September 11, 1998

Mr. Samuel Rousso, Director
for Program Management and Administration
Office of Civilian Radioactive Waste Management
U. S. Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

SUBJECT: MINUTES OF THE JUNE 18, 1998, QUARTERLY TECHNICAL MEETING

Dear Mr. Rousso:

Enclosed are the minutes of the June 18, 1998, quarterly technical meeting between the staff of the U.S. Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) concerning progress in DOE's site characterization programs at Yucca Mountain, Nevada. This meeting was held by video conference. Organizations other than DOE and NRC that were represented at the meeting were the State of Nevada; Clark County and Nye County, Nevada; State of Nevada Legislature, the U.S. Nuclear Waste Technical Review Board, and the U.S. Geological Survey.

The meeting again resulted in a good exchange of information and views between DOE and NRC. No response to this letter is required. If you have any questions regarding the enclosed meeting minutes, please contact Michael P. Lee of my staff. He can be reached at (301) 415-6677.

Sincerely,

[Original signed by:]

Michael J. Bell, Acting Chief
Performance Assessment and High-Level
Waste Integration Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

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WM-11

cc: See attached list

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Distribution for letter to S.Rousso dated September 11, 1998

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ENCLOSURE

MINUTES OF THE JUNE 18, 1998
U.S. DEPARTMENT OF ENERGY/NUCLEAR REGULATORY COMMISSION
QUARTERLY TECHNICAL MEETING

On June 18, 1998, U.S. Nuclear Regulatory Commission staff met with staff from the U.S. Department of Energy (DOE) and DOE's contractor to discuss items of mutual interest regarding DOE's site characterization programs. This meeting was another in a continuing series of periodic quarterly technical meetings (QTMs). The meeting was held via a three-way videoconference at the NRC office in Rockville (Maryland); DOE office's in Las Vegas (Nevada); and the Center for Nuclear Waste Regulatory Analyses (CNWRA) office in San Antonio (Texas). Representatives from the State of Nevada; Clark County and Nye County, Nevada; State of Nevada Legislature, the U.S. Nuclear Waste Technical Review Board, and the U.S. Geological Survey (USGS) also attended. The agenda can be found in Attachment 1[1]. Attachment 2 contains the list of attendees.

The first QTM agenda item was a series of presentations in which DOE provided an update on the status of the scientific studies program. The topics covered included updates on the following: alcove moisture studies within the exploratory studies facility (ESF); cross-drift excavation; Busted Butte field tests; unsaturated zone transport tests; and other parallel testing activities. [Most of these activities fall into the general category of work referred to as enhanced characterization of the repository block (ECRB).] The briefing materials reviewed are contained in Attachment 3. In the question and comment period that followed, the following discussion points were noteworthy:

- *ESF Moisture Studies:* Within the ESF, DOE has established four niches and two test alcoves to test water seepage and transport within the repository block. These tests also include the monitoring of surface water percolation to the waste emplacement horizon.

- *ECRB:* The principal ECRB effort at present is the construction of the cross-drift as an extension of the ESF north ramp. Tunnel construction will be achieved using a 5-meter diameter tunnel boring machine (TBM). DOE reported that the TBM was currently at Station 04 + 75 meters. In response to an NRC question, DOE noted that the NRC should now have both parts[2] of the *Determination of Importance Evaluations* (DIEs) for the cross-drift. In response to a question regarding the status of testing/geologic mapping within the cross-drift, DOE noted that it expected to produce a Phase 1 report documenting the results of these activities by the end of September 1998. (It was also noted later in the meeting that a broad DIE for ECRB

[1] At the beginning of the meeting, it was announced that two noticed discussion items on the original meeting agenda (dated June 9, 1998) would be deferred. These items were "Level of Design Detail in the License Application" and "Data Qualification."

[2] The ECRB DIEs were prepared in two parts or phases: the first phase concerns the construction of the TBM starter tunnel for the cross drift, which was completed earlier this year; and the second phase, which focuses on all remaining ECRB activities, including TBM excavations. Both DIEs have been updated and revised (i.e., Revisions 0 and 1). DOE expects to issue Revision 2 shortly.

investigations was being prepared and has not been issued yet. Among other things, the ECRB DIE is expected to address issues of water use within the ESF/ECRB as well as the potential effects (if any) on DOE's thermal testing program.

- *Boreholes WT-24 and SD-6:* ECRB activities also include the drilling of two new boreholes, designated WT-24 and SD-6. The purpose of these boreholes is to obtain additional geologic and geotechnical data to the north and the west of the proposed repository block. DOE continued to report that there is good correspondence between the driller's logs and the predicted stratigraphy.

The second QTM agenda item was a presentation on DOE's Geologic Framework Model (GFM). See Attachment 4. The GFM is to be used by DOE and its contractors to integrate the process modeling results from the respective earth science disciplines into an overall framework that can be used by DOE for evaluations concerning design and performance. Version 3 of GFM (designated GFM3.0) is currently being reviewed by the NRC staff, at DOE's request. During the presentation, DOE identified the unsaturated zone site-scale model[3] as an example of how "down-stream" users could sample GFM 3.0. DOE also noted that it intends to integrate hydrogeologic information from Nye County's so-called early warning drilling program (EWDP) into the GFM data base when that information becomes available, to the extent that the EWDP data are qualified. During the question and comment period, the NRC staff asked whether the EWDP well data would be "qualified." A representative from Nye County responded that the quality assurance (QA) program for EWDP was comparable to that of NQA-1. The Nye County representative also noted that the NRC staff had conducted an informal review of the EWDP QA program and viewed it favorably. It was also noted that the EWDP QA program had been formally submitted to NRC for its review 3 years ago but because of budget constraints, the staff have not acted on it. In closing, the Nye County representative noted that it hope to have the EWDP QA program independently audited.

The third QTM agenda item was a series of presentations that provided a status/update on a variety of seismic issues under review by DOE. These issues included: (i) recent developments in near-surface ground motion attenuation; (ii) current schedule for the *Seismic Design Basis Input Report*; (iii) current schedule for *Seismic Topical Report No. 3;* and (iv) current schedule for the *Deterministic Seismic Hazard Analysis Report* (see Attachment 5). In the question and comment period that followed, the following discussion points were noteworthy:

- DOE plans to conduct vertical seismic profile (VSP) measurements for shear velocity in the vicinity of the Sample Management Facility later this year. Results of the VSP survey are expected to be made available to the NRC staff when they have been completed.

- Due to recent analysis of near-surface ground motion attenuation (by the University

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[3] Bodvarsson G S, T M Bandurraga and Y S Wu (eds.). "The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, for the Viability Assessment." Berkeley, California: Lawrence Berkeley National Laboratory, LBNL-40376, June 1997.

of Nevada, Reno), the ***Kappa values*** used in the recently completed *Probabilistic Seismic Hazard Analysis* (PSHA)[4] may change. Moreover, DOE noted the expert panel that conducted the PSHA will not be reconvened to re-evaluate the new analyses although they would be informed of the change. Finally, because of the change in the ***Kappa value***, the original PSHA report was undergoing a revision and the revision would be published as an USGS Open-File Report.

The final QTM agenda item was a presentation by DOE of changes to the total-system performance assessment to be submitted as part the forthcoming Viability Assessment (hereafter referred to as the TSPA-VA). In anticipation of the TSPA-VA, DOE and NRC recently conducted a trio of technical exchanges[5] to better understand DOE's approaches, methodologies, and data. To the extent that analytical results were available at the time of the meetings, they were discussed as well. However, in recent months, subsequent to the last technical exchange, it was learned that DOE made changes to its base case analysis. The purpose of this agenda item was for DOE to inform the staff of the recent changes (see Attachment 6). In the question and comment period that followed, the following discussion points were noteworthy:

- The TSPA-VA assumes an average of 1 waste package container failure at 1000 years (the so-called juvenile failure) following permanent closure of the repository although runs of up to 17 waste package failures have been performed. Although the results of the DOE-sponsored expert elicitations in the area of waste package suggest that these failure rates may be too low, DOE intends to provide a full explanation of the basis for the selection of the waste package failure rate in the TSPA-VA.

- In the TSPA-VA, release of leachate from a breached waste package canister is modeled by evenly spreading leachate across the grid blocks that underlie the failed waste packages. As more waste packages fail, the leachate behaves more like an area source than a point source. A Nye County representative requested information on the area underlain by early/juvenile waste package failures. DOE responded that it would have to get back to the county representative with that specific information later.

- The TSPA-VA will include some consideration of rock-fall due to seismic events. More detailed evaluation of the effects of design basis rockfall on waste package performance is being evaluated in a separate, on-going study.

- With respect to the contribution to performance of the concrete inverts within the emplacement drifts, there are other materials within the drifts that may absorb radionuclides. However, DOE is only focusing on degraded concrete at this time.

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[4] See Wong, I.G., and J C. Stepp (coordinators), "Probabilistic Seismic Hazard Analyses for Fault Displacement and Vibratory Ground Motion at Yucca Mountain, Nevada," Oakland, California, TRW Environmental Safety Systems Inc., 3 vols., February 1998 (Prepared for the U.S. Geological Survey)

[5] July 1997, November 1997, and May 1998

- DOE does not intend to examine doses to members of a hypothetical critical group closer than 20 kilometers to the proposed Yucca Mountain repository in the TSPA-VA. Critical groups closer than 20 kilometers may be examined in the context of the draft Environmental Impact Statement for Yucca Mountain. However, the sensitivity of critical group location will be examined in the *Technical Basis Report* that is to accompany the TSPA-VA.

- The effects of pumping well withdrawal on dilution in the saturated zone are not being considered as part of TSPA-VA sensitivity studies. However, DOE does intend to evaluate, off-line, the sensitivity of dose to dilution at the well head to better understand this process. Issues related to well head dilution are expected to be examined in the *Technical Basis Report* that will accompany the TSPA-VA.

- DOE is now using a stream-tube approach for the dose assessment for the TSPA-VA, where each streamtube carries the same volume of water.[6] DOE assumes that this approach is conservative and it expects to implement a more realistic model in Fiscal Year 1999. (DOE noted that under this approach, the streamtube with the highest dose value is the streamtube that will be used in its dose assessment.)

- Retardation within the alluvium is believed to be a potentially important process at the Yucca Mountain site; however, the full extent and effect of this process is not well known at this time and is expected to be subject to detailed investigation in the future. Consequently, release rate mechanisms and values for colloids may prove to be important in a TSPA calculation.

- DOE and NRC have different approaches regarding the treatment of neptunium (Np) solubility in a the TSPA with the result being an order of magnitude difference in solubility numbers for Np.

Finally, in a related matter, DOE noted that it had received approximately 1700 comments on the TSPA-VA as a result of internal review within the Department and its contractors, and that DOE staff were in the process of addressing them. After questioning from NRC, DOE stated that despite the number of internal comments, it did not intend to slip the completion date for submitting the VA to the Director of the Office of Civilian Radioactive Waste Management (OCRWM). DOE noted that it intended to submit the TSPA-VA to its standing TSPA peer review panel before submitting it to the OCRWM Director.

At the close of these discussions, the staff representing the State of Nevada and Clark and Nye Counties (Nevada), were invited to make closing comments. These participants declined to make comments.

At the end of this QTM, the NRC staff noted that there were two follow-up items from the last QTM held in December 1997. These follow-up items concerned getting the NRC staff

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[6] It was also noted that the volumetric flux Q through the repository is equal to the flow through all six streamtubes. However, under the streamtube approach, there is no mixing of water in the streamtube with that of so-called "fresh" water in the aquifer adjacent to it.

last QTM held in December 1997. These follow-up items concerned getting the NRC staff copies of the following two products: (i) the ECRB DIEs; and (ii) a DOE contractor report entitled *Disposal Criticality Analysis Methodology*. At the close of the meeting it was confirmed that the NRC staff had received copies of the requested products.

Michael P. Lee
Division of Waste Management
Office of Nuclear Material
Safety and Safeguards
U.S. Nuclear Regulatory Commission

Christian E. Einberg
Regulatory Coordination Division
Office of Civilian Radioactive
Waste Management
U.S. Department of Energy

AGENDA FOR THE QUARTERLY DOE/NRC TECHNICAL VIDEOCONFERENCE

June 18, 1998
8:00 a.m. — 12:00 p.m. (PDT)

DOE Location:
Summerlin ("Blue Room")
1551 Hillshire Drive
North Las Vegas, Nevada 89134

NRC Location:
Two White Flint North, 11555 Rockville Pike, Room T2B5
Rockville, Maryland 20852

CNWRA Location:
Southwest Research Institute Campus, Building 189, 6220 Culebra Road
San Antonio, Texas 78238

Time	*Agenda Item*	*Lead(s)*
8:00 PDT	**Opening Remarks**	DOE, NRC, NV, AUG
8:10 PDT	**Status/Updates of Scientific Studies** - Cross-Drift Excavation and Alcove Testing - Thermal Testing Program - Busted Butte Validation Studies - Seismic Design Basis Report - Deterministic Seismic Hazard Analysis Report - Seismic Topical Report No. 3 - Geologic Framework Model, Version 3	DOE
10:00 PDT	**Changes in TSPA-VA Base Case**	DOE
11:00 PDT	**Follow-Up Items from December QTM**	DOE, NRC, NV, AUG
11:15 PDT	**Closing Remarks**	DOE, NRC, NV, AUG
11:30 PDT	**Adjourn**	

ATTACHMENT 1

LIST OF ATTENDEES
AT THE QUARTERLY DOE/NRC
TECHNICAL VIDEOCONFERENCE

June 18, 1998

Advisory Committee on Nuclear Waste
L. Deering

Booze, Allen, and Hamilton
J. York

Center for Nuclear Waste Regulatory Analyses
R. Green L. McKague W. Patrick
J. Russell J. Stamatakos

Department of the Navy
J. Symder

Nevada Legislative Assembly
B. Price

Nevada Nuclear Waste Task Force
J. Treichel

Nuclear Energy Institute
E. Supko

Nye County, Nevada
M. Murphy N. Stellavato

State of Nevada
S. Frishman

S, C, & A, Inc.
S. Colwell

U.S. Department of Energy (DOE)
D. Barr D. Bryan C. Einberg A. Gil T. Gunter P. Harrington
T. Hawe J. Linhart R. Patterson T. Sullivan M. Tynan A. van Luik

DOE Management and Operating Contractor
K. Ashe H. Benton R. Clayton A. Haghi R. Henning C. Morgan
B. Mukhopadhyay T. Ricketts R. Stevens

U.S. Geological Survey
R. Wallace G. Roseboon

U.S. Nuclear Waste Technical Review Board
R. McFarland

U.S. Nuclear Regulatory Commission
M. Bell B. Belke D.Brooks R. Byrne P. Chaput K. Cheng M. Comar
R. Codell C. Glenn B. Ibrahim P. Justus M.Lee C. Lui R. Major
K. McConnell M. Nataraja K. Stablein J. Trapp S. Wastler R. Weller

ATTACHMENT 2

ATTACHMENT 3

YUCCA MOUNTAIN PROJECT

Status of Scientific Studies at Yucca Mountain

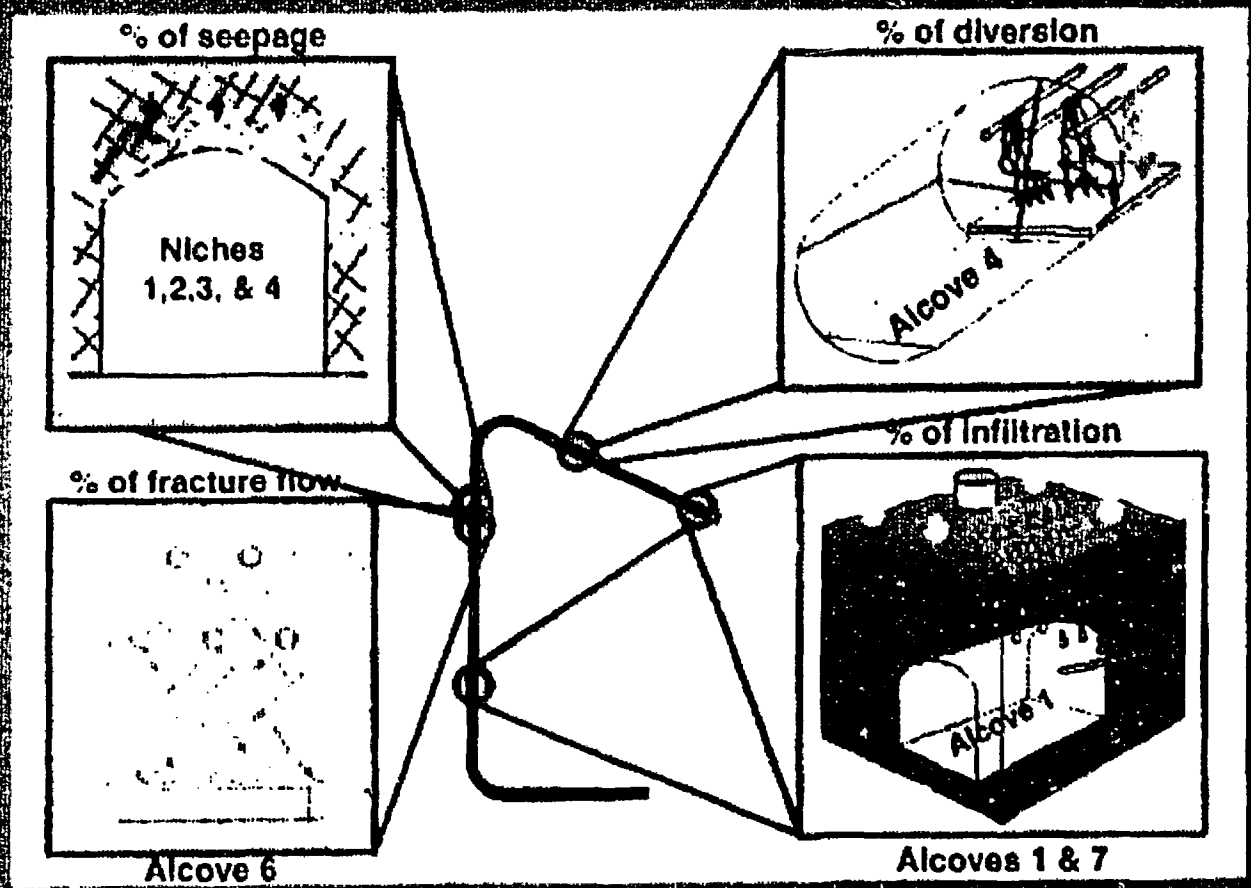
Presented to:
DOE/NRC Quarterly Technical Meeting

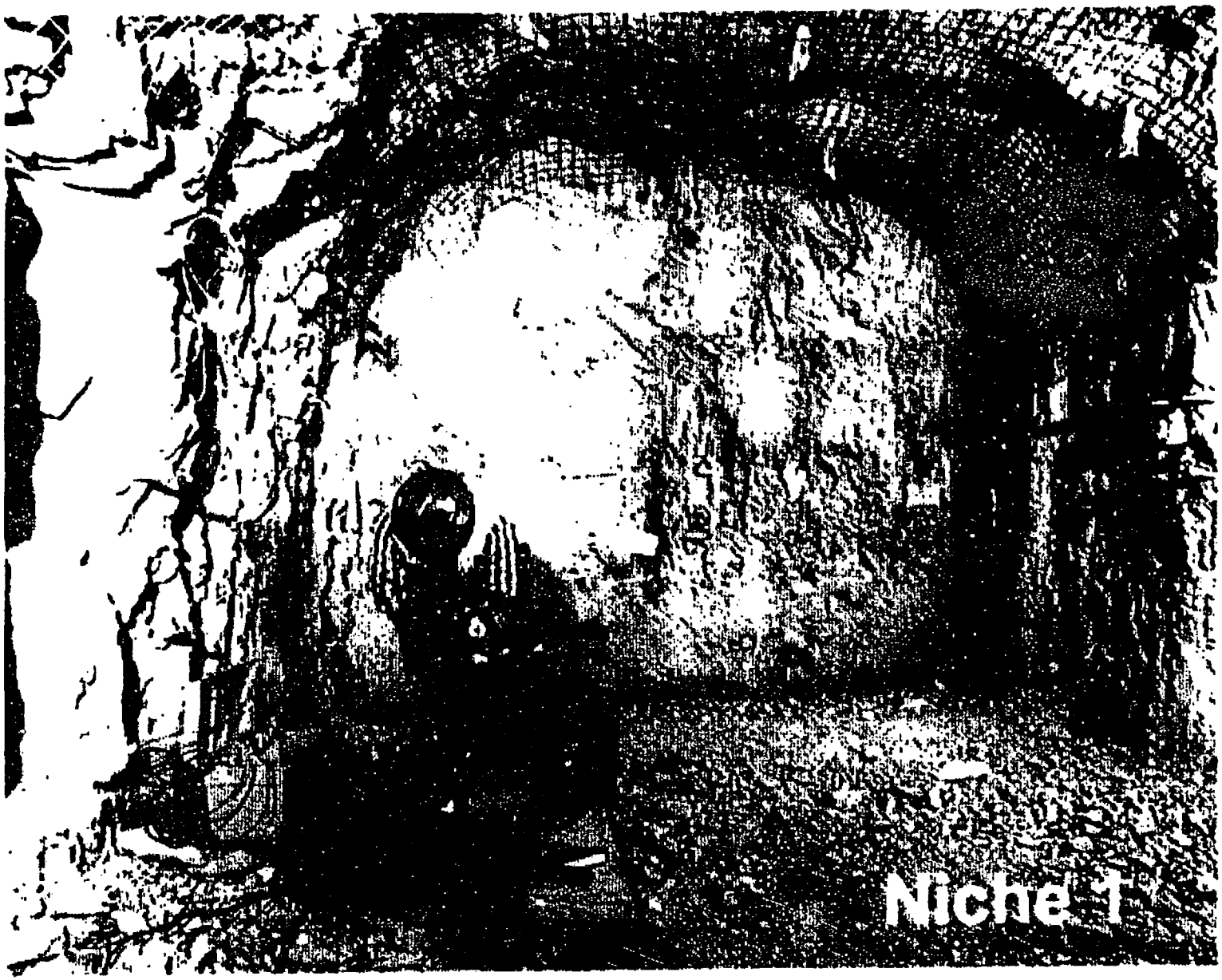
Presented by:
Debra Bryan
Yucca Mountain Site Characterization Office

June 18, 1998

U.S Department of Energy
Office of Civilian Radioactive
Waste Management

Ambient Testing in ESF

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Seepage Into Drifts - Niche Studies

Predictions and measurements at 5 injection intervals (1,000 grams/interval)

Interval	Injection Rate (grams /second)	Modeled Seepage (grams)	Measured Seepage (grams)
1	1.97	207	225
2	2.88	54	95
3	2.05	196	270
4	0.52	0	0
5	1.85	0	0

Niche Studies -- Status

- Niche 1 (35+66) Continue to monitor rock rewetting after installation of bulkhead
- Niche 2 (36+50) Completed post construction initial air permeability testing and dye / tracer injection testing
- Niche 3 (31+07) Completed pre-construction air permeability testing
- Niche 4 (47+85) Drilling initial test holes

Niche Studies -- What Have We Learned?

- **The test results suggest that:**
  - a niche opening (short drift excavated for this study) acts as a capillary barrier,
  - a seepage threshold exists, and
  - the seepage is a fraction of the liquid released above the ceiling (boreholes vary from ~1/2 to 1 m)
  - Nearly two-order-of-magnitude changes in air permeability values and in liquid release rates were measured before and after niche excavation

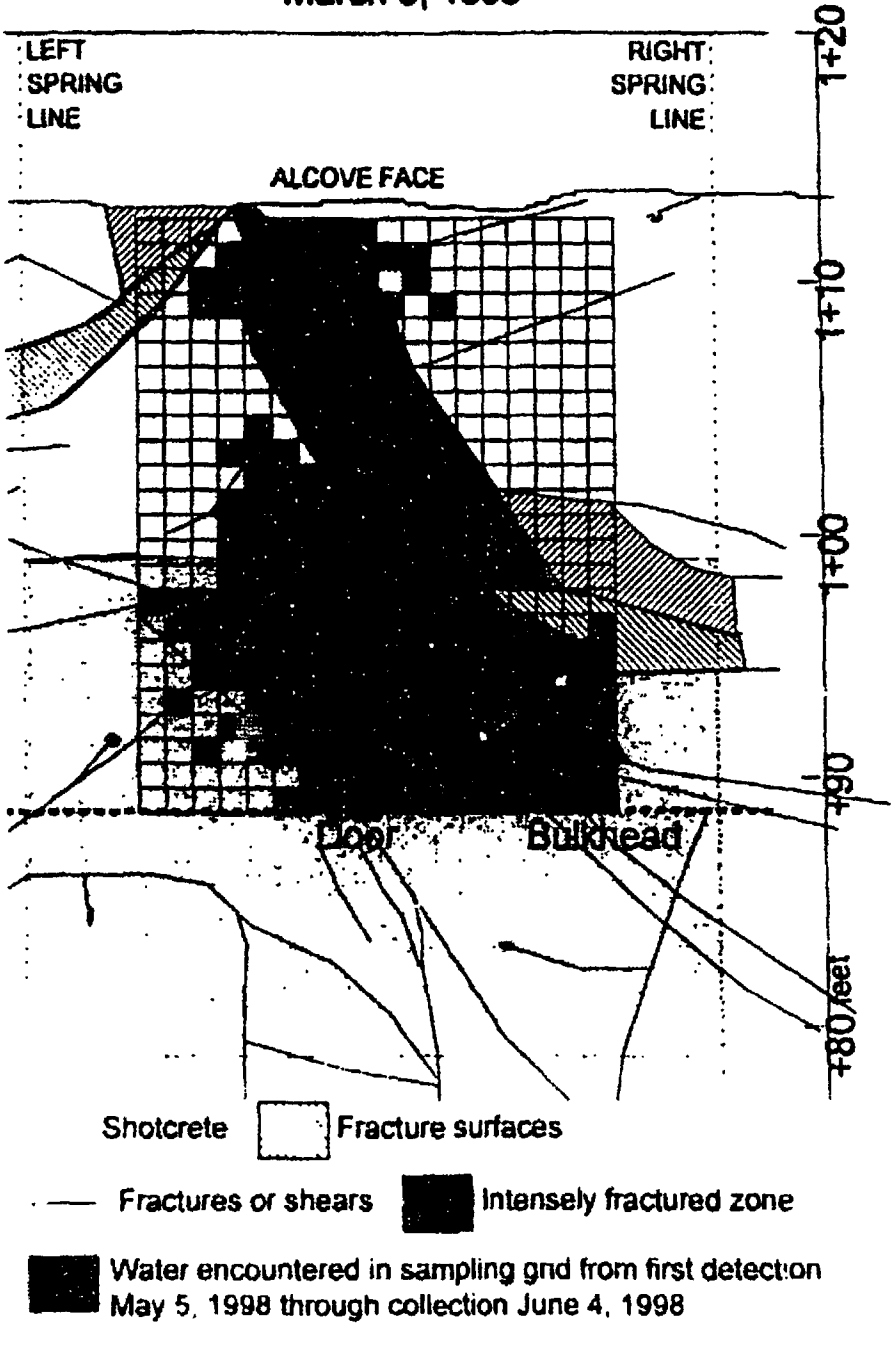
Effects of El Nino -- Status

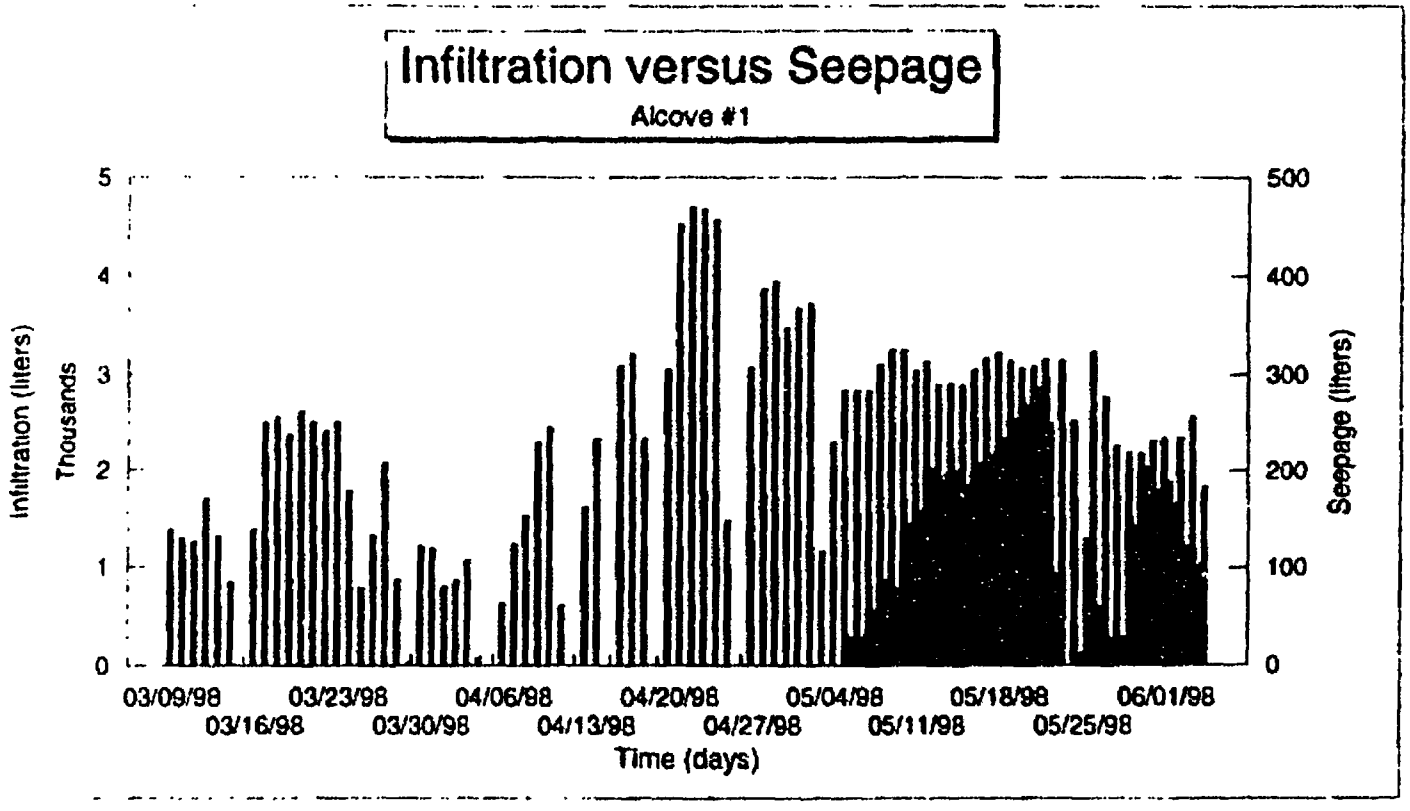
- A series of El Nino spawned winter storms occurred during mid to late February
- Significant runoff was measured in most washes on or near Yucca Mountain on February 23-24
- Infiltration is thought to be responsible for significant drops in subsurface temperature in NRG-6 (at the edge of Drill Hole Wash)
- Although near surface sensors indicated initiation of fracture flow, no indication of water flow has yet been detected in Alcove 7 of the ESF


Exile Hill

Safety Strategy Concept Infiltration Test, ESF Alcove 1

Alcove #1: Infiltration at surface begun March 5, 1998




Infiltration versus Seepage
Alcove #1
Infiltration (liters)
Thousands
5
4
3
2
1
0
500
400
300
200
100
0
Seepage (liters)
03/09/98
03/16/98
03/23/98
03/30/98
04/06/98
04/13/98
04/20/98
04/27/98
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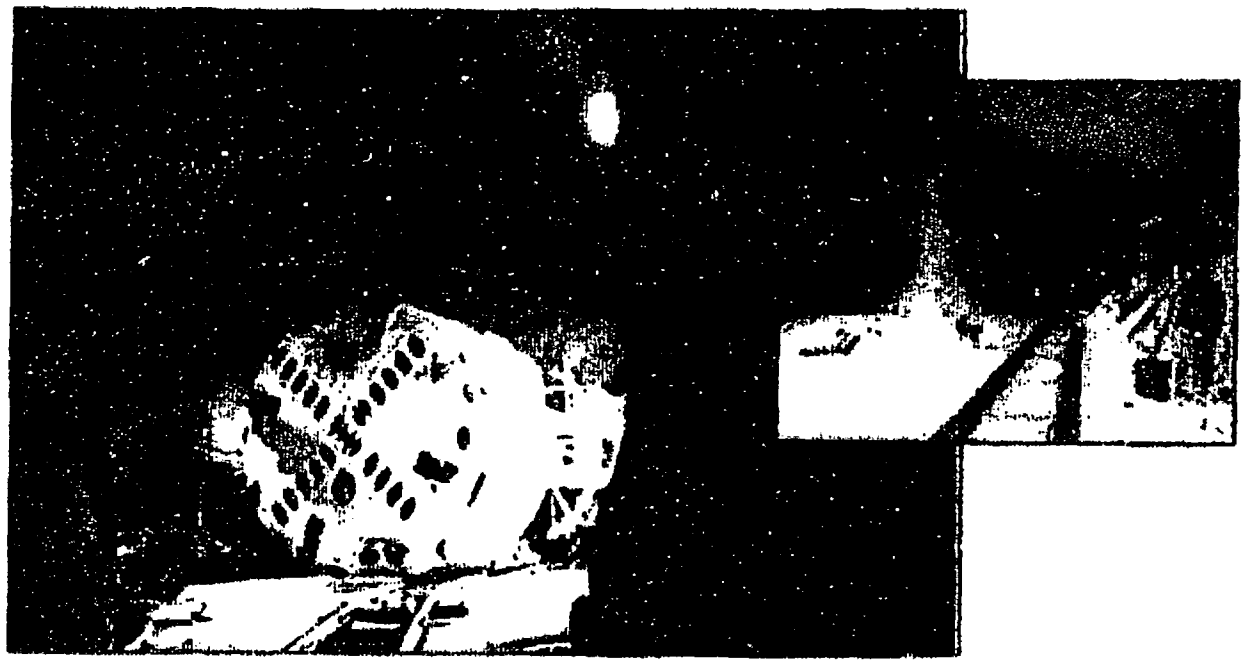
05/11/98
05/18/98
05/25/98
06/01/98
Time (days)

TBM and Launch Chamber Area



Cross-drift TBM operations initiated March 31, 1998, ahead of schedule

Cross Drift - Why Is It Important?

- Allows for reducing hydrologic uncertainties
  - characterize effects, at depth, of surface infiltration
  - characterize hydrologic parameters in different units
  - investigate seepage into drifts in different units
- Allows evaluation of mining methods and impacts at actual drift scale in the repository block
  - Evaluate dust suppression strategies
  - monitor water use and ventilation impacts
  - provide geotechnical parameters within actual host units
  - characterization of potential hazardous mineral distributions

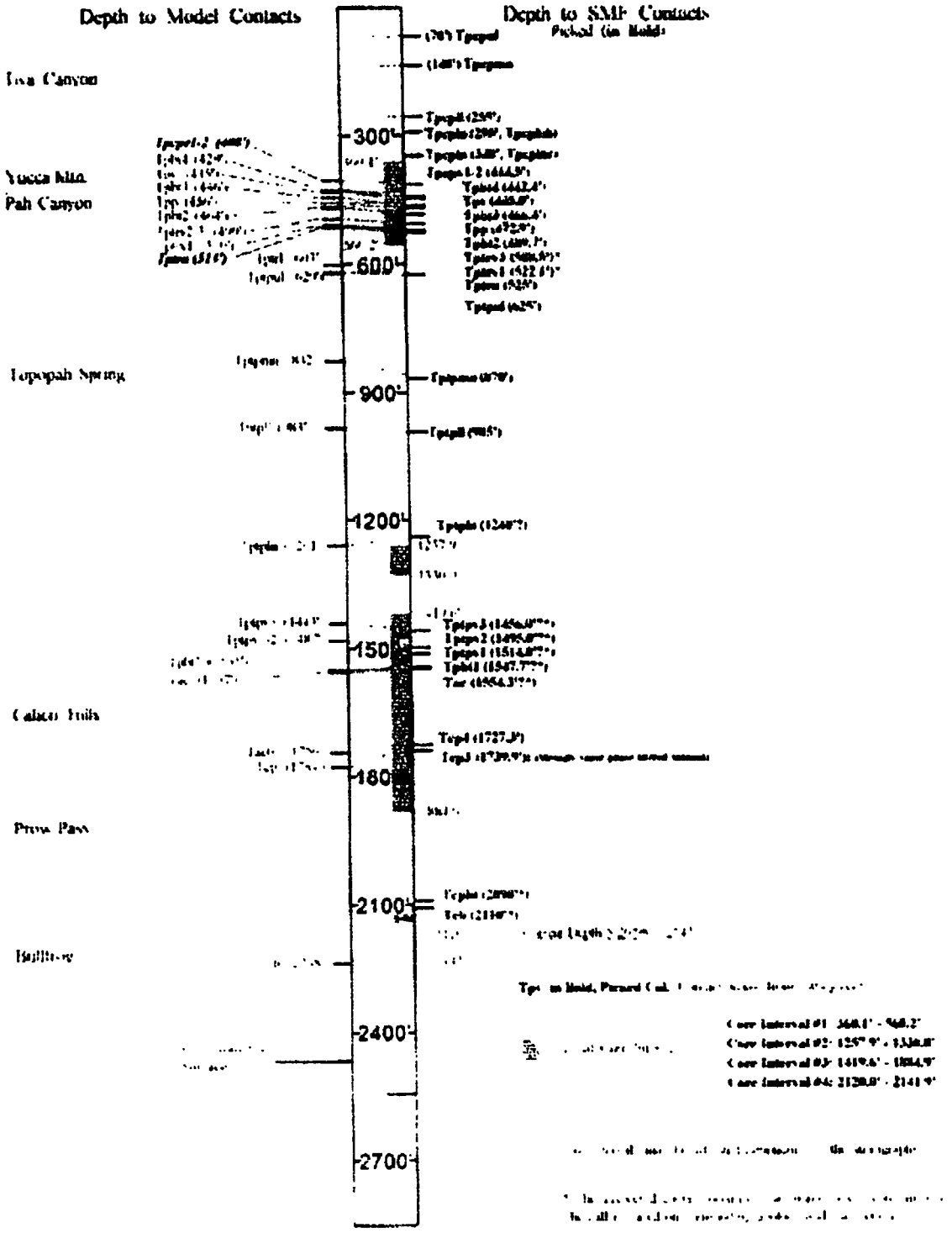
Cross Drift -- Status

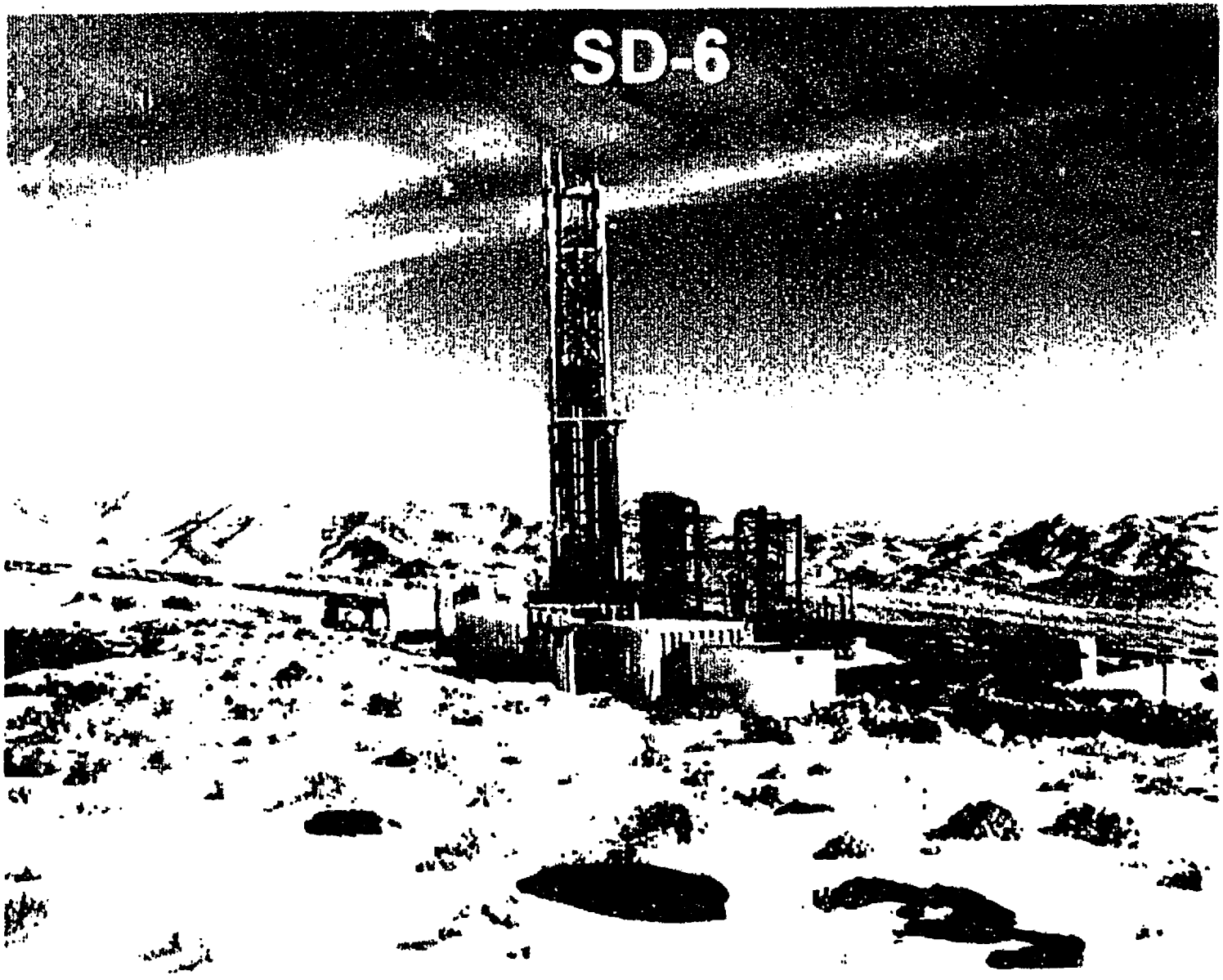
- All moisture monitoring boreholes installed and instrumented, and are actively monitored
- TBM began operations on 3/31/98
- As of 6/16/98 TBM advanced to Station 4+75m
- TZ#1 (2+38 to 2+88) was water only)(6/1-6/3)
- TZ#2 (2+90 to 3+40) was water with surfactants (6/3 - 6/6)
- From 3+41 on, operations returned to dry cutter

SD - 6 - Why Is It Important?

- It will provide information of stratigraphy, hydrologic and rock properties from the western portion of the repository block
- Information from this location have been identified by the program as critical design and performance assessment
- Allows for confirmation of models by comparing predictive reports with actual measurements
- Provides additional input for the possible revisions to the design and operation of the E-W cross-drift

USW SD-6 Preliminary Prognosis Update Log




SD-6

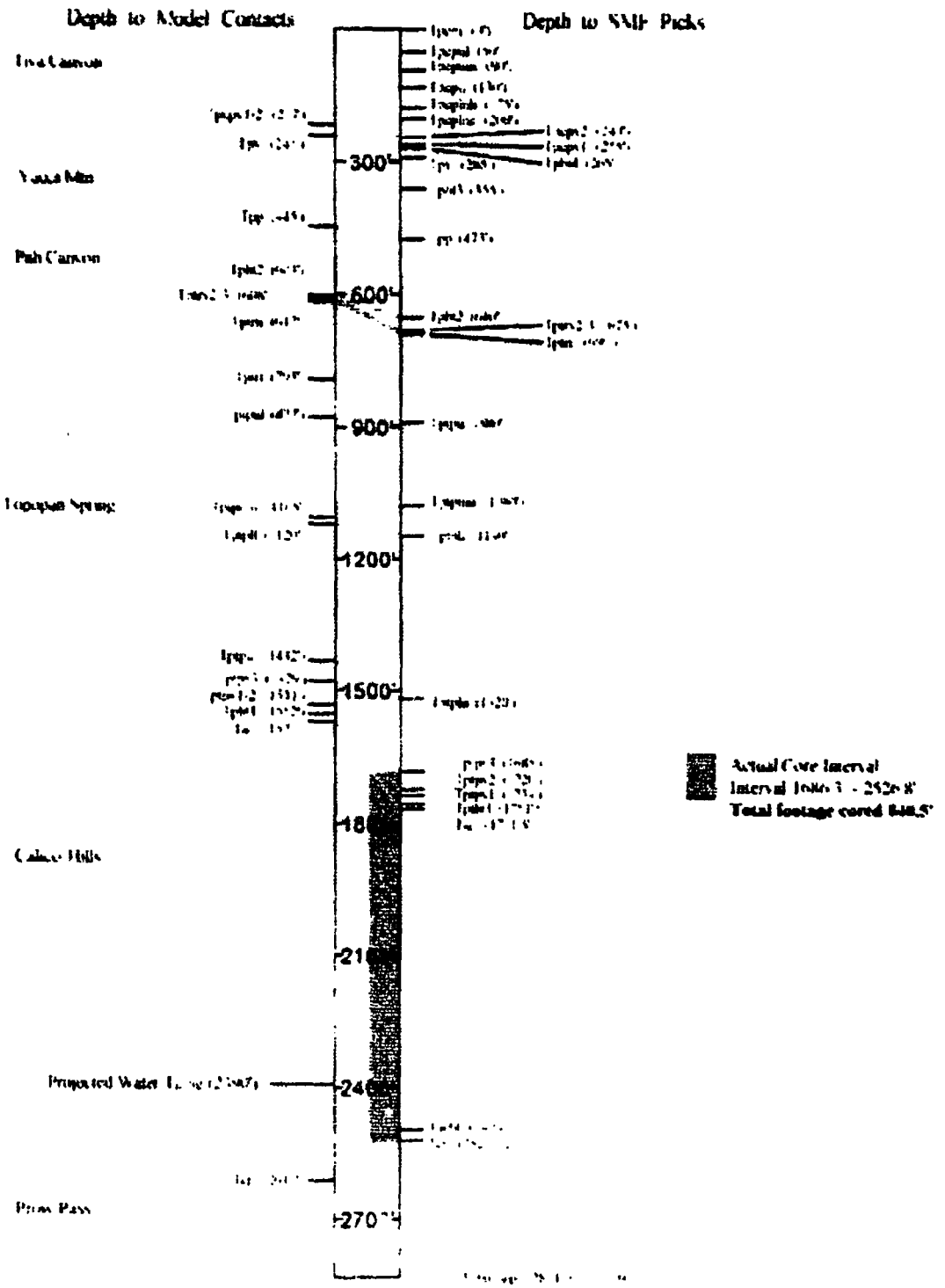
C - wells -- Status

- All testing in the high-yield Bullfrog-Tram is complete and results have been published
- Prow Pass testing has begun (Prow Pass is expected to bound the lower yielding zones closest to the water table)
- Installation of the packers/pumps/injection hardware in Boreholes C#2 and C#3 is complete. Injection tubing has been reinstalled in Borehole C#1
- Initial 3 day scoping hydraulic test pumping began on 5/29/98
- Initial conservative tracer injection testing will commence after hydraulic characterization. The tracer "soup" will include a benzoic acid and sodium iodide

WT - 24 - Why Is It Important?

- WT-24 main objective is provide additional data to assist in characterizing and understanding the potential large hydraulic gradient in the saturated zone that may exist north of the site
- It will also provide information on stratigraphy, hydrologic and rock properties north of the repository block
- Allows for confirmation of models by comparing predictive reports with actual measurements

USW WT-24 Final Prognosis Log

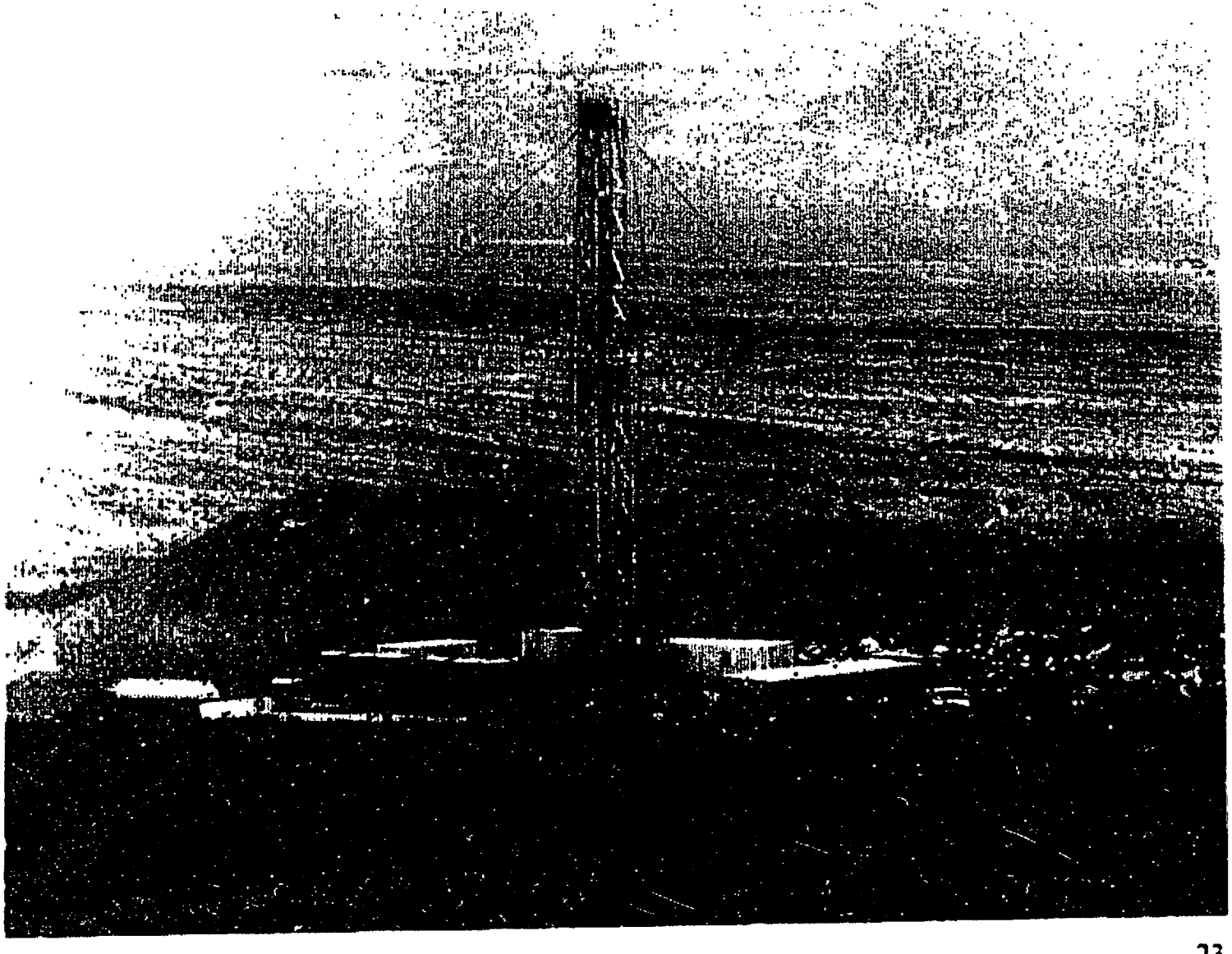


WT - 24 -- What Have We Learned?

- The preliminary test results suggest that:
  - water encountered at the basal vitrophyre is perched water (based principally on comparisons of chemistry) and more similar to perched water encountered in other boreholes north of the block than to the water at the regional water table
  - The first horizon where a large hydraulic gradient may have been present (based on predictions from surrounding wells) has been past and the core is still unsaturated. Other targets were identified.

WT - 24 -- What Have We Learned?

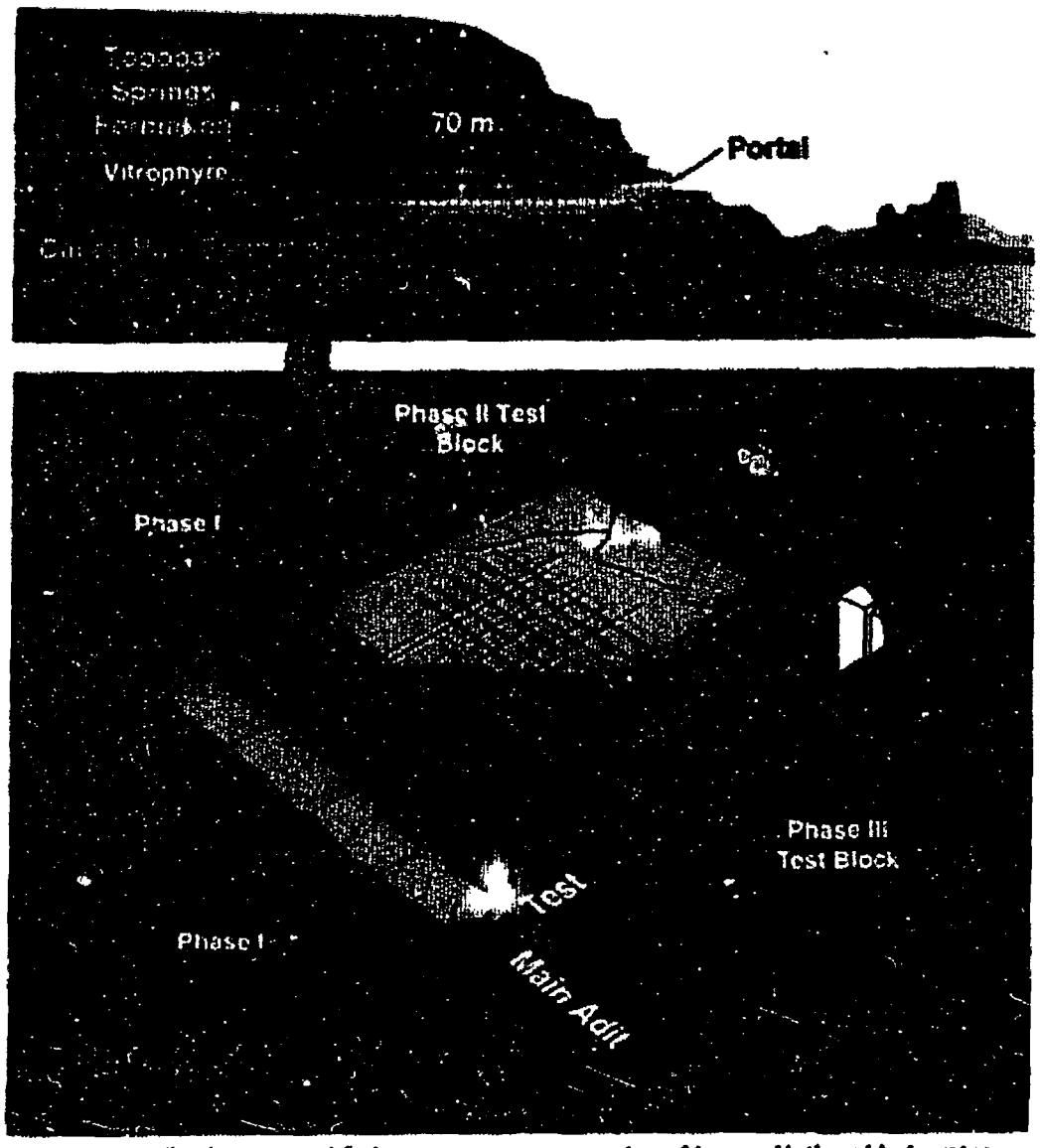
- Regional water was not encountered until a transmissive zone was encountered near the base of the Calico Hills. The water level rose 346 feet in a few days
- The suspected regional potentiometric surface is 2,146 feet bls, based on the 5-28-98 static water level. The source of this water is likely from a single fracture of low permeability encountered in the Calico Hills Formation (Tac) at a depth of 2,492 feet bls
- Preliminary geochemical results indicate the perched zone is similar to the perched water in UZ-14 and G-2. Water from the water table is similar to UZ-14 SZ (high in Na and very low in Ca) and somewhat different from other SZ water downgradient of Yucca Mountain



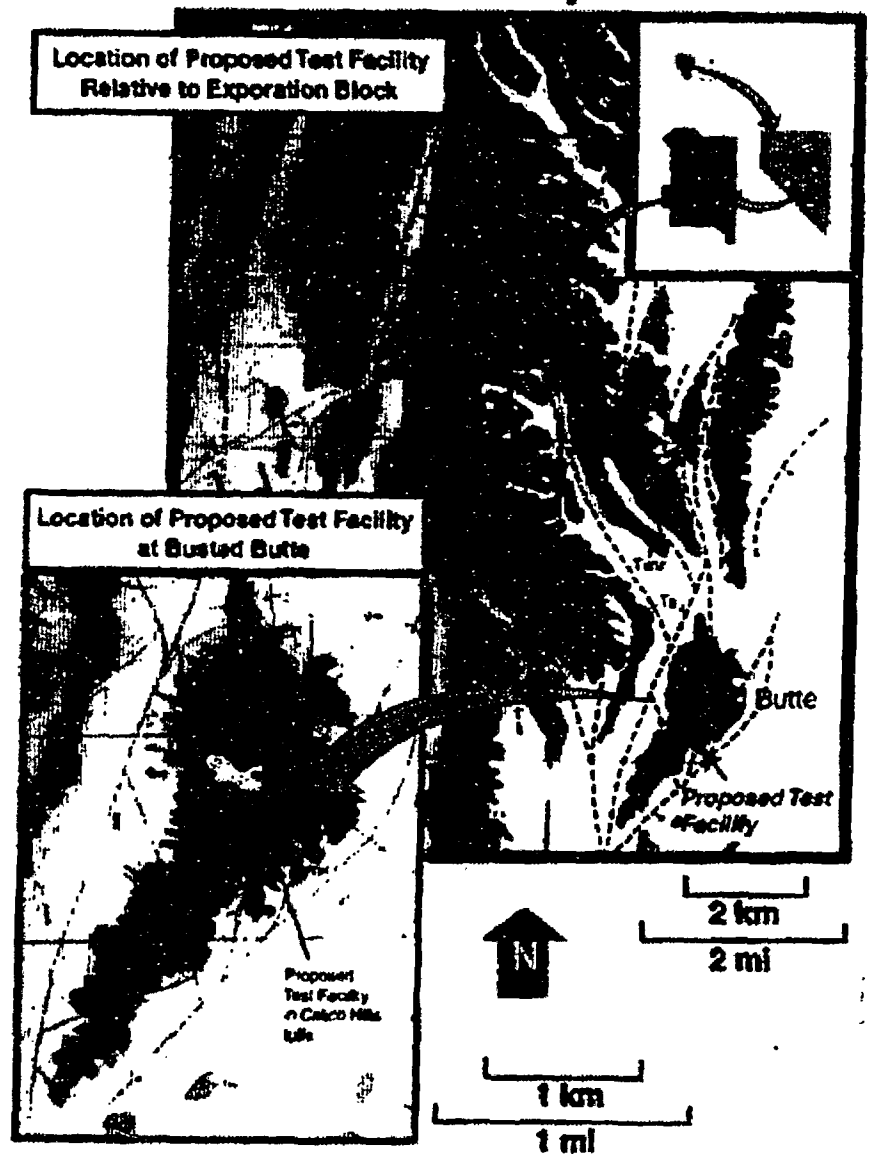
Purpose of Test at Busted Butte: Address PA Needs for Flow and Transport for TSPA-LA

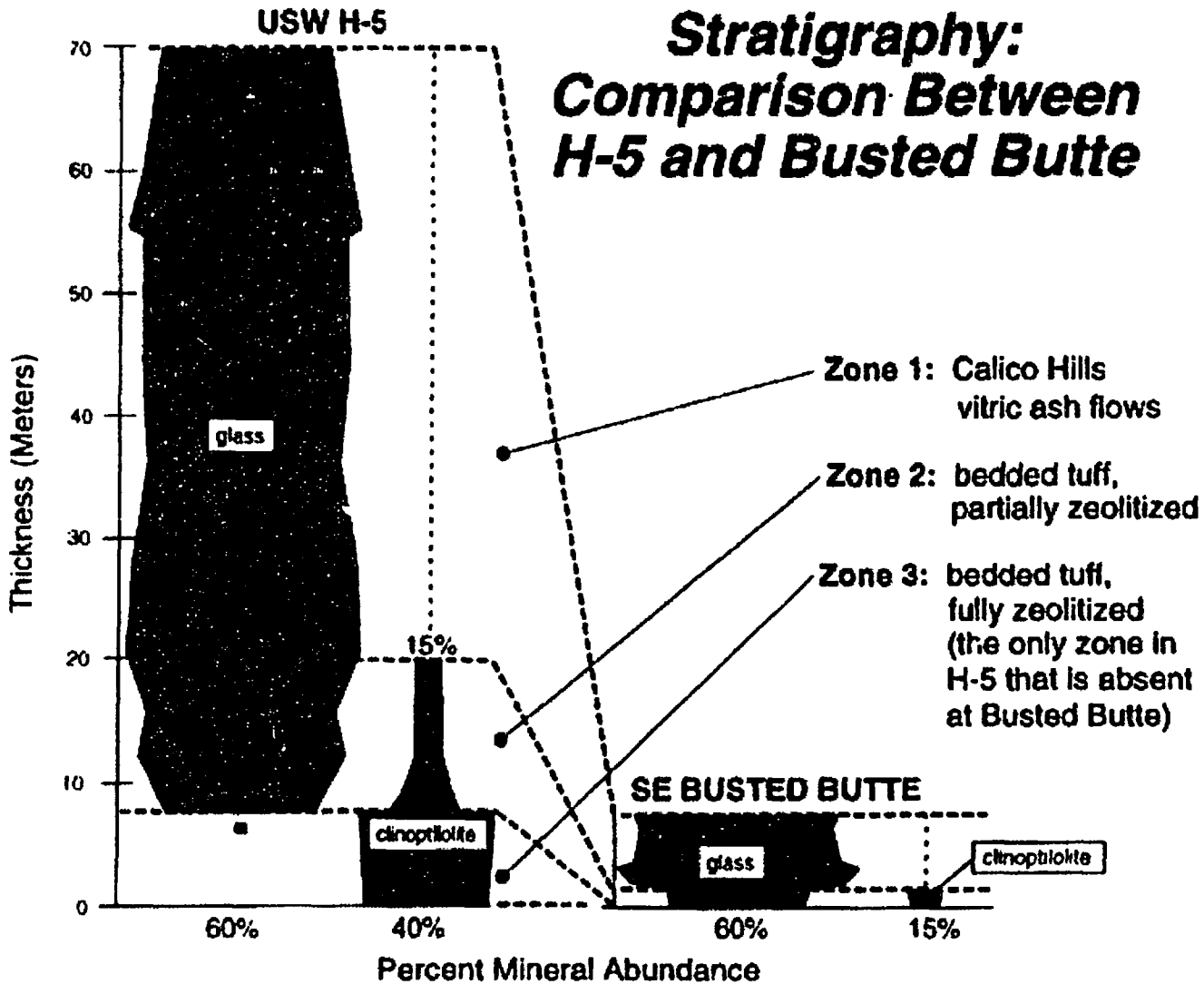
- Validate laboratory data on radionuclide and colloid migration in the UZ at Yucca Mountain (i.e., sorption and filtration in fractured and unfractured Calico Hills rocks)
- Understand the effect of heterogeneities on flow and transport under unsaturated and partially saturated conditions in the CHn:
  - Fracture/matrix interactions
  - Permeability contrast boundaries
- Calibrate/validate the 3-D site scale flow and transport process model
- Address scaling issues from lab-scale to field-scale to site-scale

Southern Busted Butte UZ Transport Test



Location Map




USW H-5
Stratigraphy:
Comparison Between
H-5 and Busted Butte
Thickness (Meters)
70
60
50
40
30
20
10
0
glass
15%
clinoptilolite
Zone 1: Calico Hills
vitric ash flows
Zone 2: bedded tuff,
partially zeolitized
Zone 3: bedded tuff,
fully zeolitized
(the only zone in
H-5 that is absent
at Busted Butte)
SE BUSTED BUTTE
glass
clinoptilolite
60%
40%
60%
15%
Percent Mineral Abundance

The Busted Butte Test Plan: Phases I, II, and III

- License Application
  - Phases I and II provide input to TSPA-LA for the license application in 2002. Phase I and II tests will be run concurrently with analog tracers
    - Milestones: Level 4 in 9-30-98 and Level 3 in 8-30-99
  - Phase I consists of six 2-m-long single-point injection tracer tests and two short collection boreholes to be overcored 5 months from injection to provide early results
  - Phase II consists of a longer duration and a spatially more expansive block testing with tomographic imaging (ERT, GPR, and neutron logging) and 12 "Seamist-type" collection boreholes
  - Phase I and II tests are associated with predictive modeling calculations

The Busted Butte Test Plan: Phases I, II, and III

(con't)

- **Performance Confirmation**
  - **Phase III tests support performance confirmation UZ transport testing and may include the use of radionuclide tracers**

Use of Numerical Simulations in the Implementation of the UZ Transport Test

- Purpose
  - Build confidence in the YMP UZ site flow and transport process model and its abstractions for TSPA-LA
- Use
  - Scoping calculations/test design
  - Prediction of and quantitative comparisons between laboratory and field test results
- Software
  - Mesh generation
    - GEOMESH unstructured 2-D and 3-D grids matching the injection system configuration
  - Flow and transport
    - FEHM dual permeability/dual porosity 2-D and 3-D sensitivity analyses and predictive simulations of coupled flow and tracer migration
    - FEHM-S 2-D and 3-D stochastically-derived code used to construct confidence intervals for flow and transport results

Permit Applications for Conservative, Reactive, and Colloidal Tracers

- **Phase I: Tracers permitted for Phase I**
  - Lithium bromide
  - Potassium iodide
  - Fluorescent polystyrene latex microspheres
  - Fluorescein sodium
  - "Pyridone" (3-carbomoyl-2(1H)-pyridone)
  - 2,4-difluorobenzoic acid
  - 2,6-difluorobenzoic acid
  - 2,4,5-trifluorobenzoic acid
  - 2,3,4,5-tetrafluorobenzoic acid
  - Pentafluorobenzoic acid

Permit Applications for Conservative, Reactive, and Colloidal Tracers

(con't)

- **Phase II: Tracers proposed for Phase II. In addition to Phase I tracers, these include**
  - **Rhodamine WT**
  - **Neptunium Analogs, NpO^{2+}, Np(V)**
    - **Nickel (Ni^{2+})**
    - **Cobalt (Co^{2+})**
    - **Manganese (Mn^{2+})**
  - **Plutonium Analogs, (Pu^{3+})**
    - **Samarium (Sm)**
  - **Plutonium Analogs, (colloidal form)**
    - **Charged (+/-) and Neutral Polystyrene Microspheres**

Permit Applications for Conservative, Reactive, and Colloidal Tracers

- Phase II: (continued)
  - Americum Analogs (Am^{3+})
    - Cerium ($Ce^{4+, 3+}$)
  - Technetium Analogs (Tc^{3+})
    - Rhenium (Rheneate, ReO_4^-)
    - Molybdenum (Molybdate, MoO_4^-)
- Phase III: Use of short-lived radionuclides under consideration

Parallel Laboratory Testing Programs

FY98

Geochemistry

- Batch sorption studies of Phase I and Phase II conservative and reactive tracers onto Calico Hills core samples

Hydrology

- Matric potential and conductivity measurements vs. saturation for Phase I samples

Min/Pet

- Characterization of Phase I and Phase II cores

Parallel Laboratory Testing Programs

FY99

Geochemistry

- Batch sorption studies of radionuclides onto Calico Hills core samples
- Saturated and unsaturated (UFA) column studies of tracer and radionuclide transport through Calico Hills core samples
- Saturated and unsaturated diffusion-cell studies of tracer and radionuclide diffusion through BB core samples

Hydrology

- Matric potential and conductivity measurements vs. saturation for Phase II samples

Min/Pet

- Characterization of Phase II cores

Construction and Testing Status

- Access road completed 11/21/97
- Pad and highwall for test tunnel completed 12/17/97
- Calico Hills - Topopah Spring Formations contact encountered 1/13/98, 43.2 meters into the main adit
- Portal construction completed 12/24/97
- Drill and blast of underground test facility (95 meters of excavation) completed 1/30/98, 1 week ahead of schedule
- Drilling of all Phase I (eight 2-m-long boreholes) and Phase II boreholes (ten 7.5-m injection holes, twelve 10-m-long collection holes, and six 10-m ERT holes) completed 3/19/98, 8 weeks ahead of schedule

Construction and Testing Status

(con't)

- Fracture mapping/video and neutron logging, hydrologic properties and water chemistry testing for Phases I and II completed April 1998
- Phase I testing initiated 3/23/98
- Phase II testing to be initiated 7/21/98
- Phase III testing design and planning underway
- Breakthrough of Flourescein tracer was detected 6/16/98 in Phase 1b

ATTACHMENT 4

YUCCA
MOUNTAIN
PROJECT

Translation and Use of Geologic Framework Model GFM3.0

Presented to:
DOE/NRC Quarterly Technical Meeting

Presented by:
Debra Bryan
Yucca Mountain Site Characterization Office

June 18, 1998

U.S Department of Energy
Office of Civilian Radioactive
Waste Management

Users of Geologic Framework Model GFM3.0

- UZ flow and transport
- SZ flow and transport
- NFE Models
- Repository Design
- Mineralogy
- Performance Assessment

Translation Methods/Formats

- ASCII text of GFM3.0 grid nodes (UZ, SZ, mineralogy, p.a.)
- VRML (virtual reality) files (SZ transport)
- Earthvision-Lynx format translation (repository design)

UZ Flow/Transport GFM Import

- Subsample to irregularly spaced cells
- Cell elevation equals nearest GFM3.0 node
- Use all horizons and faults

SZ Site Scale Flow/Transport GFM Import

- Use exact GFM without modification

SZ Regional Model

- Coarse sampling of GFM3.0 grid nodes
- Include only major faults
- Include only aquifer boundary layers

NFE Models

- Utilize properties from UZ site scale flow model

Repository Design GFM3.0 Input

- Earthvision-Lynx format translation
- Exact duplicate of GFM3.0
- Use all layers and faults

Performance Assessment and Mineralogy GFM3.0 Input

- Use GFM3.0 grid nodes to define surfaces and faults

- Use all layers and faults

Summary

- Geologic Framework Model version GFM3.0 is being used without modification in downstream models

- All needed format translations have been successfully carried out

ATTACHMENT 5

YUCCA
MOUNTAIN
PROJECT

Status/Update:

Near-Surface Ground Motion Attenuation
Seismic Design Basis Inputs Report
Seismic Topical Report #3
Deterministic Seismic Hazard Analysis Report

Presented to:
DOE/NRC Quarterly Technical Meeting

Presented by:
Tim Sullivan
Yucca Mountain Site Characterization Office

June 18, 1998

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

Recent Developments in Near-Surface Ground Motion Attenuation at Yucca Mountain

- UNR studies using Little Skull Mountain aftershocks and regional earthquakes formed the basis for near-surface ground motion attenuation in the Yucca Mountain site area. (Su and Anderson, 1995; Su and others, 1996)

- The earlier UNR studies indicated that near-surface ground motion attenuation in the Yucca Mountain area is significantly lower than in southern California

- Recent UNR measurements (1997-1998) at several borehole sites (UZ-16, UZ-7a, UZ-4/5, and SD-12) and surface locations in the Yucca Mountain area indicate that near-surface ground motion attenuation may have been underestimated

Recent Developments in Near-Surface Ground Motion Attenuation at Yucca Mountain

(Continued)

- Additional experiments are planned to reassess the near-surface ground motion attenuation values, including spatial variability in the repository site area

- This reassessment of near-surface ground motion attenuation values may have an impact on final seismic design basis values

- DOE has decided to delay completion of technical reports to ensure that the final products include our best understanding of near-surface ground motion attenuation at the site

Revised Schedule for the Seismic Design Basis Inputs Report

- Draft Seismic Design Basis Inputs Report (SDBIR) was submitted to DOE on February 25, 1998

- Studies conducted by UNR at surface and borehole locations during FY 98 indicate that site attenuation may be underestimated

- Modifications to the SDBIR are in progress:
  - Sensitivity calculations to account for a range of site attenuation parameters
  - Bounding calculations for site-wide variations in shear-wave velocity profiles

Revised Schedule for the Seismic Design Basis Inputs Report
(Continued)

- SDBIR, Revision 0, to be completed by September 30, 1998

- SDBIR, Revision 0, to include (to support LA design):
  - Repository level design values to support underground design
  - Bounding design values for surface rock sites to support surface design

- Geotechnical information on the near-surface soil and rock properties at sites of planned surface facilities, and final estimates of site attenuation values to be available in early FY 99

- SDBIR, Revision 1, to be completed in FY 99, and to include final seismic design basis values for LA design and Seismic Topical Report #3

Revised Schedule for Seismic Topical Report #3

- New information on near-surface ground motion attenuation has led to a delay in the completion schedule for Seismic Topical Report #3 (STR #3)

- Original schedule indicated submittal of STR #3 to NRC by September 30, 1998

- STR #3 to be completed in parallel with SDBIR, Revision 1, in FY 99

Revised Schedule for the Deterministic Seismic Hazard Analysis Report

- Draft Deterministic Seismic Hazard Analysis (DSHA) report was submitted to DOE on December 19, 1997
- Final DSHA to be completed in FY 99
  - Incorporate best estimates of near-surface ground motion attenuation values

ATTACHMENT 6

YUCCA
MOUNTAIN
PROJECT

Total System Performance Assessment - Viability Assessment: Rev. 00 to Rev. 01 Changes in the TSPA-VA Base Case

Presented to:
DOE NRC Quarterly Technical Meeting

Presented by:
Abe VanLuik
Yucca Mountain Site Characterization Office

June 18, 1998

U.S. Department of Energy
Office of Civilian Radioactive
Waste Management

TSPA-VA Base Case Rev. 00 to Rev. 01 Changes

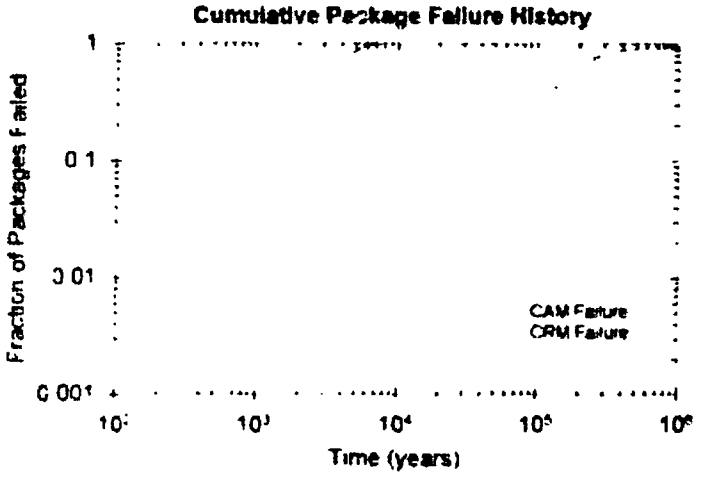
- Climate and infiltration
  - no change
- Unsaturated-zone flow
  - no change
- Seepage into drifts
  - no change
- Mountain-scale thermal hydrology
  - no change
- Drift-scale thermal hydrology
  - no change

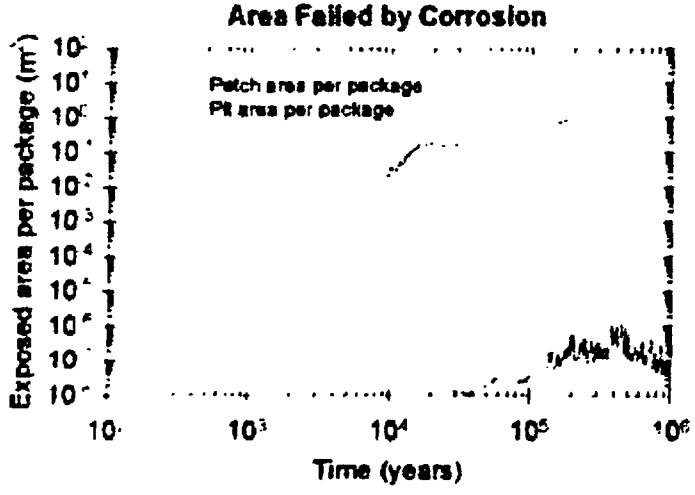
TSPA-VA Base Case Rev. 00 to Rev. 01 Changes

- Near-field geochemical environment
  - Rev. 01 includes updated input from the mountain-scale T-H model (Rev. 00 NFGE model was based on pre-Rev. 00 T-H results)
  - Rev. 01 includes oxygen fugacity, which is fed to waste-form degradation model
- Waste package degradation
  - Rev. 01 uses new input from WPD Expert Elicitation, including:
    - new probability distributions of CRM corrosion rate that reflect different weightings of likely chemical environments
    - splitting of the probability distribution for patch and pit corrosion rates into two distributions, one based on uncertainty and the other on variability (both patch-to-patch variability and package-to-package variability)
  - Rev. 01 includes a probability distribution for premature ("juvenile") package failures, due to the combined effects of human-induced factors, material defects, rockfalls, and seismic activity. The juvenile failure fraction is sampled log-uniformly from 10^{-5} to 10^{-3}, and juvenile failures are assumed to occur at 1000 years.)

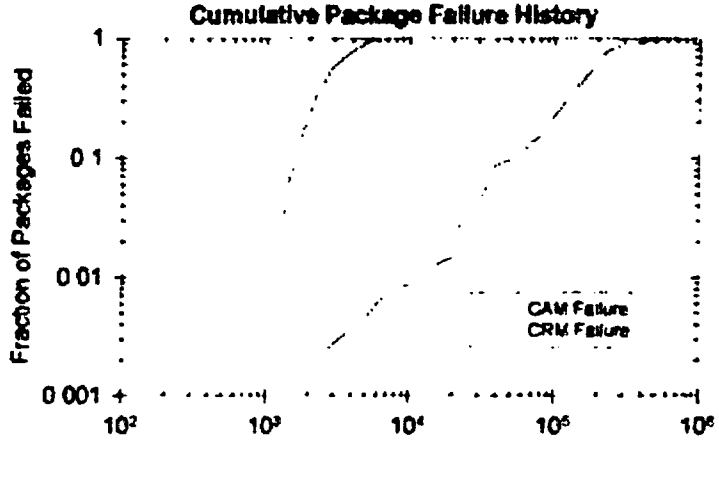
TSPA-VA Base Case Rev. 00 to Rev. 01 Changes Waste-Package Degradation

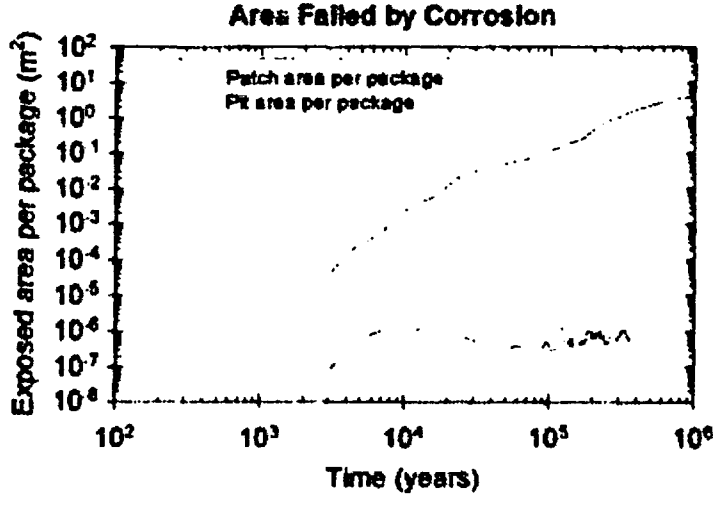
Rev. 00





Rev. 01



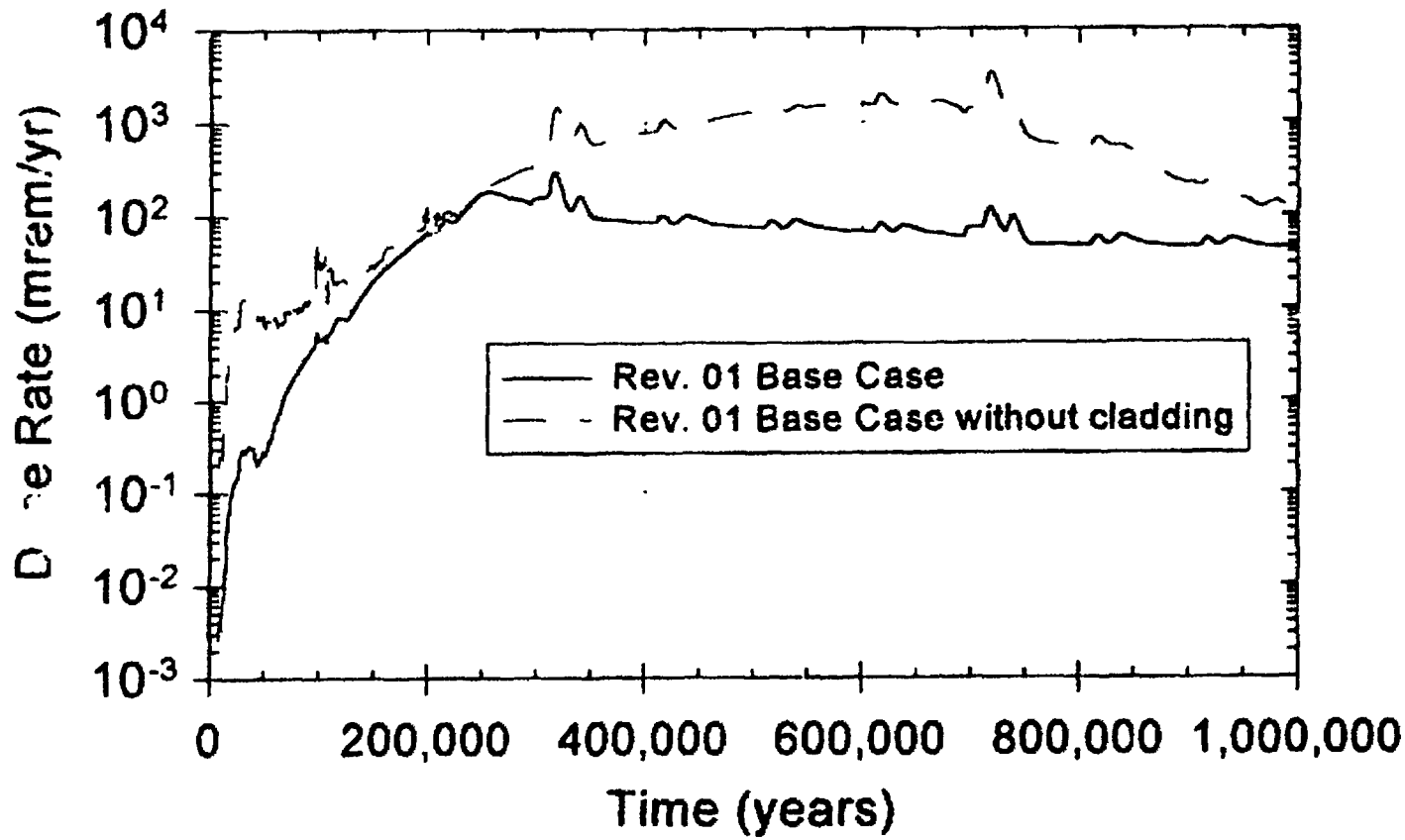


TSPA-VA Base Case Rev. 00 to Rev. 01 Changes

- Cladding
  - Rev. 01 includes a cladding degradation model for CSNF, which assumes various modes of cladding failure, including creep strain rupture, stainless steel failure, Zircalloy pitting, and mechanical failure. This results in about 1.25% initial failure, about 3.3% cladding failure at 100,000 years, and about 11% at 1,000,000 years for the expected-value case. (Rev. 00 assumed all cladding failed simultaneously with the waste package.)
- Waste-form degradation
  - Rev. 01 includes an updated glass dissolution model based on experimental data
  - Rev. 01 includes an updated spent-fuel dissolution model based on experimental data

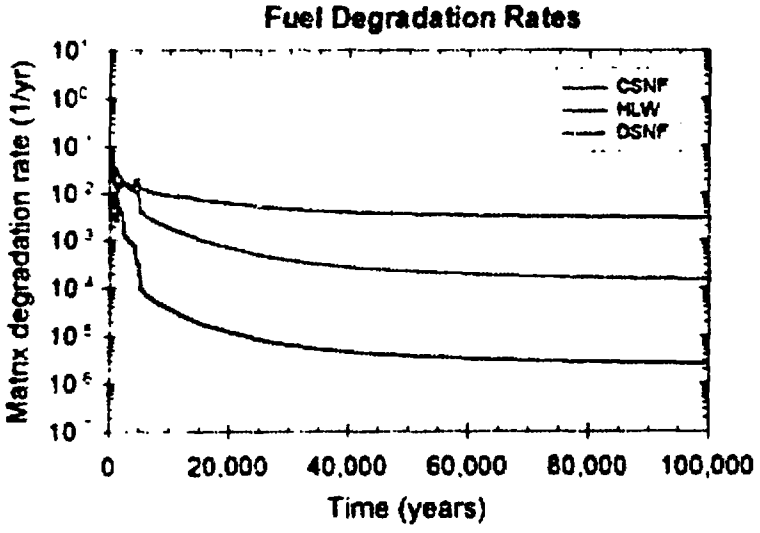
Rev. 01 Cladding Model

Expected-Value Rev. 01 Base Case Cladding Sensitivity

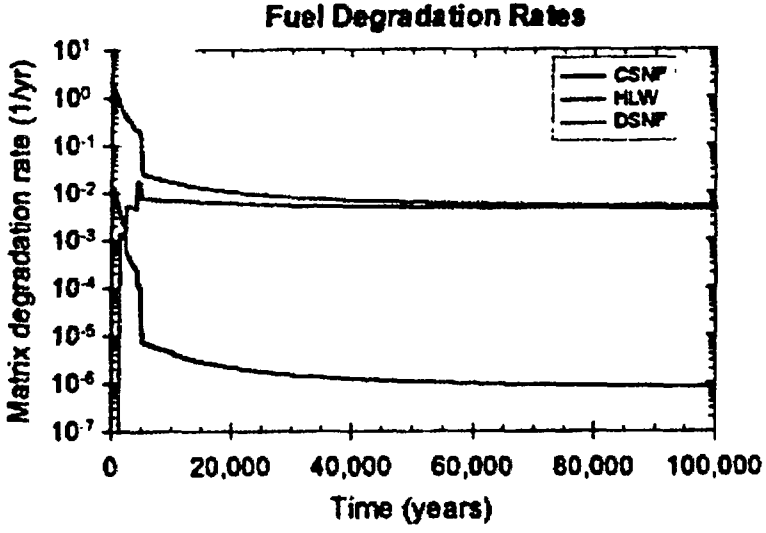


TSPA-VA Base Case Rev. 00 to Rev. 01 Changes Waste-Form Degradation

Rev. 00



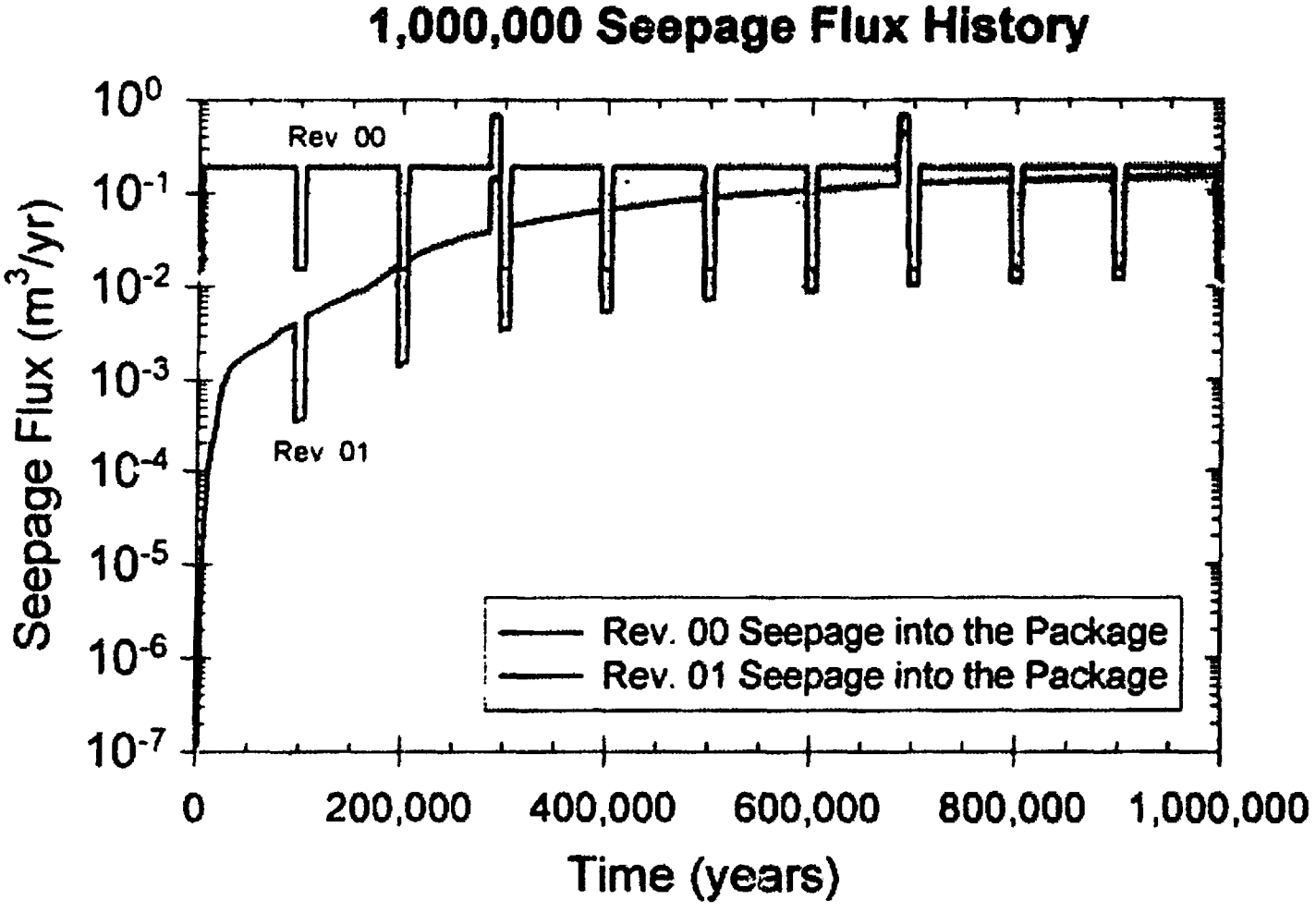
Rev. 01



TSPA-VA Base Case Rev. 00 to Rev. 01 Changes

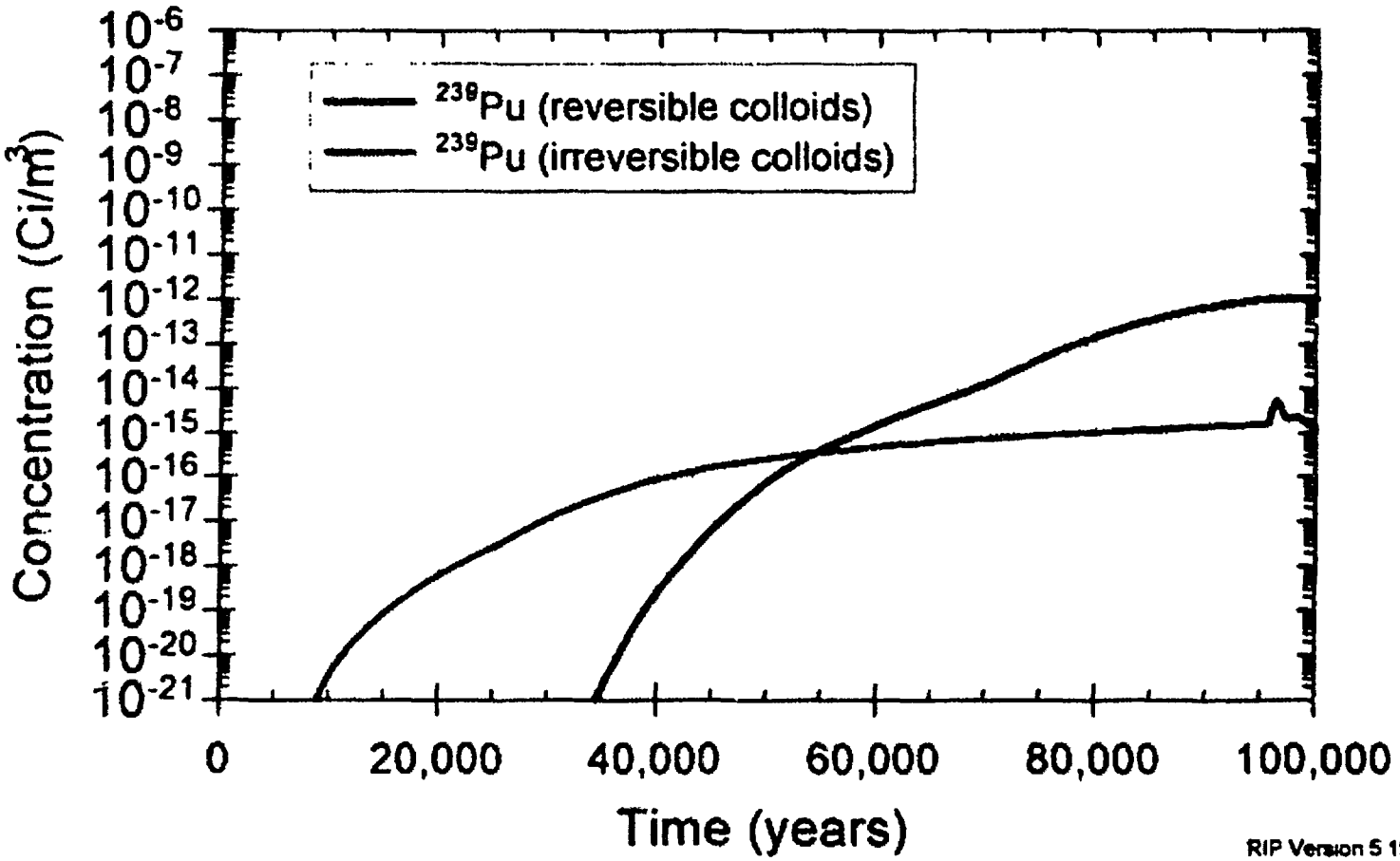
- **EBS Transport**
  - In Rev. 01, the seepage flux into the degraded waste packages is equal to the fully penetrated patch and pit area times the drift seepage times an uncertainty factor. (In Rev. 00, seepage into the package was equal to seepage into the drift.)
  - In Rev. 01, some portion of the Pu sorbs irreversibly onto colloids in the EBS. (In Rev. 00, all Pu sorption onto colloids was reversible.)
  - In Rev. 01, sorption of Pu, U, and Np in the concrete invert is presumed to occur. (In Rev. 00, no sorption in the invert was allowed.)
- **UZ Transport**
  - In Rev. 01, irreversible sorption of Pu on colloids is modeled

TSPA-VA Base Case Rev. 00 to Rev. 01 Changes Seepage into Packages



Rev. 01 Pu Transport on Colloids

Concentration at end of SZ



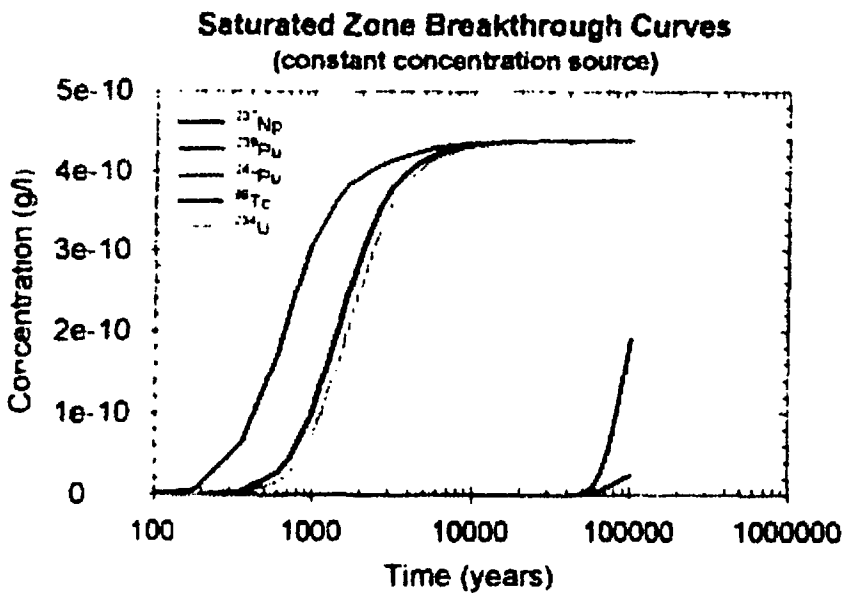
RIP Version 5 19
April 8, 1998
case0ee5

TSPA-VA Base Case Rev. 00 to Rev. 01 Changes

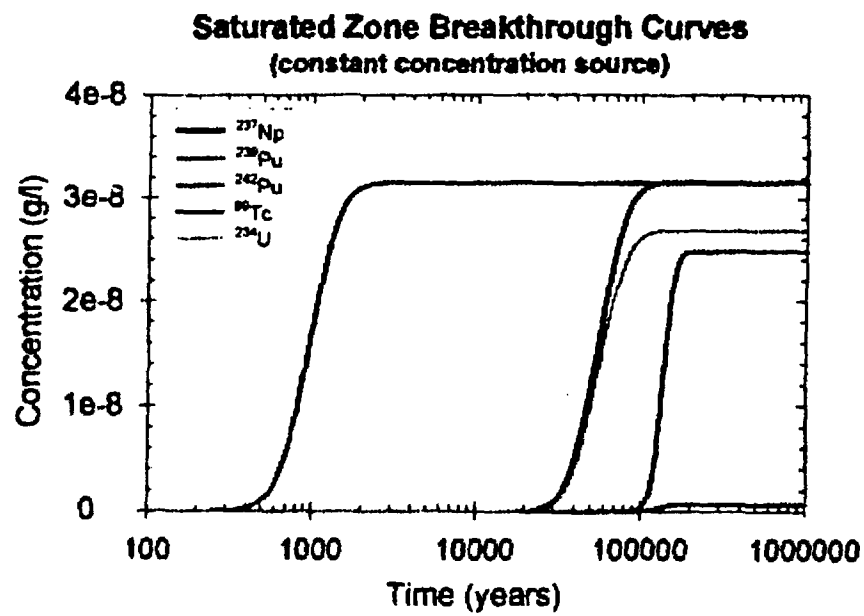
- Saturated zone flow and transport model
  - Rev. 01 includes the following changes:
    - uses a 3-D flow model to define % of travel path in 4 lithologic units
    - transport is now based on six 1-D streamtube models (rather than the 3-D transport model in Rev. 00, which had a high degree of numerical dispersion), whose volumetric flux is equal to the volumetric flux discharging into them from the corresponding area of the unsaturated-zone beneath the repository
    - an expert-elicitation-defined value of 0.6 m/yr for the Darcy velocity in each streamtube in the dry climate
    - much less dilution than Rev. 00, based on a "dilution factor" range from the SZ Expert Elicitation, which results in a factor of only about 2.5 over 20 km for the Rev. 01 expected-value base case
    - irreversible sorption of Pu on colloids included
- Biosphere
  - Rev. 01 uses updated values for the biosphere dose conversion factors (generally reduced by a factor of 2 from the Rev. 00 values for the "average" individual)

TSPA-VA Base Case Rev. 00 to Rev. 01 Changes
Saturated-Zone Breakthrough Curves

Rev. 00



Rev. 01

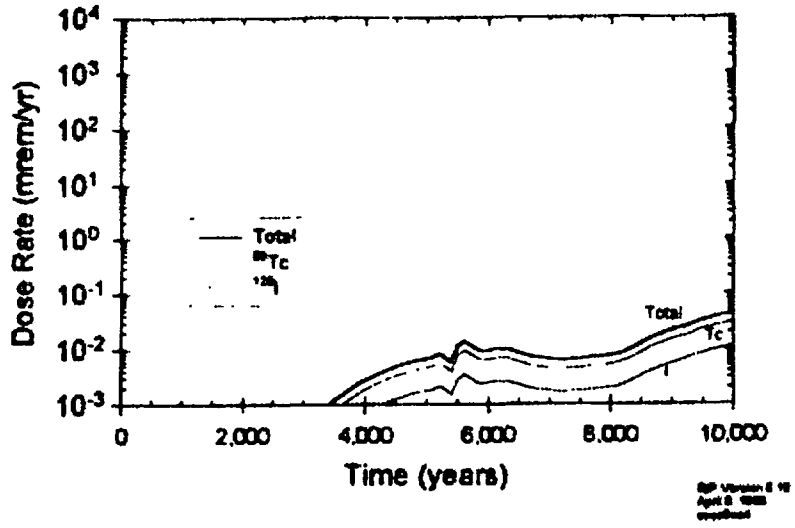


TSPA-VA Base Case Rev. 00 to Rev. 01 Changes 10,000-year doses

Rev. 00

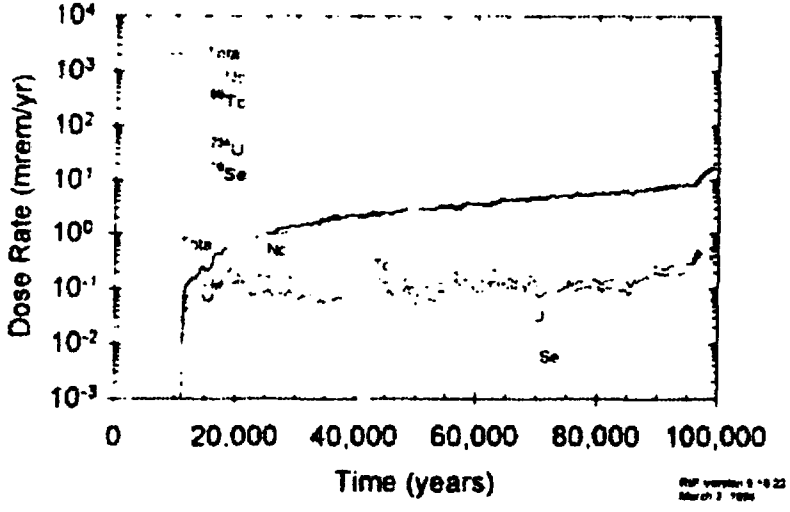
No releases at 20 km because of no package failures

Rev. 01

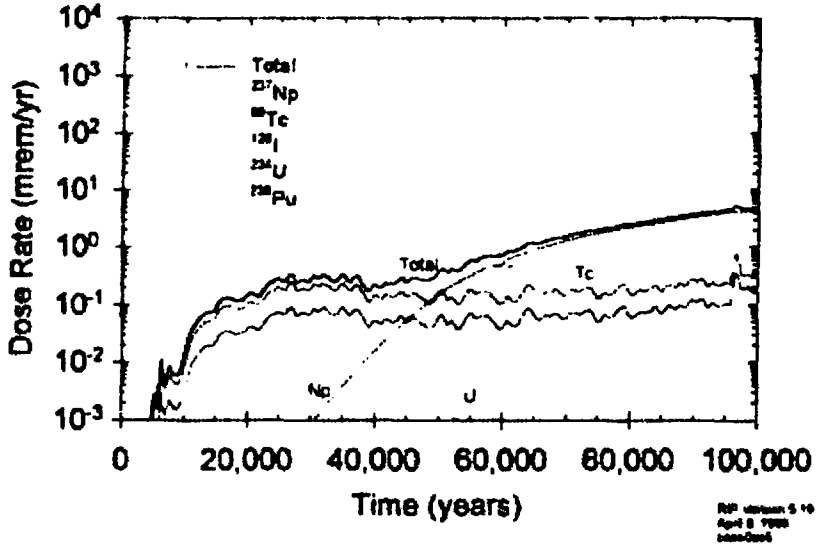


TSPA-VA Base Case Rev. 00 to Rev. 01 Changes 100,000-year doses

Rev. 00

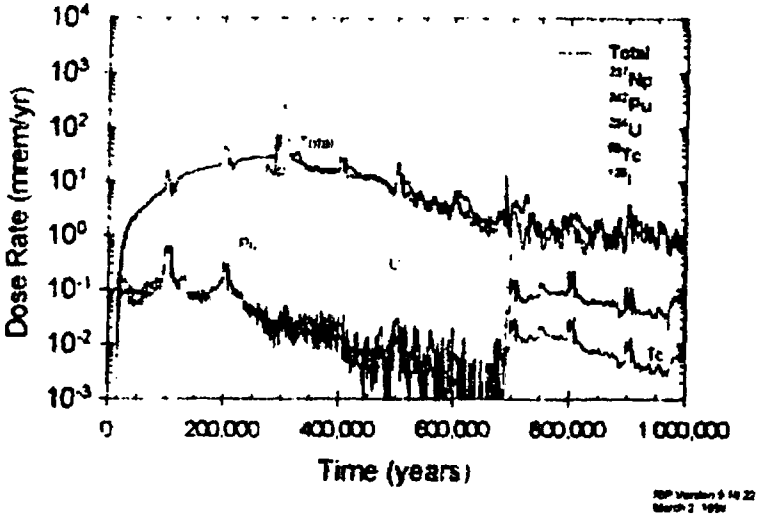


Rev. 01



TSPA-VA Base Case Rev. 00 to Rev. 01 Changes 1,000,000-year doses

Rev. 00



Rev. 01