OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37831

December 7, 1987

Dr. D. J. Brooks, Section Leader
Geochemistry Section
Technical Review Branch
Division of High-Level Waste Management
Office of Nuclear Material Safety and
Safeguards
U.S. Nuclear Regulatory Commission
Room 623-SS
Washington, D.C. 20555

Dear Dave:

Enclosed is the November 1987 progress report for B0287, Technical Assistance in Geochemistry.

Sincerely,

A. D. Kelmers/js /s/

A. D. Kelmers, Project Manager
B0287 Technical Assistance in Geochemistry
Chemical Technology Division
Bldg. 4500N, MS-268; FTS 624-6870

ADK:ech

cc/encl: Office of the Director, NMSS (Attn: Program Support Branch)
Division Director, Division of High-Level Waste Management,
NMSS, NRC (2)
R. L. Ballard, Chief, Technical Review Branch, NMSS, NRC
J. W. Bradbury, Technical Review Branch, NMSS, NRC
G. F. Birchard, Waste Management Branch, RES, NRC
A. P. Malinauskas, Director, NRC Programs, ORNL

12/03/87

PROGRESS REPORT FOR NOVEMBER 1987

PROJECT TITLE: Technical Assistance in Geochemistry (FIN No. B0287)

PROJECT STAFF: R. M. Gove, G. K. Jacobs, V. S. Tripathi, K. L. Von Damm, and G. T. Yeh

PROJECT MANAGER: A. D. Kelmers
Chemical Development Section
Chemical Technology Division
OAK RIDGE NATIONAL LABORATORY, operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.

ACTIVITY NUMBER: ORNL # 41 88 54 92 4 / NRC # 50 19 03 01

OBJECTIVE:

The objective of this project is to provide technical assistance to the NRC in the evaluation of geochemical information pertinent to the candidate high-level-waste geologic repository sites. The project emphasizes the collection and review of key information to provide input to the NRC analysis of technical issues regarding the geochemical aspects of geologic isolation of high-level-waste, and review of site selection and repository licensing documentation.

TECHNICAL HIGHLIGHTS:

Letter reports are enclosed on the evaluation and analysis of: (i) the draft document on numerical modeling of groundwater flow systems, (ii) the draft document on uncertainties in the performance of repositories, and (iii) the draft report on redox conditions. Also enclosed are updated listings of contract products.

MEETINGS AND TRIPS:

None

REPORTS AND PUBLICATIONS:

LR-287-73, K. L. Von Damm, "Review of: 'Technical Report on Redox Conditions at the Three Potential High-Level Waste Disposal Sites (Draft)',

by Walton R. Kelly"

LR-287-74, D. C. Kocher, "Review of the Draft Scoping Document on 'Treatment of Uncertainties in the Performance Assessment of Geologic High-Level Radioactive Waste Repositories'"

LR-287-75, G. K. Jacobs and V. S. Tripathi, "Comments on the Geochemistry Section of Numerical Modeling of Ground-Water Flow Systems in the Vicinity of the Reference Repository Location, Hanford Site, Washington, by P. Davis, W. Beyeler, M. Logston, N. Coleman, and K. Brinster"

PROBLEM AREAS:

None

COST/BUDGET REPORT:

Expenditures for November were not available at this time. A detailed cost/budget report will be forwarded under separate cover.

LR-287-75
11/11/87

LETTER REPORT

TITLE: Comments on the geochemistry section of Numerical Modeling of Ground-Water Flow Systems in the Vicinity of the Reference Repository Location, Hanford Site, Washington, by P. Davis, W. Beyeler, M. Logston, N. Coleman, and K. Brinster

AUTHORS: G. K. Jacobs and V. S. Tripathi
Earth Sciences Section
Environmental Sciences Division
Oak Ridge National Laboratory

PROJECT TITLE: Technical Assistance in Geochemistry

PROJECT MANAGER: A. D. Kelmers
Chemical Development Section
Chemical Technology Division
Oak Ridge National Laboratory

ACTIVITY NUMBER: ORNL #41 88 54 92 4 (FIN No. B0287)/NRC #50 19 03 01

This letter report summarizes comments on section 4.1 (Hydrochemical Data Base) of the report Numerical Modeling of Ground-Water Flow Systems in the Vicinity of the Reference Repository Location, Hanford Site, Washington, by P. Davis, W. Beyeler, M. Logston, N. Coleman, and K. Brinster. The report reviews information on the groundwater flow model for the Hanford Site and reports on progress to independently model the system. The hydrochemistry section is intended as a summary of available information that can be used to help constrain the flow model.

The discussion of sample integrity in section 4.1, though rather brief with few details, accurately reflects the three main problems in assuring that water samples are representative of the hydrostratigraphic horizon of interest. Section 4.2 summarizes the results of previous studies, including the BWIP Site Characterization Report (SCR), the U.S. Geological Survey critique of the SCR, the L. Lehman review of the BWIP hydrochemical data, and the BWIP presentation during the 1984 DOE-NRC Geochemistry Workshop. This section appears to represent the original work in a fair manner. The conclusions in section 4.3 are important (could be strengthened) and should be integrated into future work -- especially the integration of the hydrochemistry and hydrologic data. A conceptual hydrologic model must account for observed patterns in groundwater chemistry. One manner to address this issue is through the use of a coupled hydrologic-geochemical model such as HYDROGEOCHEM (developed by Yeh and Tripathi at ORNL). The work we are now performing with this model to address the transport of radionuclides could be extended to look at the evolution of major-ion chemistry in a flow system such as that at Hanford.

LR-287-74
11/10/87

LETTER REPORT

TITLE: Comments on the Applicability of ^{129}I (Data Compilation: Iodine-129 in Hanford Groundwater, WHC-EP-0037, 1987) for use in evaluating radionuclide transport characteristics for the candidate high-level waste site at Hanford.

AUTHORS: G. K. Jacobs and V. S. Tripathi
Earth Sciences Section
Environmental Sciences Division
Oak Ridge National Laboratory

PROJECT TITLE: Technical Assistance in Geochemistry

PROJECT MANAGER: A. D. Kelmers
Chemical Development Section
Chemical Technology Division
Oak Ridge National Laboratory

ACTIVITY NUMBER: ORNL #41 88 54 92 4 (FIN No. B0287)/NRC #50 19 03 01

This Letter Report provides comments on the report Data Compilation: Iodine-129 in Hanford Groundwater, WHC-EP-0037, 1987. The comments relate to the possible application of the ^{129}I data for gaining insight into the transport of radionuclides within the confined aquifer system of the candidate high-level waste site at Hanford. We have not provided comments on the usefulness of these data for interpreting the hydrologic aspects because our expertise is not is this area.

In general, the *available* data on ^{129}I will not be useful for gaining an understanding of radionuclide transport in the confined aquifer system at Hanford. The reasons for this conclusion are three-fold. First, most of the available data are for the unconfined aquifer system, which has few hydrologic/transport characteristics in common with the confined system. Second, some of the data were collected without adequate control of the drilling and sampling methods. Therefore, the integrity of the samples may be in question. Third, ^{129}I, generally considered to be a conservative element in groundwater, will provide little or no information on the transport properties of key radionuclides in the confined aquifer system at Hanford. The key radionuclides (e.g., U, Np, Pu, Am, Tc) for a HLW repository generally have a much more complicated geochemical behavior (i.e., precipitation, sorption, redox changes, complexation) than iodine. In addition, the information necessary for analyzing the radionuclide transport is incomplete (i.e., sorption data for the minerals present in this system). Should further sampling programs be planned, thought should be given to including other elements and information (groundwater chemistry, mineralogy, sorption data) so that the information may be fully utilized.

LK-287-15
11/30/87

November 1987

Review of: "Technical Report on Redox Conditions at the Three Potential High-Level Waste Disposal Sites (Draft)," by Walton R. Kelly.

Author: K. L. Von Damm

Project Title: Technical Assistance in Geochemistry

Project Manager: A. D. Kelmers

Activity Number: ORNL # 41 88 54 92 4 / NRC # 50 19 03 01

Some comments are given in the body of the text; major comments are elaborated on here.

p. 1 "Redox" and "redox-active" should be defined in the introduction at the time they are first used, rather than on p. 2.
I dislike the term "redox-active" and would describe these as species with multiple oxidation states, and hence can be involved with oxidation or reduction reactions with other species.

It is important to add "the form in which they will exist in solution" as you later make the point that speciation may affect redox reactions.

The pressure will also affect the redox conditions (although it is not as important as temperature) and it should be included with the other terms. At present it is never mentioned explicitly.

p. 2 One mole of Fe donates one mole of electrons, one atom of Fe donates one electron.

Free electrons do not exist in solution - electrons are obviously there.

p. 5 Not only may the electrodes be unstable under repository conditions but they will also be difficult to calibrate.

The measurement of H_2 has become quite prevalent as a means of determining the redox state in hydrothermal experiments. It is easily measurable by gas chromatography and appears to do very well at describing the redox state of the system. The measurement of oxygen is very problematic at its low abundances. I am not familiar with the membrane measurements but I think you are in general not giving the measurement of H_2 enough credit.

I do not believe that Mn^{3+} exists in the natural environment - Mn^{4+} is the common oxidized form.

You need to emphasize earlier and more strongly that there is no

single "system" Eh.

p. 6 Pt electrodes may not be able to determine O_2 but there are many methods which can measure it very precisely. Ion specific electrodes are easier but not necessarily very accurate. There are very precise titrations to determine O_2, which are very time consuming and require a "practiced eye" (for the colorometric endpoint) to get good results - but they do give very good results.

I am not familiar with As but I would argue against the use of Se as an "indicator". Huge redox disequilibria are observed in Se in the ocean, indicating it is very biologically active. I believe As is also a bio-active element as it is often quite concentrated in organic matter.

I am not familiar with Morin's paper but I do not like his definition of redox couples. It seems to me a <u>stronger</u> test if a redox couple that are linked by several reaction steps give the same answer as a simpler one-electron transfer. You cannot say that CO_2-CH_4 and S^{--}-S^{6+} are not couples.

It is more than a detection limit problem. Many species can be determined at pico-molar levels, the problem is the determination without changing the redox state of the species.

p. 7 On the biological point - the highest confirmed temperature for biological activity is <130°C so this is not a factor at the highest repository temperatures.

I take exception to any measurement of Eh "with confidence". The measurement may be okay but what does it mean and if it does not mean anything what good is it?

p. 8 You also do not know which, if any of the measured redox couples (Ehs) will affect the particular element(s) of interest.

p. 9 Of course there is an inverse relationship between sulfide and iron! $K_{sp} = [Fe][S]$ or $[Fe][S]^2$ depending on the phase which is forming. You need to quote this paper better or reinterpret their data.

Could their measured oxidizing conditions be a result of S^{--} poisoning their electrode?

p.10 Cannot say on the basis of this work that reducing conditions were established at temperatures up to 300°C. They were unable to measure sulfide except at 300°C and did not look at any of the other redox couples at other temperatures. It can be said that reducing conditions were achieved at 300°C, but the redox state is not known for the other temperatures.

One must be very careful quoting Icelandic work because some of the groundwaters are "fresh" and some are seawater which contains much more sulfate and will react differently.

p.12 One must be careful quoting acetate data. Yes it is consumed by organisms but it is also produced by organic matter decomposition therefore its concentration at any time is a result of both production and consumption. Is it known that anaerobic bacteria do not consume it as well? Is it known whether bacteria can exist in such saline conditions? In short, the presence of acetate is not a convincing argument for anaerobic conditions.

General comments:

Is the oxidation state and speciation of the radionuclides in the waste known? The form in which the radionuclide enters the system will have a great effect on what happens to it (as you point out re: speciation).

You should emphasize earlier and more strongly that there is no "system" Eh.

You should also emphasize more strongly that kinetics are probably important in redox chemistry, creating additional problems for "equilibrium" modeling.

LR-287-74
11/30/87

Review of the Draft Scoping Document on

TREATMENT OF UNCERTAINTIES IN THE PERFORMANCE ASSESSMENT OF GEOLOGIC HIGH-LEVEL RADIOACTIVE WASTE REPOSITORIES

David C. Kocher
Health and Safety Research Division
Oak Ridge National Laboratory

I have reviewed the draft scoping document of July 10, 1987, entitled "Treatment of Uncertainties in the Performance Assessment of Geologic High-Level Radioactive Waste Repositories," by R. M. Cranwell and E. J. Bonano of Sandia National Laboratories. My comments on this report are as follows.

The report groups uncertainties in performance assessment into three broad categories: (1) uncertainty in the future states of a disposal system, (2) uncertainty in the models used to simulate future states of the system, and (3) uncertainty in the input parameters and data used in the models. The second category includes uncertainty in conceptual models, uncertainty in mathematical models developed from a given conceptual model, and uncertainty in implementing a mathematical model in a computer code. I presume that the second category also includes uncertainty in any physical or natural analog model used to simulate the system, although this is not stated explicitly in the report.

While the grouping of types of uncertainty described above may be reasonable, I basically view the types of uncertainty in a performance assessment in a different way. I think of the different types of uncertainty as consisting of (1) uncertainty in the conceptual models (i.e., qualitative descriptions) of the disposal system, both at the present time and as it will evolve in the future, (2) uncertainty in the physical or mathematical models used to quantify the conceptual models of the system, and (3) uncertainty in the input parameters and data for the physical or mathematical models. Thus, I differ from the report mainly in the way that uncertainty in the conceptual models, including scenario definitions, is grouped. To me, the development of a conceptual model, and the uncertainties associated with such models and with reasonable conceptual models which may be left out of account, is a fundamentally different concern than the development of a mathematical model on the basis of an assumed conceptual model and quantification of its uncertainties. I also regard the problem of scenario development over time as part of the problem of developing conceptual models for the disposal system. That is, there is little difference between developing a conceptual model for a system at the present time and a model for future states; we have only added another dimension to the problem - namely, dynamic evolution of the system over time.

I certainly do not mean to imply by this discussion that my views on how uncertainties should be categorized are right and the authors' are wrong. Rather, I would only to emphasize that there may be more than one

reasonable way to group sources of uncertainty. The authors may wish either to point this out or, preferably, to discuss in some detail why they have grouped uncertainties as they have in the report.

The second paragraph on page 1 states that uncertainty in models for simulating scenarios is addressed through verification, validation, and benchmarking activities, each of which involves both qualitative and quantitative treatment. It is not clear to me how verification, validation, and benchmarking can be done on a qualitative basis, and I urge the authors to provide further explanation of this.

Section 2.1 on page 2 supposedly addresses uncertainty in the future states of a disposal system, but much of the discussion in the second paragraph of this section seems to address uncertainty in the models used to assess consequences, which is the subject of Section 2.2. An appropriate reorganization of this material would seem to be in order.

Regarding the last sentence of the paragraph at the top of page 3 beginning with "Frequently, preconceived notions....", I believe that some elucidation or examples regarding this important point would be useful.

The second paragraph on page 3 properly empasizes the importance of situations where more than one conceptual model may be consistent with available observations. However, I quite disagree with the point that probabilities should be assigned to the possible conceptual models. In my view, having more than one conceptual model that appears to describe the system is just a representation of our state of knowledge of the system, and assigning a probability to each model (in effect, assigning a probability to our belief that each model is correct) is largely meaningless and perhaps even quite misleading. Correct science is generally not based on majority opinion, and there are many examples throughout history where decidedly minority points of view proved to be correct.

The next-to-last sentence in the last paragraph on page 3 doesn't seem quite right. Presumably what is being referred to is use of a linear sorption isotherm to described retardation of radionuclides.

At the top of page 4 and elsewhere, the report discusses what is termed "uncertainty" in computer codes. In my view, the problems with computer codes discussed in the report constitute a source of <u>error</u>, not a source of <u>uncertainty</u>, and the concept of an error in a computer calculation is quite different from the concept of an uncertainty in a model or parameter value, for example. I do not believe that the report has properly distinguished between error and uncertainty in this case. I also believe, as discussed later in the report, that errors in computer codes should not be a significant problem for performance assessments. Perhaps this point needs to be made when problems with computer codes are first discussed.

In the first paragraph of Section 2.3 on page 4, I believe that an important source of uncertainty in model parameters and data has not been mentioned - namely, uncertainties associated with the transferability of

data from one site to another. This is a potentially important problem because data obtained at the site of interest probably will not be available for all parameters of interest. This problem is sort of alluded to in the next paragraph, but I believe it needs to be discussed more explicitly. Also, in the last sentence of this paragraph, what is the "reliability" of a performance measure?

Even though I am not a chemist, I basically question the whole thrust of the second paragraph on page 5, unless the discussion is supported by specific examples. Is this paragraph referring to the problems associated with non-linear sorption isotherms, i.e., distribution coefficients in a particular rock/water system that depend on the concentration of the radionuclide? Or do the authors have something else in mind? It is my understanding that measured distribution coefficients are reproducible when the conditions of the experiment are properly controlled and the relevant variables (e.g., redox potential, pH, constituents of the ground water, concentration of the radionuclide) are determined.

In line 4 on page 6, the sentence beginning with "That is" is not a sentence and needs to be rewritten.

In the third paragraph on page 6, there is some discussion of the assignment of probabilities to different scenarios. However, this problem is not evidently included in the four steps of scenario development listed in the first paragraph of Section 3.1 on page 5. This discussion would seem to belong in the section on scenario probabilities beginning on page 6.

In the discussion of scenario probabilities beginning at the bottom of page 6, it is not clear how the different modeling approaches produce estimates of scenario probabilities. Perhaps these discussions would benefit by including some specific examples.

The first paragraph of Section 3.2 on page 7 refers to data as "massive." What is presumably meant is that there are large amounts of data. More precise language is needed here.

The bullet at the top of page 8 makes an important point. With regard to the following paragraph, however, I am very sceptical about assigning probabilities to conceptual models based on the fraction of available data that support each model. The available data may be quite incomplete or highly biased towards a certain point of view which is not necessarily correct. Data supporting one type of model may be easy to obtain, whereas data for another model may be scarce because it is hard to obtain.

In the first paragraph of the section on uncertainty in mathematical models on page 8, I believe the point needs to be made that, in some cases, site characterization and model validation are essentially the same exercise, because development of the model (e.g., for ground-water flow) is based only on site-specific data. Thus, the process of site characterization may not produce an <u>independent</u> validation of the model. This problem is alluded to in the next-to-last paragraph on page 9, but it

probably should be mentioned in the discussion on page 8.

The next-to-last paragraph on page 8 discusses the issue of developing confidence that models "are accurate to the extent possible." This is a matter of perception, rather than right and wrong, but I don't view this issue in this way. I believe that what we want to achieve is a quantification of the degree of imprecision or inaccuracy of the models, whatever it might be. If the result is unacceptable, e.g., for regulatory purposes, then more work is needed to reduce uncertainties. But there certainly is no need to make all models as accurate as possible. It is also important to remember that there is no such thing as a "valid" model. All models are imprecise or uncertain to some degree, but some are better representations of reality than others.

In the paragraph beginning at the bottom of page 8, the term "dimensionless group" needs explanation. Also, it's not clear what the term "dynamic similarity" refers to. The report previously discussed an important problem with applying laboratory data to field conditions - namely, significant differences in spatial scale and their importance in determining the validity of laboratory data. Thus, it is not clear that "dynamic similarity" is the most crucial condition that must be met by laboratory experiments, as claimed in this paragraph.

I agree with the point of view expressed in the first full paragraph on page 9 concerning the potential importance of natural analogs in validating mathematical models. However, a potential problem with natural analogs that is not mentioned in this paragraph is that an analog often provides only a snapshot in time, rather than a record of the dynamic behavior over time.

I also agree with the point of view expressed in the last paragraph on page 9. Furthermore, I believe that the logic of this argument can be used to support my views expressed previously that assigning probabilities to scenarios based on the fraction of supporting evidence is potentially misleading.

As mentioned previously, I believe that the discussion of uncertainty in computer codes beginning at the top of page 10 really is concerned with sources of error, not sources of uncertainty. Also, I doubt that these errors represent a serious problem, even with complex computer codes, provided proper benchmarking and quality assurance procedures are maintained.

In the first paragraph of Section 3.3 on page 11, it is not clear what is meant by a "single-valued" parameter. In mathematics, a function is not single-valued if the dependent variable can have more than one value for a given value of the independent variable; a simple example is the function $y = x^{1/2}$. In the report, the lack of single-valuedness presumably refers to the spatial and temporal variability of parameter values, because, at any particular location and time, many of the parameters presumably do have a single value.

The meaning of the second bullet at the bottom of page 12 is not clear, particularly the meaning of "main effects" and "interactions."

I believe that the third bullet at the top of page 13 needs further explanation and examples, if the assertion is indeed correct. Regarding the latter point, it my understanding that the GRESS code developed at Oak Ridge, and discussed later in this report, generates an adjoint solution to all information contained in a computer code. Thus, the statement attributed to Harper may be incorrect.

Regarding the next-to-last bullet on page 13, I thought that the Sandia group had developed a distribution-free approach for sampling model input parameters, i.e., a method that involves sampling only measured values themselves rather than distribution functions used to represent the variability in the measurements. I must have misunderstood what the Sandia work was about, or I missed the point of this bullet.

In the first sentence of the last paragraph on page 14, what does "as a result of a known excitation" mean?

In the equation on page 15, I would strongly recommend denoting the decay rate constant for radionuclides by λ, rather than β, in order to conform to standard usage. The second sentence following the equation refers to U(x) as a "process" in x. I don't know what "process" means, but U would seem to be a variable, not a process, and the same holds for C. If I am wrong, then the term "process" needs a clear explanation.

The last paragraph on page 16 discusses the implications of conservatisms in physically unrealistic models for regulatory purposes. In my view, one need not be so equivocal, because erring on the side of conservatism is almost always preferable for regulatory purposes, especially when one considers inadequacies in our state of knowledge of a system. It is worth remembering that, for regulatory purposes, the question we would like to answer is usually "Is the outcome likely to be less than a regulatory limit?" On the other hand, if we want a "realistic" model, we are addressing the question "What is the outcome and its uncertainty?" These two questions quite naturally lead to different modeling approaches. I realize that the EPA's high-level waste standard is different from most in its explicit use of probabilistic limits, but the fact remains that there will be a strong tendency to use reasonably conservative models when there is virtually no chance that we can identify and quantify all potentially significant sources of uncertainty in a performance assessment. It must be remembered that the concept of "reasonable assurance," which is crucial to the EPA and NRC standards, is a legal concept, not a mathematical concept based on a strict quantification of uncertainties.

The last sentence on page 16 would seem to need either a reference or further discussion.

In the third paragraph on page 17, is "restitutes" the correct word in the second sentence? If so, what does it mean?

I would suggest that the first sentence at the top of page 18 needs a reference.

In the first paragraph of the section on differential analysis techniques on page 18, I believe that examples of approaches for differentiation of complex functions or models should be discussed or referenced.

Regarding the last bullet on page 19, isn't it true that estimates of sensitivity coefficients are questionable only when the independent parameters may vary widely, i.e., when extrapolation of a function using the first derivative no longer gives an accurate representation of the function at another parameter value? If the parameter variability is small, then there should be no problem with the sensitivity coefficients.

Following the last bullet on page 19, a new subheading would seem to be in order, because the discussion shifts to parameter uncertainty.

I basically disagree with the first sentence of Section 4 on page 20, as it is stated. There is no way that a sensitivity analysis reduces uncertainty in model parameters. What is presumably meant, as discussed later in this section, is that sensitivity analysis can be used to indicate those model parameters for which a reduction in uncertainty would have a significant effect on reducing the uncertainty in model output. But the first statement needs to be correct as it stands, and it is not at present.

In the last paragraph on page 20, I believe that the statement to the effect that differential analysis techniques have a disadvantage compared with statistical sampling, in that the former requires knowledge of the actual mathematical relationship between the output and input variables, is basically incorrect. In fact, the subsequent discussions in this paragraph substantiate my belief. It is my understanding that the GRESS system in effect differentiates computer codes, regardless of whether or not an explicit relationship between output and input variables is known. Also, it is perhaps worth mentioning some of the disadvantages of GRESS compared with statistical sampling techniques. In particular, it is my understanding that GRESS (and adjoint methods in general) are not appropriate for situations where the input parameters vary by several orders of magnitude, as they often do in repository performance assessments.

In the first paragraph on page 22, I believe that some elucidation of mathematical and behavioral methods, with appropriate references, for aggregating expert opinions is needed.

B0287 LETTER REPORTS

The following Letter Reports have been completed to date (11/30/87) by Oak Ridge National Laboratory staff for the NRC Project FIN No. B0287, and transmitted to the NRC Project Manager.

Date	Number	Title
11/30/87	LR-287-75	G. K. Jacobs and V. S. Tripathi, "Comments on the Geochemistry Section of Numerical Modeling of Ground-water Flow Systems in the Vicinity of the Reference Repository Location, Hanford Site, Washington, by P. Davis, W. Beyeler, M. Logston, N. Coleman, and K. Brinster"
11/30/87	LR-287-74	D. C. Kocher, "Review of the Draft Scoping Document on 'Treatment of Uncertainties in the Performance Assessment of Geologic High-Level Radioactive Waste Repositories'"
11/10/87	LR-287-73	K. L. Von Damm, "Review of: 'Technical Report on Redox Conditions at the Three Potential High-Level Waste Disposal Sites (Draft)', W. R. Kelly"
10/23/87	LR-287-72a	A. D. Kelmers, "Review of draft Chapter 10, 'Geochemical Processes', by H. D. Holland, C. Feakes, and S. Faith, of draft report Techniques for Determining Probabilities of Events and Processes Affecting the Performance of Geologic Repositories: Volume 1--Literature Review, R. C. Hunter and C. J. Mann, editors, draft NUREG/CR-3964, September 1987.
05/12/87	LR-287-72	A. D. Kelmers and G. K. Jacobs, "Review of: J. C. Laul, M. R. Smith, V. G. Johnson, and R. M. Smith, 'Disequilibrium of Natural Radionuclides in Hanford Site Groundwaters', pp. 401-410, in High-Level Nuclear Waste Disposal, ed. H. C. Burkholder, Battelle Press, Columbus-Richland, 1986."
03/06/87	LR-287-71	A. D. Kelmers and R. E. Meyer, "Concerns Relative to the Plan for Quality Assurance of Radionuclide Sorption and Precipitation Investigations (Los Alamos National Laboratory Scientific Investigation Plan SIP No. 86/4.1.5-SP), June 1986."
03/03/87	LR-287-70	J. G. Blencoe, "Review and Evaluation of: Mineralogic Summary of Yucca Mountain, Nevada,

		LA-10543-MS, D. L. Bish and D. T. Vaniman, October 1985."
02/02/87	LR-287-69	J. G. Blencoe, "Review and Evaluation of Chemistry of Diagenetically Altered Tuffs at a Potential Nuclear Waste Repository, Yucca Mountain, Nye County, Nevada, LA-10802-MS, D. E. Broxton, R. G. Warren, R. C. Hagan, and G. Ludemann, October 1986."
01/31/87	LR-287-68	K. L. Von Damm, "Review of: 'The mobility of uranium and associated trace elements in the Bates Mountain Tuff', Economic Geology 79, 558-564 (1984), by J. A. Kizis and D. D. Runnells."
01/07/87	LR-287-67	J. G. Blencoe, "Review and Evaluation of: Gamma and Alpha Radiation Levels in a Basalt High-Level Waste Repository: Potential Impact on Container Corrosion and Packing Properties, RHO-BW-SA-462 P (1985), by D. T. Reed, S. D. Bonar, and M. F. Weiner."
01/07/87	LR-287-66	K. L. Von Damm, "Review of: 'Migration of trace elements into water-exposed natural fissure surfaces of granitic rock,' Chem. Geol. 49, 31-42 (1985), by B. Allard, T. Ittner, and B. Torstenfelt."
12/08/86	LR-287-65	J. G. Blencoe, "Review and Evaluation of: 'Structures, Textures, and Cooling Histories of Columbia River Basalt Flows,' Geol. Soc. Am. Bull. 97, 1144-1155 (1986), by P. E. Long and B. J. Wood."
10/31-86	LR-287-64	K. L. Von Damm, "Review of: 'Origin of saline groundwaters in the Carnmenellis granite (Cornwall, England): Natural processes and reaction during hot dry rock reservoir circulation,' Chem. Geol. 49, 287-301 (1985), by M. Edmunds, R. L. F. Kay, and R. A. McCartney."
11/06/86	LR-287-62	J. G. Blencoe, "Review and Evaluation of: A Report on the Status of Hydrothermal Testing of Fully Radioactive Waste Forms and Basalt Repository Waste Package Components, SD-BWI-TI-253 (1984), by J. A. Schramke, S. A. Simonson, and D. G. Coles."
10/16/86	LR-287-61	G. K. Jacobs, J. G. Blencoe, and A. D. Kelmers, "Suggested Issues for a Workshop on Performance Assessment with DOE/Hanford."
09/30/86	LR-287-60	K. L. Von Damm, "Review of: 'Thorium adsorption in the ocean: Reversibility and distribution amongst particle sizes,' Geochimica et Cosmochimica Acta

49, 2253-2257 (1985), by R. M. Moore and K. A. Hunter."

10/08/86 LR-287-59 J. G. Blencoe, "Review and Evaluation of: The Effect of Basalt on the Release of Tc-99, Np-237, and Pu-239 from Borosilicate Glass under Hydrothermal Conditions, SD-BWI-TI-190 (1983), by D. G. Coles."

09/04/86 LR-287-58 A. D. Kelmers, "Review of: T. W. Newton and J. C. Sullivan, 'Actinide Carbonate Complexes in Aqueous Solution,' in Handbook on the Physics and Chemistry of the Actinides, Vol. 3, edited by A. J. Freeman and C. Keller, North-Holland (1985), pp. 387-406."

09/11/86 LR-287-57 J. G. Blencoe, "Review and Evaluation of: Icelandic Basaltic Geothermal Field: A Natural Analog for Nuclear Waste Isolation in Basalt, SD-BWI-TI-257 (1984), by G. C. Ulmer and D. E. Grandstaff."

08/25/86 LR-287-56 K. L. Von Damm, "Review of: The Organic Geochemistry of Deep Ground Waters and Radionuclide Partitioning Experiments under Hydrothermal Conditions, ONWI-448 (1983), by J. L. Means, A. S. Maest, and D. A. Crerar."

09/05/86 LR-287-55 G. D. O'Kelley, "Review of: Actinide Solubility in Deep Groundwaters - Estimates for Upper Limits Based on Chemical Equilibrium Calculations, EIR Report #507 (1983), Institute for Reactor Safety, Wurenlingen, Switzerland, by M. Schweingruber."

09/25/86 LR-287-54 G. D. O'Kelley, "Review of: Effect of Host-Rock Dissolution and Precipitation on Permeability in a Nuclear Waste Repository in Tuff, SAND84-0192 (1984), by J. F. Braithwaite and F. B. Nimick."

07/31/86 LR-287-53 J. G. Blencoe, "A Summary of DOE/Hanford Data on the Solubility/Concentration of Radionuclide-Analog Elements in Barrier Materials + Groundwater Systems."

07/31/86 LR-287-52 K. L. Von Damm, "Review of: 'Sub-sea-floor alteration in the Galapagos Spreading Center,' Chemical Geology 49, 259-274 (1985), by H. Kawahata and T. Furuta."

07/31/86 LR-287-51 G. D. O'Kelley, "Review of: 'Solubility Effects on the Corrosion of Nuclear Defense Waste Glasses,' Nuclear and Chemical Waste Management 5, 193-201 (1985), by C. Maurer, D. E. Clark, L. L. Hench, and B. Grambow."

06/25/86	LR-287-50	J. G. Blencoe, "Review and Evaluation of: 'Reactions in the system basalt/simulated spent fuel/water,' Mat. Res. Soc. Proc. 26 (1984), by D. E. Grandstaff, G. L. McKeon, E. L. Moore, and G. C. Ulmer."
06/20/86	LR-287-49	A. D. Kelmers, "Reconsideration of the NRC Draft Site Technical Position on the use of hydrazine to simulate Hanford Site redox conditions and reactions." Also contains a review of: Sorption and desorption reactions of radionuclides with a crushed basalt-bentonite packing material, RHO-BW-SA-416 P (1985), by G. S. Barney, D. L. Lane, C. C. Allen, and T. E. Jones.
06/25/86	LR-287-48	K. L. Von Damm, "Review of: The organic chemistry of ground waters from the Palo Duro Basin, Texas: Implications for radionuclide complexation, ground water origin, and petroleum exploration, BMI/ONWI-578 (1985), by J. L. Means and N. J. Hubbard."
xx/xx/86	LR-287-47	A. D. Kelmers, "Proceedings of the NRC/ORNL workshop: 'Radionuclide sorption modeling related to high-level nuclear waste repository performance assessment'."
06/04/86	LR-287-46	A. D. Kelmers, "Review of the paper: 'Adsorption of actinides by marine sediments: Effect of the sediment/seawater ratio on measured distribution coefficients,' Environ. Sci. Tech. 20, 483-490 (1986), by J. J. W. Higgo and L. V. C. Rees."
06/20/86	LR-287-45	G. D. O'Kelley, "Review of: 'Plutonium speciation in selected basalt, granite,shalem and tuff ground waters,' Nucl. Tech. 62, 298-310 (1983), by J. M. Cleveland, T. F. Rees, and K. L. Nash."
06/03/86	LR-287-44	G. D. O'Kelley, "Review of: 'Neptunium and americium speciation in selected basalt, granite, shale, and tuff ground waters,' Science 221, 271-273 (1983), by J. M. Cleveland, T. F. Rees, and K. L. Nash."
05/30/86	LR-287-43	K. L. Von Damm, "Review of: Uranium-series dating of secondary carbonate and silica precipitates relating to fault movements in the Nevada Test Site region and of caliche and travertine samples from the Amargosa desert, USGS Open-File Report 85-47 (1985), by B. J. Szabo and P. A. O'Malley, and Uranium, thorium analyses and uranium-series ages of calcite and opal, and stable isotopic

compositions of calcite from drill cores UE25a#1, USW G-2, and USW G-3/GU-3, Yucca Mountain, Nevada, USGS Open-File Report 85-224 (1985), by B. J. Szabo and T. K. Kyser."

06/02/86 LR-287-42 J. G. Blencoe, "Review and Evaluation of: Progress Report on the Hydrothermal Interaction of Defense Waste Glasses with Basalt and Groundwater at 150 C, SD-BWI-TI-312 (1986), by D. L. Lane, C. C. Allen, and R. R. Adee."

04/30/86 LR-287-41 K. L. Von Damm, "Review of: 'Isotope geochemistry of fluid inclusions in Permian halite with implications for the isotopic history of seawater and the origin of saline formation waters,' Geochim. Cosmochim. Acta 50, 419-433 (1986), by L. P. Knauth and M. A. Beeunas."

05/02/86 LR-287-40 J. G. Blencoe, "Review and Evaluation of: A final report on hydrothermal testing of ^{99}Tc-doped glass waste form and waste package components, SD BWI TI 229 (1984), by J. A. Schramke, L. E. Thomas, S. G. McKinley, S. A. Simonson, and D. G. Coles."

04/30/86 LR-287-39 G. D. O'Kelley, "Review of: Solubility limits on radionuclide dissolution at a Yucca Mountain repository, LA-9995-MS (1984), by J. F. Kerrisk."

03/31/86 LR-287-38 K. L. Von Damm, "Review of: 'Parametric Testing of a DWPF Borosilicate Glass,' in Scientific Basis for Nuclear Waste Management VIII, Mat. Res. Soc. Symp. Vol. 44, 303-310 (1985), by F. Bazan and J. Rego."

03/31/86 LR-287-37 K. L. Von Damm, "Review of: 'Leaching Savannah River Plant Nuclear Waste Glass in a Saturated Tuff Environment,' in Scientific Basis for Nuclear Waste Management VIII, Mat. Res. Soc. Symp, Vol 44, 247-256 (1985), by N. E. Bibler, G. G. Wicks, and V. M. Oversby."

04/30/86 LR-287-36 J. G. Blencoe, "Review and Evaluation of: FY-1984 Annual Report: Spent fuel and UO_2 source term evaluation results, PNL-5650, DOE/CH-19 (1986), by W. J. Gray and G. L. McVay."

02/28/86 LR-287-35 K. L. Von Damm, "Review of: 'Hydrothermal Interaction of Topopah Spring Tuff with J-13 Water as Function of Temperature,' in Scientific Basis for Nuclear Waste Management VIII, Mat. Res. Soc. Symp. Vol. 44, 539-546 (1985), by K. G. Knauss, J. M. Delaney, W. J. Beiriger, and D. W. Peifer."

02/28/86	LR-287-34	K. L. Von Damm, "Review of: 'The Behavior of Actinide Containing Glasses During Gamma Irradiation in a Saturated Tuff Environment,' in Scientific Basis for Nuclear Waste Management VIII, Mat. Res. Soc. Symp. Vol 44, 257-264 (1985), by J. K. Bates and V. M. Oversby."
03/03/86	LR-287-33	J. G. Blencoe, "Review and Evaluation of: Examination of Solids from 200 C Hydrothermal Tests with Spent Fuel, SD-BWI-TI-283 (1985), by L. E. Thomas, B. Mastel, and E. D.Jensen."
03/31/86	LR-287-32	G. D. O'Kelley, "Review of: Solubility Experiments for the Nevada Nuclear Waste Storage Investigations Project, by J. F. Kerrisk, LA-10560-MS (1985), Los Alamos National Laboratory."
02/25/86	LR-287-31	G. D. O'Kelley, "Review of 'Surface Oxidation-Reduction Kinetics Associated with Experimental Basalt-Water Reaction at 25 C,' by A. F. White, A. Yee, and S. Flexer, Chem. Geol. 49, 73-86 (1985)."
02/18/86	LR-287-30	A. D. Kelmers, "Review of the report: An Assessment of the Important Radionuclides in Nuclear Waste, by J. F. Kerrisk, LA-10414-MS, Los Alamos National Laboratory, Los Alamos, New Mexico."
02/12/86	LR-287-29	J. C. Mailen and J. T. Bell, "Plutonium Chemistry and Migration Behavior in High-Level Waste Repository Environments"
02/14/86	LR-287-28	A. D. Kelmers, "Review of the paper: 'Distribution of Plutonium and Americium Beneath a 33-year-old Liquid Waste Disposal Site,' J. Environ. Qual. 14, 501-509, (1985), by J. W. Nyhan, B. D. Drennon, W. V. Abeele, M. L. Wheeler, W. D. Purtymun, G. Truijillo, W. J. Herrea, and J. W. Booth, Los Alamos National Laboratory, Los Alamos, New Mexico."
01/30/86	LR-287-27	G. D. O'Kelley, "Review of: 'Aqueous Oxidation-Reduction Kinetics Associated with Coupled Electron-Cation Transfer from Iron-Containing Silicates at 25 C,' Geochim. Cosmochim. Acta 49, 1263-1275 (1985), by A. F. White and A. Yee."
02/02/86	LR-287-26	K. L. Von Damm, "Review of: 'Hydrothermal Interaction of Columbia Plateau Basalt from the Umtanum flow (Washington, U.S.A.) with its coexisting groundwater,' Chem. Geol. 49, 53-71 (1985), by E. L. Moore, G. C. Ulmer, and D. E. Grandstaff."

01/31/86	LR-287-25	K. L. Von Damm, "Review of: Reaction of Bullfrog Tuff with J-13 Well Water at 90 C and 150 C, UCRL-53442, by V. M. Oversby and K. G. Knauss."
02/03/86	LR-287-24	J. G. Blencoe, "Review of: Analyses of Solids from Initial 200 C, 30 MPa Hydrothermal Tests with "Fully-Radioactive" Waste Glass and Spent Fuel, SD-BWI-TI-278, by L. E. Thomas, B. Mastel, and E. D. Jensen."
01/31/86	LR-287-23	A. D. Kelmers, "Review of: 'Appendix B, Spent Fuel Dissolution,' in November Monthly Progress Report, 1985, The Aerospace Corporation."
01/20/86	LR-287-22	A. D. Kelmers, "Review of the report: Derivation of a Waste Package Source Term for NNWSI from Results of Laboratory Experiments, UCRL-92096 (1985), by V. M. Oversby and C. N. Wilson."
01/21/86	LR-287-21	A. D. Kelmers, "Review of: 'The Chemical State of the Fission Products in Oxide Fuels,' J. Nucl. Matls. 131, 221-246 (1985), by H. Kleykamp."
12/30/85	LR-287-20	K. L. Von Damm, "Review of: 'The Geochemistry of Ca, Sr, Ba, and Ra sulfates in some deep brines from Palo Duro Basin, Texas,' D. Langmuir and D. Melchior, Geochim. Cosmochim. Acta 49, 2423-2432 (1985)."
11/25/85	LR-287-19	G. D. O'Kelley, "Review of: 'Measurements of thermal neutrons in the subsurface,' by M. W. Kuhn, S. N. Davis, H. W. Bentley, and R. Zito, Geophysical Research Letters 11, 607-610 (1984)."
12/12/85	LR-287-18	J. G. Blencoe, "Review of: Field and Theoretical Investigations of Fractured Crystalline Rock Near Oracle, Arizona, by J. W. Jones, E. S. Simpson, S. P. Neuman, and W. S. Key, NUREG/CR-3736 (1985)."
11/24/85	LR-287-17	K. L. Von Damm, "Review of: Reaction of Topopah Spring Tuff with J-13 Well Water at 90 C and 150 C, by V. M. Oversby, UCRL-53552 (1984)."
11/01/85	LR-287-16	G. D. O'Kelley, "Review of: 'The Kinetics of the Oxidation of Ferrous Iron in Synthetic and Natural Waters,' by W. Davison and G. Seed, Geochimica et Cosmochimica Acta 47, 67-79 (1983)."
10/30/85	LR-287-15	K. L. Von Damm, "Review of: Mobility of Radionuclides in High Chloride Environments, NUREG/CR-4237 RW (1985), by H. J. Simpson, A. L.

		Herczeg, R. F. Anderson, R. M. Trier, G. G. Mathieu, and B. L. Deck."
10/07/85	LR-287-14	A. D. Kelmers, "Review of: Preliminary Bounds on the Expected Postclosure Performance of the Yucca Mountain Site, So. Nevada, SAND84-1492, by S. Sinnock, Y. T. Lin, and J. P. Brannen."
10/04/85	LR-287-13	J. G. Blencoe, "Review of: Evaluation of Minerals in Fractures of the Unsaturated Zone from Drill core USW-G4, Yucca Mountain, Nye County, Nevada, LA-10415-MS (1985), by B. Carlos."
09/09/85	LR-287-12	G. K. Jacobs, "Review of: Chlorine Isotopes as Environmental Tracers in Columbia River Basalt Groundwaters, RHO-BW-SA-372 P (1984), by D. Graham, S. Gifford, and H. Bentley."
09/09/85	LR-287-11	J. G. Blencoe, "Review of: Petrologic and Geochemical Characterization of the Topopah Spring Member of the Paintbrush Tuff Used in Waste Package Experiments, UCRL-53558, by K. G. Knauss."
09/09/85	LR-287-10	J. G. Blencoe, "Review of: Verification and Characterization of Continuum Behavior of Fractured Rock at AECL Underground Research Laboratory, BMI/OCRD-17, LBL-14975."
08/15/85	LR-287-9	G. K. Jacobs, "Comments concerning S. L. Phillips' reply to LR-290-10, March 28, 1985."
08/15/85	LR-287-8	J. G. Blencoe, "Review of: 'Downhole Geophysical Logging,' Ann. Rev. Earth Planet. Sci. 13, 315-344 (1985), by A. Timur and M. N. Toksoz."
07/09/85	LR-287-7	A. D. Kelmers, "Concerns Relative to the Applicability of the Yucca Mountain Radionuclide Sorption Information for Site Performance Assessment Purposes."
07/09/85	LR-287-6	A. D. Kelmers and G. K. Jacobs, "Review of: Critical Parameters for a High-Level Waste Repository, Volume I: Basalt, by E. P. Binnall, H. A. Wollenberg, S. M. Benson, L. Tsao, O. Weres, A. L. Ramirez, and G. A. Armentrout, NUREG/CR-4161 (1985)."
06/11/85	LR-287-5	G. K. Jacobs, "Review of: 'Brine Migration in Salt,' by W. Kelly."
06/11/85	LR-287-4	J. G. Blencoe, "Review of: The Dissolution of Rainer Mesa Volcanic Tuffs and Its Application to the Analysis of the Groundwater Environment, MS Thesis

		of M. S. Henne, University of Nevada, Reno, NV (1982)."
06/11/85	LR-287-3	G. K. Jacobs, "Review of: The Potential of Natural Analogues in Assessing Systems for Deep Disposal of High-Level Radioactive Waste, by N. A. Chapman, I. G. McKinley, and J. A. T. Smellie."
04/16/85	LR-287-2	G. K. Jacobs, "Review of: Geochemical Sensitivity Analysis I. Identification of Conditions and Criteria for Design of Transport Experiments When Radioelement Speciation Must be Considered in High-Level Waste Repository Risk Assessment, by Siegel, Erickson, and Vopicka, Sandia National Laboratory."
02/14/85	LR-287-1	G. K. Jacobs, "Calculated Solubilities for Selected Radionuclides as a Function of Eh: To Support NRC Review of DOE's Environmental Assessment for the Hanford Site."
11/28/84	LR-3.6	G. K. Jacobs, "Review and Evaluation of: Performance Assessment Plans and Methods for the Salt Repository Project, BMI/ONWI-545 (1984)."
10/17/84	LR-2.3	J. G. Blencoe, "Scoping Review of the Draft EA for the Yucca Mountain Site."
10/15/84	LR-3.5	G. K. Jacobs, "Scoping Review of the Draft EA for the Salt Sites."
10/11/84	LR-1.4	A. D. Kelmers, "Scoping Review of the Draft EA for the Hanford Site."
10/10/84	LR-4.1-19	S. Y. Lee, "Review of: An Application of the Population Balance to the Assessment of the Importance of Radionuclide Colloids in High-Level Waste Management, by Nuttall, Siegel, and Bonano."
08/07/84	LR-3.3	G. K. Jacobs, "Review Comments on: 'Draft Umbrella Site Technical Position on Geochemical Issues for a High-Level Waste Disposal Facility in Salt'."
05/22/84	LR-2.1	A. D. Kelmers, "Review and Analysis of NNWSI Sorption Information."
05/18/84	LR-3.1	G. K. Jacobs, "Geochemical Conditions for Candidate Salt Sites: Limitations of Available Data (ONWI)."
04/24/84	LR-1.3	C. F. Baes, III and A. D. Kelmers, "Review and Analysis of BWIP Sorption Information."
04/24/84	LR-1.2	A. D. Kelmers, J. G. Blencoe, and C. K. Bayne, "Review Comments on: Barrier Materials Test Plan,

SD-BWI-TP-022."

03/28/84	LR-4.2-6	J. G. Blencoe, "Matrix Diffusion of Radionuclides: Limitations of Available Data (NNWSI/NTS)" with a draft of the supporting topical review, "Matrix Diffusion of Radionuclides in Rock/Groundwater Systems."
02/29/84	LR-4.1-17	G. K. Jacobs, "Review of: The Salton Sea Geothermal Field, California, as a Near Field Natural Analog of a Radioactive Waste Repository in Salt, BMI/ONWI-513, by W. A. Elders and L. H. Cohen."
02/28/84	LR-4.2-5	J. G. Blencoe and G. E. Grisak, "NNWSI Site Technical Position and Review of Matrix Diffusion of Radionuclides in Rock/Groundwater Systems."
02/23/84	LR-4.2-4	A. D. Kelmers and C. F. Baes, III, "Site Technical Position and Review of Radionuclide Sorption Data for the Basalt Waste Isolation Project Site."
01/31/84	LR-4.2-3	G. K. Jacobs, "Information Required for a Conceptual Model of a Repository Located at the Nevada Test Site, with an Emphasis on Geochemistry."
01/24/84	LR-4.2-2	G. K. Jacobs, "Draft: Purpose, Objectives, and Discussion Items for a Workshop on Geochemistry with the Office of Nuclear Waste Isolation."
01/20/84	LR-4.1-15	G. K. Jacobs, "Review of: A Computer Code for Producing Eh-pH Plots of Equilibrium Chemical Systems, RHO-BW-SA-299 P, by D. R. Drewes."
01/19/84	LR-4.1-14	A. D. Kelmers, "Suggested Activity to Review the Chemical Status of Radioactive Elements in Spent Fuel."
01/13/84	LR-4.1-13	S. Y. Lee, "Review of: A Review of the State-of-the-Art and Preliminary Assessment of the Feasibility of Modeling the Transport of Radionuclides as Colloidal Particles in Geologic Media, by E. J. Bonano."
12/07/83	LR ...	C. S. Haase, "Review of geochemical portions of: A Summary of Repository Siting Models, NUREG/CR-2782, and Benchmark Problems for Repository Siting Models, NUREG/CR-3097."
11/11/83	LR ...	S. Y. Lee, "Review of: Clays and Clay Minerals for Application to Repository Sealing, ONWI-486."
11/09/83	LR ...	Letter review of documents on the conceptual models

for repositories in basalt and granite.

11/04/83	LR-4.2-1	G. K. Jacobs, "The Scope of Geochemical Issues for Nuclear Waste Repositories in Salt."
11/01/83	LR ...	Review of the second draft of: 'Assessment of Radionuclide Apparent Solubilities by Conservative Estimation of Steady-State Concentration - NRC Draft Technical Position.'
10/31/83	LR ...	Letter report on "Review of draft document entitled: 'Site Technical Position on Waste Form and Package Issues for the Nevada Nuclear Waste Storage Investigations'."
09/29/83	LR-4.3-5	G. K. Jacobs, "Review of Geochemical Parameters Section of: 'Critical Parameters for Basalt'."
09/29/83	LR-4.1-10	G. K. Jacobs, "Review of: 'Letter report on the Uncertainties in the Thermodynamics of Basalt-Oxygen and Basalt-Water Reactions,' by D. G. Schweitzer and M. S. Davis (BNL)."
09/16/83	LR ...	Letter Report discussing 1) chemical reactions in unsaturated vs. saturated media and 2) transport of volatile radionuclides in unsaturated media.
08/11/83	LR-4.3-4	A. D. Kelmers and J. G. Blencoe,"Review of: NRC Draft Technical Position 'Solubility and Speciation of Radionuclide Compounds for High-Level Repository Safety Assessments'."
08/08/83	LR ...	N. H. Cutshall, "Review of: Geochemical Controls on Radionuclide Releases from a Nuclear Waste Repository in Basalt: Estimated Solubilities for Selected Elements, RHO-BW-ST-29 P, by T. O. Early and others."
07/15/83	LR ...	A. G. Croff, "Review of Draft NRC Staff Position Paper entitled: 'Identification of Specific Licensing Information Needs.'"
07/06/83	LR-4.1-9	N. H. Cutshall, "Review of: Statistical Evaluation of Hydrochemical Data from the Saddle Mountains, Wanapum, and Grande Ronde Basalts, Basalt Waste Isolation Project, Hanford Site.'"
07/06/83	LR ...	Letter Report on review of report entitled: Draft Technical Position - Subtask 1.2; Post-Emplacement Monitoring, NUREG/CR-3219, by S. V. Panno.
06/20/83	LR-4.1-8	J. G. Blencoe and A. D. Kelmers, "Review of LA-9328-MS, Summary Report on the Geochemistry of

		Yucca Mountain and Environs."
06/06/83	LR ...	"Review of two papers: 'Solubility Equilibria in Basalt Aquifers: The Columbia Plateau, Eastern Washington, U.S.A.,' Chem. Geol. 36, 15-34 (1982), by Deutsch, Jenne, and Krupka; and Computed Phases Limiting the Concentration of Dissolved Constituents in Basalt Aquifers of the Columbia Plateau in Eastern Washington, PNL-4089 (1982), by Deutsch, Jenne, and Krupka."
05/23/83	LR ...	"Review of Section 7 of ANS Standard 2.24 entitled: '(Proposed) Standard Establishing Geotechnical Parameters for Evaluating Geologic Repositories for High-Level Wastes'."
05/20/83	LR-4.3-3	J. G. Blencoe, "A Brief Review and Critique of Commentary/Data on Radionuclide Solubility and Sorption Contained in the Three-Volume NUREG/CR Draft Final Report (Task 4): Evaluation of Engineered Barrier Design and Performance in an Underground Basalt Repository."
02/15/83	LR-4.3-2	"Review Comments on SCA Chapters and Appendices related to geochemical considerations."
11/30/82	LR-1.4-1	A. G. Croff, H. C. Claiborne, and J. S. Johnson, "Comments on RHO-BWIP Site Characterization Report."
10/08/82	LR-4.3-1	D. R. Cole and H. C. Claiborne, "Review of 'Draft Technical Position on Radionuclide Speciation and Solubility Determinations'."

B0287 MEETING REPORTS

The following Meeting Reports have been prepared to date (11/30/87) by Oak Ridge National Laboratory staff for the NRC Project FIN No. B0287, and transmitted to the NRC Project Manager.

Date	Number	Title
08/06/87	MR-287-11 (draft)	A. D. Kelmers, "NRC Data Review of Information on BWIP and PNL Experiments Using Hydrazine to Establish Reducing Redox Conditions in Radionuclide Sorption Experiments, meeting held at PNL, Richland, WA, on July 21-22, 1987"
02/18/87	MR-287-10	A. D. Kelmers, "Meeting Report on: The Second Topical Conference on Nuclear Waste Management Quality Assurance, sponsored by the Energy Division of the American Society for Quality Control, at Las Vegas, Nevada, February 9-11, 1987."
01/07/87	MR-287-9	G. K. Jacobs, "Meeting Report for NRC/DOE/BWIP Hydrology Data Review."
02/xx/86	MR-287-8	J. G. Blencoe, "ASTM Meeting on Waste Package Testing."
02/07/86	MR-287-7	G. K. Jacobs and K. L. Von Damm, "SRP/NRC Waste Package Workshop for Salt Sites."
11/18/85	MR-287-6	J. G. Blencoe and G. K. Jacobs, "Annual Meeting of the Geological Society of America"
10/04/85	MR-287-5	A. D. Kelmers, G. K. Jacobs, J. G. Blencoe, and R. E. Meyer, "NRC/DOE Data Review for Sorption Information of the Yucca Mountain Site"
08/14/85	MR-287-4	G. K. Jacobs, "Examination of Palo Duro Basin rock core - Texas Bureau of Economic Geology"
07/30/85	MR-287-3	G. K. Jacobs, A. D. Kelmers, and S. K. Whatley, "NRC/DOE Waste Package Workshop for the Yucca Mountain Candidate Site"
07/30/85	MR-287-2	G. K. Jacobs, "ACS Short Course on Environmental Chemistry of Groundwater"
07/26/85	MR-287-1	J. G. Blencoe, "Review of BWIP Solubility Topical Report"

07/26/85	MR-287-1 (# incorrect)	S. K. Whatley, "Meeting with D. J. Brooks, J. R. Bradbury, S. K. Whatley in Silver Spring, Maryland."
02/08/85	MR-287-1 (# incorrect)	J. G. Blencoe and G. K. Jacobs, "Trip Report of Geological Society of America Meeting at Reno, Nevada."
11/28/84	MR-5.4	S. K. Whatley, "Meeting Report for the B0287 and B0290 Project Review."
09/25/84	MR-5.3	G. K. Jacobs, "Penrose Conference on the Geochemistry of the Environment near a High-Level Nuclear Waste Repository."
09/07/84	MR-5.2	G. K. Jacobs and S. K. Whatley, "Discussions of Geochemistry Areas Which Might be of Mutual Interest with Malcom Siegel."
08/23/84	MR-3.4	G. K. Jacobs, "Geochemistry Program Overview for ONWI."
07/31/84	MR 2.2	A. D. Kelmers and J. G. Blencoe, "DOE/NRC Geochemistry Workshop on the NNWSI Candidate High-Level Waste Repository Site at Yucca Mountain, Nevada."
06/19/84	MR 3.2	G. K. Jacobs, "Visit to present seminar: 'Review and Assessment of Geochemical Conditions for Candidate Salt Sites of ONWI', and for discussions with NRC staff."
02/09/84	MR 4.1-16	J. G. Blencoe and A. D. Kelmers, "NRC/DOE Geochemistry Workshop in Richland, Washington."
12/08/83	MR 4.1-12	H. C. Claiborne and A. D. Kelmers, "7th Scientific Basis for Nuclear Waste Management."
11/17/83	MR 4.1-18	J. G. Blencoe, "GSA Engineering Geology Division Symposium on the Geologic Disposal of Radioactive Wastes and a GSA Forum on Nuclear Waste Disposal Issues."
12/08/83	MR 4.1-9	H. C. Claiborne and A. D. Kelmers, "Attend Seventh International Symposium on the Scientific Basis of Nuclear Waste Management."
10/31/83	MR 4.1-8	H. C. Claiborne and G. K. Jacobs, "NNWSI Waste Package Workshop."
04/15/83	MR ...	A. G. Croff, "Discussion of Work to be Performed under B0290 and Draft Work Plan Describing Same."

04/25/83	MR ...	J. H. Kessler, "International Symposium on Geochemical Behavior of Disposed Radioactive Waste."
03/11/83	MR 4.1-7	A. D. Kelmers, "BWIP Overview Seminar presented by Bill Cottam of RHO-BWIP."
01/27/83	MR 4.1-6	H. C. Claiborne and A. D. Kelmers, "NRC-NNWSI Meeting on Geochemistry Issues."
01/18/83	MR 4.1-5	H. C. Claiborne and R. R. Turner, "1982 NWTS Program Information Meeting."
11/12/82	MR 4.1-4	D. R. Cole, "Geochemical Society Symposium on Geochemistry of Radionuclide Migration/Retardation."
10/13/82	MR 4.1-3	A. D. Kelmers and D. R. Cole, "Discussions with Jess Cleveland about his Plutonium Solubility/Speciation Experiments in Site Groundwaters."
10/07/82	MR 4.1-2	A. D. Kelmers, "NRC Research Program Planning Workshop on Geochemistry of HLW Disposal."
09/21/82	MR 5.0-1	A. G. Croff, "Discussion of Proposed Activities."
08/19/82	MR 4.1-1	A. D. Kelmers and D. R. Cole, "Participation in NRC Geochemistry Workshop Team at RHO."

B0287 TOPICAL REPORTS AND MISCELLANEOUS PRODUCTS

The following Topical Reports completed to date (11/30/87) by Oak Ridge National Laboratory staff, and miscellaneous project products prepared by Oak Ridge National Laboratory staff, or subcontractors, for the NRC Project FIN No. B0287 have been transmitted to the NRC Project Manager.

Date	Number	Title
09/30/87	draft	G. K. Jacobs, K. L. Von Damm, J. G. Blencoe, and A. D. Kelmers, "Geochemistry Issues for the Yucca Mountain Candidate High-Level Waste Repository Site"
09/30/87	draft	G. K. Jacobs, K. L. Von Damm, J. G. Blencoe, and A. D. Kelmers, "Geochemistry Issues for the Hanford Site Candidate High-Level Waste Repository"
05/27/87		Express mail -- "Request for Review of Data Supporting Basalt Waste Isolation Project Reports Describing Radionuclide Sorption on Interbed Materials."
05/22/87		Express mail -- "Information Requests, Justification for the Requests, and Background References for the Data Review to be Held at the Basalt Waste Isolation Project in Richland, Washington; Data Review to Address: Use of Hydrazine in Experiments to Study Radionuclide Sorption Reactions Under Reducing Redox Conditions."
02/06/87		Manuscript submitted to Nuclear Safety, A. D. Kelmers, R. E. Meyer, J. G. Blencoe, and G. K. Jacobs, "Radionuclide Sorption Methodologies for Performance Assessments of High-Level Nuclear Waste Repositories."
02/12/86		"Radwaste Natural Analog Catalog," by D. G. Brookins, University of New Mexico.
01/10/86		A. D. Kelmers, "Glossary for sorption terms related to draft NRC Technical Position on sorption."
12/18/85		Express mail -- "Review Comments on draft NRC Techincal Position: 'Determination of Radionuclide Sorption for Assessment of High-Level Waste

		Isolation'."
04/16/85	ORNL/TM-9585 NUREG/CP-0062	"Proceedings of a Conference on the Application of Geochemical Models to High-Level Nuclear Waste Repository Assessment."
10/24/84	NUREG/CR-3763	"Final Draft: Review and Assessment of Radionuclide Solubility Information for the Basalt Waste Isolation Project Site, by J. G. Blencoe.
10/02-84		Held workshop on "The Application of Geochemical Models to High-Level Nuclear Waste Repository Assessment" at Oak Ridge, TN.
05/18/84	ORNL/TM-9221	Draft topical review: Review and Assessment of Information on Geochemical Conditions for Candidate Salt Sites of the Office of Nuclear Waste Isolation (ONWI), by G. K. Jacobs.
04/06/84	NUREG/CR-3763	Final draft of the topical review: Review and Assessment of Radioactive Sorption Information for the Basalt Waste Isolation Project Site, by A. D. Kelmers.
03/22/84		Draft Proposal on: "Workshop on the Application of Geochemical Models to High-Level Nuclear Waste Repository Assessment", by G. K. Jacobs.
01/04/84		Draft annotated outline for a Site Technical Position entitled: "Review and Evaluation of Information on the Geochemical Conditions for Candidate Salt Sites of the Office of Nuclear Waste Isolation (ONWI)", by G. K. Jacobs
10/18/83	ORNL/TM-9873	Draft copy of: "Description and Use of the Waste Management Document Data Base", by A. G. Croff.
09/29/83		Second draft copy of Appendix A and a first draft copy of section 2.5 on: "The significance of rock/water ratio for the revised DSTP on solubility."
09/29/83		Draft of: "Draft Staff Technical Position on the Geochemical Aspects of HLW Repositories", by A. G. Croff.
08/09/83		Three draft topical reviews:
	NUREG/CR-	A Scientific Review and Critique of NNWSI Studies on Radionuclide Solubility and Speciation in Tuff-Groundwater Systems, by J. G. Blencoe.
	ORNL/TM-9224	Radionuclide Sorption Information for a High-Level

		Nuclear Waste Repository in Yucca Mountain, Nevada, by A. D.Kelmers.
	NUREG/CR-	Review of Geochemical Information for the Nevada Nuclear Waste Storage Site, by C. F. Baes, III.
05/23/83	NUREG/CR-3763	Second draft of a BWIP topical review entitled: Radionuclide Sorption Information for the Basalt Waste Isolation Project (BWIP) Candidate High-Level Waste Repository: A Scientific Review and Technological Assessment.
05/23/83	NUREG/CR-4024	First draft of a BWIP topical review entitled: Review of recent studies on solubility and speciation of radionuclides relevant to the Basalt Waste Isolation Project.
05/23/83	NUREG/CR-4186	First draft of: Review of Geochemical Condition Information at the Basalt Waste Isolation Project Site.
03/28/83		Nine revised SIAs (incorporating comments from internal review), and the revised SCA redox appendix (incorporating comments from internal review and extended to include BWIP-site-specific features).
02/14/83		"Four-day review of SCR at NRC headquarters in Silver Spring", by H. C. Claiborne.
01/19/83		Consolidated version of the redox appendix, including some editorial and organizational changes as compared to earlier submission and a copy of the sorption appendix updated to include a section on redox control.
01/11/83		Revised redox appendix (whole) and Section on redox control for solubility Appendix.
01/07/83		Revised Appendix T on Sorption; revised Chapter 2 of redox appendix; and mark-up of draft SCA Chapter 6.
12/22/82		Draft list of questions for the NTS Geochemistry Workshop to be held January 12-14, 1983, in Las Vegas.
11/30/82		Nine geochemical SIAs revised to accomodate comments received as of 11/29/82 and extended to include Sections 7 and 8; SCA appendices on sorption, solubility and apeciation, and redox conditions.

11/02/82	Drafts of nine SIAs for which the geochemistry team has the lead, and draft appendices on sorption and Eh.

WM Record File
B0287
ORNL

WM Project 10,11,16
Docket No.
PDR ✓
LPDR ✓ (B, N, S)

Distribution:
DBrooks | Joan ticket

(Return to WM, 623-SS)

fcf

WM DOCKET CONTROL
CENTER

'87 DEC 11 A10:16