

Appendix F

Other U.S. Nuclear Waste Technical Review Board Correspondence

- Letter from Harry W. Swainston to Michael L. Corradini; October 27, 2003.
Subject: Transmittal of "Review of the Report 'Thermochronological Evolution of Calcite Formation at the Potential Yucca Mountain Repository Site, Nevada'"
- Letter from Michael L. Corradini to Harry W. Swainston; December 8, 2003.
Subject: Acknowledgement of letter
- Letter from Robert R. Loux, Executive Director, Nevada Agency for Nuclear Projects to Michael L. Corradini; November 25, 2003.
Subject: Internal criticality risk at Yucca Mountain
- Letter from Michael L. Corradini to Robert R. Loux; December 8, 2003.
Subject: Acknowledgement of letter

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October 27, 2003

Dr. Michael L. Corradini, Chairman
Nuclear Waste Technical Review Board
2300 Clarendon Blvd., Suite 1300
Arlington, VA 22201-3367

Dear Dr. Corradini:

Enclosed you will find a copy of a document entitled "Review Of The Report 'Thermochronological Evolution Of Calcite Formation At The Potential Yucca Mountain Repository Site, Nevada'" published under the auspices of the Siberian Branch of the Russian Academy of Sciences United Institute of Geology, Geophysics and Mineralogy, which was authored by two members of the Institute of Mineralogy and Petrography, Dr. Yuri V. Dublyansky and Dr. Sergey Z. Smirnov. The document is a review of a two part report written by UNLV coordinators, Nick Wilson, Jean Cline and Y. Amelin, of the Yucca Mountain Thermochronology Project, a project conducted in response to a suggestion by the Nuclear Waste Technical Review Board in 1998 to resolve differences in the interpretation of certain fluid inclusion and stable isotope data, which had spawned a heated controversy between scientists representing the State of Nevada and those representing the interests of the DOE (primarily the USGS) concerning the origin and ages of secondary minerals in the interior of Yucca Mountain.

Dr. Dublyansky was Nevada's representative for the UNLV Thermochronology Project. Except for DOE representatives' concession that the secondary minerals in question were, indeed, formed from heated aqueous fluids, the disagreement between the scientists, particularly the source of the heat, has persisted to the present day. The DOE aligned interests still maintain that the source of the depositing fluids was meteoric water in the form of infiltrating rainwater passing through a mountain that remained hot for millions of years. Dr. Dublyansky and a group of internationally based scientists working with him, which include many of his colleagues at the Institute, Jerry Szymanski of Las Vegas, Nevada and Dr. Tim Harper of England are convinced, based on many lines of evidence, that the secondary minerals were deposited by hydrothermal fluids driven from deep beneath Yucca Mountain and that episodes of such deposition are recent in geologic time. If hydrothermal fluids were to flood the proposed repository during its 10,000-year lifetime or even an extended period of many tens of thousands of years, steam explosions would undoubtedly result and the canisters would be breached. As the fissile material is rearranged tremendous quantities of radioactivity would be released through a variety of pathways to the biosphere, not the least of which are those created by predictable low yield nuclear explosions and uncontrollable *in situ* criticality processes.

In a letter written to the NWTRB by the Yucca Mountain Project Manager, J. Russell Dyer,

dated January 24, 2002, the lack of a consensus in the lingering rainwater-upwelling controversy was documented. Inexplicably, however, NWTRB Chairman Jared Cohon wrote a letter addressed to Mr. Lake H. Barrett, Acting Director of OCRWM dated March 11, 2002, which stated:

At the Board meeting and in a letter to the Board dated January 24, 2002, the DOE concluded that the hypothesis of hydrothermal upwelling proposed by Mr. Jerry Szymanski had been adequately addressed and may be discounted. These conclusions were based on the DOE's positive response to a Board recommendation that a joint federal-State of Nevada project be conducted to determine the ages of fluid inclusions at Yucca Mountain. A systematic joint study was coordinated by University of Nevada-Las Vegas scientists and can be considered a model for successful resolution of some contentious scientific issues. The Board concurs with the DOE's conclusions and considers this issue resolved.

The important point to recognize with respect to the foregoing communications is that they contain nothing more than political opinion. The decision whether or not the controversy is scientifically resolved is a technical issue related to the safety of the site, which is committed to the jurisdiction of the Nuclear Regulatory Commission's licensing board. The NRC is the sole entity responsible for safety considerations concerning the licensing of the Yucca Mountain site. Furthermore, the decision whether or not the State of Nevada will raise a contention based upon the continuing controversy is a question, which rests solely with the Nevada Attorney General. The bottom line is that the controversy is resolved neither politically nor scientifically.

Other political statements such as the one attributed to you as the consequence of your recent co-authorship of an editorial in a Madison, Wisconsin newspaper that in your opinion nuclear waste can be "stored safely at Yucca Mountain" are counter productive in the effort to provide the world community with a fair and unbiased process. Since that bell cannot be unringed, an appropriate strategy for the mitigation of the effects of the dissemination of misinformation might come in the form of reopening the scientific review of the origin and ages of the secondary minerals at Yucca Mountain before the NWTRB.

An unbiased consideration of reasonable interpretations, which may be attributed to data acquired during the UNLV Thermochronology Project, is warranted. A number of questions, which were raised by Board members, regarding findings by the Thermochronology Project in a meeting of the full Board on May 9, 2001 need to be resolved. Among these were questions raised concerning the source of magnesium found in samples of secondary minerals, the source of hydrocarbons in all gas inclusions, an explanation for the high salinities in the fluids of the inclusions, the use of a constant lead correction for uranium-lead age dating, thermodynamic limitations to the rainwater hypothesis, etc.

The review authored by Dr. Dublyansky and Dr. Smirnov enclosed herein and a second review authored by them: "Commentary on: 'Physical and stable-isotope evidence for formation of secondary calcite and silica in the unsaturated zone, Yucca Mountain, Nevada' by J.F. Whelan, J.B. Paces, and Z.E. Peterman" (submitted for publication in *Applied Geochemistry*, a peer-reviewed journal) as well as the reports of the USGS and UNLV researchers regarding their interpretations of the data produced by the UNLV Thermochronology Project can provide valuable resources to define the issues. The position of the international group of scientists referred to above will be fully discussed in a book length monograph presently in a draft format pending review, which will contain multiple lines of evidence proving without question that the deposition of the secondary minerals was caused by the upwelling of hydrothermal water.

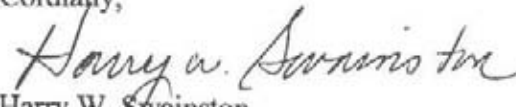
The NWTRB has the statutory mandate in Section 503 of the NWPA, 42 U.S.C. 10263, to

evaluate the technical and scientific validity of activities undertaken by the Secretary of Energy in relation to, among other things, site characterization activities. This broad grant of authority provides the Board with the power and the duty to oversee the DOE's consideration of potentially disruptive events such as the possible flooding of the proposed repository by upwelling water and to intervene with appropriate admonitions and recommendations to the Department of Energy. It is a dereliction of this duty for the Board to disregard its mandate by leaving contentious issues affecting the performance of the proposed repository left unresolved.

The Board also has the duty to report to the Congress and the Secretary of Energy with regard to findings, conclusions and recommendations as to matters within its purview. *See* 42 U.S.C. 10268. To the extent the Board has prematurely terminated consideration of the need for a comprehensive risk assessment of potential consequences associated with the controversy discussed herein, it appears that both the Secretary of Energy and the Congress have been misled by previous reports from the Board. Eventually, evidence of the dangerous nature of the site will certainly cause the abandonment of the site. At that time certain individuals and entities will be held accountable for the expenditure of billions of dollars and, more importantly, years of lost time in the resolution of a pressing national environmental problem. There will be plenty of blame to go around. Unless the NWTRB takes steps to rectify its past nonfeasance, it will likely become the scapegoat for the misfeasance of many.

I commend the enclosed review for your careful consideration and appropriate action.

Cordially,


Harry W. Swainston
Attorney At Law

Enclosure

cc:

The Honorable Brian Sandoval, Nevada Attorney General, Carson City NV
The Honorable Kenny Guinn, Nevada Governor, Carson City, NV
The Honorable Harry Reid, Nevada Senator, Washington DC
The Honorable John Ensign, Nevada Senator, Washington DC
The Honorable Jim Gibbons, Nevada Representative, Washington DC
The Honorable Shelly Berkley, Nevada Representative, Washington DC
The Honorable Jon Porter, Nevada Representative, Washington DC
The Honorable Spencer Abraham, Secretary of Energy, Washington DC
Brian McKay, Chairman, Nevada Commission on Nuclear Projects, Reno, NV
Michon Mackedon, Vice Chairman, Nevada Commission on Nuclear Projects, Fallon, NV
Richard H. Bryan, Nevada Commission on Nuclear Projects, Las Vegas, NV
Larry Brown, Nevada Commission on Nuclear Projects, Las Vegas, NV
Steven Molasky, Nevada Commission on Nuclear Projects, Las Vegas, NV
Myrna Williams, Nevada Commission on Nuclear Projects, Las Vegas NV
Paul Workman, Nevada Commission on Nuclear Projects, Las Vegas, NV
Robert Loux, Executive Director, NWPO, Carson City, NV
Pricilla P. Nelson, member, NWTRB, Arlington, VA

Paul P. Craig, member, NWTRB, Arlington, VA
Daniel B. Bullen, member, NWTRB, Arlington, VA
Norman L. Christenson, Jr., member, NWTRB, Arlington, VA
Richard Parizek, member, NWTRB, Arlington, VA
Thure E. Cerling, member, NWTRB, Arlington, VA
Ronald M. Latanision, member, NWTRB, Arlington, VA
Mark D. Abkowitz, member, NWTRB, Arlington, VA
David J. Duquette, member, NWTRB, Arlington, VA
Jared Cohon, former Chairman, NWTRB, Arlington, VA
William D. Barnard, Executive Director, NWTRB, Arlington, VA
B. John Garrick, Chairman, ACNW, Rockville, MD
Michael T. Ryan, Vice Chairman, ACNW, Rockville, MD
George M. Hornberger, member, ACNW, Rockville, MD
Milton Levenson, member, ACNW, Rockville, MD
Ruth F. Weiner, member, ACNW, Rockville, MD
Nils J. Diaz, Chairman, NRC, Rockville, MD
Jeffrey S. Merrifield, Commissioner, NRC, Rockville, MD
Edward McGaffigan, Commissioner, NRC, Rockville, MD
William D. Travers, Executive Director, NRC, Rockville, MD
Bret W. Leslie, NRC, Washington, DC
Thomas J. Casadevail, Central Region Director, USGS, Denver, CO
Wayne Premo, USGS, Denver, CO
James Paces, USGS, Denver, CO
Zell Peterman, USGS, Denver, CO
Stephen Brocoun, Assistant Manager, DOE/YMPO, North Las Vegas NV
J. Russell Dyer, Assistant Deputy Manager for Repository Design, DOE/YMPO, North Las Vegas NV
Drew H. Coleman, OLANS, DOE/YMPO, North Las Vegas, NV
Donald H. Baepler, Executive Director, Harry Reid Center for Environmental Studies, Las Vegas, NV
Jean S. Cline, Associate Professor, UNLV, Las Vegas, NV
Nicholas Wilson, Calgary, Canada
Robert J. Bodnar, C.C. Garvin Professor of Geochemistry, Blackburg, VA
Yuri Dublyansky, Geochemist, IMP, Novosibirsk, Siberia, Russia
Tim Harper, President, Geosphere, Ltd., Beaworthy, Devon, Eng.
Jerry Szymanski, Geologist, Las Vegas NV
Carol Hill, Geologist, Albuquerque, NM
Charles Archambeau, President, TRAC, Boulder, CO
Mary Beth Gray, Assoc. Professor of Geology, Bucknell University, Lewisburg, PA
Arjun Makhijani, President, IEER, Washington DC
Charles D. Bowman, LANL, Los Alamos, NM
Francesco Venneri, LANL, Los Alamos NM
William J. Broad, New York Times, New York, NY



UNITED STATES
NUCLEAR WASTE TECHNICAL REVIEW BOARD
2300 Clarendon Boulevard, Suite 1300
Arlington, VA 22201

December 8, 2003

Harry W. Swainston, Esq.
Attorney At Law
4040 Hobart Rd.
Carson City, Nevada 89703

Dear Mr. Swainston:

Thank you for your letter of October 27, 2003 and the accompanying report by Drs. Yuri V. Dublyansky and Sergey Z. Smirnov entitled *Review of the Report: "Thermochronological Evolution of Calcite Formation at the Potential Yucca Mountain Repository Site, Nevada."* We do appreciate your direct transmittal of this report to all of our Board members. In your letter you requested that we carefully consider the Dublyansky and Smirnov report and take appropriate action. Based on input from its members, the Board will decide on an appropriate course of action.

Thank you again for transmitting copies of the report.

Sincerely,

A handwritten signature in black ink that reads "Michael Corradini". The signature is written in a cursive style with a large, sweeping initial "M".

Michael L. Corradini
Chairman



OFFICE OF THE GOVERNOR
AGENCY FOR NUCLEAR PROJECTS

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November 25, 2003

Dr. Michael L. Corradini
Chairman
U.S. Nuclear Waste Technical Review Board
2300 Clarendon Boulevard
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Arlington, VA 22201

RE: Internal Criticality Risk at Yucca Mountain

Dear Dr. Corradini:

I am writing to request that the Nuclear Waste Technical Review Board ("TRB") conduct a careful review of the previously withheld, but recognized potential for internal criticality of nuclear waste residues at the proposed Yucca Mountain nuclear waste repository. We were amazed to learn, after finally obtaining some of the pertinent documents from the Department of Energy ("DOE") through the Freedom of Information Act ("FOIA"), that DOE's own studies anticipate that, if the repository operates as is now planned, *up to 60 nuclear criticalities* may plausibly occur inside the mountain, and that the conditional probability of occurrence may be greater than one in one thousand per year.

That conclusion is sharply at odds with what DOE publicly represented in its Final Environmental Impact Statement (FEIS) on the proposed facility, which assigns such events an extremely low probability of occurrence. In particular, in FEIS Volume 1 at page 5-39, DOE concluded:

The potential for criticality of commercial spent nuclear fuel would be maximized when the internal basket was fully degraded, but with the assemblies remaining intact and no breach of the bottom of the waste package. Under these circumstances, the calculated probability of a critical event within the total inventory of the 21-PWR Absorber Plate

waste packages would be less than 2×10^{-7} in 10,000 years (after closure of the repository).

However, DOE's actual criticality studies, which were omitted (improperly, we believe) from the FEIS administrative record, tell a markedly different story. Once Nevada determined that such documents existed, we filed a series of FOIA requests, which produced some, but not yet all, of the pertinent documents. One document we did receive recently is DOE's *Criticality Potential Curve Draft Report* for the proposed Yucca Mountain repository. Nevada engaged Dr. Michael C. Thorne, an independent expert in criticality safety and probabilistic risk assessment, to study that report. He has not been able to undertake a full review at this time because DOE has withheld some of the supporting documentation, calculations and analyses performed for the preparation of this report.

However, Dr. Thorne was able to make some clear and startling conclusions. He noted that the DOE report identifies three types of potential criticality events at Yucca Mountain – "Light Bulb," "SL-1," and "Waste Package." He concluded, based on his review of previous criticality accidents worldwide, that these potential criticality events and their projected fission yields were indeed plausible occurrences in the proposed repository. The DOE report estimated the conditional probability of each of these events per cask as 5.1×10^{-3} , 2.6×10^{-4} and 2.6×10^{-4} for Light Bulb, SL-1 and Waste Package criticality events, respectively. The calculated probabilities are conditional in that they assume perforation of the cask and introduction of water to the waste, but for the long term, of course, DOE's Total System Performance Assessment assumes that all packages eventually do degrade.

Moreover, Dr. Thorne observed several non-conservative deficiencies in the probabilistic arguments used in the DOE studies, implying that higher frequencies (which he assessed as 4.1×10^{-2} , 2.1×10^{-2} and 2.1×10^{-2} for Light Bulb, SL-1 and Waste Package events, respectively) cannot be ruled out. Nevertheless, even using the conditional probability estimates given in the DOE report, because the Yucca Mountain repository would contain about 11,770 waste packages (Supplemental Science and Performance Analyses, 2001, page 7-62), and because all packages will eventually degrade, the expected numbers of criticality events over the long term are 60, 3, and 3 for Light Bulb, SL-1 and Waste Package events, respectively.

These astonishing numbers raise grave concerns about the proposed repository's safety and environmental impacts, further calling into question the legal and technical adequacy and veracity of the Yucca Mountain FEIS. A criticality occurring in the repository could severely compromise the entire facility, vastly increasing radionuclide releases and making waste packages irretrievable.

DOE's *Criticality Potential Curve Draft Report* does not discuss the timescale over which these presumed criticality events would occur. However, Dr. Thorne believes the report suggests they occur uniformly over a period beginning when a package first perforates and admits water and ends when the presumed "bathtub" wall has corroded

sufficiently to release the water. (The potential long-term integrity of the canisters is a matter to which the TRB and we are also very concerned.) According to Dr. Thorne, the period from penetration of the first package to loss of the bathtub configuration in the last is likely to extend from some point within the 10,000 years following repository closure and for some tens of thousands of years thereafter. Based on more than 60 critical events over that interval, the probability of a critical event within the whole proposed repository is thus – using DOE’s own numbers – *on the order of 1×10^{-3} per year or higher*, with that probability applying to at least part of the interval within the 10,000-year regulatory compliance period. This value differs radically from the value of 2×10^{-7} per year cited in DOE’s FEIS. The criticality numbers also further underscore the absurdity of limiting Yucca Mountain’s safety analysis to 10,000 years.

We recognize that the values given in the *Criticality Potential Curve Draft Report* are based on a simplified analysis, though we see no reason why they should not have been prominently dealt with in the FEIS. This issue has become all the more important given recent determinations by the TRB and Nevada’s experts that corrosion of the Yucca Mountain waste containers and water infiltration are serious possibilities during the regulatory compliance period, and are certain to occur over longer periods.

Finally, this month we received through the FOIA process several backup documents for the *Criticality Potential Curve Draft Report* that appear only to confirm our concerns. These 1998 documents reveal that DOE’s Senior Technical Review Panel for the FEIS was likewise worried about criticality in the event of water entering a ruptured or corroded spent fuel canister, and it recommended on several occasions that DOE “quantify the consequences” if such an event “is conceivable.” The documents show that DOE’s own criticality analysts had “assumed that ingress of water into a storage cask, without any change in geometry of the spent fuel and/or movement of the neutron poison, *would result in a critical event*,” and that the probability of criticality was so high that DOE should not waste time analyzing it, but should proceed directly to analysis of the consequences. Unfortunately, DOE performed no such analysis. This same document concluded that “[a] criticality event could affect radionuclide release to the environment by damaging uranium and fuel matrix and cladding, so that the slow dissolution process which would normally occur is accelerated, and radionuclides are released in a short time period. Such a release would be more concentrated and the air release pathway would become significant, so an evaluation of the effects of potential criticality events is in order.”

We and Dr. Thorne have also examined more recent criticality reports, in particular:

Configuration Generator Model for In-Package Criticality, MDL-EBS-NU-000001 REV 01 ICN 01; and

U.S. Nuclear Regulatory Commission, Safety Evaluation Report for Disposal Criticality Analysis Methodology Topical Report, Revision 0, June 2000.

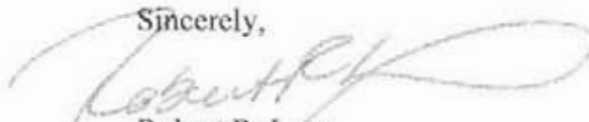
The June 2000 NRC report describes the methodology then proposed by DOE for evaluating criticality events. This methodology involved application of detailed geochemical modeling to define potentially critical configurations of fissile material both within and outside waste packages. But according to Nevada's experts, it is not clear that such geochemical modeling is feasible given the complexities of the proposed repository, the limitations of existing computer codes and the lack of appropriate data for use with those codes under proposed repository conditions. This seems to have been recognized by DOE itself, which subsequently adopted a fault tree/event tree based approach. Nevertheless, the fundamental problem remains of determining from the generalized descriptions of configuration classes used in the fault tree/event tree approach whether they can give rise to criticality events. This issue does not appear to have been addressed in DOE's proposed methodology, and it was certainly ignored in the FEIS.

In short, the documentation available to DOE at the time the FEIS was written was nowhere near sufficient for DOE to have summarily ruled out substantial numbers of criticality events occurring in the proposed Yucca Mountain repository. Indeed, the available documentation suggests internal criticality may be one of the most, if not the most, significant safety issues in repository licensing. Although subsequent work provided two alternative methodologies that, at first blush, have the potential to demonstrate lower probabilities of criticality events, more detailed examination by Nevada's experts suggests that limitations of scientific understanding, computational tools and relevant data will make it impossible to effectively deploy those alternative methodologies.

In view of the above, the potential occurrence and significance of criticality events, deliberately obscured in the FEIS, must be thoroughly analyzed and reviewed. I am requesting that the Board initiate such a review and begin by requesting from DOE a clear and comprehensive demonstration that the methodology, models and data identify the range of criticality events that could occur, quantify their probabilities of occurrence, and evaluate their potential consequences and the implications for repository operability, closure and post-closure performance.

I would be happy to share any of our documents with you, and we can put you in contact with Dr. Thorne so you can discuss this matter with him directly if you wish.

Sincerely,



Robert R. Loux
Executive Director

cc: Dr. Margaret S. Y. Chu, DOE
Dr. William D. Travers, NRC



UNITED STATES □
NUCLEAR WASTE TECHNICAL REVIEW BOARD □
2300 Clarendon Boulevard, Suite 1300
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December 8, 2003

Mr. Robert R. Loux
Executive Director
Agency for Nuclear Projects
1802 N. Carson Street, Suite 252
Carson City, Nevada 89701

Dear Mr. Loux:

Thank you for your November 25 letter dealing with internal criticality risk at Yucca Mountain and the attachments to the letter.

The Board's mission is to evaluate the technical and scientific validity of Department of Energy (DOE) activities involving the packaging, transportation, and disposal of high-level radioactive waste and spent nuclear fuel. Clearly criticality is one of those activities. The Board has reported on criticality in the past and monitors ongoing criticality developments and activities of the DOE's Office of Civilian Radioactive Waste Management. Thus, we appreciate your providing this material on criticality to us.

Thank you again for your letter and its attachments.

Sincerely,

A handwritten signature in black ink that reads "Michael Corradini". The signature is written in a cursive style with a large, sweeping initial "M".

Michael L. Corradini
Chairman

