Yucca Mountain Site Characterization Project

Monthly Activity Report

January 1992

Photograph: by Chris J. Lindberg

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LOS ALAMOS NATIONAL LABORATORY
YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT

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December 1991

WBS 1.2.1
SYSTEMS

The objective of this task is to integrate systems with the Geologic Repository Program, to describe the Yucca Mountain Site Characterization Project Mined Geologic Disposal System, and to evaluate the performance of the natural, engineered barrier, and total systems for meeting regulatory standards.

TECHNICAL DATA (WBS 1.2.1.3.5)

ACTIVITIES AND ACCOMPLISHMENTS

Staff was trained on the Automated Technical Data Tracking (ATDT) System.

Staff met with staff to discuss volcanism data for submittal to the Technical Data Base (TDB) and Reference Information Base (RIB).

Staff was trained by B. Luis of SAIC to the Technical Data Information Form (TDIF).

PLANNED ACTIVITIES

Staff will attend RIB and Parameter Normalization Working Group meetings on February 3 in Las Vegas, Nevada.

Staff will meet principal investigators to discuss submittal of milestones to TDB or RIB.

Staff will present information on Technical Data Management to the Los Alamos Technical Associates' QAL.

CAISSON EXPERIMENT (WBS 1.2.1.4.6)

ACTIVITIES AND ACCOMPLISHMENTS

Ordered limonite and contracted with New Mexico Institute of Mining and Minerals at Socorro to crush it to the desired particle size range. The material should be ready by the end of February.

Began to write standard operating procedure for caisson experiment to satisfy Los Alamos ES&H requirements.

Based on discussions with M. Siegel of Sandia National Laboratory, it was decided that Lithium will not be used as a tracer at the present time as its use would require additional experiments to describe the lithium and lithium-nickel interaction with both silica sand and limonite. Nickel, which has been thoroughly characterized, will be the primary tracer used. Bromide with sodium will be introduced as a nonreactive tracer.

PLANNED ACTIVITIES

Order silica sand.

PUBLICATIONS

E. P. Springer and M. D. Siegel
An Integrated Intermediate-Scale Caisson Experiment to Validate Models of Fluid Flow and Contaminant Transport in the Unsaturated Zone
Journal article, *Radioactive Waste Management and the Nuclear Fuel Cycle, Special issue on the Yucca Mountain Project*
In preparation.

PERFORMANCE ASSESSMENT CALCULATIONAL SUPPORT (WBS 1.2.1.4.7)

G. Valentine submitted Milestone 3331, "Physical processes and effects of magmatism in the Yucca Mountain region," to YMPO. This paper will be published in *Proceedings of the High-Level Radioactive Waste Management Conference, April 1992*. The report describes modeling and field studies geared toward constraining the types of igneous processes that might affect repository performance. The report cover letter describes how modeling is used in site characterization, and a distinction between site modeling and performance assessment is proposed.

WBS 1.2.3.1
SITE MANAGEMENT AND INTEGRATION

SITE MANAGEMENT (WBS 1.2.3.1.1)

ACTIVITIES AND ACCOMPLISHMENTS

Staff met with A. Simmons of the DOE to discuss prepared charter for radionuclide solubility working groups, which would function as an arm of the Geochemistry Integration Team and interface with the GEMBOCHS database.

A principal investigators meeting was held on 24 January. Highlights are presented in the Appendix.

PUBLICATIONS

J. A. Canepa
Strategy for Testing the Applicability and Validity of Radionuclide Transport Models for Yucca Mountain, Nevada
Conference Paper, Migration '91, Jerez de la Frontera, Spain, 14-18 October 1991
In revision.

A. M. Simmons and J. A. Canepa
Recent Developments in the Integrated Approach Toward Characteristics of Radionuclide Transport, Yucca Mountain, Nevada
Conference Paper, Waste Management '92 Symposium
In preparation.

SURFACE-BASED TEST MANAGEMENT AND INTEGRATION (WBS 1.2.3.1.1)

The goal of this investigation is to provide coordination for Los Alamos surface-based test planning package development.

ACTIVITIES AND ACCOMPLISHMENTS

We continue to support of the UZ-16 Water Movement Test. Instructions for sample collection were developed by the R. Oliver and the Sample Management Facility geologist.

The job package (JP 92-04) for UZ-16 pad construction was reviewed and approved. Staff reviewed NRG-1 drawings, specifications, and work program and submitted comments.

Staff met with B. Crowe to discuss design and test-related information for the volcanism drilling program in support of DOE, M&O, and SAIC integration teams.

WBS 1.2.3.2.1.1.1
MINERALOGY, PETROLOGY, AND ROCK CHEMISTRY OF TRANSPORT PATHWAYS

The purpose of this activity is to define the important mineralogic and geochemical variables along transport pathways at Yucca Mountain in support of performance assessment and to evaluate the impact of repository construction on natural waste-transport barriers.

ACTIVITIES AND ACCOMPLISHMENTS

Quantitative reduction of x-ray diffraction data was completed for outcrop samples from Calico Hills tuff. These data will be used, along with chemical and petrographic data, to evaluate and compare possible sites for surface experiments in adits (ref. milestone 3137). Quantitative reduction of x-ray diffraction data was also completed on 12 sorption-test experiments for I. Triay.

Fracture mineralogy studies focused on manganese oxide minerals in the Crater Flat tuff from drill cores USW G-1, G-2, GU-3, and UE-25b#1. Results of x-ray diffraction and scanning electron microscope analyses will be included in the journal article in preparation (ref. milestone 3123).

S. Bolivar and D. Broxton attended the January 23-24 Sample Oversight Committee (SOC) meeting at the Sample Management Facility. The SOC discussed various drilling options and budget limitations, and there was some discussion about principal investigator's needs and drilling priorities. Drilling priorities will be resolved at the next SOC meeting.

PLANNED ACTIVITIES

Within the next few months, we plan to

(1) analyze Mn-oxide fracture fillings in the Crater Flat and Paintbrush tuffs to determine their distribution and factors controlling that distribution;
(2) complete paper on Mn-oxides for publication in a refereed journal;
(3) analyze calcites to understand transport and precipitation mechanisms; and
(4) complete sampling of cuttings from USW H-5.

PROBLEM AREAS

None.

MILESTONE PROGRESS

3120
29 May 1992
Calcite in the Upper Paintbrush Tuff
30% complete.

3123
2 March 1992
Mn Fracture Minerals at Yucca Mountain
Undergoing extensive revision.

3130
17 August 1992
Fracture Mineralogy of the Paintbrush Tuff

3137
30 September 1992
Mineralogy of Calico Hills for Adit Development
75% complete

PUBLICATIONS

D. Bish and S. Chipera
Detection of Trace Clays and Clay Minerals Amounts of Erionite Using X-ray Powder Diffraction: Erionite in Tuffs of Yucca Mountain, Nevada, and Central Turkey
Journal article, *Clay and Clay Minerals*
In press.

D. E. Broxton
Chemical Changes Associated with Zeolitization on the Tuffaceous Beds of Calico Hills at Yucca Mountain, Nevada
Conference paper, *Proceedings of the 7th* Water-Rock Interactions Symposium, July 1992
In preparation.

B. Carlos, D. Bish, and S. Chipera
Fracture-Lining Manganese Oxide Minerals in a Silicic Tuff
Journal article, *Chemical Geology*
Undergoing extensive revision.

G. D. Guthrie, D. L. Bish, and B. T. Mossman
Quantitative Analysis of Zeolite-Bearing Dusts Using the Rietveld Method
Journal article, Submitted to *Science*

D. Vaniman, D. Bish, D. Broxton, B. Carlos, S. Chipera, and S. Levy
Mineralogy as a Factor in Radioactive Waste Transport Through Pyroclastic Rocks at Yucca Mountain, Nevada
Journal article, *J. Geophs. Res.*
Draft complete; may be revised for a different journal.

WBS 1.2.3.2.1.1.2
MINERALOGIC AND GEOCHEMICAL ALTERATION

The objective of this task is to characterize past and present natural alteration processes that have affected the potential geologic repository and to predict future effects of natural and repository-induced alteration.

ACTIVITIES AND ACCOMPLISHMENTS

Kinetics of Analcime Dehydration and Rehydration

Studies of the kinetics of analcime dehydration and rehydration continued. Using moisture evolution analysis, we found that the residual water in partly dehydrated analcime is released at a higher temperature than the bulk of the water in the undehydrated mineral. We are monitoring the state of hydration using structural refinement x-ray diffraction data.

Glass Dehydration

The current phase of glass-dehydration studies was completed. A paper presenting the results, "Dehydration and rehydration of a tuff vitrophyre," by D. Vaniman, D. Bish, and S. Chipera, is almost complete.

Hydrogenic Deposits

D. Vaniman presented the results of a number of hydrogenic deposits studies and discussed the Szymanski hypothesis at the January principal investigators' meeting. Other activities related to hydrogenic deposit studies included SEM studies of calcite-sepiolite intergrowths from Trench 14 and the preparation of plant root ashes for x-ray diffraction and INAA analysis (to determine if they contribute to authigenic mineral formation). S. Levy prepared samples of brecciated and altered rocks for petrographic and SEM examination.

PLANNED ACTIVITIES

Two papers will be submitted to the *7th International Symposium on Water-Rock Interaction*. D. Vaniman is first author of a paper that combines petrographic observations and modeling of evaporative precipitation to distinguish between hydrogenic deposits from tuff-source and carbonate-source waters. G. WoldeGabriel is preparing a paper on the preliminary results of his K/Ar dating studies of clinoptilolite.

Zeolite stability studies will continue. A new batch of K/Ar samples will be analyzed.

PROBLEM AREAS

We have finally located a certifiable thermal calibrator for our ovens; it will be obtained through a vendor certified by Lawrence Livermore National Laboratory.

MILESTONE PROGRESS

3138
30 October 1992
Chemical Transport in Zeolitic Alteration

3141
31 March 1992
Laminated Zone in Trench 14

3142
3 April 1992
K/Ar Dating of Clays and Zeolites
Research continuing; new draft in preparation.

3143
15 January 1992
Experimental Dehydration of Volcanic Glasses
Interim draft complete.

PUBLICATIONS

G. WoldeGabriel, *et. al*
Preliminary Assessment of Clinoptilolite K/ARr Results from Yucca Mountain, Nevada: a Potential High-Level Radioactive Waste Repository Site
Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium*, July 1992

S. Levy and C. Naeser
Bedrock Breccias Along Fault Zones near Yucca Mountain, Nevada
Chapter in USGS Bulletin on Yucca Mountain studies
In USGS editorial review.

S. Levy
Natural Gels in the Yucca Mountain Area, Nevada, USA
Conference paper, European Materials Research Society Symposium
In preparation.

D. Vaniman, D. Bish, and S. Chipera
Dehydration and Rehydration of a Tuff Vitrophyre
Journal article, *J. Geophys. Res.*
Interim draft complete.

D. Vaniman, *et. al*
Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada
Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium*, July 1992

WBS 1.2.3.2.1.2
STABILITY OF MINERALS AND GLASSES

The objective of this activity is to produce a model for past and future mineral alteration in Yucca Mountain. The model is intended to explain the natural mineral evolution resulting from the transformation of metastable mineral assemblages to more stable assemblages and the effects of a repository emplacement.

ACTIVITIES AND ACCOMPLISHMENTS

This activity has been deferred.

WBS 1.2.3.2.5
POSTCLOSURE TECTONICS

The objective of these volcanism studies is to determine the hazards of future volcanic activities with respect to siting a high-level radioactive waste repository at Yucca Mountain.

ACTIVITIES AND ACCOMPLISHMENTS

A paper, "Recent Progress in Volcanism Studies: Site Characterization Activities for the Yucca Mountain Site Characterization Project," describing our recent volcanism work, was prepared for the *Waste Management '92* symposium in Tucson, Arizona, in March. This paper introduces a new matrix of calculations on the disruption parameter. An important conclusion of this paper is that alternative structural models for the disruption parameter do not differ significantly from the random structural model.

Volcanism staff toured Yucca Mountain with a Congressional staff group and with the Chairman of the Nuclear Regulatory Commission. The staff also presented talks on two fields stops and the DOE/HQ and M&O field trip.

The detailed technical procedure for soils studies was completed and distributed.

Our responses to NWTRB questions on the volcanism studies were completed and submitted to DOE/LV.

Work in Progress

Samples are being processed for paleomagnetic studies of the Lathrop Wells volcanic center, and results should be available in February.

Separation of samples from Lathrop Wells (Ql_6), Little Black Peak cone, and Lunar Crater is being conducted using the U-Th disequilibrium method using solid-source mass spectrometry. An olivine separation has been obtained from the Ql_6 sample, and recrushed and magnetic separations are continuing in an attempt to remove magnetite inclusions from the olivines.

Plagioclase mineral separates from the U-Th work have been included in a suite of rocks to submit for 40Ar/39Ar analysis.

The volcanism QAL traveled to Riverside, California, to help coordinate quality assurance requirements with S. Wells.

PLANNED ACTIVITIES

We plan to begin trenching at the Cima volcanic field (permission has already been obtained from the Bureau of Land Management) and Lathrop Wells volcanic field in March.

PROBLEM AREAS

None

MILESTONE PROGRESS

The first draft of the Study Plan 8.3.1.8.1.2, Physical Process of Magmatism and Effects on the Repository, will be completed during February.

3174
8 January 1992
Effects of Magmatic Disruption on the Repository (study plan, R0)

3071
September 1992, expected completion April 1992
Status of Geochronology Studies at the Lathrop Wells Volcanic Center

3129
10 July 1992, expected completion April 1992
Geochemistry of Lathrop Wells Eruptive Sequences

3034
30 September 1992
Report on Magma System Dynamics

3035
30 September 1992, expected completion April 1992
Effects of Strombolian Eruption

3109
30 September 1992
Report of Subsurface Effects

3111
30 September 1992
Preliminary Geologic Mapping of Volcanic Centers

3164
30 September 1992
Progress Report on Thermoluminescence

PUBLICATIONS

B. M. Crowe *et al.*
Lathrop Wells Volcanic Center: Status of Field and Geological Studies
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992
In preparation.

B. M. Crowe *et al.*
Recurrence Models of Volcanic Events: Applications to Volcanic Risk Assessment
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992
In preparation.

F. V. Perry and B. M. Crowe
Geochemical Evidence for Waning Magnetism and Polycyclic Volcanism at Crater Flat, Nevada
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992
In preparation.

G. A. Valentine, B. M. Crowe, and F. V. Perry
Physical Processes and Effects of Magnetism in the Yucca Mountain Region
Conference paper, American Nuclear Society International High-Level Radioactive Waste Management Conference, Las Vegas, NV, April 1992
In preparation.

S. G. Wells, *et al.*
Multiple Eruptive Events at Small Volume Basaltic Centers: Evidence From the Cima and Crater Flat Volcanic Fields
Journal article
In preparation.

WBS 1.2.3.3.1.2.2
WATER MOVEMENT TRACER TESTS

The objective of the water movement tracer tests is to obtain measurements of chlorine isotope distributions to help quantify the percolation of precipitation in the unsaturated zone.

ACTIVITIES AND ACCOMPLISHMENTS

The first 100 QA-traceable ream-bit samples were shipped to Hydro Geo Chem (the subcontractor) from the Sample Management Facility. The samples were collected from the first 2 of 12 neutron-access boreholes and weighed approximately 3 tons. The boreholes are 145 and 200 feet deep. Collection of cutting samples from the third borehole continued.

The subcontractor focussed on defining optimum analytical parameters for determining chloride and bromide and revising the draft detailed technical procedure (DP) for ion chromatographic analysis.

J. Fabryka-Martin reviewed the draft job package and RSN work program for borehole UZ-16 to ensure that cuttings would be collected as needed to meet the objectives of the Water Movement Test task. Comprehensive instructions for geologists who will guide sample collection during drilling of UZ-16 were developed with the assistance of geologists at the Drilling Support Division (DSD) of the SMF facility.

A DP for determining bulk density was written and submitted for technical and QA reviews.

Staff developed plans to collect surface-soil grab samples from the vicinity of Yucca Mountain to establish the meteoric Cl/Br ratio; this ratio is needed to estimate the contribution of rock chloride (and hence rock chlorine-36) to the total chloride leached from the cuttings samples. Staff began to investigate the possibility of collecting soil profiles from trenches planned for FY92 in the vicinity of Yucca Mountain.

The subcontractor submitted its annual report for CY 91.

PLANNED ACTIVITIES

The subcontractor will begin processing the approximately 100 QA-traceable ream-bit cutting samples for chloride, bromide and chlorine isotope. Halide profiles from these holes will be used to

(1) determine the depth to which bomb-pulse chlorine-36 has moved and correlate these depths to the lithology;
(2) assess the extent to which the bomb- pulse chlorine-36 signals correlate to those of tritium;
(3) evaluate the variability in the meteoric chloride-36/chloride ratio; and
(4) test the proposed approach of using Cl/Br ratios to correct the chlorine-36/chlorine ratios for dilution by rock chloride.

Complete additional DPs; process cuttings samples from neutron-access boreholes; process USGS water samples; and collect surface-soil samples from Yucca Mountain area.

MILESTONE PROGRESS

3191
Procedure for Chlorine-36 Analysis of Unsaturated Zone Samples
30 September 1992

WBS 1.2.3.3.1.2.5
DIFFUSION TESTS IN THE ESF

The objective of this task is to determine *in situ* the extent to which the nonsorbing tracers diffuse into the water-filled pores of the Topopah Spring welded unit.

ACTIVITIES AND ACCOMPLISHMENTS

No significant activity in this study.

MILESTONE PROGRESS

No level II milestones are planned this fiscal year.

WBS 1.2.3.3.1.3.1
SITE SATURATED ZONE GROUND-WATER FLOW SYSTEM (REACTIVE TRACER TESTING)

Experiments will be conducted at the C-Well complex (holes UE25c#1, UE25c#2, and UE25c#3) and in other wells near Yucca Mountain. Reactive tracers will be used to characterize retardation and transport properties on a scale larger than that currently used in laboratory experiments.

ACTIVITIES AND ACCOMPLISHMENTS

Software Qualification

Reviews of three software baselines have been completed, and the following comments are being addressed:

(1) the software design document for the FRACNET application,
(2) the software requirements specification for the equation solver GZSOLVE, and
(3) the software requirements specification of an application to convert ASCII file data to the net CDF format.

The implementation phase (coding, verification, etc.) of the SORBEQ application is currently being reviewed. Review comments on the implementation baseline for the interface table tools are also being addressed.

LiBr Sorption Studies

The procedure for measuring concentrations of dissolved species using the ion chromatograph is complete; the most important aspect of this procedure is a technique we have developed to measure a suite of cations in a single IC run simultaneously. Previously, samples preserved by acidification were difficult to analyze because of interference between the Li and Na chromatograph peaks. Our new technique has solved this problem.

PLANNED ACTIVITIES

Continue the effort to bring the computer codes FRACNET, FEHMN, and SORBEQ and other software into compliance with the Los Alamos Software Quality Assurance Plan (SQAP). This consists of compiling existing documentation on these codes and writing any new material required by the SQAP.

Z. Dash and B. Robinson will continue to review each software submittal as necessary.

Continue activities necessary for the batch sorption experiments with lithium bromide, including compilation of error statistics on the measurements and the determination of the cation exchange capacity of the samples. Continue to develop techniques for measuring the concentration of polystyrene microspheres in solution.

PROBLEM AREAS

None

PUBLICATIONS

W. L. Polzer, W. L., M. G. Rao, H. R. Fuentes, and R. J. Beckman
Thermodynamically Derived Relationships Between the Modified Langmuir Isotherm and Experimental Parameters
Journal article, *Environmental Science and Technology*
Undergoing revision.

B. A. Robinson
FRACNET-Fracture Network Model for Water Flow and Solute Transport
LA-series report
In preparation.

B. A. Robinson
SORBEQ-A One-Dimensional Model for Simulating Column Transport Experiments
LA-series report
In preparation.

MILESTONE PROGRESS

3193
30 November 1991
Batch Sorption Experiments with Boron Using Single Crystals
Completed.

3188
16 January 1992
Documentation for SORBEQ

3194
1 April 1992
Batch Sorption Experiments with Lithium

T112
22 June 1992
Final Documentation for FEHMN

3196
27 July 1992
FRACNET Documentation

WBS 1.2.3.4.1.1
GROUND-WATER CHEMISTRY MODEL

The goal of this investigation is to provide conceptual and mathematical models of the groundwater chemistry at Yucca Mountain. These models will explain the present groundwater composition in relation to interactions of minerals and groundwater and will be used to predict groundwater compositions as a result of anticipated and unanticipated environments.

ACTIVITIES AND ACCOMPLISHMENTS

Study Plan

The Ground-Water Chemistry Model study plan 8.3.1.3.1.1, R0, is currently in project review.

Other Activities

A paper, "Water-rock interactions and the pH stability of ground waters from Yucca Mountain, Nevada," was completed and submitted to YMPO for review. This paper describes analyses of water composition of samples from the tuff aquifer at Yucca Mountain and from UE 25p#1, both of which were used in a modeling study of pH stability. In separate simulations, each ground water was titrated with two acidic solutions (acidified water [10^{-4} M HCl] and uranyl nitrate [10^{-4} M]), and the pH was monitored. The waters were also titrated in the presence of albite, microcline, and quartz or cristobalite and smectite. We found that water from UE 25p#1 (carbonate water) was well buffered by CO_2 and Ca^{2+}; however, lower Ca^{2+} in tuffaceous water caused large pH changes when Ca^{2+} was depleted because of Ca-montmorillonite formation or exchange. In general, we noted larger pH changes when the acidic uranyl solution was titrated into the water of interest than when the HCl solution was titrated. We also found that simulations in which minerals were allowed to dissolve and precipitate tended to produce a smaller change in pH than in simulations those in which no minerals were allowed to form.

Modeling of evaporation of various Yucca Mountain waters and waters from the surrounding area continued. A paper describing this work, "Precipitation of calcite, dolomite, sepiolite, and silica from evaporated carbonate and tuffaceous waters of southern Nevada," by D. Vaniman, M. Ebinger, D. Bish, and S. Chipera, was completed, revised, and is in YMPO review. This paper discusses field data and geochemical modeling of the evaporative concentration of ground waters in relation to the evolution of different assemblages of sepiolite, calcite, dolomite, and opal. In the geochemical modeling section, the authors describe waters in carbonate aquifers that produced dolomite along with sepiolite and calcite. They found that the amount of dolomite began to decrease as Si activity increased, and tuffaceous waters did produce some dolomite, but it dissolved as Si activity increased. No sepiolite formed in either carbonate or tuffaceous waters when opal was present, suggesting that opal formed before or after sepiolite and calcite but not at the same time. The modeling results were consistent with observations of fracture material derived from Yucca Mountain.

QA Activities

No additional progress to report on the IMOU between Lawrence Livermore National Laboratory and Los Alamos. IMOU is in review in Las Vegas.

PLANNED ACTIVITIES

Track Study Plan 8.3.1.3.1.1 during YMPO review.

USGS collaboration will continue. Dissolved gas compositions (e.g., fugacities of CO_2g and O_2g) from existing and new water-table wells will be used to determine Eh conditions independently of Pt electrode measurements. The gas composition data will also be used in further pH buffering capacity modeling and for refined models of the overall ground-water chemistry.

Continue support of QA efforts. Continue tracking IMOU mentioned above.

PROBLEM AREAS

None

MILESTONE PROGRESS

3006
31 March 1992
Eh and pH Buffering Capacity

3415
30 September 1992
Letter Report: Most Active Groundwater Chemistry

PUBLICATIONS

M. Ebinger
Water-Rock Interactions and the pH Stability of Groundwaters from Yucca Mountain, Nevada
Conference paper, *Proceedings of the 7th* Water-Rock Interactions Symposium, July 1992

D. Vaniman, D. Bish, M. Ebinger, S. Chipera
Precipitation of Calcite, Dolomite, Sepiolite, and Silica from Evaporated Carbonate and Tuffaceous Waters of Southern Nevada
Conference paper, *Proceedings of the 7th Water-Rock Interactions Symposium,* July 1992

WBS 1.2.3.4.1.2.1 and 1.2.3.4.1.2.3
BATCH SORPTION STUDIES AND SORPTION MODELS

The objective of this task is to provide sorption coefficients for elements of interest to predict radionuclide movements from the repository to the accessible environment.

ACTIVITIES AND ACCOMPLISHMENTS

The experiments to evaluate the effects of crushing on the sorption coefficients obtained by batch techniques have been completed. We are awaiting mineralogic analyses to properly interpret the data. Surface-area determinations have been completed on approximately 3/4 of the samples.

Testing of the atomic-force microscope is continuing. This instrument will ultimately be used to image substrates before and after sorption reactions involving the important radionuclides. It will also be used to characterize the detailed textures of Yucca Mountain tuffs at the nannometer scale.

Experiments in conjunction with the Stanford contract have begun. This work will focus on the dependence of solution composition (i.e., ground waters) on sorption coefficients for U and Np on several pure mineral phases.

PLANNED ACTIVITIES

Continue study of radionuclide sorption on pure mineral phases. Revise paper for sorption workshop proceedings after policy review. Complete Study Plan revisions.

MILESTONE PROGRESS

3009
20 February 1992
Variation of Water-Rock Ratio Sorption Coefficients on Zeolitic Tuff

3212
30 September 1992
Progress Report on Single Mineral Experiments

PUBLICATIONS

A. Meijer,
A Strategy for the Derivation and Use of Sorption Coefficients in Performance Assessment Calculations for the Yucca Mountain Site
Conference proceedings, *Proceedings of a Workshop on Sorption*, Los Alamos, New Mexico, 11-12 September 1990. Submitted.

WBS 1.2.3.4.1.2.2
BIOLOGICAL SORPTION AND TRANSPORT

The purpose of this research is to determine whether microbial activity can influence the movement of plutonium in tuff. Because fluids are used extensively in the exploration of locations for a nuclear repository, those micro-organisms capable of utilizing drilling fluids as growth substrates are of special interest.

ACTIVITIES AND ACCOMPLISHMENTS

The paper, "Preliminary Evidence of Siderophore/Plutonium Complexation," submitted to *Applied and Environmental Microbiology* in May, is being revised for publication.

Work was begun on Milestones 3080, Chelation, and 3092, Colloidal Agglomeration.

PLANNED ACTIVITIES

Continue plutonium K_d experiments.

Continue colloidal agglomeration experiments.

PROBLEM AREAS

None

MILESTONE PROGRESS

3080
30 September 1992
Report on Chelation
In preparation.

3092
30 September 1992
Report on Colloidal Agglomeration
In preparation.

3176
30 September 1992
Procedure for Determination of Formation Constants
In progress.

3177
30 September 1992
Procedure for Determination of Effects on Colloidal Agglomeration

PUBLICATIONS

L. R. Hersman, D. E. Hobart, and T. W. Newton
Preliminary Evidence of Siderophore/Plutonium Complexation
Journal article, *Journal of Applied and Environmental Microbiology*
Undergoing revision.

WBS 1.2.3.4.1.3
RADIONUCLIDE RETARDATION BY PRECIPITATION PROCESSES

The objective of the solubility determination task is to determine the solubilities and speciation of important waste elements under conditions characteristic of the repository and along flow paths from the repository into the accessible environment.

ACTIVITIES AND ACCOMPLISHMENTS

Speciation Studies

We continue to develop the certified version of the photoacoustic-spectrometer (PAS) software, and we are documenting the development phase of the photoacoustic work.

Experimental work on the PAS system continues to focus on the Pu(IV) carbonate systems. Specifically, we are mapping speciation boundaries as a function of both pH and total carbonate (i.e. combined bicarbonate and carbonate anion) concentrations. The pH values studied range from 8 to over 11; total carbonate concentrations examined were between 0.010 and 1.000 M. Because dilute samples of Pu(IV) are under study (0.98 micromolar), spectra from a complete matrix implied by the two independent variables have not yet been obtained. However, at least two Pu-carbonate species, characterized by peaks at 485 and 493 nm, Pu-colloid and Pu-hydroxide, have been found to co-exist within these experimental conditions. The solubilities and mobilities of these species are quite different, and these results may have important implications for studies on the suitability of a long-term repository.

We began using our new Pu(IV) stock solution to produce single crystals of several Pu(IV)-EDTA complexes that have been shown to exist in the system. Our initial attempts failed because of competition for colloid formation, but we finally determined that an excess of EDTA was competitive with colloid formation, and we observed a color change from red/brown to yellow with increasing pH. This was consistent with our observations from UV-VIS-NIR experiments. We also observed that heating of Pu(IV) in the presence of EDTA results in reduction to Pu(III) under certain conditions. We plan to characterize these species using single-crystal x-ray diffraction.

We continued efforts to produce a stable Np(V) stock solution (10-5 M in Np at pH=8.5) in J-13 water for the Dynamic Transport task (WBS 1.2.3.4.1.4).

Synthesis on model complexes continued, and final data reduction on 13-C NMR on the 242-Pu(VI) carbonate system suggested that additional experiments are warranted. These results will be submitted to the *Journal of the American Chemical Society* and published as a milestone report. The letter report on model complex studies is being rewritten as an LA-series report.

Solubility Studies

For the UE25p#1 oversaturation solubility experiments at 60° C, the Np determinations at all three pH values have reached steady-state; these solutions are being examined using UV-visible absorption spectrophotometry to determine the oxidation state(s) of Np. When these studies are complete, we will begin x-ray diffraction studies of the solids by adding fresh CO_2-equilibrated UE25p#1 water at 60° C and monitoring the concentration of soluble Np until steady-state is reached. These undersaturation solubility results will be compared to the results from the oversaturation solubility experiments.

The solubility experiments for Pu at the three pH values are beginning to approach steady-state. Once steady-state is achieved and maintained for some time, oxidation-state determinations of the soluble Pu will begin. The Am/Nd solubility experiments do not appear to have reached steady-state yet, and we will continue to monitor them until steady-state is achieved.

To ensure complete phase separation and minimal adsorption on the filters during preparation of the solution assays, a series of filtration tests was conducted. (Oxidation states of the radionuclides may change during the course of the solubility experiment; therefore, filtration experiments must be performed over time as well as at the beginning of the experiment. This will ensure that sorption of the radionuclide in different oxidation states onto the filter does not occur.) Centricon-30 centrifugal filters were used to separate the liquid from the solid phase. One filter per solution was used, and consecutive solution portions of 500 microliters were filtered through it. Each filtrate was acidified (to minimize sorption in the filtrate-collection container), and an assay was taken. An additional 500 microliters was filtered through the same filter, collected in a new container and assayed, and this was repeated until the assays showed a constant concentration. (The volume needed to saturate the filter is the cumulative amount of volumes used until the assay concentration remains constant.) For the Np filtration experiments, we found no increase in concentration with increased filtering volume, so very little adsorption, if any, took place. A similar result was obtained for Pu. For both the Np and Pu experiments, the filters continued to be presaturated with 500 microliters of solution before filtering a volume for assay. The filtration results for the Am/Nd experiment are not available at this time because some samples are awaiting analysis.

Work is almost complete on the new draft detailed technical procedure, "Concentration Determination of Soluble Radionuclides from Data Provided by the Low Energy Gamma Counting System," (TWS-LBL-DP-01, R0).

PLANNED WORK

Efforts in all above mentioned areas will continue.

D. Clark will present a seminar on plutonium carbonate speciation probed by 13-C NMR at Lawrence Berkeley Laboratory on January 30.

PROBLEM AREAS

Problems with the gamma counters were solved by re-installing the old system until hardware problems can be corrected. The Am/Nd assays have had long counting times because of low solubility of these elements in UE25p#1 water. In the future, we plan to use liquid scintillation counting for the assays, which will reduce assay time for Am/Nd to ten minutes.

MILESTONE PROGRESS

3031
30 September 1992
Speciation Measurements

3329
30 September 1992
Report on Neptunium, Plutonium, and Americium Solubility Experiments from Oversaturation

3330
15 January 1993, (anticipated early completion)
Evaluation of Alternative Distribution Schemes in PAS

PUBLICATIONS

J. M. Combes, C. J. Chisholm-Brause, G. E. Brown, Jr., G. A. Parks, S. D. Conradson, P. G. Eller, I. R. Triay, D. E. Hobart, and A. Meijer,
EXAFS Spectroscopic Study of Neptunium(V) Sorption at the a-FeOOH/Water Interface
Journal article, *Environmental Science and Technology.*
In press.

L. E. Hersman, P. D. Palmer, and D. E. Hobart, *Preliminary Evidence of a Siderophore/Plutonium Complex*
Journal article, *Journal of Applied and Environmental Microbiology*
Undergoing revision.

H. Nitsche, R. C. Gatti, E. M. Standifer, S. C. Lee, A. Miller, T. Prussin, R. S. Deinhammer, H. Maurer, K. Becraft, S. Leung, and S. A. Carpenter
Measured Solubilities and Speciations of Neptunium, Plutonium, and Americium in a Typical Groundwater (J-13) from the Yucca Mountain Region
LA-series report
In preparation.

C. D. Tait, D. E. Morris, J. M. Berg and W. H. Woodruff
Evaluation of Alternative Detection Schemes in Photoacoustic Spectroscopy
In preparation.

C. D. Tait, D. E. Morris, S. A. Ekberg, P. D. Palmer, and J. M. Berg
Plutonium Carbonate Speciation Changes with pH
Abstract, American Chemical Society National Meeting, San Francisco, California, April 1992
Submitted to YMPO on 25 November 1991.

Clark, *et.al*
Carbonate Complexation of Pu(IV)
LA-series report
In preparation.

Report
Molecular Models for Actinide Speciation
Submitted 5/30/91.
Internal technical review completed.

WBS 1.2.3.4.1.4
RADIONUCLIDE RETARDATION BY DISPERSIVE, DIFFUSIVE, AND ADVECTIVE PROCESSES

The objectives of this task are to determine the rate of radionuclide movement along the potential flow paths to the accessible environment and to examine the effect of diffusion, adsorption, dispersion, anion exclusion, sorption kinetics, and colloid movements in the flow geometries and hydrologic conditions expected to exist along the flow path to the accessible environment in the scenarios used for performance assessment.

ACTIVITIES AND ACCOMPLISHMENTS

We continued to study the transport behavior of radionuclides as a function of mineralogy. (The most probable explanations for the discrepancies between batch sorption coefficients and sorption coefficients obtained via column experiments [reported in May 1991] are pseudocolloid formation, precipitation, slow speciation kinetics, or slow mass-transfer kinetics.) This month, we continued stability experiments with Np solutions of the type used for the column-transport experiments.

Last month, we prepared a solution from a well characterized Np(V) acidic stock in J-13 water. The initial concentration was 1×10^{-5} M, and the pH was adjusted to 8.1. After filtration through a 0.05 micrometers nuclepore filter, 72% of the Np remained in the filtered solution, which remained stable over a 9-day period.

This month, we investigated the source of Np loss during filtration. In order to determine whether the source of Np loss was due to formation of a solid phase as a result of the addition of concentrated NaOH, we prepared a Np solution with an initial concentration of 1.0×10^{-7} M. Following addition of the Np(V) acidic stock to J-13 water, the pH of the solution was 7.7, and the pH was not adjusted with NaOH. This solution was filtered through a 0.05 micrometers nuclepore filter, and 98% of the Np remained in the filtered solution. This indicates that Np precipitation may occur due to formation of a solid phase (which dissolves slowly) upon addition of NaOH.

Last month, we fabricated 6 solid-tuff columns, 3 of tuff G4-271 and 3 of tuff G4-1531. This month, we tested the flow of water through these columns, and the high pressures necessary to establish a reasonable flow rate in the columns of tuff G4-271 caused the encapsulation of the solid rocks to fail.

In order to compare transport through solid tuff with the transport in crushed tuff, 2 crushed-rock columns were fabricated of tuff G4-1530.

M. Ott searched notebooks of task participants for data to include in a report summarizing the findings of the dynamic transport and diffusion studies. This data will be included in submittals to the SEPDP.

A detailed technical procedure (DP) to study radionuclide diffusive behavior using tuff wafers was written and is in internal review. The DP for the study of radionuclide diffusion behavior using diffusion cells was revised.

A. Mitchell briefed the public at the YMP open house on January 22. Staff completed the Yucca Mountain exhibit, which will be placed in the Los Alamos Administration Building.

PLANNED ACTIVITIES

We will prepare stable Np solutions in J-13 (with and without filtration) and without the addition of NaOH to adjust the pH.

Transport experiments using Np in the crushed and solid tuff columns will be started.

MILESTONE PROGRESS

3040
30 September 1992
Kinetics of Sorption on Columns of Pure Minerals

3044
31 August 1992
Letter Report on Assessment of Available Techniques for Unsaturated Column Transport Experiments
In preparation.

3027
31 March 1992
Report on Sorption by Batch and Column Techniques

PUBLICATIONS

I. R. Triay
Radionuclide Migration in Tuff under Diffusive Conditions
Conference Paper, *Proceedings of the Migration '91, Jerez de la Frontera, Spain, 14–18 October 1991*
In preparation.

I. R. Triay, A. J. Mitchell, and M. A. Ott
Radionuclide Migration Studies for Validating Sorption Data—Past, Present, and Future
Conference paper, *Proceedings of the Radionuclide Adsorption Workshop*, Los Alamos, NM, 11–12 September 1990
Submitted.

WBS 1.2.3.4.1.5.1
RETARDATION SENSITIVITY ANALYSIS

The objectives of this task are to construct a geochemical/geophysical model of Yucca Mountain and to use this model to examine the physical and chemical controls on radionuclide transport along flow paths to the accessible environment.

ACTIVITIES AND ACCOMPLISHMENTS

Analysis of Physical and Chemical Properties

No significant progress in January.

QA and Programmatic

Certification of TRACRN continues. Code modifications to incorporate dynamic memory allocation are almost complete, and modifications to incorporate interface table input/output have been deleted because of the uncertain status of the interface table software supported by EES-13 staff.

The Software Requirements Specification has been completed and has been accepted by the CCB.

The Models and Methods summary and the Software Design document are almost complete and will be submitted for formal review in early February.

Several verification examples have been completed and are being documented in the Verification and Validation Plan and Verification and Validation Report. The verification examples have been useful to find small bugs in the code.

Work on the users manual continues.

The Study Plan for the Retardation Sensitivity Analysis Task is being revised; it will be resubmitted soon.

PLANNED ACTIVITIES

None

MILESTONE PROGRESS

3052
30 March 1992
Baseline Documentation for TRACRN

WBS 1.2.3.4.1.5.2
DEMONSTRATION OF APPLICABILITY OF LABORATORY DATA

The purpose of this study is to design and conduct experiments to evaluate the applicability of laboratory data and to test models used in the Radionuclide Transport Program to determine far field radionuclide transport. Both intermediate- and field-scale experiments and natural analogs will be assessed for their potential to provide the required data.

ACTIVITIES AND ACCOMPLISHMENTS

Met with Lawrence Berkeley Laboratory (LBL) investigators to discuss experimental design for testing radionuclide transport at Yucca Mountain and to develop a schedule to complete this activity. The proposed upper- and lower-alcove design was used as a base case in our discussions of possible new designs.

Two interesting ideas were introduced at these meetings. The first idea involved interrogating the proposed alcove area with 3 to 6 boreholes to be used for hydrologic and geophysical tests and borehole data obtained from these tests would provide another way to predict the performance of the test block. A comparison of these borehole data with alcove-mining data could result in valuable modelling information for the YMP.

The second idea, posed as an alternative to the alcove design, involved tests conducted at packed-off intervals along an array of boreholes that cross zones where discontinuities are present (e.g. fractured zones or faults). Following the tests, the area would be mined to examine tracer movement from the test zones. Advantages of this approach are ensuring that discontinuities are tested (more discontinuities can be tested because of the longer length scale of the boreholes as opposed to the alcove) and avoiding the null case, which may exist in the alcove tests. (The null case may be present in the alcove design because of low-flux conditions at Yucca Mountain since the alcove might be constructed in a location in which water moves only a few centimeters in a ten-year period, and this rate of movement cannot be detected by current equipment.)

There was no resolution of these questions at the meeting, and it was decided that modeling will be needed to further define conditions for alcove or borehole-array design.

Training was completed on the TDIF for technical data submission.

The SCPB change was submitted to the WBS manager for review. The formal submittal must follow AP-06.1, and the necessary forms are being prepared.

PLANNED ACTIVITIES

Submit proposed revision to SCPB for this study according to AP 06.1.

Continue to develop study plan.

Travel to Lawrence Berkeley Laboratory to discuss field-test design and analysis.

PROBLEM AREAS

None

MILESTONE PROGRESS

No FY91 milestones.

PUBLICATIONS

E. P. Springer
The Use of Anthropogenic Analogues in Site Characterization of Low-Level Radioactive Waste Sites
Conference Paper, *Proceedings of the 13th Annual DOE Low-Level Waste Management Conference, Atlanta, Georgia, 19–21 November 1991*
In preparation.

C. Woloshun
A Summary and Discussion of Hydrologic Data from the Calico Hills Nonwelded Hydrogeologic Unit at Yucca Mountain, Nevada
La-series report
Received YMPO approval on 29 October 1991.

WBS 1.2.5
REGULATORY AND INSTITUTIONAL

The purpose of this task is to coordinate the regulatory and institutional Project requirements within the Los Alamos programmatic structure. The focus of this coordination effort is on the integration of the technical work within the regulatory and institutional framework.

Study Plans

Water Movement Test, R3 (8.3.1.2.2.2). A revision incorporating NRC and State of Nevada comments was submitted on 16 October 1991.

Diffusion Test in the Exploratory Studies Facility, R0 (8.3.1.2.2.5). A revision incorporating DOE/HQ and Project Office comments was submitted on 11 June 1991.

Testing of the C-Hole Sites With Reactive Tracers, R1 (8.3.1.2.3.1.7). Issued by DOE/HQ as a controlled document, and sent to the NRC on 10 April 1990.

Mineralogy, Petrology, and Chemistry of Transport Pathways, R3 (8.3.1.3.2.1). Accepted by the NRC on 4 September 1990. Responses to NRC comments were submitted on 19 August 1991.

History of Mineralogy and Geochemical Alteration at Yucca Mountain, R0 (8.3.1.3.2.2). A revision incorporating SAIC comments was submitted on 13 June 1991.

Kinetics and Thermodynamics of Mineral Evolution and Conceptual Model of Mineral Evolution, R0 (8.3.1.3.3.2; 8.3.1.3.3.3). Comment resolution meeting for DOE/HQ and Project Office comments was held on 14–15 March 1990; revision activity has been deferred.

Sorption Studies and Sorption Modeling, R0 (8.3.1.3.4.1; 8.3.1.3.4.3). Comment resolution meeting for DOE/HQ and Project Office comments was held in February 1990; revision is in progress.

Biological Sorption and Transport, R1 (8.3.1.3.4.2). Revision, incorporating DOE/HQ and Project Office comments, was submitted to Project Office on 20 May 1991. Additional revised text was submitted to the Project Office on 28 August 1991.

Dissolved Species Concentration Limits, and Colloid Formation and Stability, R0 (8.3.1.3.5.1; 8.3.1.3.5.2). Submitted to Project Office on 17 August 1990.

Dynamic Transport Column Experiments, R0 (8.3.1.3.6.1). Comment resolution meeting for DOE/HQ and Project Office comments was held on 28–30 August 1990; revision is in progress.

Diffusion, R0 (8.3.1.6.2). Comment resolution meeting for DOE/HQ and Project Office comments was held on 28–30 August 1990.

Probability of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.1). Revision incorporating DOE/HQ and Project Office comments was submitted on 19 June 1990.

Effects of Magmatic Disruption of the Repository, R0 (8.3.1.8.1.2). In preparation.

Characterization of Volcanic Features, R0 (8.3.1.8.5.1). Accepted by NRC on 4 September 1990.

Retardation Sensitivity Analysis, R0 (8.3.1.3.7.1). A revision incorporating DOE/HQ and Project Office comments was submitted on 18 June 1991. On 17 October additional comments were received from SAIC, P. Cloke.

Ground Water Chemistry Modeling, R0 (8.3.1.3.1.1). Submitted to Project Office on 15 March 1991.

WBS 1.2.6
EXPLORATORY STUDIES FACILITY

These exploratory studies (ES) will address the issues and information needs associated with the feasibility of storing high-level nuclear waste in a geologic repository at Yucca Mountain.

ACTIVITIES AND ACCOMPLISHMENTS

Prepared responses to comments about Exploratory Studies Facility (ESF) tests in the Construction Implementation Plan (CIP) for M&O.

Began to develop tracers, fluids, and materials management program consistent with the Project plan (YM 91-23) prepared by Los Alamos.

Supported Test Integration and Sample Management Facility meetings.

Prepared briefings for weekly ESF management meeting.

Reviewed the M&O-developed Construction Management Plan.

Resolved comments on ESFDR Appendix B.

Developed milestones and schedules identifying near-term work in support of the ESF design.

Began to develop ESF-based sample requirements for laboratory tests.

Attended NWTRB meeting at Washington, D. C., on January 7 and 8.

PLANNED ACTIVITIES

Continue to support M&O on resolving comments on CIP.

Continue to support water management meetings.

Begin to identify APs to be changed to manage tracers, fluids, and materials during site characterization.

Develop strategy to gather information on tracers, fluids, and materials from participants.

Continue to support ramp location initiative.

Continue to support integration meetings such as ESF design, TIG, SMF and surface based testing and its interface with ESF testing.

Make necessary changes to the TPP 91-5 for release as YMP-controlled document.

Prepare change requests for changes in testing needs to update the ESF requirements document (Project level document).

Update the ESF Test Support Requirements Document.

Develop interfaces for testing and the ESF design.

Prepare Title II test planning packages.

PROBLEM AREAS

None

MILESTONES

None

WBS 1.2.6.8.4
INTEGRATED DATA SYSTEM

The integrated data system (IDS) supports the Exploratory Studies Facility (ESF) test program by providing a central facility to automatically measure and control aspects of the ESF tests. The primary purposes of the IDS are to assist the principal investigators (PI's) in acquiring high-quality test data in a uniform, controlled fashion and to transfer those data to the PI's organizations for data management and analysis.

ACTIVITIES AND ACCOMPLISHMENTS

This activity has been deferred.

WBS 1.2.9.1.2.4
TECHNICAL SOFTWARE MANAGEMENT

The purpose of this activity is to manage the development, implementation, and use of all software employed on activities that will support a license application; to manage the configurations of all software and computational data; and to provide tools and procedures that support these activities.

ACTIVITIES AND ACCOMPLISHMENTS

Software Configuration Management (SCM)

During January, the Software Quality Assurance (SQA) system processed 2 baseline submissions and stored the submitted material in the certification environment, generated the necessary SCM documentation, performed physical and functional configuration audits on each, and generated software review packets to support Configuration Control Board (CCB) review of each.

The section sanctioned 9 software applications and updated the Computer Program Library for each. Three Software Implementation Notices were issued, and one CCB meeting was held at which four reviews were approved and one SCM Variance Authorization was issued.

Software Engineering

The Software engineering reviewed various baseline components of the applications currently under development.

The following support tools are being developed:

DOCGEN - (see October 1991) prototype development of the narrative description extraction and updating capabilities for source-code prologues.

COMMAND-LINE PARSER - Will enable developers to easily define legal command lines for their applications, and to obtain information from the Unix command line. This design is almost complete. This is our first application to incorporate a full, object-oriented analysis and design. This project has helped those within the software engineering effort to gain a much fuller understanding of object-oriented techniques.

FILE-LIST UTILITIES - Prototype development is underway for a set of file list reuse components for the SCM effort. These components will enable the SCM to automate many tasks that are at present human-intensive and error-prone.

PSEUDOCODE FORMATTER - owing to loss of personnel, no progress was made on this application.

CONDITION NOTIFICATION FACILITY - This application awaits SCM approval.

EXTENDED STRING UTILITIES - there is no progress to report.

EXTENDED COPY UTILITIES- there is no progress to report.

Other Activities

The Software Process Improvement Task Force was established in December; its goal is to improve the overall productivity and effectiveness of software use, development, and management throughout the Project. Two meetings were held at which various process improvement issues were identified.

PLANNED ACTIVITIES

Configuration Management

- Continue management of submitted baselines and change orders.
- Development of a Software Requirements Specification for the CSA Database upgrade.
- Development of a Software Requirements Specification for the Computer Program Library upgrade.

Software Engineering

- Continue work on the object-oriented design of the command line parser.
- Continue work on the design and implementation of the extended string utilities.
- Continue work on the design and implementation of the extended copy utilities.
- Continue support of the schedule update effort for the Project Control section.
- Continue support of the SCM effort.

PROBLEM AREAS

During January, the SQA system was notified that support from the YMP Office in Las Vegas was being withdrawn and the 1992 budget for the Group had been reduced to zero. A great deal of time was spent negotiating with Project Office representatives to determine whether Los Alamos could adopt another participant's software QA Plan as a replacement for our own, but this was discouraged by the Project Office.

The decision to discontinue the Los Alamos SQA approach is bewildering in light of the following:

- The March 1991 audit of this system by the Project Office, NRC, and State of Nevada was flawless. It generated no findings and resulted in high praise from the auditors.

- The Los Alamos SQA approach is highly regarded by the NRC.

- LANL YMP auditors have credited the system with providing timely, accurate information that has been extremely helpful during local audits and surveillances.

- The Los Alamos SQA system implemented an active process improvement effort (see December 1991) that has resulted in substantial improvements in efficiency and effectiveness.

Despite the uncertainties, this group has continued to perform the QA, configuration management, and engineering tasks required until a replacement program is approved.

The decision to terminate support for the LANL SQA system has negatively impacted LANL YMP because computer system support for all system computers has been terminated. Consequently, operating-system and software updates are not being applied and routine maintenance is not being performed on any of these systems (4 work stations, 1 VAX 4000, and 5 Macintoshes). Computer network support has also been suspended, and the Process Improvement Task Force has been disbanded.

WBS 1.2.9.1.4
RECORDS MANAGEMENT

The objective of this task is to manage records and documents related to the licensing of a geologic repository for the disposal of high-level radioactive waste by developing, implementing, and maintaining a comprehensive, automated, and integrated information management system.

ACTIVITIES AND ACCOMPLISHMENTS

The Records Processing Center rejected 9 records and accepted 63 records in January.

WBS 1.2.9.3
QUALITY ASSURANCE

The Quality Assurance (QA) Program supports Los Alamos Yucca Mountain Site Characterization Project participants and ensures that their efforts provide data and evidence admissible for the repository-licensing process.

ACTIVITIES AND ACCOMPLISHMENTS

Software

Two software Configuration Control Board (CCB) meetings were held. We have received 115 software change requests, and 50 of these have been approved.

Grading

Of the 32 grading packages being prepared, 27 have been approved, 6 (including 3 for international studies) are in review at the YMPO.

Document Control

Seven detailed technical procedures (DP-87, DP-88, DP-89, DP 90, DP-92, DP-95, and DP-97) were issued and distributed.

Program Development

Twelve quality administrative procedures (QPs) are in various stages of the review cycle. The QP writing and review cycle was examined, and several changes have been made to increase efficiency. A trending report for 1990-1991 was distributed to the TPO and Project Leaders. L. McDonald was hired as quality assurance liaison for EES-5.

S. Bolivar, J. Day, and P. Gillespie attended the PQAC meeting in Las Vegas.

Deficiencies

The YMPO closed out CAR YMP-92-001.

Audits

Audit report LANL-AR-91-12 (Lawrence Berkeley Laboratory) was approved and distributed. An audit of criterion 18 was conducted.

PLANNED ACTIVITIES

Revise grading packages. Complete unfinished survey reports and the criterion-18 audit report. Revise several QPs Close out any open CARs.

QAPL will continue to prepare 1991 progress report.

Newly designed YMP orientation class will be held each month.

EES-1 project participants (AR 92-01) will be audited.

PROBLEM AREAS

The existing software quality assurance plan is under review. See WBS 1.2.9.1.2.4 for additional information.

APPENDIX

ATTACHMENTS AND LEVEL III MILESTONE REPORTS

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Distribution

DATE: January 30, 1992

FROM: J. A. Canepa, EES-13

MAIL STOP/TELEPHONE: J521/7-4109

SYMBOL: EES-13-01-92-1188

SUBJECT: HIGHLIGHTS OF PI MEETING OF JANUARY 24, 1992

Everett Springer gave a presentation on how our data has been used in Performance Assessment calculations and the construction of CCDFs. He compared CCDFs from Sinnock et al. 1984, the NRC Performance Assessement (1990), and the ESSE Presentation (1991). It was decided by the group to invite Mike Wilson (SNL) to a PI meeting so that we might get a better understanding of how CCDFs are constructed.

Dave Vaniman gave an excellent talk on the issues raised by J. Szymanski (DOE/YMP) and the technical progress in resolving these issues (no handouts).

Dick Herbst reported on the future of the software quality assurance effort. He indicated that DOE was not supportive of the effort through the budget. Steps are being taken at EES-13 to re-evaluate the effort. The details are not yet clear on the direction of software quality assurance (SQA). An SQA program is still required by the DOE/YMP.

Dick also announced his intention to pursue a job change. He will be relocating to Washington, D.C. to support the DOE Hanford Tanks Waste Remediation Program.

JAC/em

Attachment: Handout

Distribution:
K. H. Birdsell, EES-5, MS F665
D. E. Broxton, EES-1, MS D462
B. A. Carlos, EES-1, MS D462
B. M. Crowe, EES-13/LV, MS J900/527
M. H. Ebinger, EES-15, MS J495
K. G. Eggert, EES-5, MS F665
N. Z. Elkins, EES-13/LV, MS J900/527
J. T. Fabryka-Martin, INC-7, MS J514
C. D. Harrington, EES-1, MS D462
L. E. Hersman, LS-2, MS M880
S. S. Levy, EES-1, MS D462
A. Meijer, INC-7, MS J514
D. E. Morris, INC-11, MS G739
B. A. Robinson, EES-4, MS D443
E. P. Springer, EES-13, MS J521
I. R. Triay, INC-11, MS J514
G. Valentine, EES-5, MS F665
D. T. Vaniman, EES-1, MS D462
G. A. Zyvoloski, EES-5, MS F665

Information Cy:
S. L. Bolivar, EES-13, MS J521
J. A. Canepa, EES-13, MS J521
G. P. Cort, EES-13, MS J521
D. B. Curtis, INC-7, MS J514
J. L. Day, LATA, MS M321
R. J. Herbst, EES-13, MS J521
H. N. Kalia, EES-13/LV, MS J900/527
R. A. Morley, EES-13/LV, MS J900/527
W. A. Morris, EES-1, MS D462
K. W. Thomas, INC-11, MS J514
K. A. West, EES-13, MS J521
EES-13 File, MS J521

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Distribution

DATE January 10, 1992

FROM J. A. Canepa, EES-13

MAIL STOP/TELEPHONE J521/7-4109

SYMBOL EES-13-01-92-1151

SUBJECT **PI MEETING JANUARY 24, 1992, INC-DO CONFERENCE ROOM, 9:00-11:00 A.M.**

There will be a YMP PI meeting on January 24, 1992 in the INC-DO Conference Room starting at 9:00 a.m. Technical topics to be discussed are:

1. A discussion of how our data was used by PA and a comparison of CCDF's over past 8 years - implications for the transport program. (Everett Springer).

2. Update and evaluation of the 'Szymanski' issue-implications for the water chemistry, mineralogy and modeling efforts. (Dave Vaniman).

Please advise interested colleagues of this meeting.

JAC/em

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USE OF SORPTION AND SOLUBILITY DATA IN THE YUCCA MOUNTAIN PROJECT

1984 - 1991

Preliminary Data—Do Not Reference

LITERATURE REVIEWED

- SINNOCK ET AL. (1984) ALSO J. GEOPHY. RES. (1987)
- NRC PERFORMANCE ASSESSMENT 1990 (UNPUBLISHED AS OF THIS DATE)
- ESSE PRESENTATION NOVEMBER 1991 - RICKERTSEN (PRELIMINARY)

Preliminary Data—Do Not Reference

Table 5 from Sinnock et al. (1984)

Prow Pass Member (partially welded tuff)	Americium	470
	Cesium	190
	Neptunium	6.4
	Plutonium	77
	Strontium	22
	Technetium	0.2
	Uranium	NA
	Barium	182
Bullfrog Member (welded tuff)	Americium	140
	Cesium	180
	Neptunium	NA
	Plutonium	80
	Strontium	62
	Technetium	4.2
	Uranium	1.3
	Barium	400
Tram Member (nonwelded tuff)	Americium	28000
	Cesium	610
	Neptunium	28
	Plutonium	400
	Strontium	290
	Technetium	NA
	Uranium	4.6
	Barium	760

Table 6 from Sinnock et al. (1984)

Element	Kd (cm^3/g)	Ka(g/cm^2)	Rd for Matrix Zeolitic	Rd for Matrix Vitric	Rd for Fractures Unsat	Rd for Fractures Sat
Am	180	1.8×10^{-4}	3600	1800	1.4	1.0
C	0	0	1	1	1.0	1.0
Cm	180	1.8×10^{-4}	3600	3600	1.4	1.0
Cs	290	2.9×10^{-4}	5800	2900	1.5	1.0
I	0	0	1	1	1.0	1.0
Ni	100	1.0×10^{-4}	2000	1000	1.2	1.0
Np	7	7.0×10^{-6}	140	71	1.0	1.0
Pa	64	6.4×10^{-5}	1300	640	1.1	1.0
Pb	5	5.0×10^{-6}	100	51	1.0	1.0
Pu	64	6.4×10^{-5}	1300	640	1.1	1.0
Ra	900	9.0×10^{-4}	18000	9000	2.8	1.2
Sn	170	1.7×10^{-4}	3400	1700	1.3	1.0
Sr	53	5.3×10^{-5}	1100	530	1.1	1.0
Tc	0.3	3.0×10^{-7}	7	4	1.0	1.0
Th	580	5.8×10^{-4}	12000	5300	2.2	1.1
U	1.8	1.8×10^{-6}	37	19	1.0	1.0
Zr	500	5.0×10^{-4}	10000	5000	2.0	1.1

Preliminary Data—Do Not Reference

SINNOCK ET AL. (1984)

- ASSUMED SOLUBILITY ONLY FOR URANIUM THEN OTHER RADIONUCLIDES WERE CONGRUENTLY LEACHED BASED UPON MASS IN THE WASTE FORM
- SINGLE K_D
- FLUX WAS 0.5 MM/YR

Preliminary Data—Do Not Reference

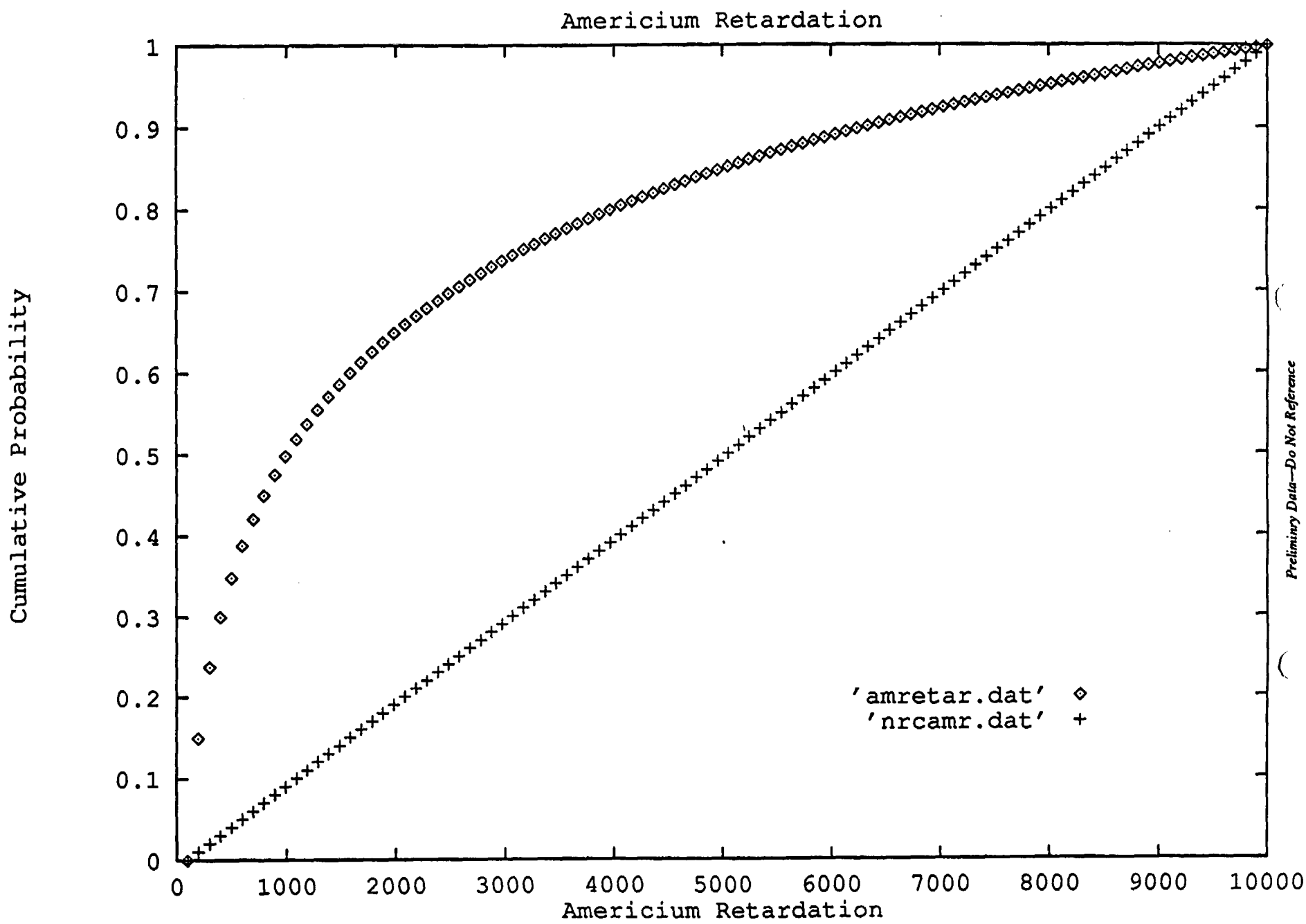
Table 5 from Sinnock et al. (1984)

Tuff Unit	Radionuclide	Sorption Ratio Kd (ml/g)
Topopah Spring Member (welded tuff)	Americium	1200
	Cesium	290
	Neptunium	7
	Plutonium	64
	Strontium	53
	Technetium	0.3
	Uranium	1.8
	Barium	900
Topopah Spring Member (bedded tuff)	Americium	180
	Cesium	16000
	Neptunium	NA
	Plutonium	120
	Strontium	17000
	Technetium	2.5
	Uranium	2.5
	Barium	38000
Calico Hills (bedded tuff)	Americium	4600
	Cesium	7800
	Neptunium	11
	Plutonium	140
	Strontium	3900
	Technetium	NA
	Uranium	5.3
	Barium	94000

NRC / ESSE

- SOLUBILITY FOR INDIVIDUAL RADIONUCLIDES WAS USED
- RETARDATION RATHER THAN K_D WAS USED
- DISTRIBUTIONS RATHER THAN SINGLE VALUES FOR BOTH PARAMETERS

Preliminary Data—Do Not Reference



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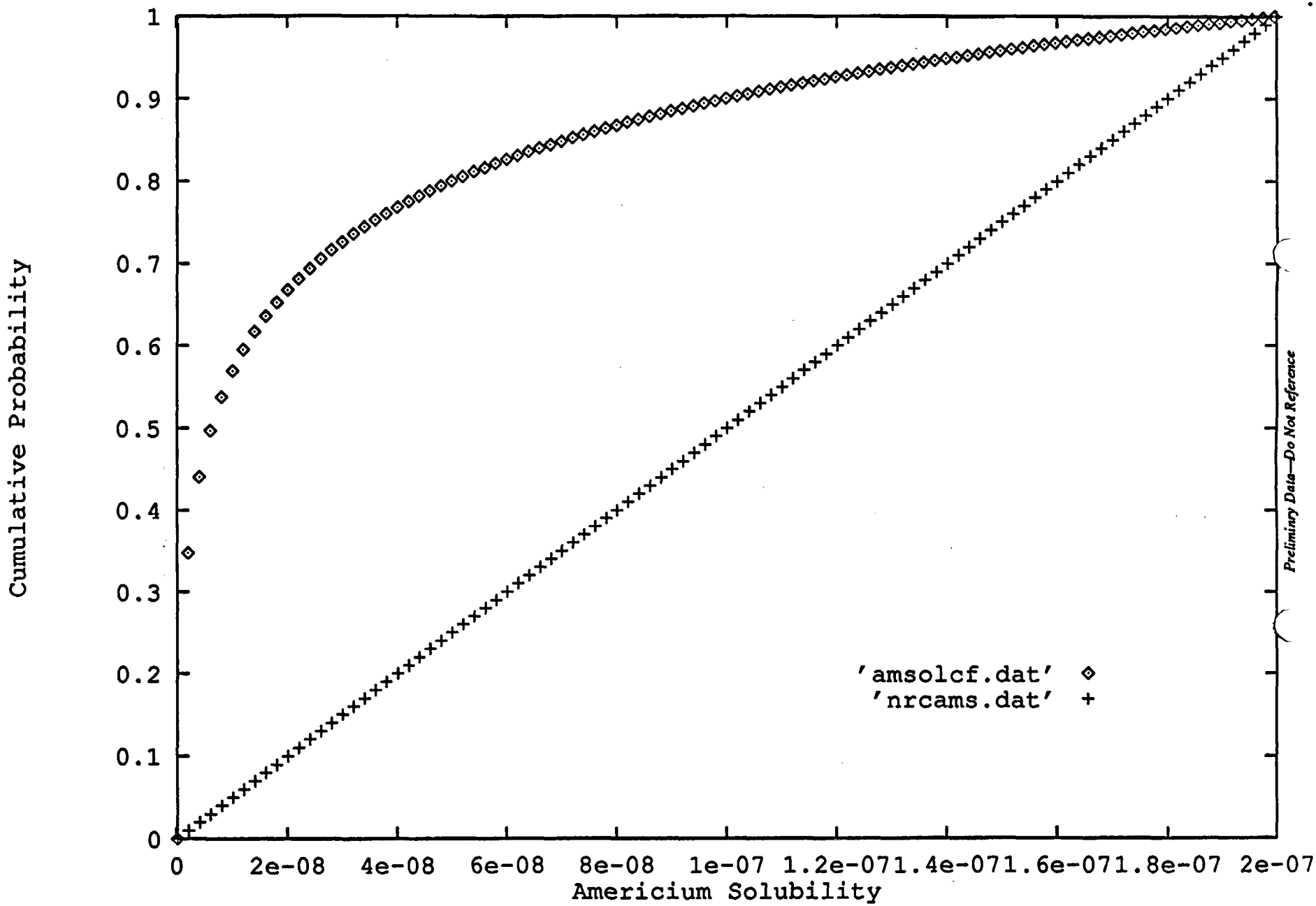

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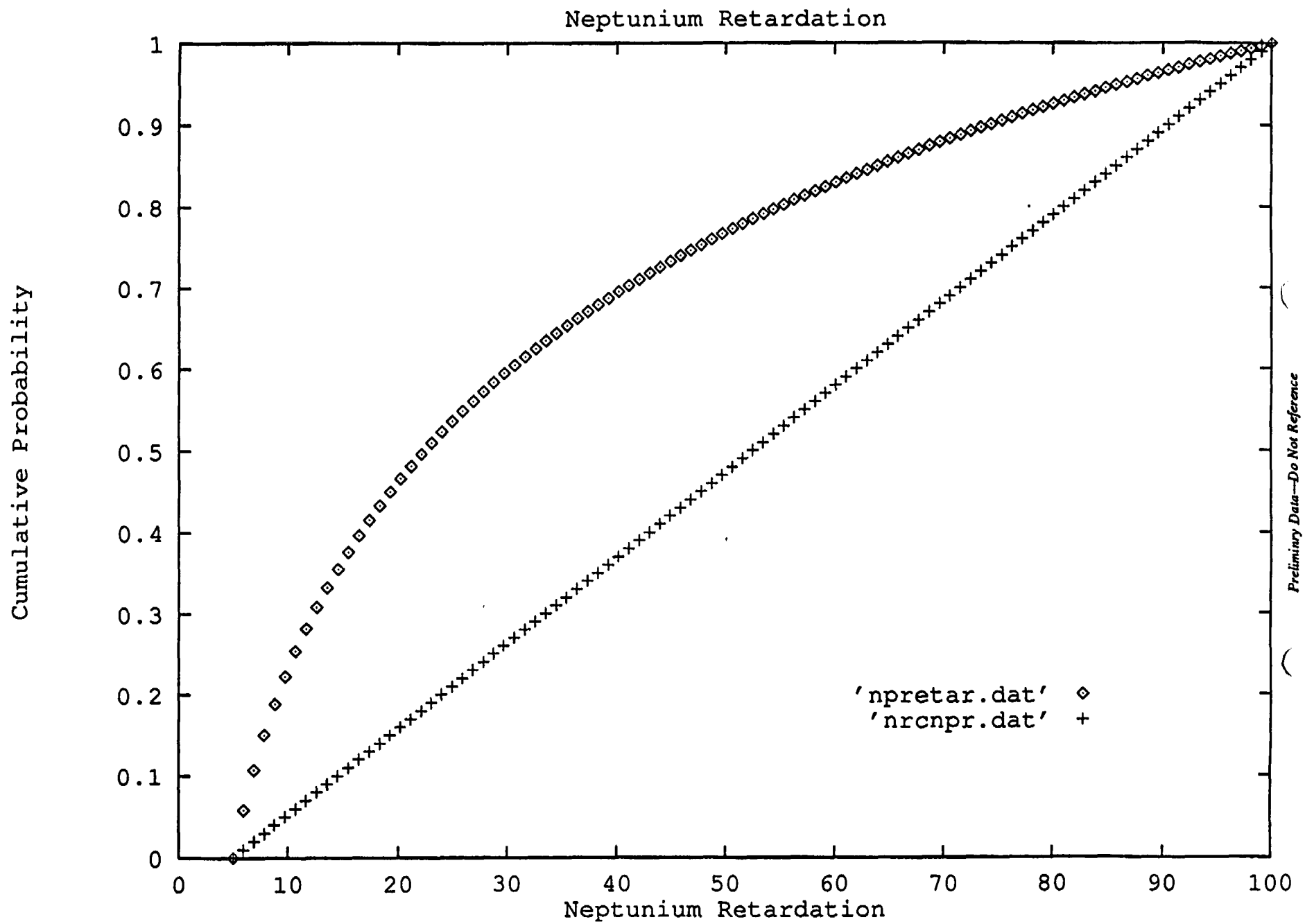

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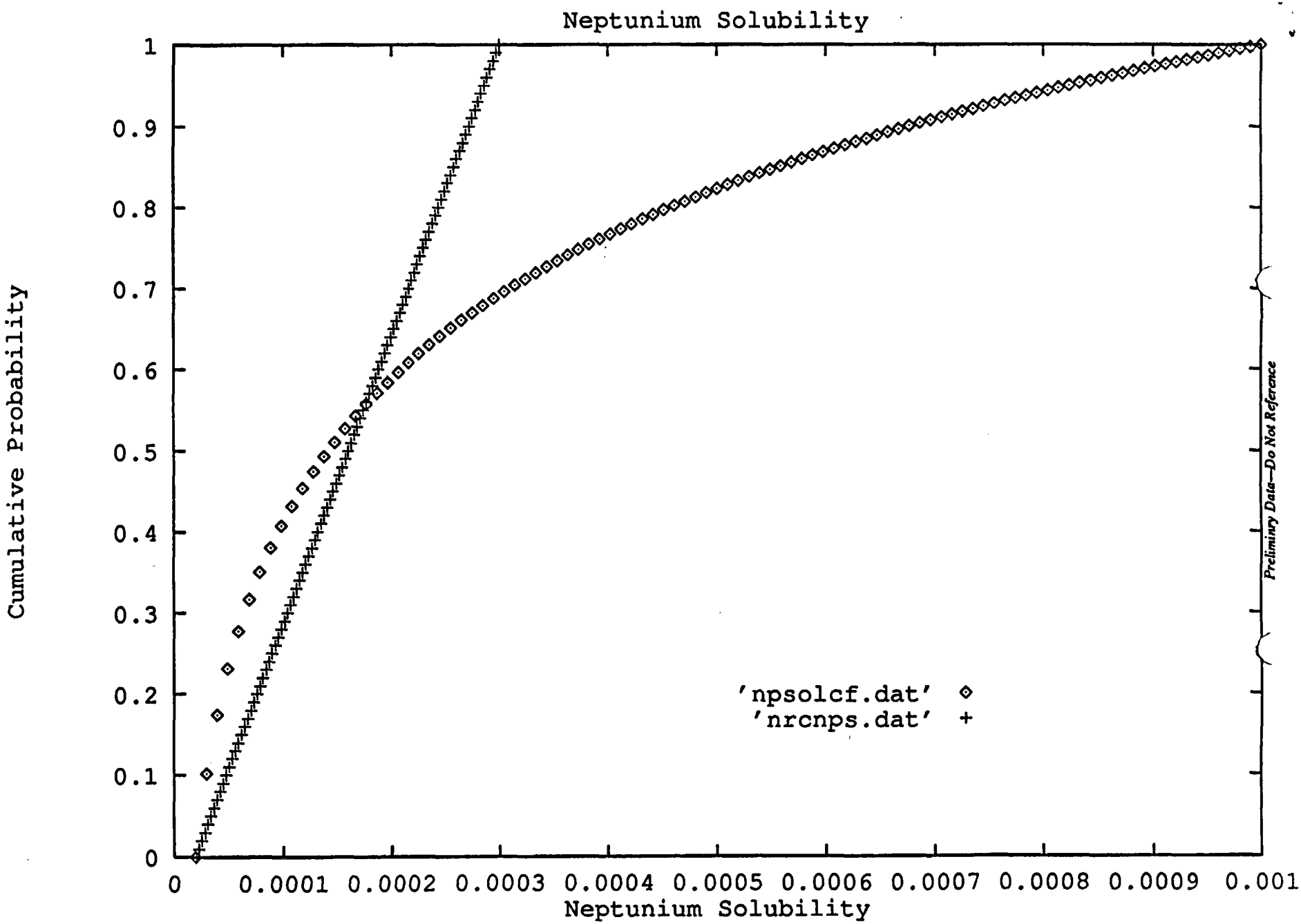
Neptunium Solubility
Cumulative Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.0001
0.0002
0.0003
0.0004
0.0005
0.0006
0.0007
0.0008
0.0009
0.001
Neptunium Solubility
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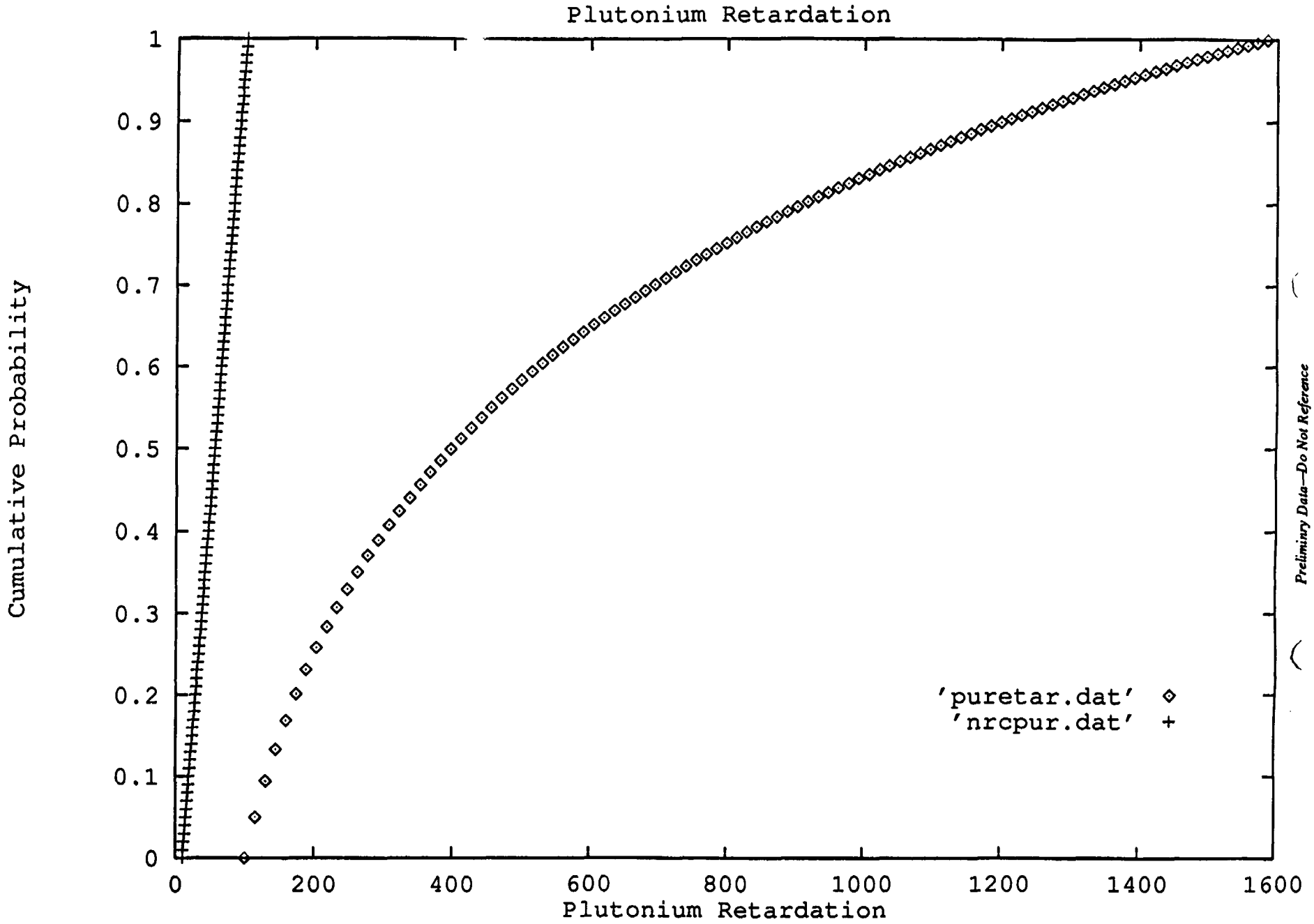
'nrcnps.dat'
Preliminary Data—Do Not Reference



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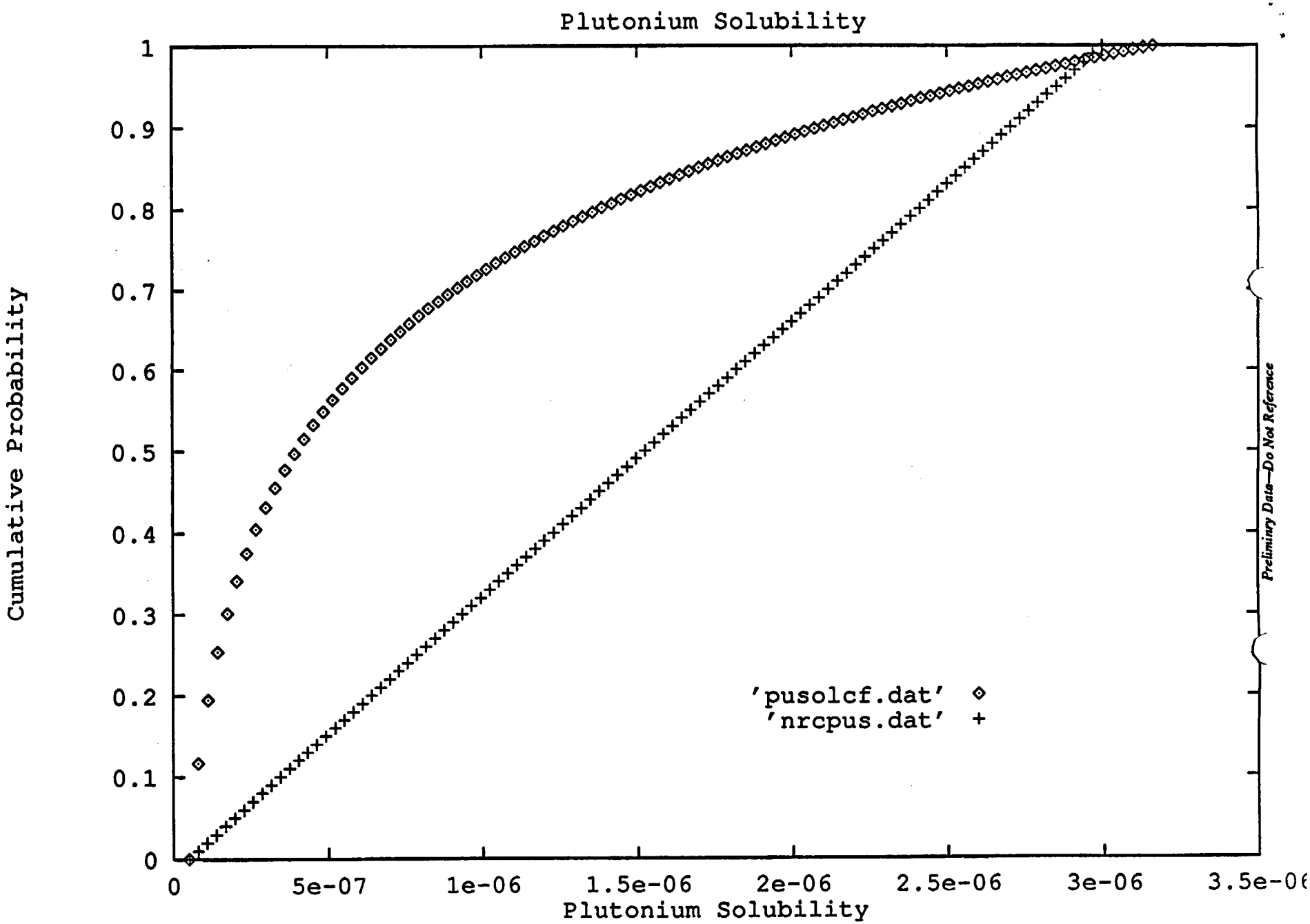

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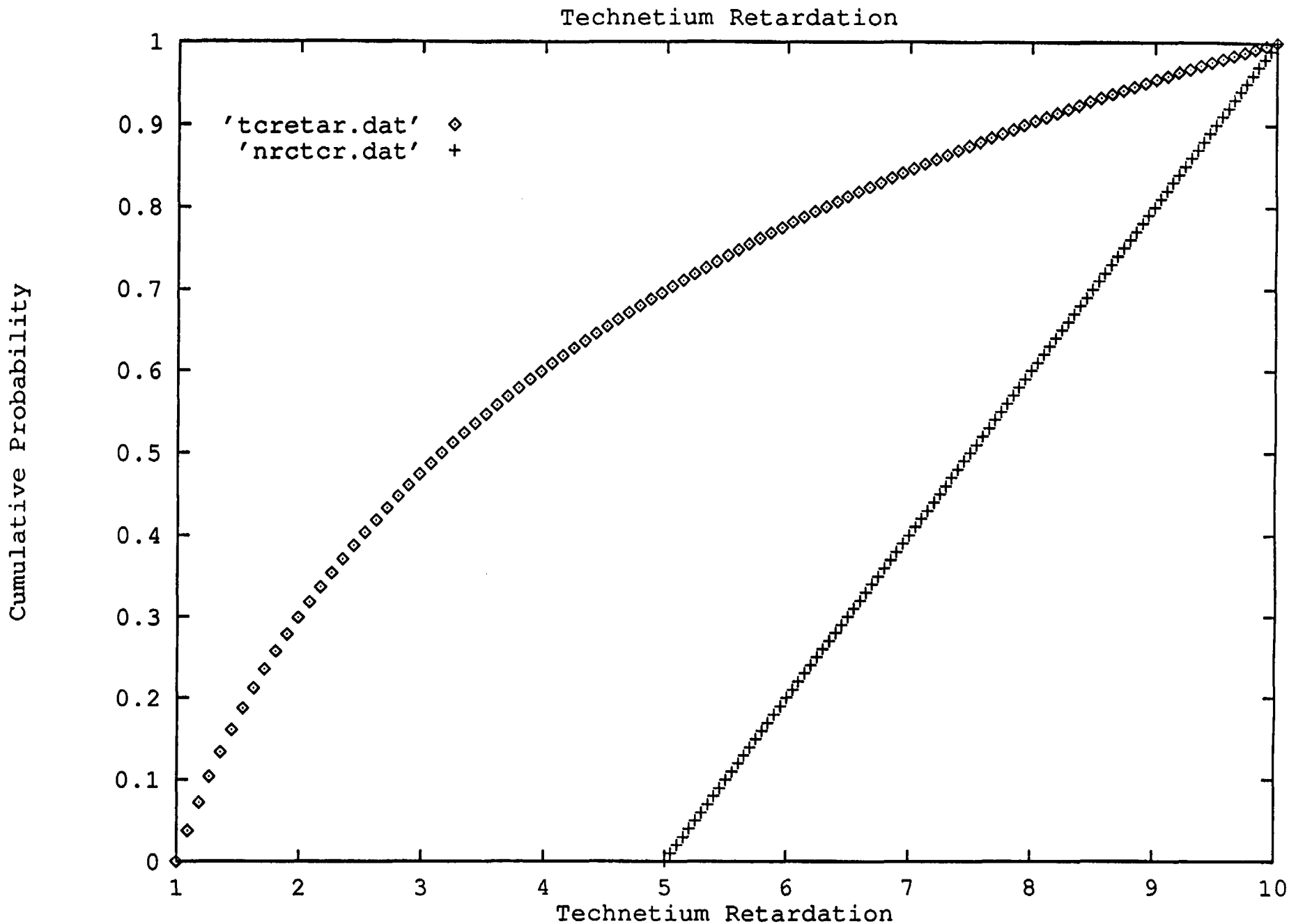

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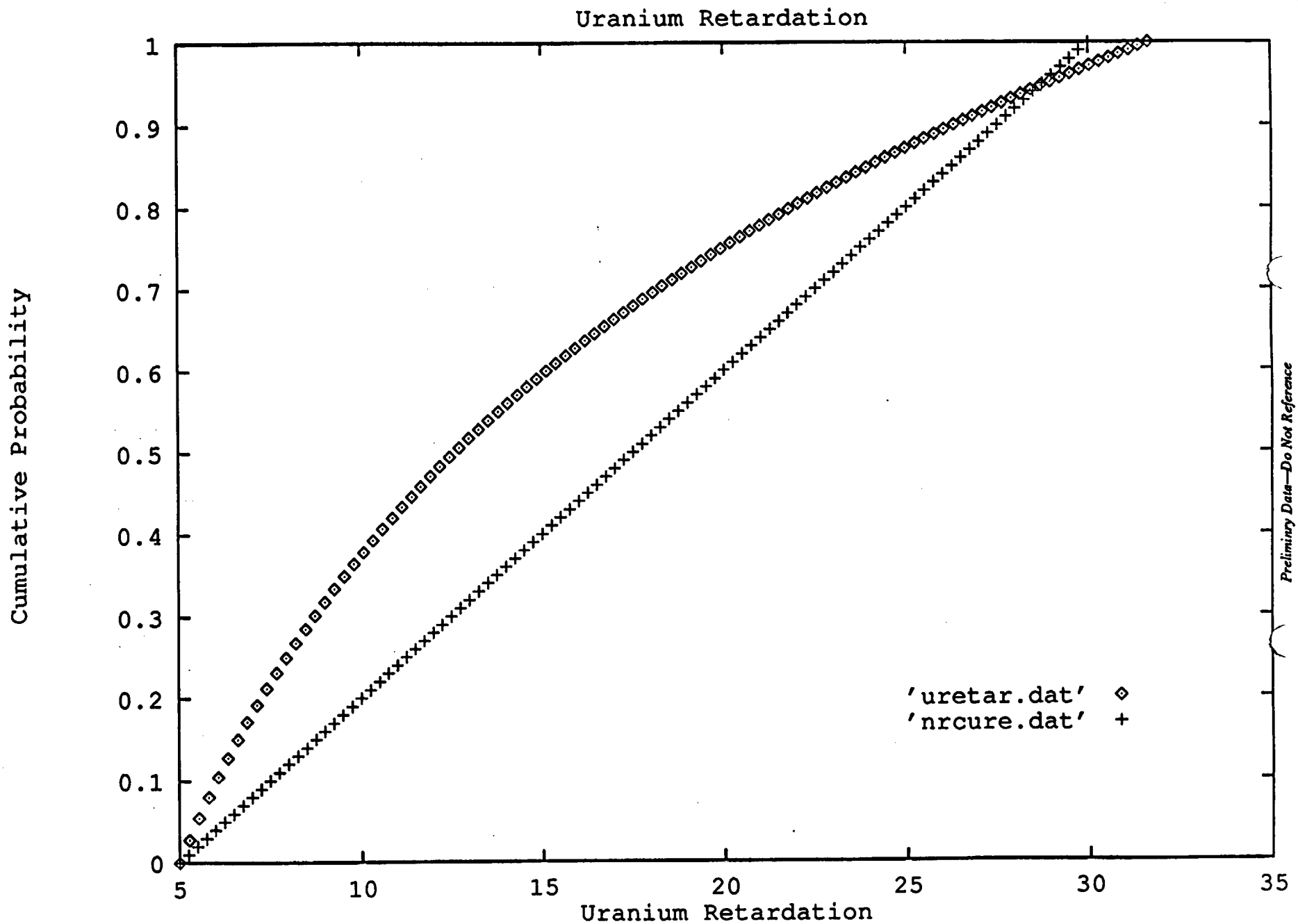
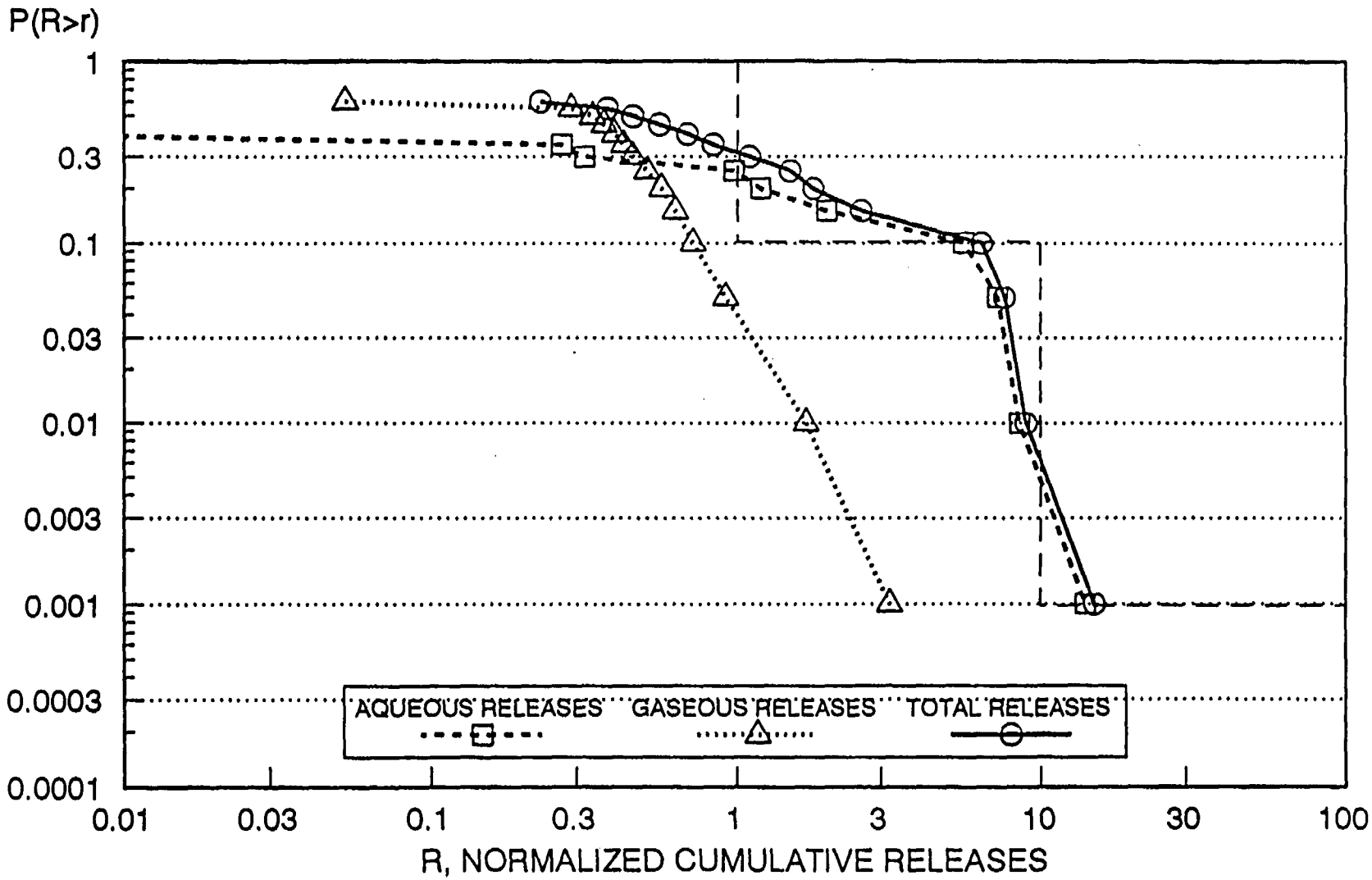


Preliminary Data—Do Not Reference

ESSE SYSTEM PERFORMANCE ASSESSMENT

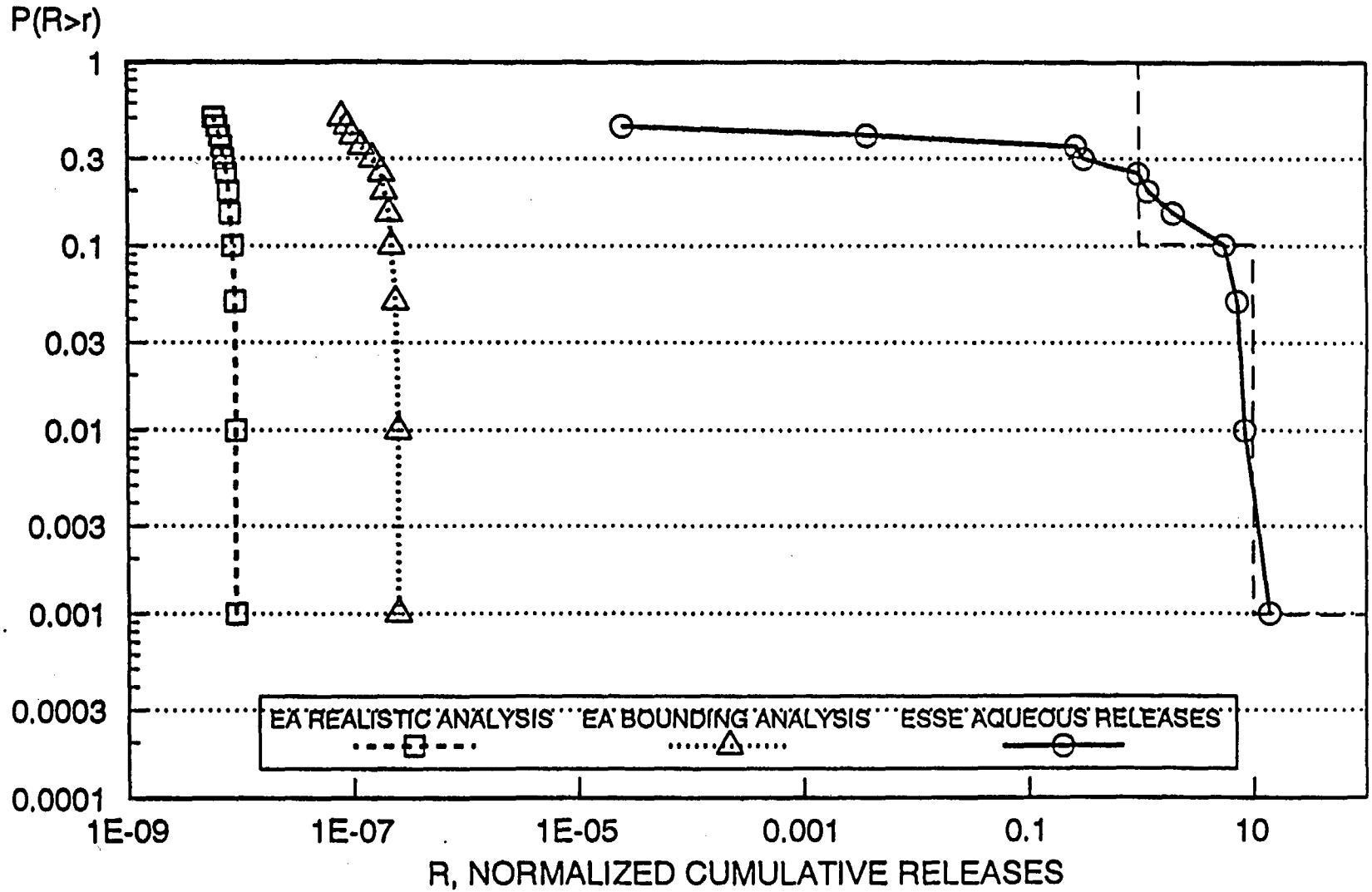
UNDISTURBED PERFORMANCE



Preliminary Data—Do Not Reference

COMPARISON OF ESSE AND EA ASSESSMENTS

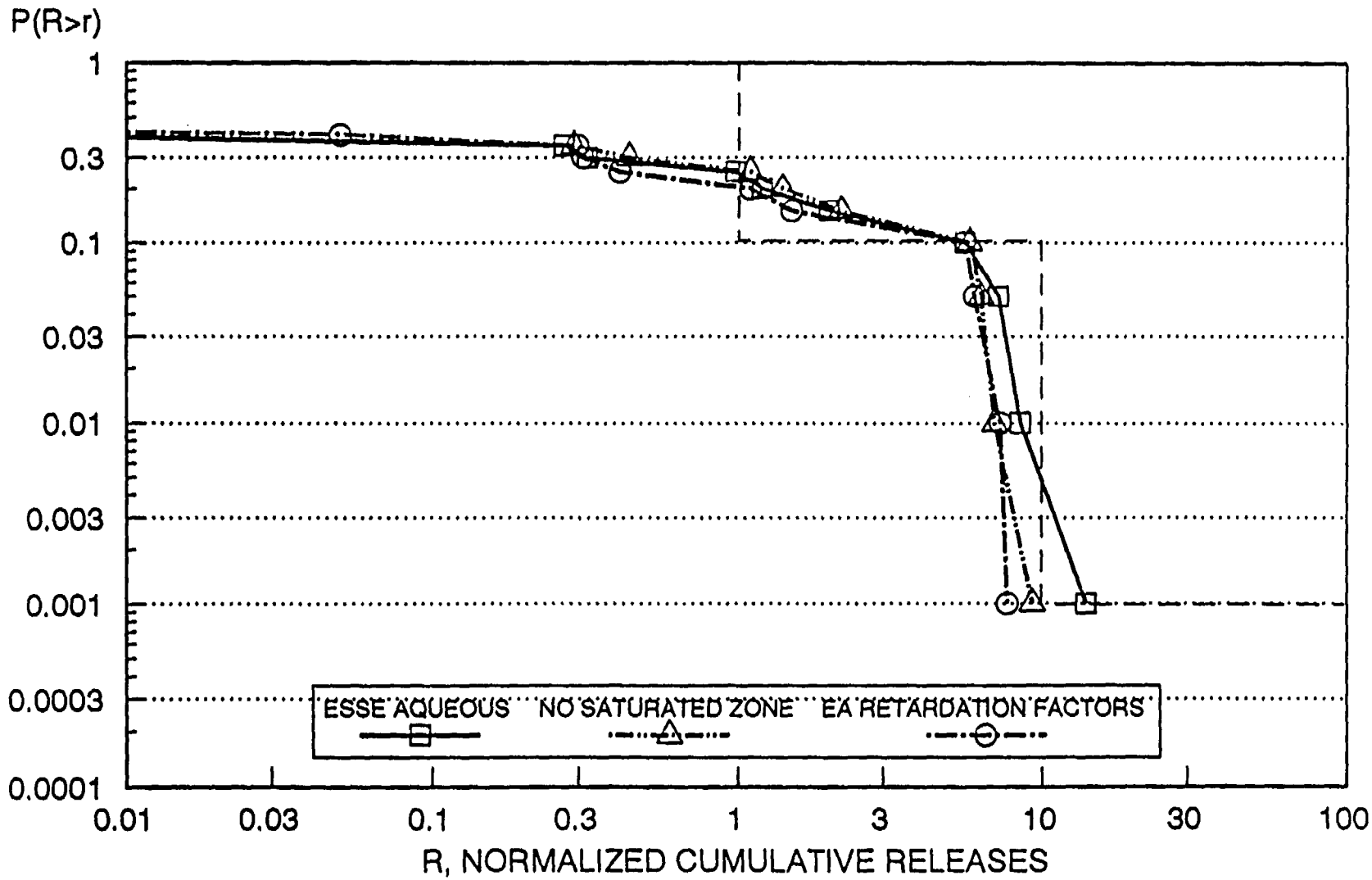
UNDISTURBED PERFORMANCE



Preliminary Data—Do Not Reference

EFFECTS OF ESSE MODEL FEATURES

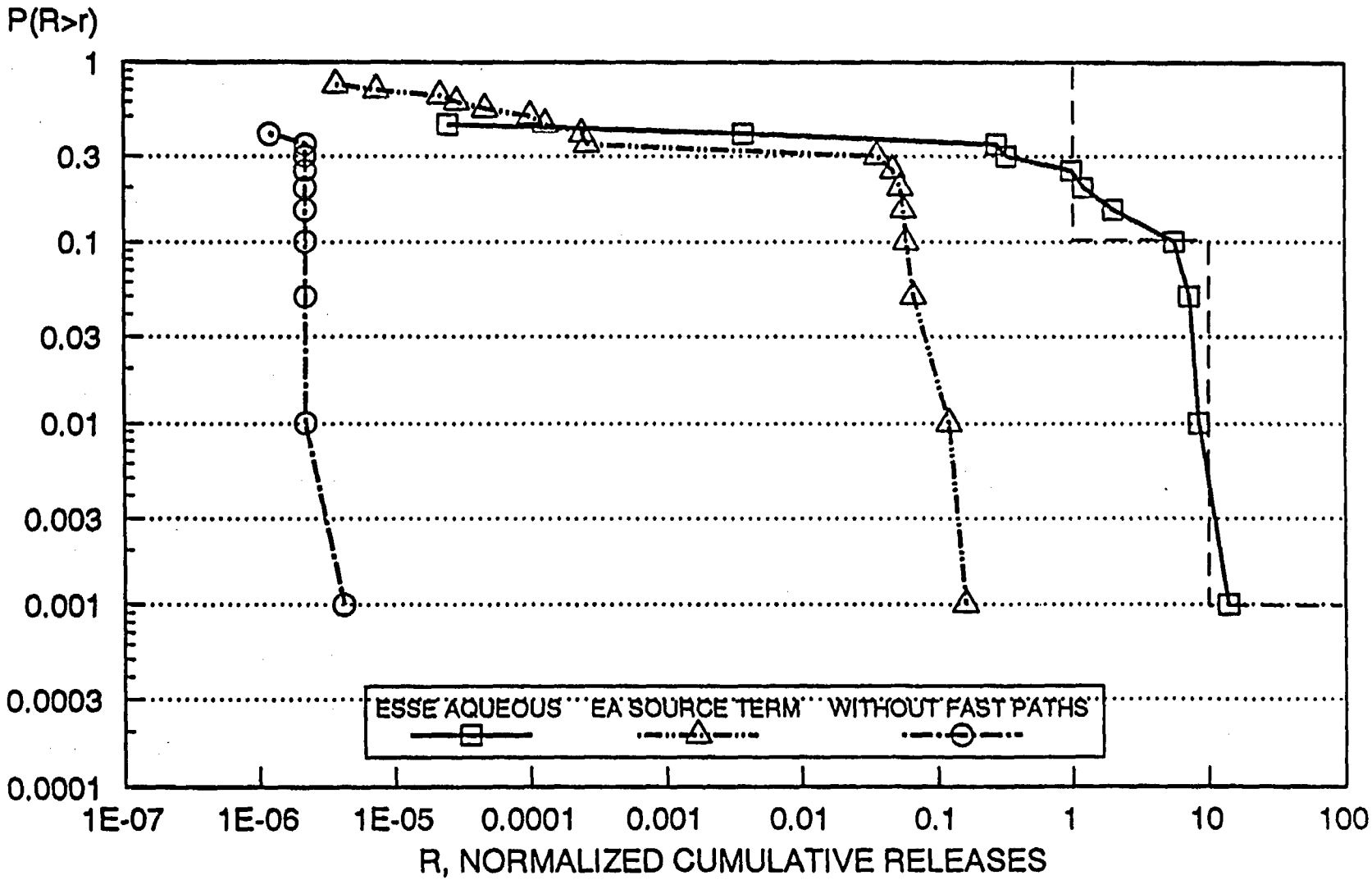
SATURATED ZONE AND RETARDATION MODELS



Preliminary Data—Do Not Reference

EFFECTS OF ESSE MODEL FEATURES

SOURCE TERM AND FAST PATH MODELS



Preliminary Data—Do Not Reference

ISSUES IDENTIFIED IN TECHNICAL GUIDELINE EVALUATION

Geohydrology

- Effect of "fast paths" (e.g. heterogeneity; episodic infiltration; topography; perching)
- Modeling uncertainty (e.g. 2D vs 1D modeling)

Geochemistry

- Colloidal transport of plutonium

Climate Changes

- Potential water table rise
- Potential increase in flux

Postclosure tectonics

- Occurrence of faults
- Local concentration of flux due to new paths
- Modification to water table

Human Interference

- Potential for future exploration

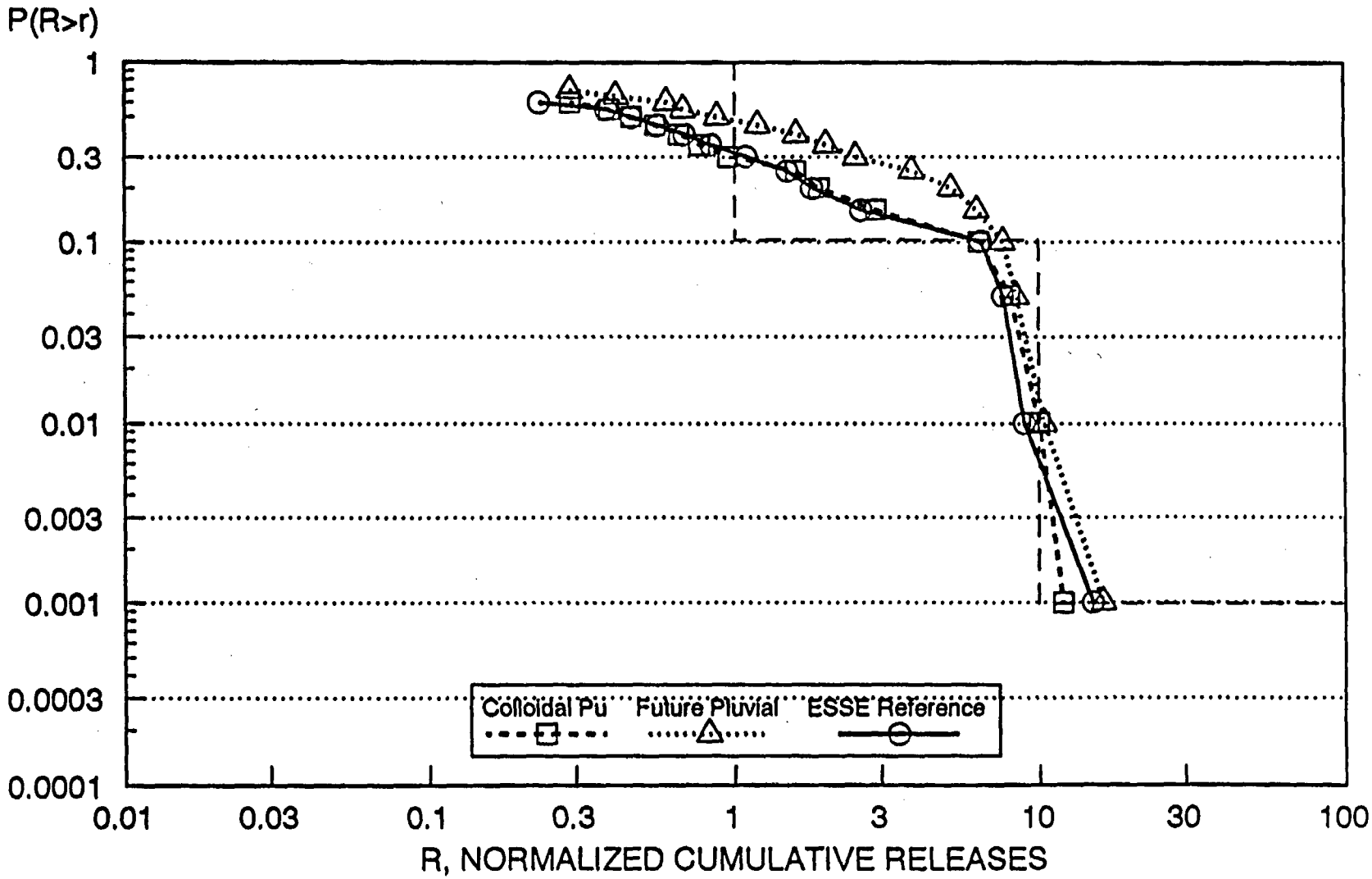
Others

- Potential for gaseous release

Preliminary Data—Do Not Reference

EVALUATION OF TECHNICAL GUIDELINE ISSUES

GEOCHEMISTRY AND CLIMATE CHANGES



Preliminary Data—Do Not Reference

CONCLUSIONS

- CURRENT INFORMATION INDICATES NO FEATURES OR CONDITIONS AT YUCCA MOUNTAIN THAT MAKE IT UNSUITABLE
- MOST IMPORTANT ISSUE FOR SYSTEM PERFORMANCE IS PRESENCE OF FAST PATHS; EARLY TESTS SHOULD FOCUS ON THESE
- GASEOUS RELEASE ALONE CAUSES SITE TO BE MARGINALLY LICENSABLE, EVEN IF NO FAST AQUEOUS PATHS
- CONCLUSIONS REGARDING SITE SUITABILITY DO NOT DEPEND ON ENGINEERED BARRIERS

Preliminary Data—Do Not Reference

SUMMARY

- THE LIST OF IMPORTANT RADIONUCLIDES IS CONSISTENT - Tc, I, C, Pu, Am, Np, U
- HOW MUCH CAN THESE DISTRIBUTIONS BE CHANGED? IS THE DISTRIBUTION THE RIGHT APPROACH?
- CAN "OUR" DATA SHIFT THE CCDFs BACK TO THE LEFT?
- IN TERMS OF SENSITIVITY, IS THERE AN OBJECTIVE FUNCTION OTHER THAN A CCDF THAT SHOULD BE USED?

Preliminary Data—Do Not Reference

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