the chlorine-36 data. Are you familiar with that?

Senator REID. With what?

Dr. MACFARLANE. The chlorine-36 data. Are you familiar with that issue?

Senator REID. It is the water stuff?

Dr. MACFARLANE. It has to do with the unsaturated zone, the——

Senator REID. I was hoping there was not a follow-up question. I may have had to answer it.

Dr. MACFARLANE. Let me give you a little background. The area under study that we are talking about is the region between the surface—you know, the Yucca Mountain surface, earth's surface—and the water table. That is what they call "the unsaturated zone." And the question was, How quickly is water transported——

Senator REID. Yes.

Dr. MACFARLANE [continuing]. From the surface down to the repository? So that is 1,000 feet. And it used to be thought that it was transported really slowly and so it would not be an issue. And then, in the 1990's, there were some scientists who did some collection of data and found—there was this one isotope called chlorine-36, and they found high amounts of it associated with fractures at the repository, you know, in the 5-mile-long—or 5-kilometer—no, 5-mile-long access tunnel. And chlorine-36 is not naturally occurring in large amounts.

Senator REID. I see.

Dr. MACFARLANE. It comes from nuclear weapons—above-ground nuclear-weapons tests. So it was clear that it was transported by rain and snow precipitation down that thousand feet in 50 years or less. Okay? Because that is when the nuclear-weapons tests were. So that meant there was fast transport at Yucca Mountain,

fast water transport. And this was a problem for the Department of Energy in saying that this site was good. Okay?

Now——

Senator ENSIGN. Will you just clear up—excuse me for interrupting——

Dr. MACFARLANE. Yes, go ahead.

Senator REID. Please. No, please proceed.

Senator ENSIGN [continuing]. Will you clarify why it is important whether there is water present in the repository?

Dr. MACFARLANE. Sure. Excellent question.

It is important because the assumption was that not much water is going to get down and attack the canister. And water is the enemy of these canisters, because the idea is that it is supposed to be this dry repository where water will not rust the canisters, essentially. And it turns out that that is—it is a lot more complicated than originally thought. That clarify it?

Senator REID. Yup.

Dr. MACFARLANE. Yup?

So this data, my understanding of it is that it was well done, well collected, well analyzed, published in the peer-reviewed literature, accepted by the hydrologic community as reasonable, but the Department of Energy did not like it. They did not like the results, because the results meant the site was a lot more complicated than they had originally planned.

So they have been redoing this work. And in redoing it, and in their first analysis of the quality of this work, some of the scientists who originally collected this data sort of took a bashing.

Now, I cannot tell you details, because I do not know——

Senator REID. Well, the problem that we have, Dr. MacFarlane, with this, though, is that these scientists are most, most unlikely to speak out——

Dr. MACFARLANE. They are.

Senator REID [continuing]. For fear——

Dr. MACFARLANE. And I do not want to identify them.

Senator REID [continuing]. For fear that they will never get another grant.

Dr. MACFARLANE. Exactly. And I do not want to identify them, because—for the same reasons.

Senator REID. So we have danced this tune before.

Dr. MACFARLANE. Right.

Senator REID. Ms. Nazzaro, one of the main issues raised by so-called "insiders" at the project is the emphasis on adhering to the program time line over ensuring quality engineering and science. It is a problem. Push. Keep pushing. We have heard, in various ways, all the witnesses talk about this. The General Accounting Office's primary conclusion at this point would appear to support this claim that there has been emphasis on pushing the program time line rather than looking at quality. Have you found evidence that supports this, in your investigation?

Ms. NAZZARO. Well, while—as I stated, we are in the preliminary stages of this particular investigation. We do have some indications that that may be true. You have, certainly, recurring problems, and yet the time lines have not changed.

Another issue that is rather curious is that, as you know, in fiscal year 2003, for this particular project, DOE's budget was cut $130 million. Well, what was that money going to be spent on? You know, was this excess funds that they had available? You would think if you have less money, there is something that is not being done, and that is going to affect your ultimate time line. Our concern is are there quality assurance things that are not being done and what is pushing it is the time line rather than the quality of the project? So this is something we will be following up on in the next few months.

Senator REID. One of the things that was interesting in your testimony is that there has been a pattern of problems with quality assurance with this project.

Ms. NAZZARO. Right.

Senator REID. And the other thing that I think I heard you say is that this is not through all Federal Government that you have these problems. I mean, there may be—I mean, my point is, for long periods of time with Department of Energy and Yucca Mountain, it appears to be a pattern of not dealing with the problems that occur. And my point I want to make is, this is not happening through all areas of Government. It is unique to DOE. Is that as extensive as it has been?

Ms. NAZZARO. I guess it would be hard to say that it does not happen at all——

Senator REID. No, I——

Ms. NAZZARO [continuing]. For the rest of the Federal Government——

Senator REID [continuing]. No, I recognize that——

Ms. NAZZARO [continuing]. Because, I mean, there certainly are recurring problems throughout the Federal Government that we see, you know——

Senator REID. That is part of your responsibility——

Ms. NAZZARO [continuing]. In the course of our audit role, but——

Senator REID [continuing]. Is to look into that.

Ms. NAZZARO [continuing]. But we certainly do see recurring problems at DOE in a number of areas. I mean, some of the areas that we highlight is their high-risk area, as far as contract management, that this is a pervasive problem.

I think where we are going, though, in the near future with our work, is to try to identify are there any root causes for these—you know, that we see these recurring problems, DOE does not seem to be able to correct them, and——

Senator REID. And the answer is——

Ms. NAZZARO [continuing]. We need to really——

Senator REID [continuing]. The question is why.

Ms. NAZZARO [continuing]. What we really need to get at is why. Now, there are some problems that are pervasive across the complex that we are beginning to see some indications that Yucca Mountain is no different than the rest of the Department of Energy. And certainly one of the things that was developed, you raised, and Dr. MacFarlane, is the accountability issue, and that has been a pervasive problem throughout DOE as far as the accountability of contractors. Another——

Senator REID. Yes, the—I want to make sure that I have stressed this point, and I want to phrase the question differently than I did before, but——

Ms. NAZZARO. Okay.

Senator REID [continuing]. Is not it unusual that you would have these recurring problems over such an extensive period of time with a Government agency? This is a Cabinet-level agency.

Ms. NAZZARO. Yes. Well, I would say, certainly, through the audit work that we have done, we do see corrective actions. I mean, once a problem has been identified, we do see corrective actions. Here, you have a situation where after 20 years you are still seeing the same problem. As I highlighted, you know, in 2001, we are seeing the same problems with software verification that you saw in 1998. You know——

Senator REID. Thank you.

Ms. NAZZARO [continuing]. You would think by now there would be some corrective actions taken, that you would not see that kind of a problem.

Senator REID. Senator Ensign?

Senator ENSIGN. Thank you, Mr. Chairman.

Back in Washington, DC, when we meet with people about some of the things that we are talking about today and some of the Yucca Mountain scientific reports, a lot of it is written off as, "Well, that is just the Nevada folks," you know, "being biased against the project and not wanting nuclear waste to come to their State, and they are just politically posturing."

I want to get something on the record from the witnesses here today. Question one is, Are you for or against nuclear power? And question two is, Are you for or against the nuclear repository at Yucca Mountain?

Mr. Belke.

Mr. BELKE. I think nuclear power is a good, viable source of energy. As a Government employee, I think, the high-level waste site, I was to be neutral. My personal opinion is that I think burying the waste out at Yucca Mountain is not the best of ideas. Why I say that is a little over 100 years ago, we did not have a light bulb. And you can see how much technology has evolved. I think we could store this at the site in these canisters, which are accepted by NRC. They are approved. More so, you could put them in a concrete bunker and monitor from the sites. The nuclear power sites are all investigated by NRC, seismic and flooding and tornados and that jazz. So it would cut the costs down. And I think, in the future, that they would develop a technology to use this again for nuclear power.

Senator ENSIGN. For those skeptics out there, though, as far as your personal beliefs, you are pro-nuclear power——

Mr. BELKE. Yes.

Senator ENSIGN [continuing]. And you think that we should be able to deal with the waste. You are just concerned that Yucca Mountain needs to be built the right ways if we are going to build it—is that correct?

Mr. BELKE. It has got to be built safely, yes.

Senator ENSIGN. Okay.

Dr. MacFarlane, same questions. Are you pro or against nuclear power? And do you have any bias against the actual site, aside from some of the problems that we have heard? "If these problems can be cleared up, are you against the site?" I guess is the best way to say it.

Dr. MACFARLANE. Okay. The first question, on nuclear power, I am not against nuclear power. It is a viable source of energy. As long as the problems are solved, and one of the problems is nuclear waste.

Second question, nuclear waste in Yucca Mountain, I am not, a priori, against Yucca Mountain. It may be an okay site. I think that we are very far from saying that it is an okay site, though.

I will go on the record as saying, though, I do think some kind of geologic repository is needed. It is not clear to me that Yucca Mountain is the right location.

Senator ENSIGN. Okay, but you do not come in with a prejudice against Yucca Mountain.

Dr. MACFARLANE. Nope.

Senator ENSIGN. Thank you.

Ms. Nazzaro, obviously, you answer to the Congress. GAO is a reporting arm that answers to the Congress. The people that are doing this investigation, are they on the pro-Yucca Mountain side, on the anti-Yucca-Mountain side or——

Ms. NAZZARO. To answer that, I think you have to go back to some of the comments that Senator Reid made in my introductory remarks. GAO is certainly on record as being an accountable agency, one with integrity and a lot of reliability behind the data that they present. And we go through stringent review processes, not only of the products, but also of the individuals that do the work, to make sure that we do not bring any biases toward the work. So, I mean, we have certainly reported, similar to, as Dr. MacFarlane says, that nuclear energy is a viable source of energy.

And as far as Yucca Mountain, I mean, we do have to deal with nuclear waste somehow. So, I mean, we are not saying that Yucca Mountain is a bad idea. In fact, we have not said that the science is bad. What the problem is, is that they have not been able to prove that the assumptions that they are making are the right assumptions.

Senator ENSIGN. Well, I thank each of you. I think that the reason it was important to get that on the record is, something can look incredibly bad or incredibly good, depending on bias. And what I wanted to establish is that we do not have anybody here who is testifying today—let us say, that is from an environmental group that would be totally anti-nuclear power. We have unbiased witnesses who are pointing out some serious discrepancies. There are some serious quality assurance problems at the Yucca Mountain Project, and it is important that the public understand this. And not just the public in Nevada, but the public in America.

Cost estimates are, according to the General Accounting Office, as high as $58 billion by the time that Yucca Mountain is supposedly complete. And so we are talking health and safety. We are talking a lot of money.

The majority of us here in Nevada would love to see nuclear waste never come here. But if it is going to come here, we want

to make sure that the DOE is conducting themselves in a proper manner. The DOE should not be afraid of light shining in on the Yucca Mountain process if they are doing it right.

We have a lot of good people working on the Yucca project. I have met a lot of these scientists, a lot of good people—who truly believe that they are trying to do the right thing. And unfortunately, when negative results come out and they try to do the right thing, they are shut down, they are intimidated, they are fired.

And that is why so many of us have such a huge problem with the way that DOE is acting. As Senator Reid talked about earlier, there is something deep in the bowels of the Department of Energy that just says, "We do not care what information is being shown. We are going forward with this project regardless of what is shown." For example, the DOE finds the water problem, and decides, "Oh, that doesn't count."

If you study the history of Yucca Mountain the repository was to be, as you said, Dr. MacFarlane, a geologic repository. This is no longer a geologic repository; this is a man-made repository. It was supposed to be the earth which protected us from all this nasty stuff. Well, the earth cannot protect us because of all the faults with Yucca Mountain.

So we appreciate your being here. I will have some more questions, but I will turn it over to Senator Reid so we can go back and forth.

Senator REID. John, that was extremely good. Thank you very much.

Mr. Belke, we have stated that we appreciate your being here today. It was not easy for you to be here. As you know, there are press reports released the last few days indicating that DOE was reluctant to encourage their employees and contract employees to testify at today's hearing. But as a former NRC Commission employee, why do you think the DOE's response was this? I still have trouble comprehending this. I cannot understand it.

Mr. BELKE. Senator, my immediate reaction when I read that in the paper was kind of twofold. I think it is atrocious. I respect your positions as Senators and I honor them. And if a Senator asked me to do something or respond, I think I am obligated to. And I feel DOE should be here, without question. And especially when you have a hand on the purse strings. I do not know why they are doing this. I really cannot answer that.

And the other thing, the twofold part, is, it was about 5 years ago, NRC had a study performed about their response to outreach of the public, and this was under Chairman Meserve, and he initiated a program, and it is even out here, of the local office, the NRC office goes out to the public every 3 or 4 months and hands out the literature and everything. DOE does likewise with tours of the site and everything. To me, they should be outreach to the public. We have this openness in Government. And I see this, this is just—I do not understand it. I really cannot answer the question. I am just shocked by it.

Senator REID. And for Dr. Chu to write a letter back to us saying, in effect, "Well, he would testify, but he does not work there anymore." I mean, it is like——

Mr. BELKE. I could pull the same tack, as retired in 2002. I mean, you know—Bob was very good, and so is Don, by the way. I enjoyed them.

Senator REID. Dr. MacFarlane, in your written testimony—and I have read every word of it, and I appreciate, all three of you, the depth of your testimony; it will be made part of the record—you state that Germany has scrapped its own "Yucca Mountain" program because of public concern about the safety of the site.

And then we have just heard Mr. Belke say what Senator Ensign and I have been saying for 3 years now, "Leave it where it is. Why do we have to deal with the transportation problem? Leave it where it is. You do not have to worry about terrorists trying to sabotage these trains or trucks traveling across the country. Leave it where it is, in these dry-cask storage containers."

Do you agree with Mr. Belke that dry-cask storage containment is a safe alternative? For 100 years, not forever.

Dr. MACFARLANE. Yes, for 100 years, the NRC has said that it is a safe alternative. I think, certainly, dry casks would have to be monitored. They may have to be changed out after 40 or 50 years. But I think it is quite a safe alternative. In fact, I think, in terms of the terrorism question, it would be much better if we would take most of the spent fuel out of the pools at nuclear power plants and put it into dry casks at the nuclear power plants.

Senator REID. No question about that.

Dr. MACFARLANE. So——

Senator REID. And is not it true that Germany has gone to hardened dry-cask storage at the present time?

Dr. MACFARLANE. Yes, they actually have a couple of centralized facilities, storage facilities, where they move some of the spent fuel off site and store it.

Senator REID. You, Dr. MacFarlane, mention in your testimony about DOE's research being published gray literature. I had not heard that term before. Explain what this means, for those of us who are not scientists. And what does gray literature have to do coming up with a positive result?

Dr. MACFARLANE. What do you mean by a positive result?

Senator REID. Well, what I mean is a scientifically validated response.

Dr. MACFARLANE. Right. Most scientists would not consider gray literature to be scientifically valid.

Senator REID. And what is gray literature?

Dr. MACFARLANE. Gray literature is literature that is basically reports. People who have published reports, the Department of Energy reports, all of the Department of Energy reports are gray literature. Any contractors' reports are gray literature. These are pieces of scientific analysis that have not been offered to a scientific journal——

Senator REID. Dr. MacFarlane, let me interrupt and say this. That is part of the problem that some of us have, is that—you know, when I used to practice law, and you had a trial, you had to make very sure that your witness could not be impeached with cross-examination, that he used to work for the plaintiff or, you know, whatever it might be. And here is a situation where the bias is so obvious. These contractors who have jobs—when I say con-

tractors, I mean the corporation that has a contractor out there—those are huge bucks.

Dr. MACFARLANE. Yes.

Senator REID. And I have heard—I do not know if this is valid—but large amounts of money are paid to these people. One of these witnesses here is a man over 70 years old. So you can understand—he is 71 years old—you can understand why he is concerned about his job. He makes over $100,000 a year. Where is this man going to go, at 71, 72, 73 years old, to find another job? I mean, I think that we all, being understanding of human nature, no matter how much you want to do the right thing, and you need this job—I have also heard—this could be checked by others—that he lost a tremendous amount of money on the stock market, as a lot of people have done, and he is desperate to keep working at the—at his advanced age.

Now, if this person were testifying in a trial, his testimony would not be credible. And that is what gray literature is all about, is it not?

Dr. MACFARLANE. In——

Senator REID. I am not saying——

Dr. MACFARLANE [continuing]. A sense.

Senator REID [continuing]. I am not saying they are all lying or cheating. But if—you cannot have any confidence in what they are saying. It has not been peer reviewed.

Dr. MACFARLANE. Right. It has been peer reviewed, but it is an internal peer review. It is DOE reviewing itself. And that is——

Senator REID. But doesn't——

Dr. MACFARLANE [continuing]. You know, they have a lot of scientists there——

Senator REID [continuing]. Does that not answer——

Dr. MACFARLANE [continuing]. And that is okay.

Senator REID [continuing]. Though?

Dr. MACFARLANE. But in general, peer review, in the scientific community, the larger scientific community, works when somebody sends in an article to a journal, and an editor at that journal sends that article out to two or three individuals who may not know the person who wrote the piece, and then they say, "This is good work. This is bad work. These are the problems. Do it over. Revise it. Trash it. It is okay." And this is the kind of review that is not happening at DOE.

Senator REID. As I said before, this is not people out there trying to determine the best way to build a freeway across the deserts of Nevada. We are dealing with the most poisonous substance known to man: plutonium, nuclear waste. And it would seem to me that the Department of Energy would be well served to have what they are doing held up to the scrutiny of at least a congressional hearing. And I think that it is fair to say that Senator Ensign and I are going to return to Washington and do what we can to compel the testimony of these witnesses. This is not right, that a Government agency, Cabinet-level agency, can, in effect, just thumb their nose at a congressional committee. I do not think Senator Stevens, I do not think Senator Byrd, the chairman and ranking member of the full committee, are going to put up with this.

Senator Ensign.

Senator ENSIGN. Thank you.

I want to get back to this whole idea, Dr. MacFarlane, of a peer review. How would it be received in the scientific community—let us say, for a pharmaceutical company to develop a drug, to complete an in-house study which had really nice results about the drug's benefits, and to have some of their other scientists, within their company, do the only peer review. What would the FDA say in that case?

Dr. MACFARLANE. Well, I do not know about this FDA, but——

Senator ENSIGN. I guess we will not go there.

Dr. MACFARLANE. But the larger scientific community would say that is trash.

Senator ENSIGN. Yes.

Dr. MACFARLANE. And they would not believe that, of course.

Senator ENSIGN. I mean, it would be a joke.

Dr. MACFARLANE. Yes. Of course. It would be.

Senator ENSIGN. I do not know of any place in the scientific community where internal peer review is adequate, if you want your research accepted by the general scientific community. And as Senator Reid talked about, we are talking about nuclear waste that is going to be around for hundreds of thousands of years.

Dr. MACFARLANE. Yes.

Senator ENSIGN. So the more people that look at this information, in as objective a manner as possible, the better.

Dr. MACFARLANE. I agree completely.

Senator ENSIGN. It would seem to me that the purpose for external peer review is to make sure that there is not an agenda, that you are as objective as possible. No one is ever 100 percent objective. We know that. Everybody goes in with some kind of a bias. But you want objective people looking at the data to say, "Oh, there was a mistake made there, there was a procedure that was not good scientific procedure," or something along those lines. And it seems to me the Yucca Mountain Project has not been subject to nearly as much external peer review as should be.

Dr. MACFARLANE. I agree. I would say that, just for the record, the Department of Energy would probably argue that it is intensively peer reviewed. It has—you have the Nuclear Waste Technical Review Board, which—with members appointed by the President——

Senator ENSIGN. By the way, though, the Nuclear Waste Technical Review Board has said that the science is weak.

Dr. MACFARLANE. Yes, I agree.

Senator ENSIGN. Okay?

Dr. MACFARLANE. Yes.

Senator ENSIGN. I mean, so their peer review has said they have had weak science.

Dr. MACFARLANE. Yes, that is right. So they have not gotten a good peer review——

Senator ENSIGN. Yes.

Dr. MACFARLANE [continuing]. Even from the Nuclear Waste——

Senator ENSIGN. And——

Dr. MACFARLANE [continuing]. Technical Review Board.

Senator ENSIGN [continuing]. And the Nuclear Waste Technical Review Board is composed of scientists trying to come up with objective concerns.

Dr. MACFARLANE. Well, they are a——

Senator ENSIGN [continuing]. The best that they can.

Dr. MACFARLANE [continuing]. Very few—the point I would like to make is that they are—the Yucca Mountain Project, the science being done there, is incredibly complex. It encompasses many, many subdisciplines. And with the few members on the Nuclear Waste Technical Review Board and other peer-reviewed panels that DOE has gotten together, these people, although they may be eminent scientists and well qualified in their particular areas, they cannot be expected to understand and review the entire Yucca Mountain Project science. And so the whole project would be better served by going to those specific sub-communities and asking them to peer review particular pieces of science.

Senator ENSIGN. Well, Mr. Chairman, we have a lot of very talented scientists working on the Yucca Mountain project. We all know that. There are some just brilliant minds working out there, and there are some people who believe in the project who are trying to do the right thing. The unfortunate thing is that there is a culture at the DOE that says, "We are going to build this thing."

Secretary Abraham told me that Yucca Mountain is going to open by 2010. I think that there is no chance that it is going to open by 2010—so I have asked a lot of people who are associated with this project, "What do you think of that statement?" Recently I spoke to an expert who said, "Technically you could overcome a lot of the things if you put enough money into it, except for the problems associated with transportation." Well, that is a little bit of an issue, the issue of transportation.

So there are so many unanswered questions, and to have people going full steam ahead with this project is ridiculous. Scientists use double-blind studies so that you do not know what the result is going to be; you just let the facts prove out what is going to happen. There is no chance that this is anywhere close to a double-blind study. As a matter of fact, the DOE has blinders on, because they want to go forward to make sure the science shows what they want it to show.

It is a shame. It is too important a project for this kind of shoddy science to be going on. I hope that—with hearings like this, that we can shine some more light on what is going on at DOE and let the DOE know that we are not going to let them get away with shoddy science.

So I want to thank all three of you for having the courage to come today. We know that it is risky. There are chances of losing grants. Unfortunately, anytime you are a Government employee, you always take a risk by doing these things. And, sir, enjoy your retirement, and thanks for your service.

Senator REID. John, I have just a few more questions.

Ms. Nazzaro, in a 1988 report, you found the culture within the Yucca Mountain Project did not promote safety and a safety-conscious work environment. In your preliminary work, have you found that culture persists today? And would you say that the failure of two witnesses to appear today is a reflection of that culture?

Ms. NAZZARO. Our preliminary work certainly shows that there is a problem, as far as culture and attitude. And I think, again, it was Mr. Belke who raised the issue, as far as the culture and attitude.

The issue is not whether they have a plan in place or not. Consistently, we see DOE having a lot of plans, a lot of rhetoric. But what we do not see is implementation of those plans. And I think that goes back to, certainly, the culture and the attitude, and it is probably reflective today as to why we do not see certain witnesses here.

Senator REID. In your December 2001 report, the General Accounting Office found that there were 293 key technical issues at Yucca Mountain that had not been resolved. And how has this progressed, as far as you know? How many DOE—how many of these specialized reports have been completed since then?

Ms. NAZZARO. Yes, there were 293 key technical issues. As of March 2003, 77 of those have been closed. Now, none are classified as open. The remainder are classified as "closed, pending," meaning that there is a strategy, what they are calling a "path forward," that they have identified what the problem was and they have developed a strategy. Again, we do not see implementation. NRC has not closed them. That there is a plan in place, and, again, we are waiting to see implementation.

Senator REID. Dr. MacFarlane, when you talked about the chlorine-36 studies, I want you to tell me why you believe DOE refuses to accept this result and continues to conduct experiments to disprove what appears to a lot of us to be pretty good science.

Dr. MACFARLANE. Well, I suppose if I were DOE, and I were tasked with what I was tasked, I would be alarmed by the results of the original chlorine-36 study, and I would probably want to check it. So that is reasonable, I guess, even though it appears, on the surface, that the science, the original science, was good.

The problem comes with how they have checked it. They have done a number of studies, and I will just give you one example.

The original study found the high concentrations of chlorine-36 associated with fractures in the rock. What the DOE did in redoing one of the studies was, instead of sampling again near those fractures in the exploratory studies facility, they just drew up a grid and sampled along the grid. Now, the grid missed the fractures. So, guess what? No high chlorine-36 signal. Problem solved. So that is bad science.

Senator REID. Mr. Belke, in your written testimony, you stated, quote, erroneous or questionable calculations found in the final technical report necessitated a multi-year corrective-action program.

Would you, as my final question to the panel today, expand on this statement and include how it was corrected and what changes needed to be made and how it affected the integrity of the project as a whole?

Mr. BELKE. That was ongoing as I was retired. It is probably a 2-some-odd-year program. But we would meet with DOE and the contractors, probably on a weekly basis, about that problem, specifically, and they would show us that they revised the review proc-

ess, the procedures, to make it better. I do not know if that has been completed yet.

As far as the effect on the project, the way these calculational errors were found is our technical people back East looked at a random number of reports, and they basically found missing—erroneous calculations, missing references, things like that. And it affects the overall integrity of the report, itself.

Whether or not that is going to have an outcome on the project, you have got to—for licensing and/or construction, you have got to submit data of a very high pedigree. DOE has to make that case. I do not know if that data—I mean, they went back and corrected it—I do not know the ultimate outcome of that.

Senator REID. It seems to me when you are doing something scientific, and certainly something scientific as complex as this, and you miscalculate the beginning, it is hard to catch up. It slows down what you originally started to do. Well——

Mr. BELKE. Yes. My contacts—and I do not know this for sure. That is why I think it would be very valuable to have NRC-ongoing people here also. They could tell you that. But what I hear—and I cannot prove this—I hear that—my contacts say they are not very happy with the program at this time. It is not as effective as it should be. It is still ongoing.

Senator REID. Well, let me say this. I am not very happy with the program. And I want all—as Senator Ensign said, we appreciate your educating us here today. And I think that John's initial question really said a lot. We do not have here a bunch of people who are out to prove that nuclear power is bad, that Yucca Mountain was bad to begin with. We have people here who have been involved in science and the project for many years.

The panel here is about as unbiased as anyone I could find. And the two vacant seats would only have complemented the fact that we were trying to get people who had no prejudice against the project.

We are talking—I repeat, for the third time today—about a multi-billion-dollar project. Senator Ensign said it could go as high as $58 billion. There are some who say it will top $100 billion before this is over. $100 billion. You know, we are talking about building railroads and all kinds of things like that.

So we are—we have not stopped. And again, I appreciate a representative from the County Commission being here. I appreciate, more than words can say, that the Attorney General, himself, has spent time here this afternoon.

We, in Nevada, believe that this is a wrong thing for Nevada. But we also believe it is a wrong thing for the country. And we hope that good sense will prevail, and there will come a time in this country where the Department of Energy and the Administration, whoever is in power, will say, "You know, we have wasted a lot of money. Let us just leave it where it is until we come up with a better answer."

And we are going to continue working on this as a team, the State of Nevada team, to do what we can to exert whatever influence we can to complement the very, very important testimony that we have heard here today.

ADDITIONAL MATERIAL SUBMITTED SUBSEQUENT TO CLOSE OF HEARING

[CLERK'S NOTE.—The following letter was written to the Secretary of Energy to request written responses from the Department to the specific issues and questions resulting from the May 28, 2003 Yucca Mountain field hearing held in Las Vegas, NV.]

LETTER FROM SENATOR PETE V. DOMENICI

U.S. SENATE,
Washington, DC, June 18, 2003.

The Honorable SPENCER ABRAHAM,
Secretary, U.S. Department of Energy, 1000 Independence Ave., SW, Washington, DC 20585.

DEAR MR. SECRETARY, The Senate Appropriations Subcommittee on Energy and Water Development's May 28 hearing in Las Vegas, Nevada, addressed the Department of Energy's management of the Yucca Mountain Repository. At that hearing, Senators Reid and Ensign joined three testifying witnesses in suggesting certain concerns pertaining to the Yucca Site's operation. Chief among the issues raised at the hearing were the Department's alleged silencing of employees wishing to speak-out on quality assurance matters and the alleged discounting of credible health and safety questions in the interest of maintaining project schedule.

Because the Subcommittee has a great interest in the consolidation and permanent disposition of waste currently located at approximately 131 sites in 39 states around the country, I am writing to request that the Department respond specifically and in writing to the issues raised at the hearing. Such a response should address the particular concerns noted in the above paragraph, as well as those similar to them appearing in the hearing record. The responding statement should also be prepared with the knowledge that it will be included in the complete hearing record.

Sincerely,

PETE V. DOMENICI,
Chairman.

RESPONSE FROM MARGARET S.Y. CHU

DEPARTMENT OF ENERGY,
Washington, DC, July 8, 2003.

The Honorable PETE V. DOMENICI,
Chairman, Subcommittee on Energy and Water Development, Committee on Appropriations, United States Senate, Washington, DC 20510.

DEAR MR. CHAIRMAN, This is in response to your June 18, 2003, letter to the Secretary requesting that the Department of Energy respond to issues raised at the Senate Appropriations Subcommittee on Energy and Water Development field hearing that was held on May 28, 2003, in Las Vegas, Nevada. I appreciate the opportunity to provide you with more complete information and to set the record straight.

Three witnesses testified at the hearing: Robin Nazzaro of the General Accounting Office; Dr. Allison Macfarlane of the Security Studies Program of MIT; and William Belke, a retired Nuclear Regulatory Commission On-Site Representative. Two Senators, Senators Reid and Ensign, were present for the hearing. No member of the Department of Energy management either in Washington or Las Vegas was invited to testify.

ACCUSATION OF WITNESS INTIMIDATION

I have been particularly concerned about the serious allegations of witness intimidation that were made at the hearing. I have looked into those accusations, and I am confident that they are entirely unfounded. I am not aware of nor would I tolerate any effort by the Department or its contractors to intimidate DOE or contractor employees from testifying or otherwise coming forward to share their views.

Here is my understanding of what happened. I am informed that Senate staff approached Mr. Robert Clark, an employee of the Office of Civilian Radioactive Waste Management (OCRWM) Office of National Transportation, and Mr. Donald Harris, an employee of Navarro Research and Engineering, a Yucca Mountain Project contractor, to urge them to testify, and that one of the Nevada Senators also spoke to

each of them about testifying at the field hearing. A few days before the hearing, Senator Reid also wrote me a letter requesting that I "compel" the testimony of Mr. Clark, and that I "encourage" the testimony of Mr. Harris.

I thought it was important that the Department and Navarro make clear to Mr. Clark and Mr. Harris, respectively, that DOE would not pressure them one way or the other and that whether they testified in this circumstance was their personal decision to make.

Accordingly, in the week before the hearing, Mr. Joe Ziegler, Acting Director of the Office of License Application and Strategy, spoke to Mr. Clark about the matter and assured him that the decision on whether to appear at the hearing was entirely his. Mr. Bob Hasson, Navarro Program Manager, sent a memorandum to Navarro employees, including Mr. Harris, conveying a similar message prior to the hearing. I am enclosing a copy of that memorandum. I likewise responded to Senator Reid on May 23, 2003, informing him that this was the Department's view. A copy of the correspondence is enclosed. Both Mr. Clark and Mr. Harris chose not to testify.

At the hearing, it was alleged that the Department had "instructed" Mr. Clark and Mr. Harris not to appear before the Subcommittee. As you can see, there is no truth to that allegation at all. To the contrary, DOE and contractor management took action to assure these employees that the decision on whether to appear at the hearing was entirely theirs, and they made their own decision on the matter.

At the hearing, Senator Reid raised the possibility that "intimidation at the project" could result in employees feeling "fear that [they] and [their] families will be made to suffer for simply telling the truth." This suggestion is not an accurate representation of the environment at the Yucca Mountain Project. At the Federal, Departmental, and Program level, policies exist to encourage employees to voice concerns, and significant protections are in place to shield DOE and contractor employees who raise health and safety concerns from retaliation or reprisal. I am continuing my efforts to ensure that everyone understands that we take seriously any allegations of employee intimidation. Following the hearing, my deputy, John Arthur, sent an e-mail message to all Yucca Mountain Project employees to reaffirm our long-standing commitment. In that e-mail, he stated, "I am committed to seeing to it that all of us know and believe we work in an open environment where people are free to raise concerns without fear of retaliation."

ALLEGATIONS THAT DOE HAS DISCOUNTED CREDIBLE HEALTH AND SAFETY QUESTIONS IN THE INTEREST OF MAINTAINING SCHEDULE

Senator Reid stated at the hearing that "DOE is intent on pushing the project forward regardless of the risk it poses to the health and safety of Nevadans and the rest of the country." Senator Ensign stated that, "There are real concerns that the Department of Energy's fierce commitment to its schedule . . . has allowed an unrealistic timeline to take precedence over quality control." Neither the Senators nor the three witnesses participating in the hearing presented evidence that substantiated these allegations.

It is true that the Department is working very hard to submit the license application for a repository at Yucca Mountain to the Nuclear Regulatory Commission (NRC) by the end of next year. In striving to meet this objective, however, there has been no compromise in our commitment to quality work and protection of health and safety. OCRWM is committed to submitting a license application that complies with 10 Code of Federal Regulations Part 63 and in which data, software, and models used in our safety analyses meet or exceed applicable quality assurance requirements. During the licensing proceeding, the license application will be subject to intense scrutiny from NRC staff, the State of Nevada, and other parties, and ultimately the NRC Commissioners must judge its adequacy.

CONCERNS ON QUALITY ASSURANCE (QA) PROGRAM

At the field hearing, Ms. Nazzaro and Mr. Belke expressed their views on QA. Efforts to improve quality assurance have been a primary focus of our transition from site characterization to preparation for licensing, and the Program has been open about quality assurance problems and the work needed to correct them. While Ms. Nazzaro and Mr. Belke did discuss issues that are very important to the Program, neither revealed any new facts on this topic. Both witnesses' view of the program is limited and they have not had the benefit of seeing all of the changes we have been working hard to implement over the past year or so and continue to make. We agree that improving QA compliance is critical to our efforts. For over a year, we have focused on improving individual accountability for work and strengthening line management ownership of procedures so that quality is reflected in our work products. I described our ongoing efforts in a May 29, 2003, letter to

the NRC (which is provided as an enclosure). Over the coming months and years, the GAO will have the opportunity to observe and assess our improvements. Of course, the success of our efforts in this regard ultimately will be judged by the NRC in its assessment of our license application.

SCIENTIFIC INTEGRITY

The testimony of Dr. Allison Macfarlane also calls for some comment. At the hearing, Dr. Macfarlane indicated her dissatisfaction with a wide range of political and procedural determinations underlying the current repository program. She considers Congress's direction for DOE to characterize the Yucca Mountain site "a mistake," takes issue with procedures put in place to ensure that only qualified data are used, and specifically questions the objectivity of the Nuclear Waste Technical Review Board and the National Academy of Sciences. Perhaps most important, Dr. Macfarlane asserted that "[t]he science done in support of siting a repository at Yucca mountain has clearly been influenced by politics." However, she produced no actual evidence for that sound-bite allegation.

Dr. Macfarlane does not claim that any scientist doing work on Yucca Mountain has in fact sought to tailor his or her scientific efforts to reach a particular result or that any DOE manager has in fact sought to persuade any scientist to do so. Rather, her "science influenced by politics" accusation rests entirely on a word game built around the deliberately idiosyncratic misuses of the words "politics" and "political." Specifically, the entire foundation for the accusation is Dr. Macfarlane's observation in her testimony that Yucca Mountain science "is requested by and evaluated by managers at DOE who must fulfill legal and regulatory obligations under the Nuclear Waste Policy Act and Nuclear Regulatory Commission and the Environmental Protection Agency rules." This, she argues, means that "not only are the managers at DOE seeking particular knowledge, but the scientists themselves are required to gather data in a way that fulfills DOE's *political* [read: statutory and regulatory] obligations" (emphasis added). In other words, because the science at Yucca Mountain is directed to assisting DOE in making a determination pursuant to criteria set by law, the science is "influenced by politics."

All Dr. Macfarlane is really saying is that any time any scientist is asked to produce scientific work for the government, or for that matter anyone else, that will be used to help evaluate a particular project or approach that must meet legal or regulatory requirements, the work should be dismissed because it is "influenced by politics." That assertion answers itself.

The scientific reputations of the DOE National Laboratories and the U.S. Geological Survey (USGS) and their scientific staff are impeccable. Dr. Macfarlane's innuendo, that because these scientists were doing scientific work on a project that must meet particular statutory and regulatory requirements their work has therefore been tainted by political considerations, is entirely unfounded.

One example discussed by Dr. Macfarlane to support her allegation was chlorine–36 studies. She stated that DOE "did not like the results" of the original study related to the possible existence of fast paths for water flow inside the mountain and therefore had them redone. There are numerous problems with Dr. Macfarlane's account of this matter, however.

First, Dr. Macfarlane fails to take note of the fact that this study whose results DOE supposedly "did not like" was produced by DOE science. Yet this fact, it seems to me, undermines the core of Dr. Macfarlane's suggestion that the Yucca Mountain Project's science is result-oriented, since it demonstrates that our science is directed not to finding "results we like" but rather to going wherever science leads us.

Dr. Macfarlane also fails to take note of the fact that, far from ignoring this study's results, DOE incorporated them (and not those of the later studies of which Dr. Macfarlane complains) into its calculations for the Site Recommendation models. These models provide the key scientific information underpinning the Secretary's conclusion regarding the suitability of Yucca Mountain for the siting of a repository. The use of the original study's results demonstrates our commitment to making regulatory judgments based on the best available data, regardless of whether that information is favorable or unfavorable to Yucca Mountain's suitability.

Further, based on models and data incorporating the results of the original study, DOE concluded that Yucca Mountain is in fact a suitable site for a repository because a repository there is likely to meet the stringent health and safety standards that EPA and the NRC have established. Thus, as it turns out, the original study's results do not undermine the proposition that a repository can safely be sited at Yucca Mountain—a third key point of which Dr. Macfarlane also fails to make any mention.

Finally, Dr. Macfarlane suggests that there is something suspicious about the fact that DOE has continued to examine the results of this study. That is not suspicious. It is good scientific practice. We have also continued to examine the results of numerous other studies, as it is our responsibility to do, to make sure that the models and data underlying our conclusion that the repository can operate safely are well-founded and meet NRC data quality requirements.

I am confident in the quality and integrity of our scientific work, which project scientists and external peer reviewers have affirmed. It is unfortunate that none of these scientists or engineers was invited to testify on the topics discussed during the hearing. Had they been invited, I believe interested members of the public would have been given a more accurate view of the Project. The testimony of individuals with an understanding of the current status of DOE's actions to continue to improve our QA program also would have contributed to a more balanced understanding of this program. And, had testimony been sought from any of the DOE or contractor senior managers, we would have testified about our efforts to ensure our employees were not intimidated with regard to their personal decision on whether to testify at the hearing.

I hope that this information will assist the Subcommittee in understanding more fully some issues raised at the field hearing. Please let me know if I can provide any additional information or if you have any further questions.

Sincerely,

DR. MARGARET S.Y. CHU,
Director, Office of Civilian Radioactive Waste Management.

Enclosures.

MEMORANDUM FROM NAVARRO RESEARCH AND ENGINEERING, INC./NAVARRO QUALITY SERVICES (NQS)

TO: ALL NQS STAFF
FROM: Bob Hasson, Program Manager
DATE: May 23, 2003

As you know, I am in the process of meeting with each of you along with your manager. I have already met with several of you in the past few days and I will continue these meetings in the near term. These meetings are to determine what concerns or suggestions for improvement you may have. It is very important to me and our company to hear any concerns and address them appropriately. I have been trying very hard to create an environment where everyone understands that they are free to raise concerns without any fear of retaliation. I am committed to this and I have that as one of my highest management priorities. I am open to any suggestions for improving our environment and welcome any comments.

I also want to clarify that in a recent NQS all hands meeting I requested that you behave professionally in meetings and be factual when you speak. Also, I requested that when the client makes a decision and you have a professional difference of opinion, that you support the decision of the client. Clearly, if your concern is not just a difference in professional opinion, but constitutes a technical or safety concern, please bring it forward so your manager or I can address it. I requested that you raise any concerns and refrain from off-the-cuff remarks and unprofessional behavior. I have stated this several times whenever I've had the opportunity.

Lately, you have seen in the newspapers claims that some of our employees were retaliated against for participating in a surveillance that caused a stop work order on Bechtel SAIC, Company LLC (BSC). I can assure you that I have not retaliated or intended to retaliate against anyone. I responded to concerns based on BSC claims and through my investigation did not substantiate those claims. I believe the steps that I took show you that I will not take employment actions without closely investigating the matter. NQS management will not permit anyone to retaliate or harass any employee who raises concerns. As always, each one of us must do everything possible to avoid even the perception of a hostile working environment.

Additionally, as you may know, the Senators from Nevada will be conducting a field hearing on Yucca Mountain. Navarro Headquarters and NQS management takes no position on whether an NQS employee participates in the field hearing. Each of you should know that your decision to participate will not affect your employment status.

I know that each and every one of you is working very hard under these stressful conditions. I personally appreciate your dedication to your work.

As I stated earlier in this memo, and I can't stress this enough, it is important that you continue to raise concerns about any aspect of your work.

As always, my door is open to all the staff.

UNITED STATES SENATE,
COMMITTEE ON APPROPRIATIONS,
Washington, DC, May 22, 2003.

The Honorable MARGARET CHU,
Director, Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, DC 20585.

DEAR DR. CHU: I am writing in regard to a pending field hearing of the Senate Energy and Water Development Appropriations committee on the recently reported quality assurance problems of the Yucca Mountain Project.

The Subcommittee intends to accept testimony from two witnesses who are currently employed by the Department of Energy or as a contractor to the Department of Energy. Recent news articles about potential quality assurance problems indicate that Robert Clark, former Director of Quality Assurance for the Yucca Mountain Project, and Donald Harris, quality assurance auditor with Navarro Research and Engineering, Inc., have unique knowledge of these reported quality assurance deficiencies.

The Subcommittee does not intend to subpoena their testimony, but believes that they will provide important information regarding the reported quality assurance problems. I am writing to urge you to compel Robert Clark and to encourage Donald Harris to testify on May 28, 2003.

I expect that you will promptly inform the witnesses of their obligations to appear before the Subcommittee and appreciate your willingness to work with the Subcommittee to obtain important information regarding the status of the Yucca Mountain Project. If you believe these witnesses will not be able to testify or have any questions about this request, please contact me or have your staff contact Drew Willison.

Sincerely,

HARRY REID,
United States Senator.

DEPARTMENT OF ENERGY,
Washington, DC, May 23, 2003.

The Honorable HARRY REID,
Ranking Member, Subcommittee on Energy and Water Development, Committee on Appropriations, United States Senate, Washington, DC 20510–6025.

DEAR SENATOR REID: Your May 22, 2003, letter requested that I "compel" Robert Clark, and "encourage" Donald Harris, to appear and testify at your field hearing scheduled for May 28, 2003, in Las Vegas, Nevada. We have given no direction to Mr. Clark or Navarro, Mr. Harris's employer, regarding this hearing. As for Mr. Clark, the subject matter for which his testimony is sought is not within the scope of his current duties as an employee of the Department, and therefore I do not believe it would be appropriate for me to order his appearance. Similarly, as you know, Mr. Harris is an employee of a Departmental contractor rather than the Department, and we are not in a position to instruct or otherwise pressure him to testify at your hearing.

Sincerely,

DR. MARGARET S.Y. CHU,
Director, Office of Civilian Radioactive Waste Management.

DEPARTMENT OF ENERGY,
Washington, DC, May 29, 2003.

Mr. MARTIN J. VIRGILIO,
Director, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Two White Flint North, Rockville, MD 20852.

DEAR MR. VIRGILIO: I am submitting this letter in response to the request made during the April 30, 2003, U.S. Nuclear Regulatory Commission (NRC)/U.S. Department of Energy (DOE) Quarterly Management Meeting. The Office of Civilian Radioactive Waste Management (OCRWM) leadership team is pleased to provide details of the actions being taken to ensure that our license application meets NRC expectations for completeness, accuracy, and compliance with quality assurance requirements. My team and I strongly believe that the management improvements currently underway—in areas such as procedural compliance, corrective action programs, individual accountability, and safety conscious work environment—are means to that end.

I have recognized the need to change our focus and improve our processes to meet rigorous NRC licensing requirements. The elevation of the Project Manager position at the Office of Repository Development in Las Vegas to a Deputy Director position vests greater authority and accountability directly into this line organization. This change, along with a Program wide functional realignment and the implementation of our Management Improvement Initiatives, establishes the conditions in which our objectives can best be achieved. The Federal and contractor leadership team has shared our vision, expectations, and commitments with all employees to help us achieve the desired improvement.

LICENSE APPLICATION

OCRWM is committed to submitting a license application that complies with 10 Code of Federal Regulations Part 63 and in which data, software, and models used in our safety analyses meet or exceed applicable quality assurance requirements. To that end, my leadership team and I will continue to aggressively work to establish metrics and management processes to aid in accomplishing our goals.

The Office of Repository Development conducts Monthly Operating Reviews, in which progress is assessed and managers are held accountable for performance. The NRC onsite representatives observe these meetings. At these reviews, a progress assessment that encompasses the five major components of our pre-licensing technical work is used to describe performance:

—Key technical issue (KTI) agreement closure
—License application document production
—Preclosure safety assessment
—Total system performance assessment
—Design for license application.

Reporting the status and percentage complete allows each component to be assessed independently and forms an integrated picture of overall performance. This assessment methodology ensures that the rate of progress is measured against consistent indicators over time.

We are also tracking the current state of completion of data qualification, computer code qualification, and model validation. Progress in these areas is monitored and reported at the Monthly Operating Reviews, where management attention is focused on areas of concern. The enclosure to this letter provides an example of information prepared for the Monthly Operating Review, showing both percentage-complete status by component and the status of data qualification, computer code qualification, and model validation.

In addition to strengthening the management processes needed to assess status and focus on problems, we are improving the approach to completing the technical work called for in the KTI agreements. I believe that the commitments embodied in these agreements and further enhancements of the KTI analyses are keys to facilitating NRC review of our license application. For example, one enhancement under consideration is to group related agreement items, identify common threads and underlying questions, and develop integrated, in-depth responses to related issues. Such an approach should result in better products and accelerated resolution of KTI agreements. We will present our planned approach, showing the grouping of KTI agreements and the reschedule for submittal of agreement responses, to NRC by June 30, 2003.

PROCEDURAL COMPLIANCE

Procedural compliance is a critical element of our continued improvement process. We are working to strengthen line management ownership of procedures in the spirit of building quality in as opposed to inspecting it in. We are establishing performance indicators and trend reporting to support our improvement efforts. We are committed to responding to instances of non-compliance with timely and effective corrective action, and will evaluate the types and significance of violations and take actions to address recurring problems. We will have an effective trend report by September 30, 2003, that will allow us to monitor procedural compliance trends, identify causes of non-compliance, and take prompt corrective action as necessary.

We are currently streamlining the review and revision process for procedures through enhancements to the governing Administrative Procedure 5.1Q, Procedure Preparation, Review, and Approval. This will be completed and implemented by July 30, 2003. When this procedure has been updated, we will screen other procedures for needed improvements, starting with a prioritized mission-critical subset.

CORRECTIVE ACTION PROGRAM

We will have a single, improved Corrective Action Program implemented by September 30, 2003. The Corrective Action Program includes self-assessment and lessons-learned components as well as methods to identify and correct adverse conditions. Goals under this improved program will be to prepare and approve 90 percent of corrective actions within 30 days of initiation for deficiency reports (DRs) and corrective action reports (CARs); to complete the corrective actions for DRs in fewer than 60 days on average; and to complete the corrective actions for CARs in fewer than 100 days on average.

Based on ongoing tracking, there has been a decrease in the average age of open DRs and CARS. The monthly number of deficiency report closures has increased, and the numbers of DR and CAR weekly late actions has decreased.

SAFETY CONSCIOUS WORK ENVIRONMENT (SCWE)

Our goal and responsibility is to create an environment in which employees freely raise safety issues without fear of harassment, intimidation, retaliation, or discrimination (HIRD) and receive a timely, effective, and respectful response. In March and April 2003, an internal, limited-sample survey was performed to monitor progress to date in developing a safety conscious work environment. This has established an initial indicator against which improvement can be measured. These internal surveys will be performed on a quarterly basis and the results will be made available to NRC.

The OCRWM and the BSC Concerns Programs are improving the timeliness of investigating concerns. Based on nuclear industry practices, targets of 30 days to investigate routine concerns and respond to the concerned individual and 90 days for complex or HIRD-related issues were established. Currently, the concerns program is averaging 17 days to investigate and respond to routine concerns and 63 days for complex and HIRD concerns. The overall average time to investigate and respond to an employee concern in calendar year 2003 is 27 days, a significant improvement over the 111-day average for calendar year 2002.

We have conducted Program-wide management and employee training to build a common understanding of SCWE. The recent survey found that employees now have a much improved understanding of SCWE and its importance to the Program. However, the results indicated that continued effort is needed to fully instill this culture. We are planning to implement additional training to increase managers' effectiveness in receiving and acting upon concerns. SCWE is also a topic for continuing discussion in quarterly meetings jointly led by DOE and contractor senior management. Supervisors and staff are encouraged to continue these discussions and to return with feedback for senior management. I believe that sustaining internal discussions of this crucial aspect of nuclear culture, coupled with the formal mechanisms that have been put in place, are the most effective way to instill and maintain a safety conscious work environment.

The Management Improvement Initiative recognized the need to measure progress more systematically. Therefore, in addition to quarterly internal surveys, we plan to have external experts conduct annual Program-wide surveys, the first of which is planned for this summer.

The results of these activities will be evaluated and applied to foster continuous improvement in SCWE.

ACCOUNTABILITY

Individual accountability is the key to achieving the outcomes identified in the preceding sections of this letter. OCRWM has responded to performance problems with appropriate action and has recognized good performance. The Monthly Operating Review is a good tool for measuring progress and ensuring managers are accountable for performance in their work areas.

We are continuing to strengthen mechanisms to hold individuals accountable for the quality, timeliness, effectiveness, procedural compliance, and safety of their work products and processes. Individuals and organizations will have performance criteria for these elements built into their appraisals and evaluations. Demonstrated actions that exceed these expectations will be recognized. Failure to meet these expectations will be addressed vigorously. We will provide a report to employees semiannually to highlight successes, communicate lessons learned, and underscore our commitment to accountability.

We now have a stronger organization whose fundamental objective is to demonstrate that a permanent repository at Yucca Mountain will meet NRC's requirements. We will continue to report our progress to NRC at Quarterly Meetings.

Please feel free to request additional details about the actions described in this letter. We look forward to continuing our pre-licensing interactions and appreciate NRC's ongoing feedback on our progress.

Sincerely,

DR. MARGARET S.Y. CHU,
Director, Office of Civilian Radioactive Waste Management.

ENCLOSURE.—MONTHLY OPERATING REVIEW PROGRESS ASSESSMENT MATERIALS

Percentage-complete status for five major pre-licensing components

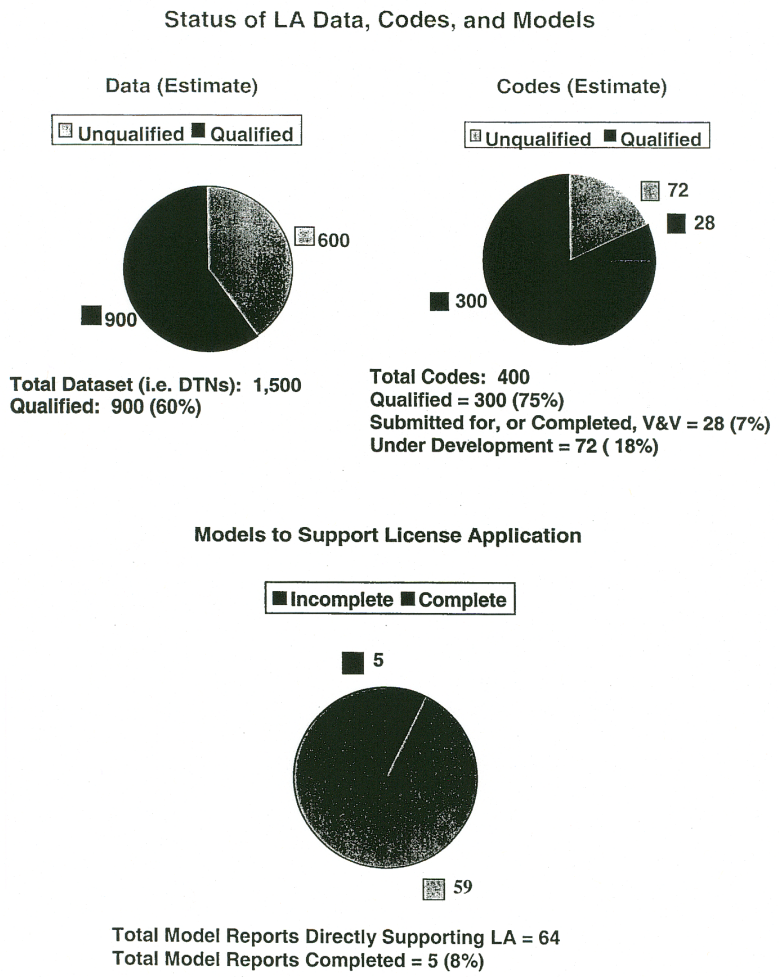
Status of data qualification, code qualification, and model validation

MANAGEMENT ASSESSMENT OF PROGRESS TOWARD LA

[Percent]

Component	Percent Complete	Weight
KTI Agreement Closure	26	10
LA Document	5	20
Preclosure Safety Assessment	12	10
TSPA–LA	25	30
Design	12	30
TOTAL PERCENT COMPLETE	16	

Note: ORD MOR Report as of 4/28/03.



CONCLUSION OF HEARING

Senator REID. So, again, thank you very much. And this Senate subcommittee stands recessed.

[Whereupon, at 2:39 p.m., Wednesday, May 28, the hearing was concluded, and the subcommittee was recessed, to reconvene subject to the call of the Chair.]

○