See file pocket 8 for encl.

DISK:LV001:PTP:DOC0032102185

WM Record File 102

WM Project 11
Docket No.
PDR ✓
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October 21, 1985

MEMORANDUM FOR: Robert E. Browning, Director
Division of Waste Management

FROM: Paul T. Prestholt, Sr. OR-NNWSI PTP

Subject: NNWSI Site Report period October 1, through October 18, 1985

I. The September TPO-NNWSI Project Manager meeting was held on October 2 and 3. A number of topics were discussed that are of interest ot the staff.

A. The NNWSI Project Charter between the DOE Albuquerque Office and the DOE Navada Office has been revised, giving Don Vieth "Contracting Officer's Technical Representative" authority (COTR/NV). A copy of the document detailing the charter revisions is enclosed.

Two aspects of the above charter revision are or particular interest to the NRC. They are:

1. Dr. Vieth now has official control over the day to day activities of those Sandia and Los Alamos Laboratory organizations that are directly involved in NNWSI work;

2. The NNWSI QA organization will furnish the lead auditor at all future audits of the NNWSI work being done at Sandia and Los Alamos Laboratories.

It is anticipated that a similar agreement will be finalized between DOE San Francisco Operations Office (LLNL) and DOE Nevada in the near future.

B. In a previous report I mentioned that the NNWSI was supporting the appointment of a common architectural engineer for repository design. This idea was opposed by both the SRP and BWIP and is now dead. Instead, an "Enhanced Coordination Group" for designs will be appointed to coordinate the efforts of the three repository design contractors.





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C. DOE Hq wants to see hard copy of all DOE to NRC presentations (viewgraphs) before they are given to the NRC.

D. There are still discussions between NNWSI QA and DOE Hq on what should be included on the "Q" list.

E. A presentation comparing horizontal coring and drifting in the Exploratory Shaft was given by Paul Aamodt, LANL. The viewgraphs that Dr. Aamodt used are enclosed. On technical merit, drifting is perferred by the NNWSI technical staff. Cost-wise, drifting is not so much more expensive than coring for this consideration to impact on the NNWSI technical staff recommendation that a program of drifting be substituted for the horizontal coring called for in the ESTP.

A short hole prototype horizontal air-coring program is being proposed. The work would take place in the welded Grouse Canyon formation in "G" Tunnel. The Grouse Canyon is considered to be an excellent analog for the Topopah Spring formation. A discussion of this program is given on the enclosed viewgraphs.

F. A presentation entitled "Licensing Up-date" was given by Mike Glora and MJ Wise, SAIC (viewgraphs enclosed). Of particular interest was the discussion of a document called the "Regulatory Compliance Plan". This is a rather detailed document that is designed to act as a guide toward compliance with regulations by the NNWSI. The plan is presently under review by WMPO. The table of contents is included in the enclosed handout.

G. The status of the SCP was discussed. Work on the document is progressing but at a reduced pace because of the final EA production schedule. Of particular interest is a decision taken by DOE Hq that the three companion documents to the SCP, the Exploratory Shaft Test Plan (ESTP), Performance Assessment Plan (PAP), and the Surfact Base Test Plan (SBTP), will not be issued as separate documents. The three plans will be folded in the SCP proper. It is feared that this could result in a grossly expanded chapter 8.3, to a possible length of 10,700 pages for this section alone. There is a discussion of this along with the Issues Hierarchy information needs in the handout.

II. The subject of the application of 10 CFR 100 Appendix A to the Waste program has come up again. The NNWSI is seeking guidance, particularly for pre-closure, as to whether or not any or all of 10 CFR 100 Appendix A will apply and, if not, what criteria will be substituted.

In speaking with the staff, I have been told that 10 CFR 100 Appendix A does not apply except for some definitions.

However, nothing has been substituted. This leaves a vacuum. This is an important consideration. Members of the public are applying the criteria found in 10 CFR 100 Appendix A to the Yucca Mountain Site (Bell, State of Nevada comments on the draft EA) because there is nothing else. I ask for staff consideration of this subject.

III. It has been suggested that an Appendix 7 meeting on seismo-tectonics he held, possibly in December. This is, of course, a subject of prime interest at the NNWSI and I believe that discussions with the NRC, in the field, would be welcomed.

IV. The USGS is conducting a two day field trip to discuss the calcite/silicate deposits found in the vicinity of Yucca Mountain. The trip is scheduled for November 5 and 6.

On November 5, Ike Winograd will lead the group to Death Valley, Ash Meadows, and the Amargosa Desert. On the 6th, Gary Dixon will take the group to Glendale, Nevada on the Moapa Indian Reservation.

The purpose of the workshop is to acquaint the participants with the origin of the spring deposits found in the area in order to promote a better understanding of the possible spring deposits found at Yucca Mountain.

I have suggested to GT Branch that one or two geologists from NRC Hq attend with me.

V. The October TPO-NNWSI Project Manager Meeting is scheduled for October 30 & 31st and November 1. As noted in IV, the calcite/silicate workshop is to be held on November 5 & 6 and the November TPO-NNWSI Project Manager meeting is scheduled for November 20, 21, & 22nd.

VI. Larry Skousen, DOE-WMPO is now Acting Chief of the WMPO Engineering Branch. Vern Witherill, former Branch Chief, has been promoted to Director, Nevada Test Site Office (DOE).

PTP/brm

enc.

Rec'd with memo dtd. 10/21/85
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WM-11

Las Vegas SUN

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Friday, VOL. 36 NO. 95 ©1985 Las Vegas SUN LAS VEGAS, NEVADA, SEPTEMBER 27, 1985

# Where I Stand

By Hank Greenspun

Keep those letters coming.

Newspaper editors are supposed to reflect the feeling of the community, at least the good newspapers try.

Some of the editorial thinking that received the most response was a recent SUN column suggesting that Death Valley would be an ideal place for the low-level and high-level nuclear waste repository.

The idea was not original with me. It came from a good friend, Bob Campbell, and since he first mentioned the use of Death Valley, he has expanded on the premise — explaining how Nevada can get all the benefits without being subjected to any of the detriments.

There are some who feel that the respository will add another thousand people to the employment ranks and they are willing to accept the hazards just for the additional jobs and payroll.

Campbell has come up with another plan on how we can have our cake and eat it, too.

Give the waste dumps to Death Valley and we will get the benefits of the employment, housing, and everything that comes with it.

We are all for expanding Southern Nevada's economic base, but would prefer it be done through clean industry rather than a nuclear garbage dumpsite. If it means exposing our children and generations after them to the greatest harm, we are against it.

To all those who feel we will be losing jobs if we don't accept the government's plans for dumping radioactive wastes in Nevada, let them be comforted by Bob Campbell's sage advice.

If the dumpsite is in Death Valley, the workers don't have to live there. They can come right over the hill to Beatty or a few miles further to Las Vegas, and buy their homes and their groceries. They can even send

(See WHERE I STAND, Page 2A)



# Where I Stand

Hank Greenspun

(Continued from Page 1A)

their children to school. They would work in Death Valley and live in Nevada.

Here's the way Campbell sees it:

"Regarding your column in the Sept. 11 edition of the SUN: 'Death Valley for the dealers in death,' I am so happy to see you promote Death Valley for the nuclear dump site. The only possible thing I can see it harming in Death Valley would be the burros — and the government has been trying to kill them off for years.

"Another item that may be of interest would be the employment factor. It seems that one of the failings of the American race is we would rather suffer the consequences of our actions later if there is something in it for us right now. Some of the proponents for locating these 'death dumps' in our state say it would create jobs. Well, the same jobs would be available for Nevadans if these dumps were located in Death Valley. I'm sure that the population base would be based in Beatty, Nevada. The workers would buy their gas, travel to Death Valley daily, and for the most part, buy the majority of their staples in our state.

"The only loss to our state would be the nuclear waste that someday certainly would trickle down to Las Vegas."

So, there you have it. The argument for Death Valley is sane and safe, and the preponderance of opinion as revealed by letters to the editor is that Nevada residents favor Campbell's idea.

Those who insist on maintaining a nuclear garbage dump in Nevada to provide jobs are putting monetary values over human values. It's not only wrong but it's short-sighted, because what would be gained by the economic impact in the present would be lost in the human misery of the future.

Put the dumpsite in Death Valley — make those employed welcome in Beatty — and everyone will prosper.

That's Bob Campbell's idea and the SUN endorses it heartily.

# AG doesn't want court to speed up nuke train

CARSON CITY (UPI) — The state Attorney General's office said Thursday the U.S. Supreme Court should not speed up hearings on a suit by New Jersey in a dispute between the two states over a train carrying a load of low-level nuclear waste.

And the Attorney General's office suggests New Jersey officials have made inconsistent statements about the risk to the public of the radium-laced dirt.

New Jersey filed suit in the U.S. Supreme Court asking the court to invalidate regulations of the Nevada Department of Human Resources, the Nevada Public Service Commission and a city of Las Vegas ordinance, all of which govern packaging and rail transportation on low-level radioactive wastes.

Some 7,200 tons of dirt is being dug up from beneath homes in Montclair, N.J., for rail shipment to a burial grounds in Nevada. It is being stored in 55-gallon cannisters waiting for the train to leave.

But Nevada Gov. Richard Bryan and others have led the fight to stop Union Pacific Railroad from departing.

William E. Isaeff, chief deputy attorney general, and William H. Kockenmeister, general counsel for the Nevada Public Service Commission, say in their new motion to be filed Friday that there has been no showing that would justify an expedited hearing by the U.S. Supreme Court.

New Jersey, in asking for the hearing to be accelerated, argues the principal danger of the radioctive dirt "is it emits radon gas which creates a health risk if there is exposure of longer periods in a confined space — such as in a home." Isaeff and Kockenmeister say that in the same New Jersey motion it states on another page that all the residents now live in nearby motels and not in their homes any more.

"When closely examined, the statements made by New Jersey in support of its motion for urgent and expedited consideration amount to no more than suggestions that it might cost New Jersey some more money if this court were to consider this case in the normal and orderly fashion," said the two lawyers.

The Nevada motion said New Jersey failed to submit affidavits or other facts to back up its allegations.

"No responsible official of the state of Nevada has ever said we would never allow this radioactive waste to be shipped to our state for burial at the state-owned dump site at Beatty. The position of state officials has always been that the shipments must conform with all legally applicable federal, state and local laws."

Las Vegas SUN

INSIDE: Moderate quake jolts So. Calif./6A

SHOWBIZ: Hudson's life marked by courage/1C

SPORTS: LA Dodgers win NL West pennant/1E

Thursday VOL. 36 NO. 101 ©1985 Las Vegas SUN LAS VEGAS, NEVADA, OCTOBER 3, 1985 Circ. 383-7200 25¢ 70 PAGES Final

# Vucanovich takes a stand on nuke site

By MARY O'DRISCOLL
SUN Staff Writer

U.S. Rep. Barbara Vucanovich, R-Nev., joined U.S. Rep. Harry Reid, D-Nev., and Gov. Richard Bryan Wednesday in opposing Nevada being characterized as a possible site for a high-level nuclear waste dump before other options are fully explored.

"By only characterizing three sites, we are running the risk of having only one site or even no sites judged suitable by the end of the process," Vucanovich said after a private briefing in Washington, D.C., with James Devine, United States Geological Survey assistant director for Engineering.

The Department of Energy last month announced it will bypass many complex site characterization studies and focus instead on examining the three primary sites for the proposed nuclear waste dump. Yucca Mountain, 70 miles northwest of Las Vegas, Deaf Smith County in Texas and Hanford, Wash., are being considered for the nuclear waste dump site.

The site characterization studies are to be conducted to determine which of the three sites will best house the nuclear waste burial site. Previously, the DOE

(See SHE, Page 6A)

# She won't 'sit still' while DOE railroads nuke site

(Continued from Page 1A)

was going to study various sites to further determine geological and geographical characteristics and base the eventual selection of the nuclear dump on calculated, complex evaluations. The DOE last month changed its plans and shortened the site selection time by characterizing only the Nevada, Texas and Washington sites.

Shortly after the DOE announced that change, Nevada officials protested, saying the DOE decision adds more credence to the thought that Nevada already has been selected as the site.

During her briefing, Vucanovich told Devine she will work to ensure the DOE allows adequate time for the full range of complex geological studies. She also said she will insist the DOE not complete its findings with only one or two suitable sites.

"I foresee that if this cannot be resolved through a written agreement with DOE or by legislative remedies, it is going to end up in legal battles," she said.

"No state wants this repository, and unless the people of Nevada are convinced by an overwhelming number of scientific facts that our state is the best choice out of several other suitable options, they are not going to accept it," she said. "I will not sit still and allow a high-level repository to be rammed down our throats if the DOE is unwilling to spend the time or the money to do this siting process right."

Reid, who has fought the DOE in its decision to change its plans, said he has sent a letter to U.S. Rep. Edward Markey, D-Mass. and chairman of the congressional subcommittee studying the nuclear waste dump issue, concerning his questions about the DOE's action. Markey is expected to oppose the DOE's plans.

# Local

Israelis use retaliation, not rhetoric

Page 7B

Inside:



B



# Geology study urged for nuke dump site

By David Koenig
Review-Journal Washington Bureau

WASHINGTON — The federal government should study Yucca Mountain's geology before giving it a preliminary stamp of approval as a possible dump site for high-level nuclear waste, Nevada's U.S. senators told the Energy Department Wednesday.

In a letter to Energy Secretary John Herrington, Sens. Paul Laxalt and Chic Hecht, both R-Nev., said Nevadans contribute "their fair share" to the nation's good, but "We will not, however, allow the federal government to impose a process upon us which is not clearly defined and is unfair."

The letter — dated Wednesday and issued by Laxalt's office — refers to popular opinion in Nevada, much of which opposes the selection of Yucca Mountain as a nuclear waste dump.

"There are a number of people in the state of Nevada who have construed the DOE's site selection process to be a meaningless exercise designed only to justify eventually locating the repository at Yucca Mountain," the letter stated. "While we do not necessarily agree with this position, we certainly feel that the 'unquestioned credibility' of the process is at stake."

The dispute stems from the Energy Department's decision this summer to declare Yucca Mountain and two other sites "preliminarily suitable" to house the nation's first dump for commercial high-level radioactive waste.

By law, enough sites must jump the hurdle of "preliminary suitability" to ensure that the process is thorough and fair. But there is disagreement over when that suitability label should be attached to potential dump sites.

The Energy Department says it has three sites that meet the test of "preliminary" fitness. The department next plans to conduct multi-billion-dollar tests — a step called "site characterization" — at Yucca Mountain, Hanford, Wash., and Deaf Smith County, Texas, then recommend a site to the president in 1991.

But critics, including some members of the Nuclear Regulatory Commission, say Congress wanted the Energy Department to do the studies first, then find three suitable sites.

That is the view expressed by Laxalt — whose staff has studied the high-level waste law for the past two weeks — and Hecht.

"We believe that it was the intent of Congress that the preliminary determination include a sufficient number of sites to ensure that three suitable sites would be presented to the president at the conclusion of the characterization process," the senators' letter said. "The law is unclear as to what constitutes a sufficient number, but selecting only three sites for the preliminary determination of suitability is clearly insufficient."

In their letter, the senators charge the selection process cannot be fair and thorough "if only three sites are deemed to be preliminarily suitable and if that determination is made ahead of extensive geologic studies."

Last week, Laxalt said he was "concerned" because "we had agreed on a given (selection) procedure, and it appeared for a while that procedure was going to be departed from."

He said he asked the Energy Department's top nuclear waste official, Ben Rusche, about the apparent change, but "We were told that there wasn't any change, that the tests will be conducted."

Laxalt said he hopes Nevada is not selected for the high-level nuclear waste dump, but finding a dump is a national concern and not Nevada's alone.

He also rejected the argument that the state's tourism industry will be hurt if Yucca Mountain is selected.

"Since World War II, we've had extensive nuclear testing out there and we are right now," Laxalt said. "I don't suppose we've ever had a tourist who didn't come to Nevada simply because there was nuclear activity out at the (Nevada) Test Site."

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SEP 24 1985

W. J. Purcell, Director, Office of Geologic Repositories, DOE/HQ (RW-20), FORSTL

NNWSI PROJECT WEEKLY HIGHLIGHTS FOR WEEK ENDING SEPTEMBER 19, 1985

I. Issues Requiring Involvement of HQ or Other Projects

A. New Issues:

None to report.

B. Previously Reported Issues:

| | Issue | Status | First Report Date |
|---|---|---|---|
| 1. | The Project requests that HQ write a letter to NRC requesting postponement and send a copy of that letter to WMPO. | Open | 9/5/85 |

II. Major Internal Concerns

None to report.

III. Significant Accomplishments (SA)/Information Items (II)

SA

The "Eleventh Quarterly Tuff Data Base Document" which is compiled by Sandia was distributed to all participants that are on distribution for the Tuff Data Base Document on September 4. This satisfies a level 2 Project milestone.

Sandia completed the revised section 5.1 of the draft Environmental Assessment and sent it to SAIC on September 11. This satisfies a level 2 Project milestone.

For most Project participants, all efforts on the SCP have been postponed so individuals can work on revising the EA and CRA.

II

Paul Aamodt has been selected to replace Wes Myers as the Project Leader at LANL for Exploratory Shaft Test Plan Development and Tom Merson will replace Dean Nelson as Project Manager on all Exploratory Shaft activities. Both Wes and Dean have received promotions involving more management responsibilities at the Laboratory.

Los Alamos has established a new position for QA implementation; Paul Guthals has been appointed QA Manager.

C. Edward Kay, Ben Rusche's Executive Assistant, is coming to tour Yucca Mountain on September 27.

Paul Prestholt, the NRC on-site representative, took a group of NRC contractors to visit Yucca Mountain and G-Tunnel on September 17, 18, and 19th.

Vern Witherill made a presentation to the Nevada Public Health association on September 12. Included on the panel were representatives from the DOE/NV Health Physics Department, Department of Transportation, the State of Nevada, and Citizens Alert. About sixty people attended.

Mike Voegele made a presentation to the Lawrence Berkeley Coupled Processes Symposium on September 18 in Berkeley, California. He described tests that are to be conducted in the Exploratory Shaft.

IV. Upcoming Events

1. Coordination Group Meetings

- Thursday-Friday, October 2-3: SCP Coordination group meeting.
- Wednesday-Thursday, October 2-3: Institutional-Socioeconomic Coordination group meeting, Denver.

2. HQ Meetings

- Firday, September 27: Ed Kay visit to Yucca Mountain.
- Tuesday, October 8: QA SCP Meeting, D.C.
- Thursday, October 10: Program Manager's Meeting, (Tentative).
- Thursday-Friday, October 10-11: SCP Chapter 3 HQ Review, HQ.

3. Internal Project and DOE/NV Meetings

- Thursday, September 26: Robotics and Remote Handling Meeting, Richland.
- Monday-Wednesday, September 30-October 2: SCP Chapter 1 review, Las Vegas.
- Tuesday-Friday, October 1-4: Performance Assessment Plan meeting.
- Wednesday-Thursday, October 2-3: PM-TPO Meeting, Las Vegas.
- Thursday, October 3: ESTP Meeting, Las Vegas.
- Monday-Wednesday, October 7-9: SCP Chapter 1 Review, Las Vegas.
- Tuesday, October 8: SOC Meeting, NTS.

4. State and Public Interaction

- Thursday, September 19: Bunkerville Town Meeting, (Vern Witherill).
- Friday, October 4: Air Force Association Speech, (Don Vieth), Las Vegas.

5. NRC Interaction

- Thursday, September 26: NRC visit to Meteorological Monitoring towers site, NTS.
- Thursday-Friday, September 26-27: NRC/DOE Performance Allocation Meeting, D.C.

Donald L. Vieth, Director
Waste Management Project Office

WMPO:DLV-1798

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OCT 04 1985

W. J. Purcell, Director, Office of Geologic Repositories, DOE/HQ (RW-20), FORSTL

NNWSI PROJECT WEEKLY HIGHLIGHTS FOR WEEK ENDING SEPTEMBER 26, 1985

I. Issues Requiring Involvement of HQ or Other Projects

A. New Issues:

None to report.

B. Previously Reported Issues:

| | Issue | Status | First Report Date |
|---|---|---|---|
| 1. | The Project requests that HQ write a letter to NRC requesting postponement of NRC Workshops and send a copy of that letter to WMPO. | Open | 9/5/85 |
| 2. | Regarding letter dated 9/5 to Hilley requesting consideration of continued use of E-MAD on a cost-shared basis, no reply has been received. | Open | 9/26/85 |

II. Major Internal Concerns

None to report.

III. Significant Accomplishments (SA)/Information Items (II)

SA

Ben Rusche is expected to sign the Copper Status Report Summary on September 26 and then submit it to Congress. The reference report will be delivered to HQ on Monday, September 30 by LLNL.

The Performance Assessment Scientific Support (PASS) Interaction Letter (Milestone M277) was submitted to HQ on September 26.

II

Eight Japanese nationals were taken on a tour of the Nevada Test Site on September 23 by Larry Skousen and Bob Barner.

On September 24-26, a QA audit of SAIC's Technical and Management Support Services was conducted.

IV. Upcoming Events

1. Coordination Group Meetings

- o Thursday-Friday, October 3-4: SCP Coordination Group meeting.
- o Wednesday-Thursday, October 2-3: Institutional-Socioeconomic Coordination Group meeting, Denver.

2. HQ Meetings

- o Monday, September 30: Common Canister Workshop, D.C.
- o Tuesday, October 1: Bureau of Reclamation meeting, (Don Vieth, Mitch Kunich) D.C.
- o Tuesday, October 1: EA SHPO, D.C.
- o Tuesday, October 1: HQ/NNWSI meeting re: EA, Carson City.
- o Tuesday, October 8: QA SCP meeting, D.C.
- o Thursday, October 10: EA Chapter 7 Review, HQ.
- o Thursday-Friday, October 10-11: SCP Chapter 3 HQ Review, HQ.

3. Internal Project and DOE/NV Meetings

- o Monday, September 30: EA Water Rights Workshop
- o Monday-Wednesday, September 30-October 2: SCP Chapter 1 review, Las Vegas.
- o Tuesday, October 1: EA Tectonics Meeting, Las Vegas.
- o Tuesday-Friday, October 1-4: Performance Assessment Plan meeting.
- o Wednesday-Thursday, October 2-3: PM-TPO Meeting, Las Vegas.
- o Thursday, October 3: ESTP Meeting, Las Vegas.

- Friday, October 4: ESF Design Status Meeting, Mercury.
- Monday-Wednesday, October 7-9: SCP Chapter 1 Review, Las Vegas.
- Monday-Friday, October 7-11 and 14-18: EA TOC, Las Vegas.
- Tuesday, October 8: SOC Meeting, Nevada Test Site.
- Wednesday-Thursday, October 16-17: ESTP Committee Meeting, Las Vegas.
- Tuesday-Thursday, October 22-24: SEIG Meeting, Las Vegas.
- Tuesday-Wednesday, October 29-30: ESF Licensing and GRD Workshop (Tentative Oakland).
- Wednesday-Friday, October 30-31-November 1: PM-TPO Meeting, Las Vegas.

4. <u>State and Public Interaction</u>

- Friday, October 4: Air Force Association Speech, (Don Vieth), Las Vegas.
- Saturday, October 12: Speech to Sigma-Delta-Phi Conference, Tonopah (Don Vieth).

5. <u>NRC Interaction</u>

- Thursday-Friday, September 26-27: NRC/DOE Performance Allocation Meeting, D.C.
- Wednesday, October 9: Tour of Nevada Test Site for German citizens (Mitch Kunich).
- Friday, October 18: Nevada Legislative Commission tour of Nevada Test Site (Tentative).
- Thursday, October 24: Speech to State Planners' Conference, (Don Vieth).

Donald L. Vieth, Director
Waste Management Project Office

WMPO:DLV-1845

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OCT 17 1985

W. J. Purcell, Director, Office of Geologic Repositories, DOE/HQ (RW-20), FORSTL

NNWSI PROJECT WEEKLY HIGHLIGHTS FOR WEEK ENDING OCTOBER 11, 1985

I. Issues Requiring Involvement of HQ or Other Projects

A. New Issues:

None to report.

B. Previously Reported Issues:

| Issue | Status | First Report Date |
|---|---|---|
| Regarding letter dated 9/5 to Hilley requesting consideration of continued use of E-MAD on a cost-shared basis, no reply has been received. | Open | 9/26/85 |

II. Major Internal Concerns

None to report.

III. Significant Accomplishments (SA)/Information Items (II)

SA

The NNWSI Project revised draft Environmental Assessment and Comment Response Appendix was delivered on schedule to DOE/HQ. The document was express-mailed on October 4.

A management agreement between Nevada Operations and Albuquerque Operations was signed on October 9. The agreement defines responsibilities and authorities and makes Don Vieth the contracting officer's technical representative for Sandia and Los Alamos roles in the NNWSI Project.

II

Project participation plans were developed with the Robotics and Remote Waste Handling group during a meeting on October 8.

A project-wide Technical Overview review of the EA is being conducted starting on October 7 and continuing through October 18.

Lynn Ballou and Ed Russell (LLNL) participated in the Common Receipt Canister Workshop that was held last week. NNWSI Project efforts are complete unless further work by the Materials Research Society and Transportation Group have an impact.

The Waste Acceptance Committee has produced a first draft of waste acceptance specifications for West Valley and Savannah River waste. The specifications are now in review and comments are due on November 1.

Don Vieth will make a presentation to Sigma Delta Chi, the journalism professional fraternity, in Tonopah, Nevada, on Saturday, October 12. Approximately 25 people from southern Nevada and an equal number from northern Nevada will participate in the meeting.

Nevada met with the Air Force staff to discuss the potential use of the test site for the Hardened Mobile Launch System for the small ICBM. The compatability of programs at the NTS and ICBM System was discussed in depth. There does not appear to be a high degree of compatability.

Don Vieth talked with Mike Baughman regarding the revision of the EA to account for Lincoln County's concerns. A meeting to resolve the issue is scheduled for Tuesday morning, October 15.

IV. Upcoming Events

1. Coordination Group Meetings

None to report.

2. HQ Meetings

- Wednesday, October 16: Materials Steering Committee, Germantown.
- Tuesday, October 22: Program Manager's Meeting, D.C.
- Monday-Friday, October 21-25: EA/CRA Review, HQ.
- Friday, November 8: First Repository States Meeting.

3. Internal Project and DOE/NV Meetings

- Monday-Friday, October 7-11 and 14-18: EA TOC, Las Vegas.
- Wednesday-Friday, October 16-18: DOE/NTS Contractors Exploratory Shaft Meeting, Las Vegas.
- Tuesday-Thursday, October 22-24: SEIG Meeting, Las Vegas.
- Wednesday-Thursday, October 23-24: GAO Audit, WMPO.
- Tuesday-Wednesday, October 29-30: ESF Licensing and GRD Workshop (Tentative Oakland).
- Wednesday-Friday, October 30-31-November 1: PM-TPO Meeting, Las Vegas.
- Tuesday, November 5: SOC Meeting, NTS.
- Tuesday, November 5: PAQC Meeting, Las Vegas.

4. State and Public Interaction

- Saturday, October 12: Speech to Sigma-Delta-Chi Conference, Tonopah (Don Vieth).
- Thursday, October 24: Speech to State Planners' Conference (Don Vieth).
- Monday, October 28: Don Vieth Briefing to State Coordinating Council, Las Vegas.
- Tuesday, October 29: Pahrump Town Hall Meeting, Pahrump.
- Thursday, October 31: Nevada Energy Symposium Speech (Don Vieth), Las Vegas.
- Tuesday, November 5: Nye County Commissioners Briefing (Don Vieth), Tonopah.
- Tuesday, November 12: Citizens Alert Meeting, Pahrump (Don Vieth).
- Wednesday, November 13: Pahrump Legislative Committee Meeting (Don Vieth), Pahrump.
- Wednesday, November 13: Citizens Alert Meeting (Don Vieth), Beatty.
- Thursday, November 14: Citizens Alert Meeting (Don Vieth), Death Valley.

5. NRC Interaction

None to report.

Donald L. Vieth, Director
Waste Management Project Office

WMPO:DLV-159

cc:
Allen Benson, DOE/HQ (RW-25), FORSTL
R. J. Blaney, DOE/HQ (RW-22), FORSTL
C. R. Cooley, DOE/HQ (RW-24), FORSTL
M. W. Frei, DOE/HQ (RW-23), FORSTL
V. J. Cassella, DOE/HQ (RW-22), FORSTL
Ralph Stein, DOE/HQ (RW-23), FORSTL (2)
E. S. Burton, DOE/HQ (RW-25), FORSTL
J. O. Neff, DOE/SRPO, Columbus, OH
S. A. Mann, DOE/CRPO, Argonne, IL
O. L. Olson, DOE/RL, Richland, WA
R. W. Taft, AMES, DOE/NV
T. O. Hunter, SNL, 6310, Albuquerque, NM
R. W. Lynch, SNL, 6300, Albuquerque, NM
W. W. Dudley, Jr., USGS, Denver, CO
L. D. Ramspott, LLNL, Livermore, CA
D. T. Oakley, Los Alamos, NM
J. B. Wright, W/WTSD, Mercury, NTS
M. E. Spaeth, SAIC, Las Vegas, NV
J. R. LaRiviere, SAIC, Las Vegas, NV
W. S. Twenhofel, SAIC, Lakewood, CO
J. H. Fiore, SAIC, Las Vegas, NV
R. R. Loux, NWPO, Carson City, NV
C. H. Johnson, NWPO, Carson City, NV
P. T. Prestholt, NRC/Las Vegas, NV
David Siefken, Weston, Rockville, MD
Donald Schweitzer, BNL, Upton, NY

DEPARTMENT OF ENERGY
MANAGEMENT AGREEMENT
BETWEEN
NEVADA OPERATIONS OFFICE
AND
ALBUQUERQUE OPERATION OFFICE
FOR
TECHNICAL SUPPORT TO THE OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
AND THE
NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT

1. PURPOSE. The purpose of this MA is to set forth agreements and understandings between AL and NV, and establish guidelines for their authorized representatives in the conduct of their respective responsibilities concerning SNL and LANL activities on the NNWSI Project. NV has primary responsibility for management control and technical direction for the NNWSI Project. AL has primary DOE administrative responsibility and contractual authority for SNL and LANL. This MA has been established to define AL and NV management controls for these contracts in a manner that provides certain authorities to the assigned NV personnel responsible for management and control of specific aspects of the SNL and LANL activities on the NNWSI Project.

2. BACKGROUND. The NWPA of 1982 assigns certain responsibilities and authorities to the DOE and the NRC with regard to geologic disposal of commercial high-level radioactive waste. NV has been assigned responsibility for management and technical direction of the NNWSI Project by the DOE Headquarters Program Office, OCRWM. SNL and LANL are two of the participating organizations, which perform technical support work on the NNWSI Project. These two major NNWSI Project participating organizations are under contract to DOE, and these contracts are administered by the AL.

The NNWSI Project has been established for the purpose of evaluating Yucca Mountain, on and adjacent to the NTS, as a potential location for a geologic repository for commercial and defense high-level radioactive waste. As specified in the Energy Reorganization Act of 1974 and the NWPA of 1982, a construction authorization and license will be required from the NRC in order for DOE to construct and operate a geologic repository. A major regulatory requirement established by the NRC on potential licensees is to assure documented direction of the QA program. Clear management controls, effective lines of communication, and authority must be established by the licensee over all participating organizations and contractors performing quality-related work applicable to licensee actions. The office within NV assigned responsibility for the NNWSI Project is the WMPO. The Director, WMPO, has been designated as the pertinent representative for all NV contracts and agreements, which principally provide support to the NNWSI Project. NV will be the licensee.

* Attachment No. 1 provides a definition of terminology used in this agreement.

3. GENERAL. The NNWSI Project has been designated as part of a MSA Project (First Commercial Radioactive Waste repository) under the programmatic direction of the OCRWM. The DOE Orders applicable to MSA Projects are being implemented by NV, and the Project participants performing work on the NNWSI Project are subject to all applicable provisions of those orders. NVO-196-17, NNWSI Project Quality Assurance Plan, defines QA requirements for the NNWSI Project. Its application to work performed by DOE and contractors on the NNWSI Project is considered mandatory to meet NRC requirements. NVO-196-18, WMPO Quality Assurance Program Plan, defines the policies and methods to be used by the DOE personnel and NV's Quality Assurance Support Contractor on the conduct of quality related activities. Its application on the work performed on the NNWSI Project is also considered mandatory.

The FMFIA of 1982 requirements are applicable to DOE. Vulnerability Assessments and Internal Controls Reviews are required to be performed by the responsible Field Offices as defined in this agreement. AL is responsible for compliance with the FMFIA with respect to administrative and financial control systems at SNL and LANL. NV is responsible for compliance with FMFIA with respect to programmatic management and direction for activities performed by SNL and LANL in support of this NNWSI Project funded from the NWF.

4. ADMINISTRATION OF AGREEMENT.

a. The Manager, AL, or such other persons whose names or titles shall be communicated to NV by the Manager, AL, in writing, will administer this MA for AL.

b. The Manager, NV, or such other persons whose names or titles shall be communicated to AL by the Manager, NV, in writing, will administer this MA for NV.

5. DELEGATION OF AUTHORITY AND RESPONSIBILITIES.

a. Manager, AL, is responsible for the following:

(1) Provide documented authority to the Director, WMPO/NV, for the SNL and LANL contracts by taking the necessary contractual and other actions to enable the Director, WMPO/NV to represent the Contracting Officer and perform the administrative functions over SNL and LANL for only that work funded from the NWF for the NNWSI Project as defined in 5.b.(1) below. For the purposes of this agreement, this authority is referred to as Contracting Officers Technical Representative authority (COTR/NV).

(2) While AL does not plan to conduct its own QA audits of SNL and LANL on NNWSI Project activities or participate in NV conducted QA audits of same, AL may, at its direction:

(a) Provide observers on NV conducted QA audits of SNL and LANL.

(b) Conduct its own QA audits to meet its own requirements.

If an AL QA audit is NNWSI Project specific QED/AL will provide an invitation to the PQM/NV to send an observer, and the audit report will be provided to the PQM/NV for information at the time of issuance.

b. Manager, NV, is responsible for the following:

(1) Provide notification in writing to the Manager, AL, of the name of the individual currently assigned to the position of Director, WMPO, who will act as the NV authorized representative (COTR/NV) of the AL Contracting Officer and assume the responsibilities and authority to perform the functions as specified below:

(a) Act as principal point of contact between NV and the SNL and LANL TPO's for the technical direction of all NNWSI Project sponsored work assigned to those Laboratories.

(b) Ensure the performance of all necessary actions for effective SNL and LANL performance and compliance with DOE policies and quality requirements, laws and regulations, and DOE and NRC Agreements, established by appropriate authority, applicable to the NNWSI Project. The policies and quality requirements include, but are not limited to, applicable DOE Orders, NVO-196-17, and NVO-196-18, and Laboratory NNWSI Project Quality Assurance Program Plans and Procedures. The DOE/NRC agreements are the Procedural Agreement and Site Specific Agreement and latest revisions. Laws and Federal Regulations are those applicable to geologic repositories such as the NWPA of 1982, 10CFR50 Appendix B, 10CFR60, 10CFR960, 40CFR191 and others.

(c) Ensure identification and resolution of variances between NV and AL policies, if and where they might exist, in their application to Laboratory operations.

(d) Manage and coordinate the allocation of NWF resources provided for the NNWSI Project, and direct and support the technical work performed by SNL and LANL at the NTS, at the respective Laboratories, or other appropriate locations.

(e) Establish priorities involving NWF resources provided to the SNL and LANL and resolve conflicts in plans, funding allocations, and Project requirements.

(f) Provide administrative direction and instructions in accordance with administrative policies and procedural requirements established for the NNWSI Project.

(g) Request and approve work assignments, special Project assignments, and other items requiring approval of a DOE Project Manager (Director, WMPO) to expend NWF resources on the NNWSI Project.

(h) Issue "suspension of work orders" to the Laboratory Technical Project Officer responsible for directing NNWSI Project work on a specific activity, such as structures, systems and components important to safety or isolation. Work may be halted consistent with NNWSI Project QA requirements for prompt corrective action to respond to audit findings and for the control of nonconformances. Since there are no standard suspension of work clauses in Laboratory contracts, it is understood by NV that the issuance of "suspension of work orders" by the COTR/NV will not establish the basis nor create an unallowable cost.

(i) Issue letters rescinding "suspension of work orders" issued to the affected Laboratory including authority to determine acceptability of corrective action.

(j) Provide the names of any individuals authorized to act for the Director in the absence of the Director, WMPO.

(k) The foregoing NV authorities do not include the authority reserved by the AL Contracting Officer to issue or accept changes in scope, price, terms or conditions of the SNL and LANL contracts, or to sign contractual documents.

(2) Provide notification in writing to the Manager, AL, of the name of the individual currently assigned to the position of NNWSI Project Quality Manager for NV. Also, provide the names of any individuals authorized to act for the PQM/NV in his absence.

(3) Provide the Director, QED/AL, as a minimum, controlled copies of the approved NNWSI Project QA Plan and Standard Operating Procedures (NVO-196-17), WMPO QA Program Plan and Quality Management Procedures (NVO-196-18), and all approved changes upon issuance for information. Additional copies of the current approved QA Plan and Procedures will be provided upon request of the Director, QED/AL.

(4) Provide the Manager, AL, copies of the approved DOE/NRC Procedural Agreement (Morgan-Davis Agreement) and DOE/NRC Site Specific Agreement and appendices and all approved changes at the time of issuance or when otherwise available to NV. Additional copies of the approved DOE/NRC Agreements will be provided by NV upon request by AL.

(5) Provide the Contracting Officer, AL, a copy of all "suspension of work orders" issued by the COTR/NV to SNL or LANL. A copy of the audit finding or the Nonconformance Report, which establishes the basis for the action will accompany all "suspension of work orders." A copy of letters rescinding "suspension of work orders" will also be provided to the Contracting Officer, AL, at the time of issuance, and will include a copy of the dispositioned and approved Nonconformance Report.

(6) Provide and maintain the annual NNWSI Project QA audit schedule, and any approved changes, designating the month audits are planned for SNL and LANL. Audit schedules will be provided to QED/AL, MSD/AL and LAAO as appropriate and in a timely manner. QA audit checklists, audit reports, and audit close-out letters will be provided by NV to QED/AL, MSD/AL and LAAO as appropriate, at the time of issuance.

(7) Provide qualified lead auditor, and conduct all NNWSI Project scheduled QA audits of SNL and LANL. Lead auditors will be qualified in accordance with the requirements specified in NVO-196-18.

(8) All NNWSI Project QA audits of SNL and LANL will be conducted to a checklist and scope developed and established by the NV. The PQM/NV will have final approval authority to close out the NNWSI Project audit findings. Audit planning, reporting, and close out documentation will be originated by NV and be considered NV QA records. Copies of all documentation will be provided to QED/AL in a timely, efficient, and appropriate manner.

(9) Provide qualified QA audit team members and/or observers for the conduct of NNWSI Project QA audits as considered sufficient or appropriate by the PQM/NV. All audit team members will be qualified in accordance with the requirements specified in NVO-196-18.

(10) Provide qualified QA surveillance personnel and conduct NNWSI Project QA surveillance on SNL and LANL technical activities as considered sufficient or appropriate by the PQM/NV.

6. PUBLIC INFORMATION. NV will perform the lead public affairs responsibilities for the NNWSI Project in accordance with the NNWSI Project Public Affairs Plan, as may be revised from time to time. SNL and LANL may deal directly with NV on activities associated with public hearings, public meetings, and other public affairs activities on the NNWSI Project. NV Office of Public Affairs (OPA/NV) will be responsible to inform OPA/AL on actions taken, as appropriate.

7. COMMENCEMENT, CHANGE, AND TERMINATION. This MA shall be effective upon signature of both parties. This MA will remain in effect until terminated or as may be modified from time to time by mutual agreement in writing.

| | |
|---|---|
| R. G. Romatowski | Thomas R. Clark |
| R. G. Romatowski, Manager<br>Albuquerque Operations Office | T. R. Clark, Manager<br>Nevada Operations Office |
| October 9, 1985<br>Date | October 9, 1985<br>Date |

## DEFINITION OF TERMINOLOGY

| TERMINOLOGY | DEFINITION |
|---|---|
| AL | Albuquerque Operations Office, Department of Energy |
| DOE | Department of Energy |
| DOE/NRC Procedural Agreement | A procedural agreement between the Nuclear Regualtory Commission and the Department of Energy identifying guiding principles for interface during site investigations and site characterization for geologic repositories. This document was executed and published in the Federal Register on August 25, 1983 (FR48:38701). The document is sometimes referred to as the Morgan-Davis Agreement. |
| DOE/NRC Site Specific Agreement | An agreement between the Department of Energy's Office of Site Geologic Repository Deployment Projects (including the NNWSI Project) and the Nuclear Regulatory Commission during the site investigation and characterization programs and prior to the submittal of an application for authorization to construct a repository. This document was transmitted to DOE personnel by memorandum from William J. Bennett, dated September 15, 1984.1984. The document contains several appendices and may be revised from time to time. |
| FMFIA | Federal Managers' Financial Integrity Act of 1982. |
| LAAO | Los Alamos Area Office |
| LANL | Los Alamos National Laboratory |
| MA | Management Agreement |
| MSA | Major Systems Acquisition as defined in DOE Order 4240.1 |
| MSD/AL | Management Support Division, Albuquerque Operations Office |
| NNWSI | Nevada Nuclear Waste Storage Investigations |
| NRC | Nuclear Regulatory Commission |
| NTS | Nevada Test Site |
| NV | Nevada Operations Office, Department of Energy |
| NVO-196-17 | A Nevada Operations Office document defining the NNWSI Project Quality Assurance Plan and Standard Operating Procedures, latest revision |
| NVO-196-18 | A Nevada Operations Office document defining Waste Management Project Office Quality Assurance Program Plan and Quality Management Procedures, latest revision |
| NWF | Nuclear Waste Fund as established by Congress in the Nuclear Waste Policy Act of 1982 |
| NWPA | Nuclear Waste Policy Act of 1982 |
| OCRWM | Office of Civilian Radioactive Waste Management, Department of Energy, Headquarters |
| OPA | Office of Public Affairs |
| PQM/NV | Project Quality Manager. A matrix support individual assigned to manage and implement the NNWSI Project QA activities and reports to the Director, QAD/NV |
| QA | Quality Assurance |

## DEFINITION OF TERMINOLOGY
(continued)

| TERMINOLOGY | DEFINITION |
|---|---|
| QED/AL | Quality Engineering Division, Albuquerque Operations Office |
| QAD/NV | Quality Assurance Division, Nevada Operations Office |
| SNL | Sandia National Laboratories |
| TPO | Technical Project Officer. The title used in reference to the Lead Manager of a technical participating contractor organization on the Nevada Nuclear Waste Storage Investigations Project |
| WMPO | Waste Management Project Office, DOE/NV |

Department of Energy
Nevada Operations Office
P. O. Box 14100
Las Vegas, NV 89114-4100

OCT 10 1985

W. J. Purcell, Director, Office of Geologic Repositories, DOE/HQ (RW-20), FORSTL

NNWSI PROJECT WEEKLY HIGHLIGHTS FOR WEEK ENDING OCTOBER 5, 1985

I. Issues Requiring Involvement of HQ or Other Projects

A. New Issues:

None to report.

B. Previously Reported Issues:

| Issue | Status | First Report Date |
|---|---|---|
| Regarding letter dated 9/5 to Hilley requesting consideration of continued use of E-MAD on a cost-shared basis, no reply has been received. | Open | 9/26/85 |

II. Major Internal Concerns

None to report.

III. Significant Accomplishments (SA)/Information Items (II)

II

WMPO representatives met with the State of Nevada to discuss findings in the EA with respect to the guidelines. The meeting went well; no major problems surfaced.

The revised NNWSI Project Environmental Assessment and Comment Response Appendix will be sent to HQ on schedule October 4.

IV. Upcoming Events

1. Coordination Group Meetings

- Thursday-Friday, October 3-4: SCP Coordination Group meeting.

2. HQ Meetings

- o Tuesday, October 8: QA SCP meeting, D.C.
- o Thursday, October 10: EA Chapter 7 Review, HQ.
- o Thursday-Friday, October 10-11: SCP Chapter 3 HQ Review, HQ.

3. Internal Project and DOE/NV Meetings

- o Tuesday-Friday, October 1-4: Performance Assessment Plan meeting.
- o Friday, October 4: ESF Design Status Meeting, Mercury.
- o Monday-Wednesday, October 7-9: SCP Chapter 1 Review, Las Vegas.
- o Monday-Friday, October 7-11 and 14-18: EA TOC, Las Vegas.
- o Tuesday, October 8: SOC Meeting, Nevada Test Site.
- o Wednesday-Thursday, October 16-17: ESTP Committee Meeting, Las Vegas.
- o Tuesday-Thursday, October 22-24: SEIG Meeting, Las Vegas.
- o Tuesday-Wednesday, October 29-30: ESF Licensing and GRD Workshop (Tentative Oakland).
- o Wednesday-Friday, October 30-31-November 1: PM-TPO Meeting, Las Vegas.

4. State and Public Interaction

- o Friday, October 4: Air Force Association Speech, (Don Vieth), Las Vegas.
- o Saturday, October 12: Speech to Sigma-Delta-Phi Conference, Tonopah (Don Vieth).
- o Thursday, October 24: Speech to State Planners' Conference (Don Vieth)

5. NRC Interaction

- o Thursday-Friday, September 26-27: NRC/DOE Performance Allocation Meeting, D.C.

- o Wednesday, October 9: Tour of Nevada Test Site for German citizens (Mitch Kunich).
- o Friday, October 18: Nevada Legislative Commission tour of Nevada Test Site (Tentative).
- o Thursday, October 24: Speech to State Planners' Conference, (Don Vieth).

Donald L. Vieth

Donald L. Vieth, Director
Waste Management Project Office

WMPO:DLV-109

cc:
Allen Benson, DOE/HQ (RW-25), FORSTL
R. J. Blaney, DOE/HQ (RW-22), FORSTL
C. R. Cooley, DOE/HQ (RW-24), FORSTL
M. W. Frei, DOE/HQ (RW-23), FORSTL
V. J. Cassella, DOE/HQ (RW-22), FORSTL
Ralph Stein, DOE/HQ (RW-23), FORSTL (2)
E. S. Burton, DOE/HQ (RW-25), FORSTL
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S. A. Mann, DOE/CRPO, Argonne, IL
O. L. Olson, DOE/RL, Richland, WA
R. W. Taft, AMES, DOE/NV
T. O. Hunter, SNL, 6310, Albuquerque, NM
R. W. Lynch, SNL, 6300, Albuquerque, NM
W. W. Dudley, Jr., USGS, Denver, CO
L. D. Ramspott, LLNL, Livermore, CA
D. T. Oakley, Los Alamos, NM
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C. H. Johnson, NWPO, Carson City, NV
P. T. Prestholt, NRC/Las Vegas, NV
David Siefken, Weston, Rockville, MD
Donald Schweitzer, BNL, Upton, NY

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OGR

# SUMMARY OF RESULTS

| | MERIT VALUE |
|---|---|
| ALTERNATIVE 1 (SIX AIR CORED HOLES) | 2.5755 |
| ALTERNATIVE 2 (SIX "WET" CORED HOLES) | 2.2776 |
| ALTERNATIVE 3 (APPROXIMATELY 4100 FT DRIFTS) | 3.3540 |
| ALTERNATIVE 4 (APPROXIMATELY 12,600 FT DRIFTS) | 4.3244 |

# CONCLUSION

BASED ON THE CRITERIA AND SUBCRITERIA USED
AS VALUE-WEIGHTED BY 10 OF 15
ESTP-COMMITTEE MEMBERS POLLED
ALTERNATIVE 4 IS THE PREFERRED
EXPLORATION METHOD

# ESTIMATED COSTS FOR ALTERNATIVES

**EXCAVATION COSTS:**

| | |
|---|---|
| SNL-A ESTIMATES TO DRILL-AND -BLAST | $320 TO $390/FT |
| SNL-A ESTIMATES TO TUNNEL BORE | $510 TO $600/FT |

THESE COSTS ARE PROBABLY NOT FULLY "LOADED" FOR SUPPORT

REECO ESTIMATES TO DRILL-AND-BLAST $1100/FT

NOTE: DIRECT LABOR COSTS ARE ABOUT 40% OF THIS OR $440/FT., FOR COMPARISON WITH SNL-A ESTIMATES

**DRILLING COSTS:**

DEEP HORIZONTAL DRY CORING HAS NOT BEEN DONE IN MATERIALS OF THIS TYPE

F & S ESTIMATES $460/FT

NOTE: CONVENTIONAL "WET" CORING COSTS ARE ANTICIPATED TO BE ABOUT 1/3 THIS VALUE BECAUSE OF HIGHER PENETRATION RATES AND LOWER TOOL CONSUMPTION COSTS

# RECOMMENDATIONS

- THE NNWSI PROJECT SHOULD CONDUCT AT-DEPTH GEOLOGICAL AND HYDROLOGICAL INVESTIGATIONS USING LONG (12,600 FT) DRIFTS
- THE DRIFTS SHOULD BE MINED COINCIDENT WITH DRIFTS PLANNED AS PART OF A REPOSITORY FOR THE YUCCA MOUNTAIN SITE - SHOULD IT BE LICENSED
- DRIFT DIMENSIONS AND MINING METHODS SHOULD BE THE SAME AS THOSE PROPOSED FOR A REPOSITORY

# OTHER RECOMMENDATIONS RESULTING FROM THE STUDY

- ESTABLISH AN NNWSI OVERVIEW COMMITTEE TO INTEGRATE AND COORDINATE THE ENTIRE SITE CHARACTERIZATION EFFORT
- ESTABLISH THROUGH TESTING ESTIMATED FLUID LOSSES FOR WET CORE DRILLING, CONVENTIONAL MINING, AND TUNNEL BORING TECHNIQUES
- REEXAMINE THE POSSIBILITY OF A RAMP ACCESS TO THE REPOSITORY LEVEL IN THE CONTEXT OF IMPROVED (QUALITY AND QUANTITY) SITE CHARACTERIZATION DATA AS WELL AS EFFICIENCY OF THE OVERALL EFFORT
- INTEGRATE THE EXPLORATORY TESTING PROGRAM MORE CLOSELY WITH THE REPOSITORY DESIGN EFFORT

OCRWM OGR — Nevada Nuclear Waste Storage Investigations PROJECT

# REQUESTED ACTION BY PM/TPOs

- AUTHORIZATION TO DEVELOP CONCEPTUAL DESIGNS/COSTS/SCHEDULES BY DEC. 1985
- SNL PROVIDE GUIDANCE ON REPOSITORY/ESF DESIGN INTERFACE
  - INTERSECT ELEVATION, DRIFT DIMENSIONS, CONSTRUCTION METHODS, DRIFT ORIENTATIONS, QUALITY CONTROLS
- USGS DEVELOP DETAILED PLANS/REQUIREMENTS FOR SITE CHARACTERIZATION USING LONG DRIFTS

# SHORT HOLE

# PROTOTYPE HORIZONTAL

# AIR-CORING IN G-TUNNEL

OCRWM OGR — NNWSI Project (Nevada Nuclear Waste Storage Investigations)

# PURPOSE:

Los Alamos

- ESTABLISH TECHNICAL FEASIBILITY
- IDENTIFY AND ASSESS PROBLEM AREAS
- PROVIDE HOLES FOR PROTOTYPE TESTS

# THE SCOPE OF THE PROBLEM:

Los Alamos

- THERE ARE OVER 550 BOREHOLES PLANNED IN THE EXPLORATORY SHAFT FACILITY AND MOST OF THESE ARE PLANNED TO BE DRILLED OR CORED DRY
- AIR-CORING TECHNOLOGY IS NOT WELL DEVELOPED AT PRESENT TIME

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# TARGET OBJECTIVES:

Los Alamos

- AIR-CORE HORIZONTAL HOLES IN FRACTURED, WELDED TUFF USING EXISTING EQUIPMENT
- ACHIEVE REASONABLE PENETRATION RATES
- ACHIEVE CORING AT ACCEPTABLE COSTS
- OBTAIN REAL-TIME DATA ON DRILLING PARAMETERS
- ASSESS PROBLEM AREAS
- EVALUATE SPACE CONSTRAINTS ON OPERATIONS
- ESTABLISH SPECIFIC OPERATING PROCEDURES
- RESOLVE SAFETY CONCERNS
- VERIFY COSTS ESTIMATES
- EVALUATE EFFECTIVENESS OF DUST COLLECTION SYSTEM
- EVALUATE ENGINEERING/DESIGN FOR EACH SYSTEM FUNCTION IN ADVANCE OF FIELDING ESF EXPERIMENTS

# STATEMENT OF WORK:

Los Alamos

1) RETAIN CONSULTANT

2) LOCATE SITE IN PROTOTYPICAL GEOLOGIC ENVIRONMENT

3) UTILIZE THE ODEX SYSTEM

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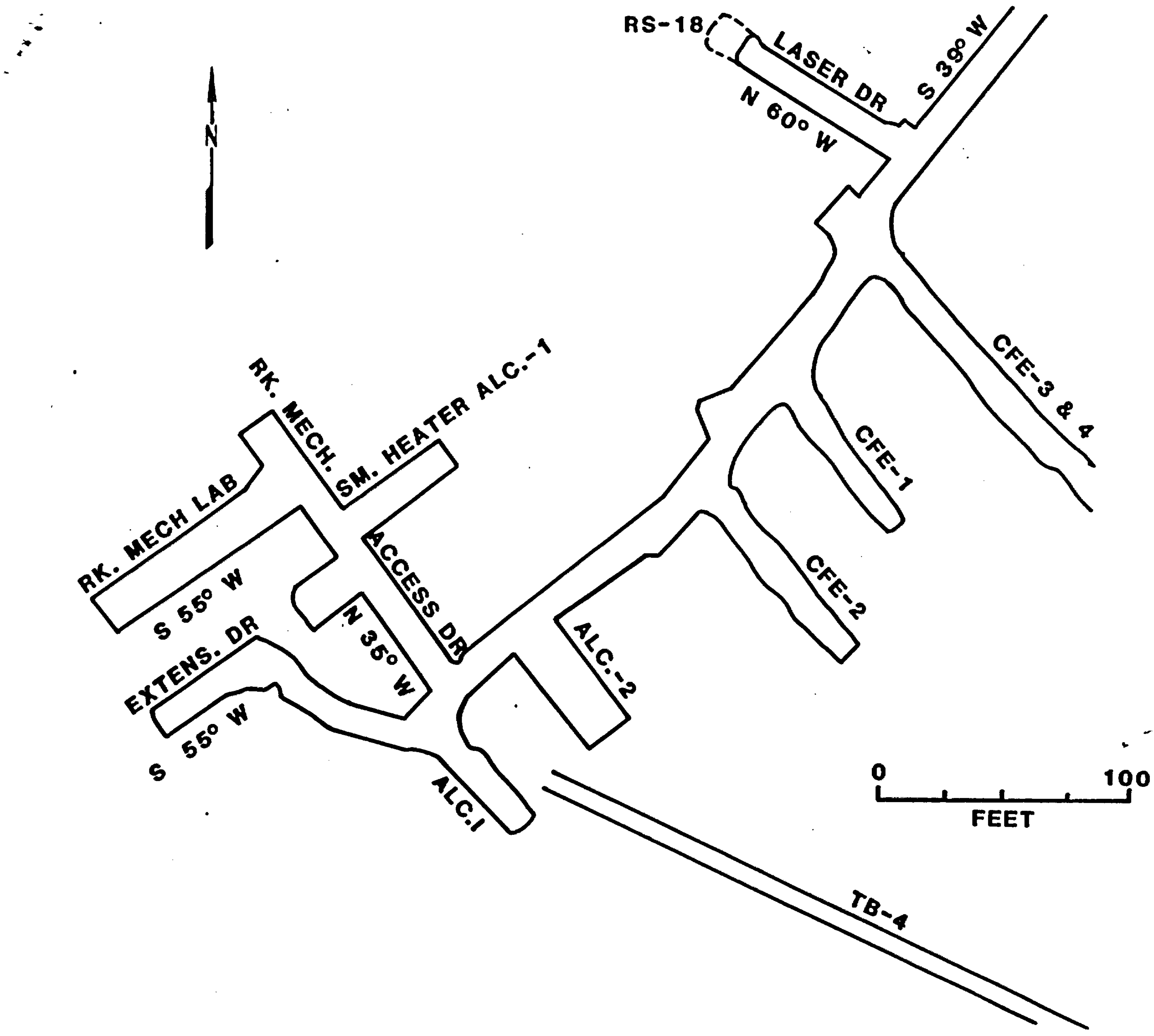
OGR

# 2) LOCATE SITE IN PROTOTYPICAL GEOLOGIC ENVIRONMENT TO:

Los Alamos

- SIMULATE CONDITIONS EXPECTED IN ESF BREAKOUT ZONES
- SIMULATE OVERBURDEN LITHOSTATIC PRESSURES
- SIMULATE SPACE CONSTRAINTS TYPICAL OF AN UNDERGROUND DRIFT
- G-TUNNEL PROVIDES THESE CONDITIONS


N
RS-18
LASER DR
S 39° W
N 60° W
CFE-3 & 4
CFE-1
CFE-2
RK. MECH.
SM. HEATER ALC.-1
RK. MECH LAB
S 55° W
ACCESS DR
N 35° W
EXTENS. DR
S 55° W
ALC.-2
ALC.I
TB-4
0
100
FEET

# 3) UTILIZE THE ODEX SYSTEM TO:

Los Alamos

- TAKE ADVANTAGE OF PREVIOUS NTS EXPERIENCE WITH THIS TECHNOLOGY
- PROVIDE HOLE STABILITY IN FRACTURED TUFF
- UTILIZE ITS FLEXIBILITY ON VERTICAL, HORIZONTAL, AND ANGLED HOLES

# PROPOSED FIELD TRIALS:

Los Alamos

| PROCEDURE | # OF HOLES | DIAMETER | DEPTH | ORIENTATION | PROTOTYPE TESTING |
|---|---|---|---|---|---|
| 1. AIR-CORE | 1 | 4-INCH | 30 FEET | VERTICAL | LANL, TRANSPORT PHENOMENA |
| 2. AIR-CORE | 1 | 4-INCH | 30 FEET | HORIZONTAL | LANL, TRANSPORT PHENOMENA |
| 3. AIR-CORE | 1 | 3-INCH | 30 FEET | VERTICAL | LANL, TRANSPORT PHENOMENA |
| 4. AIR-CORE | 1 | 3-INCH | 30 FEET | HORIZONTAL | LANL, TRANSPORT PHENOMENA |
| 5. AIR-CORE | 5 | 4-INCH | 50 FEET | HORIZONTAL | USGS, HYDROLOGY |
| 6. AIR-CORE | 2 | 3-INCH | 50 FEET | ANGLED (+18°,-18°) | SNL, GEOMECHANICS |
| 7. AIR-DRILL | 1 | 3-INCH | 50 FEET | ANGLED (-18°) | SNL, GEOMECHANICS |
| 8. AIR-CORE | 1 | 4-INCH | 100 FEET | HORIZONTAL | USGS, HYDROLOGY |
| 9. AIR-CORE | 1 | 4-INCH | 150 FEET | HORIZONTAL | USGS, GEOLOGY |
| 10. AIR-DRILL & AIR CORE | 1 | 1.5 INCH 6-INCH | 30 | ANGLED (+2°-+5°) | USGS, GEOMECHANICS |
| 11. TO BE DETERMINED | | | | | LLNL, NEAR FIELD |
| TOTALS......... | 15............................ | | 800 FT | | |
| | 9............................ | | 560 FT | HORIZONTAL | |
| | 2............................ | | 60 FT | VERTICAL | |
| | 4............................ | | 180 FT | ANGLED | |

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# COMPARISON OF ALTERNATIVE METHODS AND RECOMMENDATION FOR SITE EXPLORATION AT YUCCA MOUNTAIN EXPLORATORY SHAFT FACILITY


BY WESLEY C. PATRICK 9/9/85
LAWRENCE LIVERMORE NATIONAL LABORATORY

PRESENTED BY P. L. AAMODT
LOS ALAMOS NATIONAL LABORATORY

# APPROACH

A "FIGURE OF MERIT" (FOM) TECHNIQUE WAS SELECTED IN ORDER TO USE SUBJECTIVE PROFESSIONAL JUDGEMENTS TO EVALUATE MULTIPLE ALTERNATIVES FOR DATA ACQUISITION

# EXPLORATION ALTERNATIVES WERE SELECTED ON BASIS OF TESTING OBJECTIVES

## OBJECTIVES

1. LOCATE AND CHARACTERIZE KEY GEOLOGICAL FEATURES

2. ESTABLISH DEGREE OF VARIABILITY IN GEOLOGICAL CONDITIONS, PROCESSES, AND PROPERTIES WITHIN AND NEAR THE YUCCA MOUNTAIN BLOCK

3. ESTABLISH DEGREE OF VARIABILITY IN HYDROLOGICAL CONDITIONS, PROCESSES, AND PROPERTIES WITHIN AND NEAR THE YUCCA MOUNTAIN BLOCK

4. OBTAIN SAMPLES FOR LABORATORY TESTING

# TO MEET THE OBJECTIVES CONSIDERATION WAS GIVEN TO

- NEGATIVE IMPACTS OF THE EXPLORATION TECHNIQUE ON THE GEOLOGICAL AND HYDROLOGICAL CONDITIONS, PROCESSES AND PROPERTIES
- DEVELOPMENT AND OPERATIONAL COSTS AND SCHEDULES
- RISK OF FAILURE OF EACH ALTERNATIVE METHOD
- COMPLIANCE WITH HEALTH AND SAFETY REGULATIONS
- COMPLIANCE WITH QUALITY ASSURANCE REQUIREMENTS FOR DATA

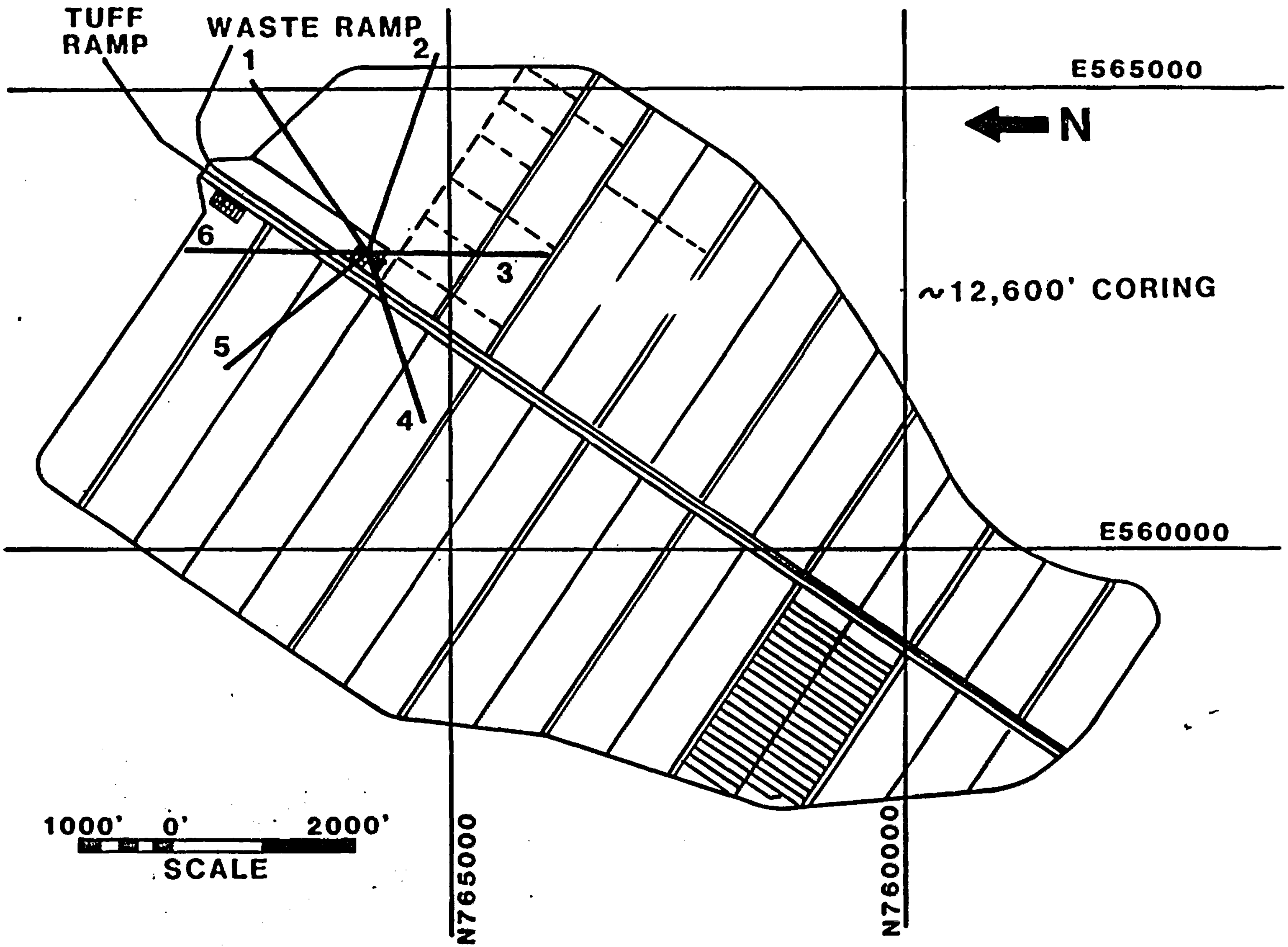
# FOUR ALTERNATIVE METHODS OF EXPLORATION WERE SELECTED FOR EVALUATION

1. CURRENT PROPOSAL TO AIR CORE SIX 2000 + FT HOLES LATERALLY FROM THE ES FACILITY AT 1200 FT

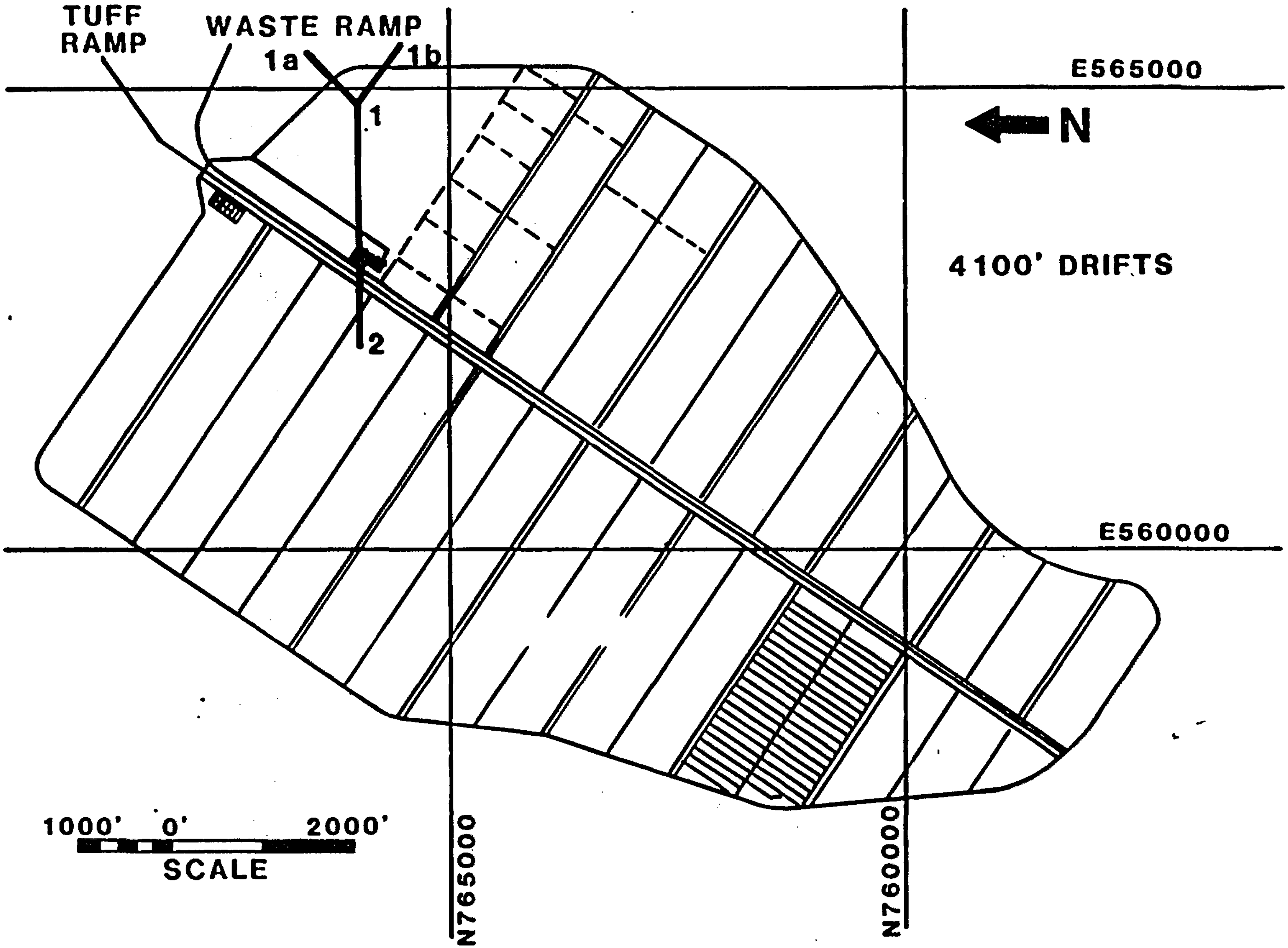
2. CORE SIX 2000 + FT HOLES USING CONVENTIONAL "WET" CORING TECHNIQUES

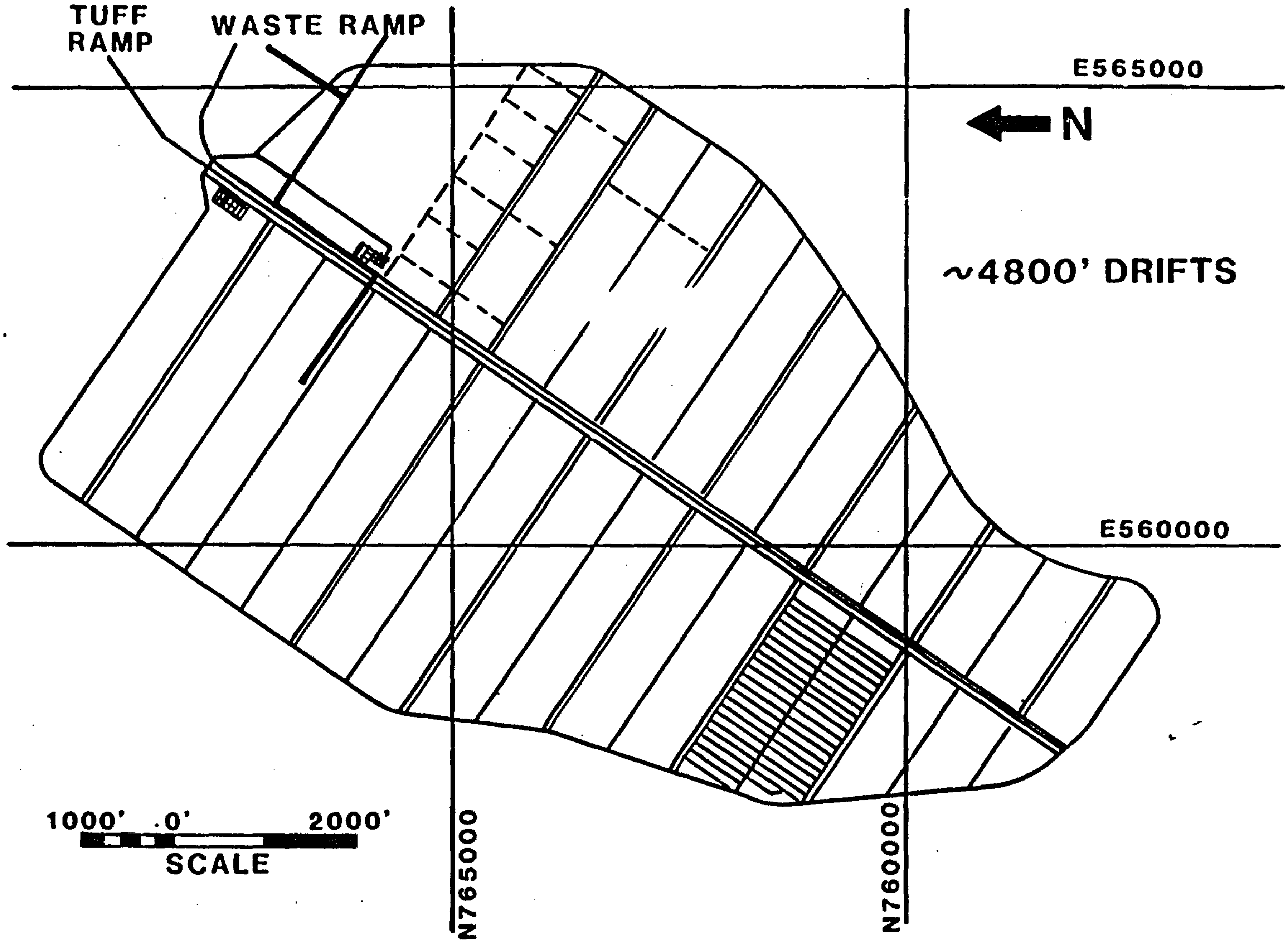
3. DRIFT WEST ACROSS GHOST DANCE FAULT AND EAST TO THE BLOCK BOUNDARY AS PER THE CONTINGENCY PLAN IN THE ESTP REV. 1 (APPROXIMATELY 4100 FT TOTAL)

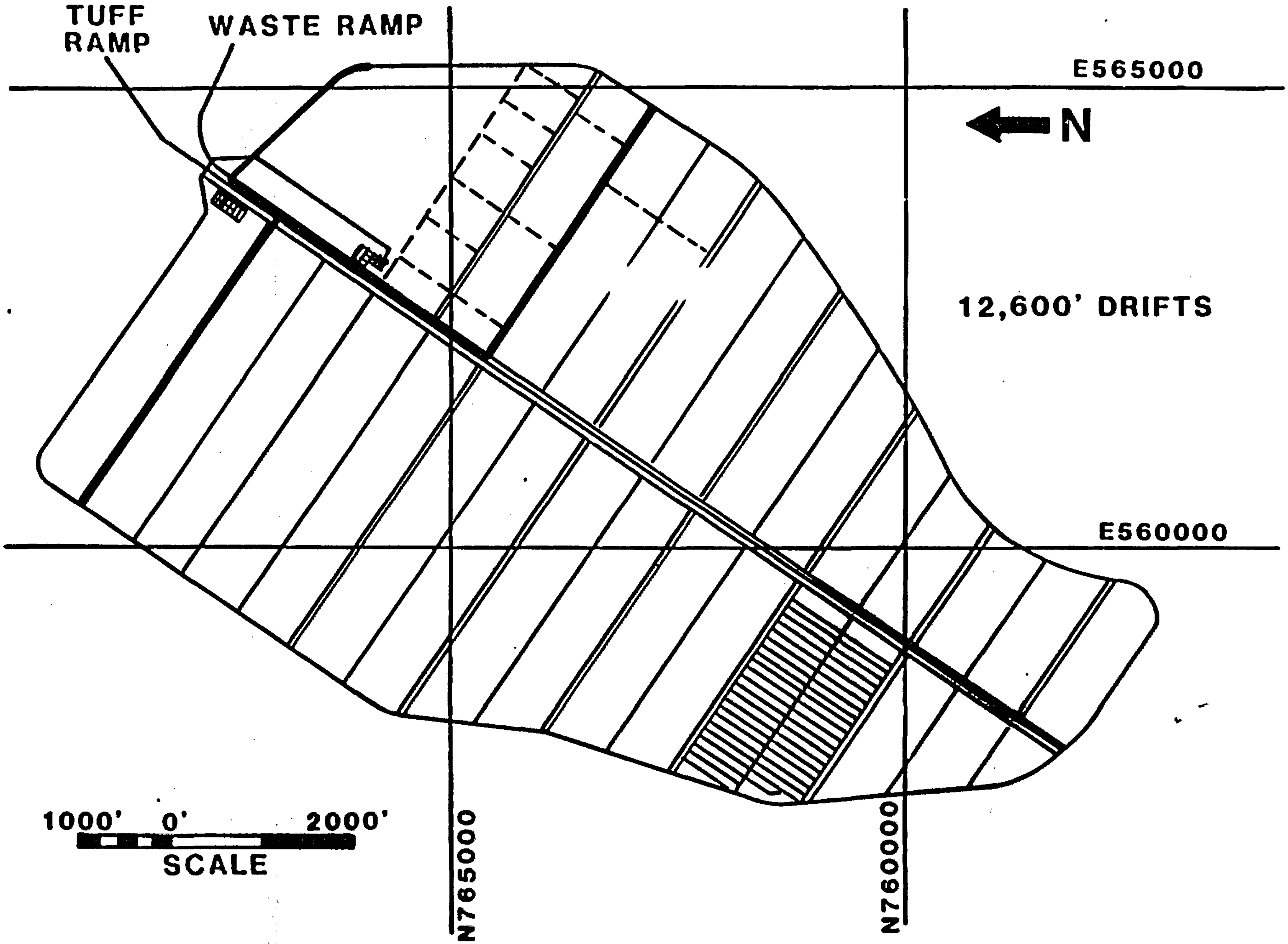
4. CONSTRUCT 12,600 FT OF DRIFTS TO INVESTIGATE STRUCTURES AND BOUNDARIES (AS IN 3 ABOVE) AND ALSO TO THOROUGHLY INVESTIGATE THAT PORTION OF THE BLOCK LIKELY TO CONTAIN THE FIRST HIGH-LEVEL WASTE



TUFF
RAMP
WASTE RAMP
1
2
3
4
5
6
E565000
N
~12,600' CORING
E560000
1000'
0'
2000'
SCALE
N765000
N760000


TUFF RAMP
WASTE RAMP
1a
1b
1
2
E565000
N
4100' DRIFTS
E560000
N765000
N760000
1000'
0'
2000'
SCALE


TUFF
RAMP
WASTE RAMP
E565000
N
~4800' DRIFTS
E560000
N765000
N760000
1000' 0' 2000'
SCALE



TUFF RAMP
WASTE RAMP
E565000
N
12,600' DRIFTS
E560000
1000'
0'
2000'
SCALE
N765000
N760000

# FIGURE OF MERIT
# CRITERIA AND SUBCRITERIA DEVELOPED FOR EVALUATION BY THE PRINCIPAL INVESTIGATORS AND ESTP COMMITTEE

| CRITERIA | SUBCRITERIA |
|---|---|
| GEOLOGICAL FEATURES | DRILL HOLE WASH, GHOST DANCE FAULT, NE BOUNDARY, OTHER STRUCTURES |
| GEOLOGIC CONDITIONS, PROCESSES & PROPERTIES | FRACTURE SPACING, ORIENTATION LITHOLOGY, FRACTURE INFILLING, ROCK PROPERTIES *IN SITU* STRESS |
| HYDROLOGIC CONDITIONS, PROCESSES & PROPERTIES | FRACTURE NETWORKS, FLUID INVASION G4, HYDROLOGIC PROPERTIES, HYDROLOGIC CONDITIONS PROCESSES |
| SAMPLING FOR LAB TESTING | GEOMECHANICAL PROPERTIES, HYDROLOGICAL PROPERTIES, GEOCHEMISTRY |
| NEGATIVE IMPACTS | GEOLOGICAL CONDITIONS & PROCESSES, GEOLOGICAL PROPERTIES, HYDROLOGIC CONDITIONS & PROCESSES, HYDROLOGIC PROPERTIES |
| COST & SCHEDULE | OPERATIONAL COST, DEVELOPMENT COST, EXECUTION SCHEDULE, DEVELOPMENT SCHEDULE, RISK OF FAILURE |
| REGULATORY COMPLIANCE | HEALTH & SAFETY, DATA QUALITY / ADEQUACY |

FIGURE OF MERIT EVALUATION
AVERAGE WEIGHTS, GROUP P.M.

| CRITERIA | WEIGHT | SUBCRITERIA | WEIGHT | FACTOR | PERFORMANCE MEASURES A1 | A2 | A3 | A4 | MERIT VALUES A1 | A2 | A3 | A4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GEOLOGICAL FEATURES | | DRILL HOLE WASH | | 0.04746 | 3 | 3 | 5 | 3 | 0.1424 | 0.1424 | 0.2373 | 0.142 |
| | | GHOST DANCE FAULT | | 0.06 | 3 | 3 | 5 | 5 | 0.18 | 0.18 | 0.3 | 0.3 |
| | | NE BOUNDARY | | 0.0365 | 3 | 3 | 3 | 3 | 0.1095 | 0.1095 | 0.1095 | 0.109[illegible] |
| | | OTHER STRUCTURES | | 0.036 | 5 | 5 | 1 | 5 | 0.18 | 0.18 | 0.036 | 0.18 |
| | | | Subtotal | 0.17996 | | | | | | | | |
| GEOL. CONDITIONS, PROCESSESS & PROP. | | FRAC SPAC, ORIENT | | 0.09325 | 1 | 1 | 3 | 5 | 0.0933 | 0.0933 | 0.2798 | 0.466[illegible] |
| | | LITHOLOGY | | 0.0321 | 3 | 3 | 3 | 5 | 0.0963 | 0.0963 | 0.0963 | 0.160[illegible] |
| | | FRAC. INFILLING | | 0.02425 | 3 | 3 | 3 | 5 | 0.0728 | 0.0728 | 0.0728 | 0.121[illegible] |
| | | ROCK PROPERTIES | | 0.0275 | 1 | 3 | 3 | 5 | 0.0275 | 0.0825 | 0.0825 | 0.1375 |
| | | IN SITU STRESS | | 0.0229 | 1 | 1 | 3 | 5 | 0.0229 | 0.0229 | 0.0687 | 0.1145 |
| | | | Subtotal | 0.2 | | | | | | | | |
| HYDRO. CONDITIONS, PROCESSES & PROP. | | FRAC NETWORK | | 0.05788 | 1 | 1 | 3 | 5 | 0.0579 | 0.0579 | 0.1736 | 0.2894 |
| | | FLUID INVASION 64 | | 0.02802 | 3 | 1 | 3 | 5 | 0.0841 | 0.028 | 0.0841 | 0.1401 |
| | | HYDRO PROPERTIES | | 0.0498 | 3 | 1 | 3 | 5 | 0.1494 | 0.0498 | 0.1494 | 0.249 |
| | | HYDRO COND, PROC | | 0.0643 | 3 | 1 | 3 | 5 | 0.1929 | 0.0643 | 0.1929 | 0.3215 |
| | | | Subtotal | 0.2 | | | | | | | | |
| SAMPLING FOR LAB TESTING | | GEOMECH PROP. | | 0.03155 | 3 | 3 | 3 | 5 | 0.0947 | 0.0947 | 0.0947 | 0.1573 |
| | | HYDRO PROP. | | 0.02855 | 3 | 1 | 3 | 5 | 0.0857 | 0.0286 | 0.0857 | 0.1428 |
| | | GEOCHEM. | | 0.0198 | 3 | 1 | 3 | 5 | 0.0594 | 0.0198 | 0.0594 | 0.099 |
| | | | Subtotal | 0.0799 | | | | | | | | |
| NEGATIVE IMPACTS | | GEOL. COND & PROC | | 0.01575 | 3 | 3 | 3 | 3 | 0.0473 | 0.0473 | 0.0473 | 0.0473 |
| | | GEOL PROP | | 0.01875 | 3 | 3 | 3 | 5 | 0.0563 | 0.0563 | 0.0563 | 0.0938 |
| | | HYDRO. COND & PROC | | 0.05625 | 5 | 1 | 3 | 3 | 0.2813 | 0.0563 | 0.1688 | 0.1688 |
| | | HYDRO PROP | | 0.04425 | 3 | 1 | 3 | 3 | 0.1328 | 0.0443 | 0.1328 | 0.1328 |
| | | | Subtotal | 0.135 | | | | | | | | |
| COST & SCHEDULE | | OPERATIONAL COST | | 0.01275 | 3 | 5 | 3 | 1 | 0.0383 | 0.0638 | 0.0383 | 0.0128 |
| | | DEVEL. COST | | 0.011 | 1 | 5 | 5 | 5 | 0.011 | 0.055 | 0.055 | 0.055 |
| | | EXECUTION SCHED | | 0.03525 | 1 | 5 | 5 | 3 | 0.0353 | 0.1763 | 0.1763 | 0.1058 |
| | | DEVEL. SCHED. | | 0.0175 | 1 | 5 | 5 | 5 | 0.0175 | 0.0675 | 0.0875 | 0.0875 |
| | | RISK OF FAILURE | | 0.0405 | 1 | 3 | 5 | 5 | 0.0405 | 0.1215 | 0.2025 | 0.2025 |
| | | | Subtotal | 0.117 | | | | | | | | |
| REGULATORY COMPLIANCE | | HEALTH & S[illegible] | | [illegible]0395 | 3 | 5 | 3 | 1 | 0.1185 | 0.1975 | 0.1185 | 0.0395 |
| | | DATA QUAL./A[illegible] | | 0.0495 | 3 | 1 | 3 | 5 | 0.1485 | 0.0495 | 0.1485 | 0.2475 |
| | | | Subtotal | 0.089 | | | | | | | | |
| | | | TOTALS | 1.00086 | | | | | 2.5755 | 2.2776 | 3.354 | 4.3244 |

# STATUS OF SCP
# GENERAL COMMENTS

- STILL ALIVE AND KICKING
- WORK CONTINUING IN SPITE OF EA
- ONLY ONE DOE/HQ REVIEW SO FAR, CHAPTER 2, WENT VERY WELL
- SCP MANAGEMENT PLAN PROCESS BEING FOLLOWED (EXCEPT SCHEDULE AND DIVA FORMS)
- MEETINGS HELD - CONTENT OF 8.3
  - DOE/HQ DISCUSSIONS
- PLANNED MEETING WITH NRC ON 8.3
- SCPMG WILL DEVELOP REBASELINED SCHEDULE FOR APPROVAL LATE NOVEMBER
- NNWSI PROJECT REVIEW OF DOE/HQ SCP MANAGEMENT PLAN REQUESTED

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YUCCA MOUNTAIN

# STATUS OF SCP DATA AND DESIGN CHAPTERS

| CHAPTER | STATUS |
|---|---|
| 1, GEOLOGY | REVIEW MEETING HELD SEPT. 30 - OCT. 2<br>CHAPTER TO BE REWRITTEN |
| 2, GEOENGINEERING | DOE/HQ REVIEW COMMENTS BEING RESOLVED<br>IN GOOD CONDITION |
| 3, HYDROLOGY | BEING REWRITTEN BY USGS AND SAIC (AND OTHERS?) |
| 4, GEOCHEMISTRY | IRC COMMENTS BEING RESOLVED |
| 5.1, METEOROLOGY | IRC COMMENTS BEING RESOLVED |
| 5.2, CLIMATOLOGY | WRITE-IN BEING HELD SEPT. 30 - OCT. 4 |
| 5.0, 5.3 | WILL BE PREPARED WHEN 5.2 IS AVAILABLE<br>EXPAND IRC TO INCLUDE PEER REVIEWERS |
| 6, REPOSITORY DESIGN | IRC COMMENTS BEING RESOLVED |
| 7, WASTE PACKAGE DESIGN | IRC COMMENTS BEING RESOLVED |

3-Oct-85

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Nevada Nuclear Waste Storage Investigations PROJECT

# STATUS OF SCP ISSUES AND PLANS CHAPTER

| SECTION | STATUS |
| --- | --- |
| 8.1, RATIONALE<br>8.2, ISSUES | DOE/HQ GUIDANCE ON 8.3 REQUIRED FOR 8.1 PREP<br>- CHRISTMAS PRESENT FOR TPO REVIEW |
| 8.3, TESTS, PLANS & ANALYSES | PROBLEM CHILD - TO BE DISCUSSED LATER |
| 8.4, SITE PREPARATION | IRC COMMENTS BEING RESOLVED |
| 8.5, SCHEDULE | NOT ON SCHEDULE - WILL GO WITH 8.3 |
| 8.6, Q.A. | IRC COMMENTS BEING REVIEWED |
| 8.7, D & D | IRC COMMENTS BEING RESOLVED |

3-OCT-85

# STATUS OF SCP
## SECTION 8.3 STATUS

- o VARIOUS MEETINGS TO UNDERSTAND PSYCHOLOGY OF "PROBLEM CHILD"

  - AUG. 28, SAIC AND USGS TO DISCUSS USGS SECTIONS
  - AUG. 29, COMBINED WITH PACG MEETING TO DETERMINE CONTENT OF 8.3.5, WITH DOE/HQ, NNWSI PROJECT
  - SEPT. 25, TASK LEADERS TO DISCUSS DETAILS
  - OCT. 3,4, DOE/HQ TO DISCUSS DETAILS
  - OCT. 27, 28, MEETING WITH NRC TO PRESENT DOE/HQ's SUGGESTIONS
  - ?, DOE/HQ OFFICIAL GUIDANCE TO PROJECTS ON 8.3 CONTENT

# STATUS OF SCP
## SECTION 8.3 STATUS (CONT'D)

o IMPORTANT ASPECTS OF 8.3

- LETTER TO DOE/HQ ON DEVIATIONS FROM AO TO AGREE WITH ISSUES HIERARCHY (IH)
  - NO RESPONSE

- SOME OF DETAILS OF ESTP, PAP, SBTP IN 8.3 -- HOW MUCH?

- INFORMATION NEEDS (IN) BROKEN DOWN TO INVESTIGATIONS (APPROX. 10 INVESTIGATIONS PER IN)

- 8.3 WILL DISCUSS IH AT INVESTIGATIONS LEVEL - 5 TO 15 PAGES EACH (AVG. 10)

- AMOUNT OF WORK? 107 INs X 10 INVESTIGATIONS X 10 PAGES = 10,700 PAGES

- DEVELOPMENT OF DATA TRAC WILL HELP
  - TRACKS IH
  - CONNECTED WITH LIMS, RIB, RMS

## USGS SCP INVESTIGATION WORK ACTIVITIES

1.1.1 Description of the Hydrogeology---- — INFORMATION NEED

1.1.1.1 Stratigraphic Studies----- INVESTIGATION
- Geologic Mapping
- Photogrammetric Analyses
- Television and Acoustic Televiewer Surveys
- Rock Physical Properties Testing
- Gravity Surveys
- Magnetic Surveys
- Seismic Surveys
- Electrical Surveys
- Radioactive Surveys

} ACTIVITIES

1.1.1.2 Rock Matrix Hydrogeologic Characterization
- Drilling Log Interpretation
- Rock Bit Cuttings, Core and Surface Sample Evaluation
- Geophysical Testing of Core Samples
- Laboratory Testing of Core Samples
- Radioactive Surveys

1.1.1.3 Fracture Distribution Studies
- Reconnaissance Fracture Traverses
- Exposed Pavement Fracture Traverses
- Drilling Log Interpretation
- Television and Acoustic Televiewer surveys
- Borehole Seismic Surveys

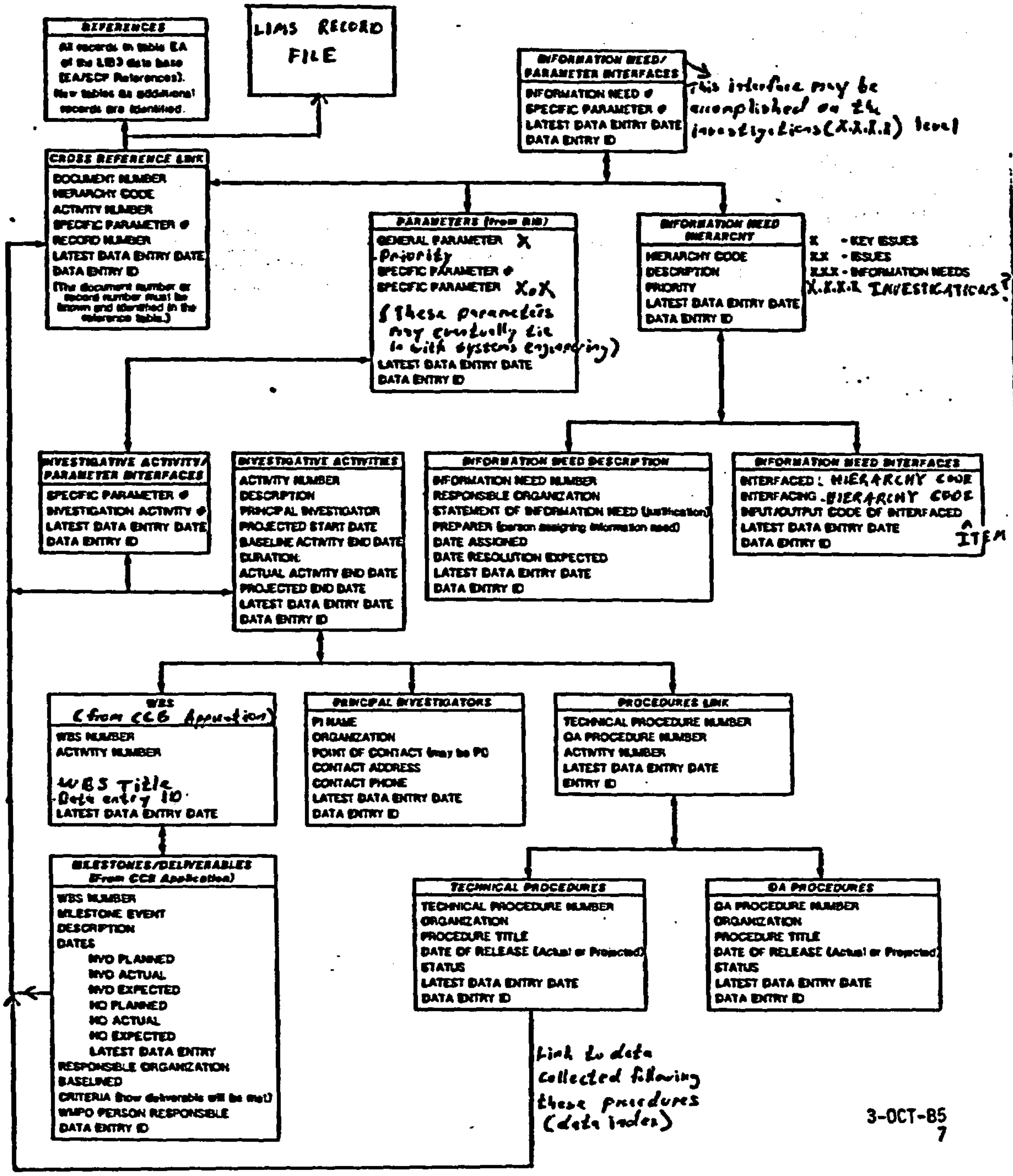
1.1.1.4 Fracture Hydrogeologic Characterization
- Drilling Log Interpretation
- Core Analysis
- Television and Acoustic Televiewer Surveys
- Exposed Pavement Fracture Traverses
- Trench Mapping

1.1.1.5 Fault Distribution Studies
- Geologic Mapping
- Field Reconnaisssance Surveys
- Photogrammetric Analyses
- Geomorphologic Studies
- Television and Acoustic Televiewer Surveys
- Gravity Surveys
- Magnetic Surveys
- Seismic Surveys
- Trench Mapping

1.1.1.6 Fault Hydrogeologic Characterization
- Geologic Mapping
- Field Reconnaissance Surveys
- Photogrammetric Analyses
- Geomorphologic Studies
- Drilling Log Interpretation
- Television and Acoustic Televiewer Surveys
- Gravity Surveys
- Magnetic Surveys
- Seismic Surveys
- Trench Mapping

# PROPOSED DATA TRAC DESIGN

B. Foster
10/3




3-OCT-85
7

# APPROACH TO COMPLETING 8.3

GIVEN:

- INDO's ARE COMPLETED; MANY AS SECOND DRAFT
- EXPANSION TO NARRATIVE HAS BEEN DRAFTED FOR SECTIONS 8.3.2 (REPOSITORY) AND 8.3.3 (SEALS)
- THE LABS ARE WORKING ON (OR ARE POISED TO WORK ON) THE EXPANDED NARRATIVES
- THE SUPPORT DOCUMENTS (ESTP, PAP, SIP, ETC.) WILL BE ROLLED INTO THE SCP, AND HQ WILL TELL US HOW TO DO THIS

ASSUMPTION:

- HQ WILL PROVIDE <u>REASONABLE</u> GUIDANCE ON THE LEVEL OF DETAIL REQUIRED TO ADDRESS THE ACTIVITIES IN THE SCP

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## APPROACH TO COMPLETING 8.3 (CONT'D)

GOAL:

- TO INCORPORATE THE GUIDANCE PROVIDED BY HQ WITH AS LITTLE PERTURBATION AS POSSIBLE
  - TO THE SCHEDULE
  - TO THE PEOPLE
  - TO THE SCP DOCUMENT

METHODS:

- TABULATE AS MUCH INFORMATION AS POSSIBLE
  - INVESTIGATION TABLES: USED TO RELATE WORK ACTIVITIES, PARAMETERS, PROCEDURES, AND DELIVERABLES

TABLE A
INFORMATION NEED INVESTIGATION
TECHNICAL SUMMARY

INVESTIGATION 1.3.1.1 Lithostratigraphic Characterization

| Activity | Quantities Measured | Output Parameter |
|---|---|---|
| Geologic Field Mapping | Location of Lithologic Units<br>Lateral Extent of Lithologic Units<br>Strike and Dip of Lithologic Units | Geometry of Lithologic Units<br>Thickness of Lithologic Units<br>Orientation of Lithologic Units |
| Photogrammetric Analysis | Location of Lithologic Units<br>Lateral Extent of Lithologic Units<br>Strike and Dip of Lithologic Units | Geometry of Lithologic Units<br>Thickness of Lithologic Units<br>Orientation of Lithologic Units |
| Borehole Television Surveys | Contacts of Lithologic Units<br>Thickness of Lithologic Units<br>Orientation of Lithologic Units | Geometry of Lithologic Units |
| Borehole Acoustic Televiewer Surveys | Contacts of Lithologic Units<br>Thickness of Lithologic Units<br>Orientation of Lithologic Units | Geometry of Lithologic Units |
| Drilling Log Interpretation | Penetration Rate<br>Fluid Loss | Degree of Alteration of Lithologic Uni<br>Porosity of Lithologic Units |
| Rock Bit Cuttings, Core and Surface Sample Analysis | Degree of Welding<br>Degree of Induration<br>Degree of Vitrification<br>Degree of Zeolitization<br>Degree of Argillation<br>Degree of Silicification<br>Degree of Vapor Phase Crystallization<br>Flow Lines<br>Mineralogical Content<br>Lithophysea Cavity Size<br>Lithophysea Cavity Shape<br>Lithophysae Cavity Orientation | Competance of Lithologic Units<br>Porosity of Lithologic Units<br>Degree of Alteration of Lithologic Uni<br>Isotropy of Lithologic Units<br>Homogeneity of Lithologic Units |

TABLE B
INFORMATION NEED INVESTIGATION
INFORMATION SUMMARY

Investigation 1.3.1.1 Lithostratigraphic Characterization

| Output Parameter | Subsystem | Expected Value |
|---|---|---|
| Thickness of Lithologic Units | Alluvium | 0 - 30+ meters |
| | Tiva Cannyon Number | 0 - 69 meters |
| | Pah Canyon Member | 11 - 83 meters |
| | Yucca Mountain Member | 0 - 36 meters |
| | Topopah Spring Member | 287 - 356 meters |
| | Tuffaceous Beds of Calico Hills | 95 - 306 meters |
| | Prow Pass Member | 127 - 176 meters |
| | Bullfrog Member | 99 - 161 meters |
| | Tram Member | 154 - 328 meters |
| | Dacitic Lava and Flow Breccia | 0 - 112 meters |
| | Lithic Ridge Tuff | 42 - 311 meters |
| | Older Volcanics | 9 - 323 meters |
| | Pre-Tertiary Rocks | - |

TABLE C
INFORMATION NEED INVESTIGATION
QUALITY ASSURANCE SUMMARY

Investigation 1.3.1.1 Lithostratigraphic Characterization

| Activity | Technical Procedure Method | Technical Procedure Number |
|---|---|---|
| Geologic Mapping | Geologic Mapping | GP-01 |
| | Stratigraphy Studies | GP-03 |
| | Geological Investigations | UIP-03 |
| Photogrammetric Analysis | | |
| Drilling-Log Interpretations | Subsurface Investigations | GP-02 |
| Television and Acoustic Televiewer Surveys | Subsurface Investigations | GP-02 |
| Rock Bit Cuttings, Surface Samples, and Core Analysis | Subsurface Investigations | GP-02 |
| | Stratigraphic Studies | GP-03 |
| | Geo, Support | GP-05 |
| | Geological Investigations | UTP-03 |
| | Rock Property Analysis of Core Samples | GPP-10 |
| Gravity Surveys | Geophysical Investigations | UTP-02 |
| | Subsurface Investigations | GP-02 |
| | Gravity Measurement | GPP-01 |
| | Bore Hole Gravity Measurement | GPP-12 |
| | Absolute Measurement of Gravity | GPP-16 |
| Magnetic Surveys | Subsurface Investigations | GP-02 |
| | Paleomagnetics Investigations | GPP-06 |
| | Geophysical Investigations | UTP-02 |
| | Magnetic Susceptibility Borehole Logging Operations | GPP-15 |

TABLE D
INFORMATION NEED INVESTIGATION
WORK BREAKDOWN SUMMARY

Investigation 1.3.1.1 Lithostratigraphic Characterization

| Activity | Work Breakdown Element | | | Deliverable | | |
|---|---|---|---|---|---|---|
| | Title | Number | Investigator | Title | Number | Date |
| Geologic Mapping | Site Geology | 2.3.2.1.1.G | Spengler | | | |
| Photogrammetric Analysis | | | Wu | | | |
| Drilling-log Interpretations | | | Spengler | | | |
| Borehole Television Surveys | | | Spengler | | | |
| Borehole Acoustic Televiewer Surveys | | | Spengler | | | |
| Rock Site Cuttings, Surface Samples, & Core Analysis | Site Geology | 2.3.2.1.1.G | Anderson | | | |
| Gravity Surveys | Gravity and Magnetics | 2.3.2.2.1.G | Oliver | | | |
| Magnetic Surveys | Gravity and Magnetics | 2.3.2.2.1.G | Oliver | | | |
| Seismic Surveys | Seismic Investigations | 2.3.2.2.2.G | Mooney | | | |
| Electrical Surveys | Rock Properties | 2.3.2.2.3.G | Anderson | | | |
| Radioactivity Surveys | Rock Properties | 2.3.2.2.3.G | Anderson | | | |
| Investigation Synthesis | Site Geology | 2.3.2.1.1.G | Spengler | Preliminary Site Geology Description | M368 | 07-[illegible] |
| | | | | Complete Geologic Model | M384 | 01-[illegible] |

# APPROACH TO COMPLETING 8.3 (CONT'D)

METHODS: (CONT'D)

- WRITE DETAILS AT THE INVESTIGATIONS LEVEL; INCLUDE SHORT DESCRIPTIONS OF THE ASSOCIATED WORK ACTIVITIES
  - MAKE HEAVY USE OF TABLES
  - AVERAGE 5 TO 15 PAGES FOR EACH INVESTIGATION
  - AVOID REDUNDANCY, WRITE AN INVESTIGATION DESCRIPTION ONLY ONCE

SUGGESTIONS:

- IN-HOUSE (PARTICIPANT LEVEL) WORKSHOPS SHOULD BE HELD TO ASSURE CONSISTENCY AND COMPLETENESS IN PARTICIPANT'S CONTRIBUTIONS TO SCP (SECTION 8.3 AND CHAPTERS 1-7)

- PROJECT WORKSHOPS SHOULD BE HELD TO ASSURE CONSISTENCY AND CONTINUITY WITHIN AND BETWEEN THE SECTIONS OF 8.3

- HOLD SEPARATE REVIEWS FOR 8.3.1, 8.3.2, 8.3.3, 8.3.4, AND 8.3.5; USE TAG MEMBERS WHO PARTICIPATED IN REVIEWS OF CHAPTERS 1-7.

Oct. 3, 1985
10:00 a.m.

TENTATIVE
(WORKING)
((DRAFT))

SCP SCHEDULE

| hapter/ ection | Draft Input | Internal Review Distr. | Mtg. | CRAP 1 | HQ Review Distr. | Mtg. | CRAP 2 |
|---|---|---|---|---|---|---|---|
| 2 | | - | - | 7/2 - 8/23 | 8/26 | 9/11-12 | 9/16 - 11/22 |
| 7 | 6/21 | 6/24 | 7/17-19 | 7/22 - 11/15 | 11/18 | 12/2-3 | 12/9 - 1/31 |
| .4, 8.7 | 6/28 | 8/12 | 8/19-20 | 8/26 - 10/25 | 10/28 | 11/7 | 11/11 - 12/20 |
| .6 | 8/6 | 8/12 | 8/21 | 8/26 - 10/25 | 10/28 | 11/8 | 11/11 - 12/31 |
| 6 | 7/19 | 8/26 | 9/3-6 | 9/9 - 11/1 | 11/4 | 11/21-22 | 11/25 - 1/17 |
| 4 | 8/13 | 8/29 | 9/11-13 | 9/16 - 11/22 | 11/25 | 12/5-6 | 12/9 - 1/17 |
| 1 | 7/22 | 8/26 | 9/30-10/2 | 10/7 - 12/31 | 1/1 | 1/16-17 | 1/20 - 2/28 |
| .3.2, 8.3.3 | 10/14 | 10/21 | 10/31-11/1 | 11/4 - 11/22 | 11/25 | 12/10-11 | 12/16 - 1/31 |
| 5 | 10/18 | 11/4 | 11/13 | 11/18 - 12/31 | 1/1 | 1/15 | 1/20 - 2/28 |
| .3.4 | 10/21 | 11/4 | 11/14-15 | 11/18 - 12/31 | 1/1 | 1/13 | 1/20 - 2/28 |
| .3.1 | 10/25 | 11/11 | 11/19-22 | 11/24 - 1/31 | 2/3 | 2/18-21 | 2/24 - 4/4 |
| .3.5 | 10/11 | 10/18 | 11/27 | 12/2 - 1/10 | 1/13 | 1/24 | 1/27 - 3/7 |
| 3 | 11/27 | 12/2 | 12/12-13 | 12/16 - 1/31 | 2/3 | 2/13-14 | 2/17 - 3/28 |
| .1, 8.2 | 11/29 | 12/9 | 12/19-20 | 12/23 - 1/31 | 2/3 | 2/11-12 | 2/17 - 3/28 |
| .3, 8.5 | 1/1 | 1/13 | 1/23-24 | 1/27 - 2/14 | 2/17 | 2/27-28 | 3/3 - 4/4 |

| | |
|---|---|
| Total Document Consolidation | 4/7 - 4/11 (SAIC) |
| HQ/Internal Reviews | 4/14 - 5/2 (HQ/NNWSI Project) |
| Comment Clarification & Consolidation | 5/5 - 5/9 (HQ) |
| Comment Resolution | 5/12 - 5/30 (SAIC) |
| Production | 6/2 - 6/27 (SAIC) |
| HQ Approval | 6/30 - 7/18 (HQ) |
| Camera Ready | 7/21 - 8/15 |
| Final Reproduction | 8/18 - 9/12 |

DOE F 1325.8
(4-84)

United States Government | Department of Energy

# memorandum

DATE: SEP 6 1985

REPLY TO ATTN OF: RW-22

SUBJECT: Preliminary Guidance for FY 1986

TO: Don Vieth, WMPO

ACTION: ______
: Vieth
CC: Kunick
CC: BC's
CC: Blaylock

This letter provides preliminary guidance to the NNWSI Project for FY 1986 planning purposes. Although there is some uncertainty underlying this preliminary guidance, e.g., Congress is still acting on the FY 1986 budget request, the guidance is being provided now to facilitate your development of FY 1986 plans that are consistent with Headquarters expectations in terms of both budgets and milestones to be accomplished. We will advise you in the event changes in this preliminary guidance are needed. Also, additional guidance will be provided by Headquarters as required.

The following four enclosures contain the preliminary budget and schedule guidance for FY 1986 planning purposes:

- The key program milestones through 1998 are contained in Enclosure 1. These milestones, which are only to be changed under the signature of the Associate Director, Office of Geologic Repositories, should be the basis for the NNWSI's schedule.

- The preliminary list of milestones that should be incorporated in your monthly MSA reports are contained in Enclosure 2. The milestones in Enclosure 2 that are asterisked are designated Headquarters controlled milestones, which are to be changed only under the signature of the Director, Repository Coordination Division. Although the milestones that do not contain an asterisk can be changed without prior Headquarters approval, the monthly MSA reports should report progress on them. We plan to issue a final list of such milestones following your review. Any recommended changes to Enclosure 2 should be provided to Headquarters by September 27. We also plan to update the list at six-month intervals, always maintaining at least a twelve-month projection.

- The current budget for the NNWSI Project is contained in Enclosure 3. Your FY 1986 plans should not require more funds than are currently budgeted. With the exception of the exploratory shaft, you may reallocate funds among the nine Level 2 WBS elements. Exploratory shaft funds should not be shifted to support other project activities. Also, any reallocation of FY 1986 funding for other WBS elements that results in a change of more than 15 percent will require prior Headquarters approval. As mentioned

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previously, Congress is still reviewing the FY 1986 budget request and a reduction may be made. You will be advised immediately if a reduction in your FY 1986 budget is required.

Funding projections for FY 1987 and beyond are in FY 1987 dollars and are, of course, subject to the Federal budget process. You will be notified of any programmatic or funding changes necessitated by the ongoing review of the FY 1987 budget. Changes in the exploratory shaft budget will be made to reflect the submission that will be made to the Office of Management and Budget in the near future.

- The budget outlays at Level 3 of the WBS are provided in Enclosure 4. These budget outlays resulted from the May-June 1985 reviews of your FY 1987 budget request and were the basis for preparing Enclosure 3.

Our objective in providing this preliminary guidance is to help enable the NNWSI Project to have its FY 1986 plans in place on October 1, 1985. You will be requested to submit, for MSA and monthly project status report purposes, a FY 1986 cost plan by month for each of the nine Level 2 WBS elements. This cost plan along with the Headquarters controlled milestones that are finally established will be the principal basis for tracking the performance of the NNWSI Project in FY 1986.

If you have any questions on this letter, please contact Vince Cassella on 252-9789.

William J. Purcell
Associate Director
for Geologic Repositories
Office of Civilian Radioactive
Waste Management

4 Enclosures

Enclosure 1

Key Milestones - Nevada Nuclear Waste Site Investigations Project

| | |
|---|---|
| Issue Final Environmental Assessment | 12/20/85 |
| Presidential Approval of Sites to be Characterized | 2/86 |
| Start ESF Site Preparation | 2/86 |
| Issue Site Characterization Plan to Public | 3/86 |
| Start Exploratory Shaft Construction | 8/86 |
| Start LA Waste Package Design | 6/87 |
| Complete First Exploratory Shaft | 12/87 |
| Start LA Repository Design | 2/88 |
| Start Exploratory Shaft In-Situ Test Program | 6/88 |
| Complete Exploratory Shaft In-Situ Testing for Draft Environmental Impact Statement | 12/89 |
| Complete LA Repository Design | 5/90 |
| Complete LA Waste Package Design | 5/90 |
| Issue Draft Environmental Impact Statement | 6/90 |
| Complete Exploratory Shaft Testing for LA | 11/90 |
| Issue Final Environmental Impact Statement | 12/90 |
| Issue Site Selection Report | 1/91 |
| Presidential Site Recommendation | 3/91 |
| Submit License Application to NRC | 5/91 |
| Receive Construction Authorization from NRC | 8/93 |
| Initial Acceptance of Waste | 1/98 |

All dates assume the first day of the month unless otherwise specified.

Enclosure 2

MSA Milestones - NNWSI Project
October 1985 through September 1986

Systems

| | | |
|---|---|---|
| *1. | Draft Systems Engineering Management Plan received at HQ for review | 12/85 |
| 2. | Draft Systems Description Document received at HQ for review | 1/86 |
| *3. | Draft Systems Requirements Document received at HQ for review | 11/85 |
| 4. | Annual PASS Program Interaction-Letter Report received at HQ for information | 9/86 |

Waste Package

| | | |
|---|---|---|
| *1. | Revised Draft Waste Package Subsystem Advanced Conceptual Design Requirements to HQ for review | 11/85 |
| *2. | Waste Package Advanced Conceptual Design Report received at HQ for review | 9/86 |
| 3. | Preliminary Long-term Waste Package Assessments for Selected Conceptual Design completed | 6/86 |
| 4. | Waste Package Prototype Fabrication Based on Advanced Conceptual Design Complete | TBD |
| *5. | Final HQ-approved Report on Use of Copper as a Waste Package Material issued | 9/86 |
| 6. | Report on System Model for Waste Package Performance Analysis received at HQ for review | 3/86 |
| 7. | Waste Package Container Material for Advanced Conceptual Design Selection to HQ for review | 11/85 |
| 8. | Decision on Packing Material for Spent Fuel Waste Package to HQ for review | 3/86 |

*Headquarters controlled milestone, to be changed only under signature of the Director, Repository Coordination Division.

Site

| | | |
|---|---|---|
| 1. | Final Radiological Monitoring Plan received at HQ | 2/86 |
| 2. | Complete model of chemical composition of Yucca Mountain groundwater | 4/86 |
| 3. | Transportation Radiological Risk Report received at HQ | 4/86 |
| *4. | Draft Monitoring and Mitigation Plans for Socioeconomic and Environmental Studies received at HQ for review | 4/86 |
| 5. | Updated Report on Geochemical Simulation of Yucca Mountain received at HQ for information | 6/86 |
| 6. | Report on Evaluation of Natural Resources at Yucca Mountain and Vicinity received at HQ for information | 8/86 |
| 7. | Surficial Geologic Mapping completed | 9/86 |
| 8. | Summary Report on Regional Geophysical Investigations received at HQ for information | 9/86 |
| 9. | Report on Quaternary Climate of Yucca Mountain received at HQ for information | 9/86 |
| 10. | Update of Seismic Hazards and Risks Report received at HQ for information | 12/85 |

Repository

| | | |
|---|---|---|
| 1. | Assistance to HEDL in defining remote/automated waste handling systems requirements initiated | 10/85 |
| 2. | Feasibility Analysis of Horizontal Emplacement and Retrieval Letter Report received at HQ for review | 10/85 |
| 3. | Horizontal Waste Emplacement Equipment Development Plan received at HQ review | 1/86 |
| *4. | Draft Repository Subsystem Advanced Conceptual Design Requirements received at HQ for review | 11/85 |
| *5. | Seals Subsystem Design Requirements and Materials Recommendation received at HQ for review | 11/85 |

| | | |
|---|---|---|
| *6. | Draft Site Specific SCP Conceptual Design Report received at HQ for review | 2/86 |
| 7. | Design Information and Cost Estimate required for for FY 88 Budget Validation of LA Design received at HQ for review | 4/86 |
| 8. | G-Tunnel Data Summary Report received at HQ for information | 4/86 |
| *9. | Repository Advanced Conceptual Design initiated | TBD |
| 10. | Report Outlining a Preliminary Study of the Effects of Uncertain Geologic Data on Design of the Underground Facility received at HQ for information | 5/86 |
| 11. | Review of concepts developed by HEDL for remote/automated waste handling systems initiated | 7/86 |
| 12. | Preliminary Demonstration of Horizontal Waste Emplacement System completed | 9/86 |

<u>Regulatory/Institutional</u>

| | | |
|---|---|---|
| *1. | Final EA (camera-ready) received at HQ | 11/15/85 |
| *2. | Draft SCP received at HQ for final review | 12/85 |
| *3. | Issue SCP to Public | 3/86 |
| 4. | Project Office input on EIS Implementation Plan received at HQ | 3/86 |
| *5. | C&C Agreement with the State of Nevada signed | 6/86 |
| 6. | Licensing Information Management System, Phase I becomes operational | 9/86 |

<u>Exploratory Shaft</u>

| | | |
|---|---|---|
| 1. | Award Shaft Construction Subcontract; Start Site Preparation | 2/86 |

| | | |
|---|---|---|
| 2. | Design Information and Cost Estimate for FY 88 Budget Validation received at HQ for review | 4/86 |
| 3. | Construction prerequisites readiness review completed | 6/86 |
| *4. | Test procedures, implementing and control plan completed; start shaft construction | 8/86 |
| 5. | Surface Facilities Construction completed | 9/86 |

<u>Test Facilities</u>

| | | |
|---|---|---|
| 1. | G-Tunnel Mining in Welded Tuff Mining Evaluation Test completed | 2/86 |

<u>Project Management</u>

| | | |
|---|---|---|
| *1. | Implement Earned-value System - Phase I | 10/85 |
| 2. | FY 86 Cost Plan received at HQ | 10/85 |
| 3. | List of Project Office Controlled Milestones issued | 12/85 |
| 4. | FY 88 Budget Submission/WPAS received at HQ | 4/86 |

Enclosure 3

AUGUST 22 1985

# GEOLOGIC REPOSITORIES

## NUCLEAR WASTE FUND

($ in M)

NNWSI PROJECT (TUFF)

| | FY 1986 | | FY 1987 | | FY 1988 | | FY 1989 | | FY 1990 | | FY 1991 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | B/A | B/O | B/A | B/O | B/A | B/O | B/A | B/U | B/A | B/O | B/A | B/O |
| SYSTEMS | 5.1 | 5.2 | 6.9 | 6.8 | 7.4 | 7.6 | 6.3 | 6.3 | 6.2 | 6.2 | 6.0 | 6. |
| WASTE PACKAGE | 9.1 | 9.1 | 10.5 | 10.5 | 8.1 | 8.2 | 7.5 | 7.7 | 5.9 | 5.9 | 5.5 | 5. |
| SITE | 38.2 | 39.6 | 54.0 | 53.1 | 37.4 | 38.0 | 29.6 | 29.9 | 21.1 | 21.6 | 14.1 | 14. |
| REPOSITORY | 15.0 | 15.1 | 21.5 | 22.6 | 31.6 | 32.2 | 34.9 | 35.2 | 37.8 | 37.9 | 40.1 | 35. |
| REGULATORY/INSTITUTIONAL | 8.8 | 8.8 | 12.5 | 12.2 | 13.4 | 13.4 | 14.8 | 14.8 | 15.3 | 15.4 | 15.1 | 15. |
| EXPLORATORY SHAFT | 21.9 | 22.1 | 51.5 | 44.0 | 40.4 | 45.8 | 26.2 | 26.2 | 8.1 | 10.0 | 4.8 | 4. |
| TEST FACILITIES | 0.9 | 0.9 | 0.8 | 0.8 | 0.5 | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0. |
| LAND | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0. |
| PROJECT MANAGEMENT | 17.7 | 18.0 | 22.2 | 21.4 | 24.4 | 24.5 | 23.0 | 23.4 | 22.6 | 22.7 | 22.5 | 22. |
| TOTAL NNWSI PROJECT | 116.7 | 118.8 | 179.9 | 171.4 | 163.2 | 170.2 | 142.7 | 143.9 | 117.4 | 120.1 | 108.5 | 104 |

Figures for FY 1987 through FY 1991 are in FY 1987 dollars

Enclosure 4

07-Aug-85

Total Budget Outlays (B/O) - FY 1987 Budget
($000)

TUFF

| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| **WBS Element: Systems** | | | | | | |
| Management and Integration | 240 | 261 | 266 | 212 | 212 | 205 |
| Systems Engineering | 1,037 | 1,709 | 1,985 | 1,689 | 1,689 | 1,647 |
| Technical Data Base Management | 810 | 1,044 | 1,095 | 877 | 877 | 846 |
| Total System Performance Assessment | 3,054 | 3,639 | 4,144 | 3,322 | 3,322 | 3,202 |
| Capital Equipment | 73 | 145 | 75 | 200 | 137 | 70 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 5,214 | 6,798 | 7,565 | 6,300 | 6,237 | 5,970 |
| ** TOTAL B/A ** | 5,141 | 6,886 | 7,383 | 6,300 | 6,212 | 5,970 |

| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| **WBS Element: Waste Package** | | | | | | |
| Management and Integration | 505 | 500 | 450 | 425 | 425 | 400 |
| Waste Package Environment | 870 | 875 | 735 | 630 | 500 | 500 |
| Waste Form and Materials Basalt | 5,845 | 7,095 | 5,310 | 4,900 | 3,400 | 3,400 |
| Design, Fabricate and Prototype Testing | 655 | 775 | 750 | 790 | 700 | 630 |
| Waste Package Performance | 800 | 925 | 850 | 850 | 850 | 850 |
| Capital Equipment | 375 | 315 | 100 | 100 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 9,050 | 10,485 | 8,195 | 7,695 | 5,875 | 5,780 |
| ** TOTAL B/A ** | 9,050 | 10,485 | 8,138 | 7,480 | 5,863 | 5,531 |

22-Aug-85

Total Budget Outlays (B/O) - FY 1987 Budget
($000)

TUFF

| WBS Element: Site | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Management and Integration | 410 | 1,040 | 855 | 835 | 795 | 720 |
| Geology | 6,845 | 7,060 | 6,890 | 5,025 | 5,025 | 4,525 |
| Hydrology | 4,220 | 4,895 | 4,400 | 3,400 | 3,400 | 2,900 |
| Geochemistry | 6,820 | 6,680 | 6,387 | 4,651 | 2,036 | 1,180 |
| Drilling | 15,502 | 26,840 | 17,137 | 14,107 | 8,387 | 3,830 |
| Environment | 1,205 | 1,390 | 750 | 500 | 500 | 500 |
| Socioeconomic | 570 | 630 | 515 | 300 | 300 | 115 |
| Site Performance | 1,789 | 2,111 | 850 | 850 | 1,128 | 1,128 |
| Deferred Site Close-out | 0 | 0 | 0 | 0 | 0 | 0 |
| Capital Equipment | 2,235 | 2,470 | 180 | 250 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 39,596 | 53,116 | 37,964 | 29,918 | 21,571 | 14,898 |
| ** TOTAL B/A ** | 38,238 | 54,019 | 37,357 | 29,619 | 21,075 | 14,138 |

08-Aug-85

Total Budget Outlays (B/O) - FY 1987 Budget
($000)

TUFF

WBS Element: Repository

| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Management Integration | 2,837 | 8,681 | 3,209 | 2,333 | 1,862 | 1,819 |
| Development and Testing | 6,266 | 7,223 | 6,648 | 5,013 | 4,003 | 3,895 |
| Facilities | 3,476 | 2,769 | 1,238 | 894 | 713 | 697 |
| Operations and Maintenance | 1,090 | 925 | 359 | 262 | 209 | 204 |
| Decommissioning | 48 | 245 | 189 | 142 | 113 | 110 |
| Repository Performance | 1,266 | 2,668 | 3,440 | 2,506 | 2,000 | 1,955 |
| Capital Equipment | 114 | 45 | 72 | 25 | 20 | 20 |
| Construction | 0 | 0 | 17,048 | 23,994 | 28,931 | 26,424 |
| ** TOTAL B/O ** | 15,097 | 22,556 | 32,203 | 35,169 | 37,851 | 35,124 |
| ** TOTAL B/A ** | 14,976 | 21,473 | 31,559 | 34,923 | 37,825 | 40,124 |

WBS Element: Regulatory/Institutional

| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Management and Integration | 570 | 579 | 716 | 1,057 | 1,057 | 944 |
| Licensing | 4,379 | 6,586 | 7,530 | 8,926 | 9,412 | 9,282 |
| Environmental Compliance | 746 | 631 | 305 | 485 | 485 | 485 |
| Communication and Liaison | 317 | 750 | 800 | 825 | 900 | 900 |
| Financial and Technical | 2,808 | 3,661 | 4,012 | 3,500 | 3,500 | 3,500 |
| Capital Equipment | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 8,820 | 12,207 | 13,363 | 14,793 | 15,354 | 15,111 |
| ** TOTAL B/A ** | 8,820 | 12,488 | 13,416 | 14,823 | 15,308 | 15,111 |

07-Aug-85

Total Budget Outlays (B/O) - FY 1987 Budget
($000)

TUFF

WBS Element: Exploratory Shaft

| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Management and Integration | 2,306 | 3,591 | 3,652 | 3,094 | 2,266 | 1,425 |
| Site Preparation | 3,710 | 0 | 0 | 0 | 0 | 0 |
| Surface Facilities | 741 | 0 | 0 | 0 | 0 | 0 |
| First Shaft | 1,582 | 10,366 | 1,903 | 0 | 0 | 0 |
| Second Shaft | 114 | 436 | 1,291 | 0 | 0 | 0 |
| Subsurface Excavations | 0 | 1,377 | 2,182 | 0 | 0 | 0 |
| Underground Service Systems | 655 | 2,164 | 1,949 | 0 | 0 | 0 |
| Operations | 923 | 2,848 | 5,655 | 3,411 | 1,047 | 670 |
| Testing | 10,001 | 19,624 | 28,050 | 19,248 | 6,446 | 2,634 |
| Decommissioning | 0 | 0 | 0 | 0 | 0 | 0 |
| Capital Equipment | 2,078 | 3,552 | 1,129 | 397 | 222 | 109 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 22,110 | 43,958 | 45,811 | 26,150 | 9,981 | 4,838 |
| ** TOTAL B/A ** | 21,889 | 51,492 | 40,391 | 26,192 | 8,121 | 4,809 |

08-Aug-85

Total Budget Outlays (B/O) - FY 1987 Budget
($000)

TUFF

| WBS Element: Test Facilities | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Management and Integration | 0 | 0 | 0 | 0 | 0 | 0 |
| Testing | 918 | 839 | 519 | 350 | 350 | 350 |
| New Facility Acquisition | 0 | 0 | 0 | 0 | 0 | 0 |
| Capital Equipment | 0 | 0 | 0 | 0 | 0 | 0 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 918 | 839 | 519 | 350 | 350 | 350 |
| ** TOTAL B/A ** | 918 | 823 | 515 | 350 | 350 | 350 |

| WBS Element: Project Management | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| Management and Integration | 6,550 | 7,620 | 9,312 | 9,167 | 9,042 | 9,042 |
| Project Control | 6,140 | 8,125 | 8,841 | 8,144 | 7,840 | 7,840 |
| Quality Assurance | 4,800 | 5,280 | 6,177 | 5,845 | 5,599 | 5,564 |
| Capital Equipment | 492 | 369 | 209 | 212 | 215 | 203 |
| Construction | 0 | 0 | 0 | 0 | 0 | 0 |
| ** TOTAL B/O ** | 17,982 | 21,394 | 24,539 | 23,368 | 22,696 | 22,649 |
| ** TOTAL B/A ** | 17,730 | 22,207 | 24,392 | 23,041 | 22,583 | 22,490 |

==========================================================================

| | FY86 | FY87 | FY88 | FY89 | FY90 | FY91 |
|---|---|---|---|---|---|---|
| ** TOTAL PROJECT B/O ** | 118,857 [7] | 171,353 | 170,159 | 143,743 | 119,915 | 104,720 |
| ** TOTAL PROJECT B/A ** | 116,862 [7] | 179,873 | 163,151 | 142,727 | 117,337 | 108,524 |

Washington, D.C.

SEP 24 1985

Mr. Robert R. Loux, Director
Nuclear Waste Project Office
Office of the Governor
Carson City, Nevada 89710

Dear Mr. Loux:

As you know, the Department of Energy (DOE) recently notified Governor Richard Bryan that the National Academy of Sciences' Board on Radioactive Waste Management has agreed to review the ranking methodology that DOE will apply in the forthcoming Environmental Assessments to support selection of sites to be recommended for site characterization for the first high-level waste repository. Subsequently, your office was informed by telephone that when DOE sent the methodology report to the Board you would be provided with a copy of the report for your information.

Enclosed is a copy of the methodology report, including our transmittal letter to the Staff Director of the Board.

Sincerely,

William J. Purcell
Associate Director
for Geologic Repositories
Office of Civilian Radioactive
Waste Management

Enclosures

Department of Energy
Washington, D.C. 20585

SEP 16 1985

Dr. Peter B. Myers
Staff Director
Board on Radioactive Waste Management
National Academy of Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Dear Dr. Myers:

As a follow up to my letter to Frank L. Parker of August 29, 1985, we are pleased to provide for review by the Board on Radioactive Waste Management a report describing the ranking methodology to be used in the final Environmental Assessments (EAs) to accompany the nomination of sites as suitable for site characterization for the first geologic repository.

The ranking methodology has been developed in response to comments received from the Board and others regarding the adequacy of the three methods presented in the draft EAs. The methodology is a much refined and more detailed version of the "utility-estimation method" presented in the draft EAs. This method was regarded by most commenters on the draft EAs as being potentially the most appropriate if it were implemented in a fashion more strictly consistent with the professional decision-analysis literature.

The decision-aiding methodology is not intended to reduce the professional judgment required in selecting sites for characterization. It should, however, permit the scientific and value judgments to be made explicit to the reviewer. Furthermore, the methodology should permit sensitivity analyses that can be used to explore the sensitivity of the decision to alternative judgments. The methodology is not intended to be used, by itself, to determine which sites should be recommended; its purpose is to provide a technical basis, in conjunction with the provisions of the siting guidelines specifying diversity of rock types and other information, for such a decision. The decision as to which sites will be recommended will be made by the Secretary of Energy, based on the EAs.

The description of the methodology contained herein is generic. The various steps in the methodology are discussed and illustrated specifically enough, however, so that the application to the repository siting decision should be clear. All assumptions and value judgments presented in the report are for illustrative purposes only. We believe that this methodology description is as you and my staff have discussed.

We appreciate your undertaking this review on the schedule discussed in the August 29 letter. We believe that the importance of the site-recommendation decision and the increased public confidence following such a review of the methodology warrant such steps. We look forward to the meeting with the Board on October 1-3, and if we can be of further assistance until then, please do not hesitate to call.

Sincerely,

Ben C. Rusche

Ben C. Rusche, Director
Office of Civilian Radioactive
Waste Management

Enclosure

# A METHODOLOGY FOR AIDING REPOSITORY SITING DECISIONS

August 1985

# I. BACKGROUND AND INTRODUCTION

On December 20, 1984, the Department of Energy (DOE) published draft environmental assessments (EAs) to accompany the proposed nomination of five sites as suitable for site characterization for the first geologic repository. The final chapter of the draft EAs (Chapter 7) contained a comparative evaluation of the five sites against the DOE's siting guidelines (10 CFR Part 960). To determine which three sites appeared most favorable for recommendation for characterization, three simple quantitative methods were employed to aggregate the rankings assigned to each site for the various guidelines. These methods were reviewed by several groups commenting on the draft EAs, including the National Research Council's Board on Radioactive Waste Management. Two of the methods (averaging and pairwise comparison methods) were criticized for lacking firm theoretical foundations. The third method, described variously as the utility-estimation, rating, or weighting-summation method, was criticized because its application did not follow the formal procedures suggested by the professional literature. In response to these comments, the DOE has developed a more formal utility-estimation method (hereafter referred to as a decision-aiding methodology) to provide a more defensible overall comparative evaluation of sites. That methodology is described in this document.

## Relationship to, and Consistency with, the Siting Guidelines

The decision-aiding methodology must be consistent with the DOE siting guidelines, which consist of implementation guidelines, system guidelines, and technical guidelines. System and technical guidelines are defined for the postclosure and the preclosure periods. The system guidelines contain broad requirements that are based generally on the objectives of protecting public health and safety and the environment during repository construction, operation, closure, and decommissioning and of assuring reasonable costs. The data required for a complete assessment of site performance against the system guidelines, however, will be available only after site characterization and the concurrent socioeconomic and environmental investigations. In lieu of such data and analyses, technical guidelines were defined for each system guideline to give a measure of the potential suitability of a site before detailed studies of the site can be performed.

The postclosure technical guidelines govern the performance of a repository over the long term and are concerned with the physical properties and physical phenomena at a site (e.g., geohydrologic conditions). The preclosure technical guidelines are concerned with the impacts of a repository before it is closed. The preclosure guidelines are divided into three subgroups: (1) preclosure radiological safety; (2) environment, socioeconomics, and transportation; and (3) ease and cost of siting, construction, operation, and closure.

The implementation guidelines establish a number of requirements that constrain the application of the methodology. Briefly, they require that primary significance or weight be given to the postclosure guidelines and that, for the preclosure period, radiological safety; environmental impacts, socioeconomics, and transportation; and the ease and cost of siting, construction, operation, and closure be considered in decreasing order of importance.

The decision-aiding methodology is used primarily to aggregate the performance rankings assigned for the technical guidelines because the data collected to date are insufficient for a conclusive comparison of sites on the basis of the system guidelines.

## Role of the Methodology

It has been suggested that the ranking of sites should be based on the results of performance assessments. However, the assessments that can be performed before site characterization are preliminary, inconclusive, and incomplete; for example, they do not account for the effects of heat on the isolation capability of the host rock. Nonetheless, the results of the preliminary performance assessments can be used for consistency checks against the results obtained from the formal methodology, which is more specific.

The decision-aiding methodology is intended to provide a framework for systematically accounting for the professional judgment required in selecting sites for characterization. It should permit the scientific and value judgments to be made explicit to the reviewer. Furthermore, the methodology should permit sensitivity analyses and, if necessary, more-complex uncertainty analyses that can be used to explore the sensitivity of the decision to alternative professional judgments. The methodology is not intended to be used, by itself, to determine which sites should be recommended; its purpose is to provide a technical basis, in conjunction with the provisions in the siting guidelines on the diversity of rock types and other information, for such a decision. The decision as to which sites will be recommended will be made by the Secretary of Energy.

## Methodology Overview

The technical name for the decision-aiding methodology is multiattribute utility analysis. The procedures and sequence of application follow those recommended in the professional decision-analysis literature (e.g., Keeney and Raiffa, 1976; Keeney, 1980; Edwards and Newman, 1982; Hobbs, 1982; Merkhofer, in press).

The methodology consists of six steps: (1) identifying and organizing objectives, (2) establishing performance measures and associated scales for measuring the extent to which a site meets the objectives, (3) verifying the independence assumptions necessary for the simple aggregation of assessments against competing objectives, (4) assessing single-attribute utility functions, (5) assigning scaling factors or weights, and (6) performing numerical calculations and sensitivity analyses.

The various steps of the analysis are being conducted by a DOE team consisting of experts in decision analysis, the technical disciplines corresponding to the technical siting guidelines, and repository performance. The technical information for the analysis is being obtained from the final EAs. Value tradeoffs and other judgments necessary for sensitivity analyses are being provided by DOE management and staff.

The next section of this document describes the basic concepts and methods on which the methodology relies. Section III describes the basic steps of the methodology in detail.

## II. CONCEPTS AND METHODS USED IN THE DECISION-AIDING METHODOLOGY

This section introduces the basic concepts and methods that provide the logical foundation for the decision-aiding methodology. Readers not concerned with the theory on which the methodology relies or those already familiar with decision theory may wish to skip to Section III, which provides a detailed description and explanation of the decision-aiding methodology.

### Basic Structure and Logic of Decision-Aiding Methodology

A fundamental tenet of virtually all decision-aiding methodologies is that understanding can be improved by dividing a decision into its parts; analyzing the parts separately, and combining the results at the end. Common sense suggests that this divide-and-conquer strategy improves the quality of decisions.

Perhaps the most important "decomposition" produced by decision-aiding methodologies is the separation of knowledge from preferences, or value judgments. Decision theory argues that a decision should logically depend on the likelihoods of the possible consequences of each alternative and the relative preferences of decisionmakers for those consequences. Figure 1 shows how decision-aiding methodologies generally separate knowledge and judgment. First, alternatives are characterized in terms of technical factors or descriptors. Next, an assessment is made of the consequences associated with the selection of an alternative with the specified characteristics. This assessment provides measures of the performance of the alternative. Finally, the various performance measures are evaluated and integrated to obtain an overall measure of the desirability of the alternative. Nearly all decision-aiding methodologies have this basic form (Merkhofer, 1983).

An advantage of a methodology of the form shown in Figure 1 is the division of responsibility between technical experts and policymakers. Technical experts are responsible for all aspects of the methodology that deal with information or knowledge. For example, a comprehensive and accurate description of an alternative in terms of technical descriptors requires a detailed understanding of the characteristics of the alternative and is therefore the logical responsibility of those most familiar with the alternatives. Similarly, the assessment of the possible consequences of an alternative--which must be based on all available information, including collected data, models, and professional judgment--is also the logical responsibility of technical experts.* Those aspects of the methodology that

*The same experts, however, need not both characterize the alternatives and estimate their consequences, because the latter task relies more on an understanding of cause-and-effect relations than a detailed understanding of the options. The ability to separate the tasks assigned to such experts not only permits data to be collected from those most qualified to provide it but also helps to reduce the potential for biases.

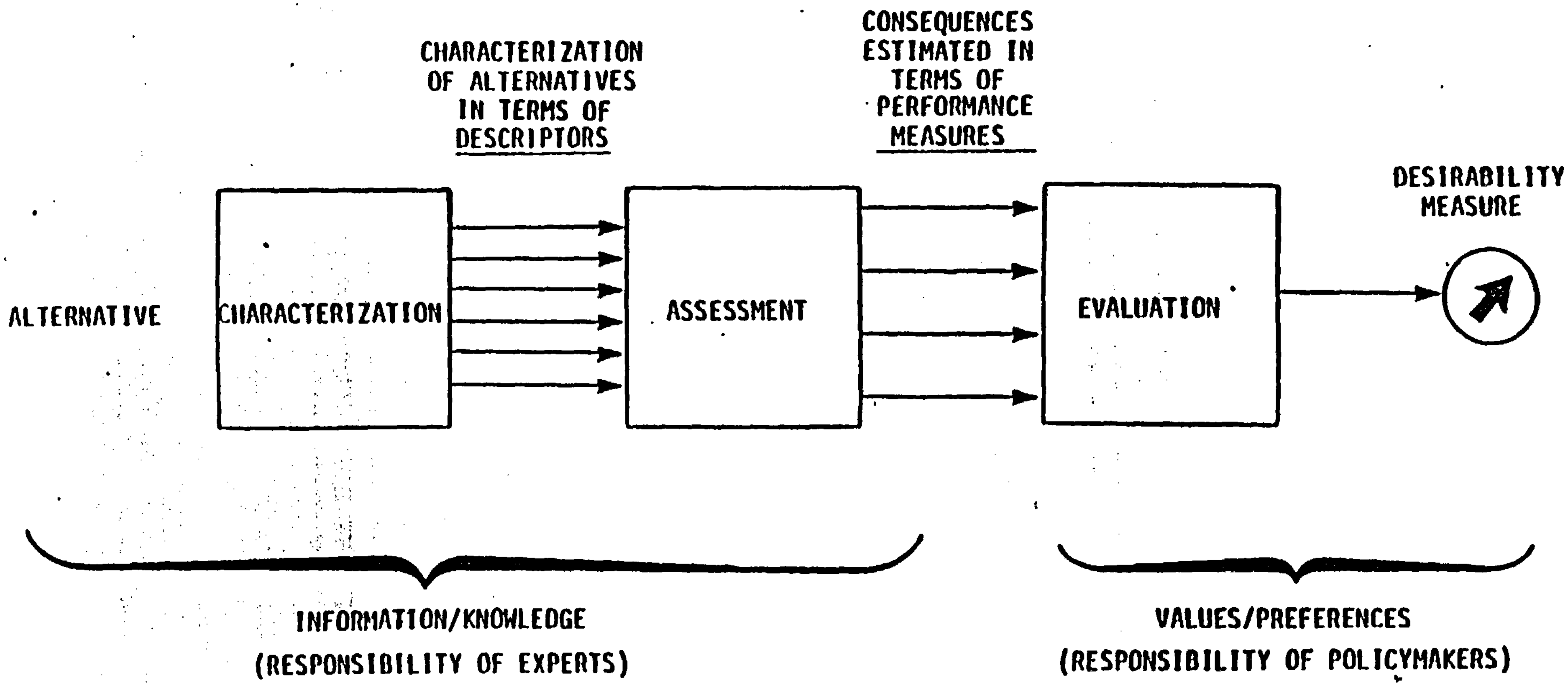


Figure 1. Basic form of most decision-aiding methodologies.

deal with preferences, or value judgments, on the other hand, are assigned to policymakers. To establish preferences, it is necessary to consider the objectives and the values of stakeholders. This is the logical responsibility of policymakers.

To represent and account for knowledge and judgment, the decision-aiding methodology relies on concepts that are well established in the decision-analysis literature. The most important of these concepts are the multiattribute utility theory and probability theory.

## Multiattribute Utility Theory

Performance measures provide assessments of an alternative along specific dimensions. The multiattribute utility theory provides a means for making these assessments commensurable in terms of a common scale of value (Holloway, 1979; Keeney and Raiffa, 1976; Keeney, 1980).

According to the theory, the value, or "utility," of an alternative can be expressed as a mathematical function of its performance measures. Thus, if numerical values are assigned for each performance measure for each site, then a numerical utility for each site can be calculated with the property that the more desirable sites will have the higher utility values.

Nearly all practical applications of the multiattribute utility theory include independence assumptions that permit the utility function to be decomposed. In most such cases, the utility function has a linear additive form. Expressed mathematically, if $x_1, x_2, x_3, \ldots, x_n$ are the performance measures of interest and independence holds, then the multiattribute utility can be calculated from an equation of the form

$$U = w_1 U_1(x_1) + w_2 U_2(x_2) + w_3 U_3(x_3) + w_n U_n(x_n)$$

where $U_1$, $U_2$, etc., are single-attribute (marginal) utility functions (described below) for each performance measure and $w_1$, $w_2$, etc., are weighting factors.

Although independence assumptions often seem difficult to interpret conceptually, procedures for their verification are available. Keeney (1980), for example, gives an illustrative series of questions for verifying an additive form for the utility function. If such procedures indicate that the appropriate form of independence cannot be assumed, then the definitions of performance measures must be changed until independence does apply (or more-complex forms than the linear additive for the utility function must be used).

The advantage of the additive form is that it greatly simplifies the construction of a multiattribute utility function. Although general multiattribute utility functions are difficult to derive, single-attribute utility functions are relatively easy. Therefore, independence permits a multiattribute utility function to be constructed by (1) assessing single-attribute (marginal) utility functions for each performance measure, (2) assessing weighting factors, and (3) calculating the overall utility of a site as a weighted average of the marginal utilities.

Techniques for constructing utility functions are described by Keeney and Raiffa (1976), Keeney (1980), and Changkong and Haimes (1983). A possible form of a single-attribute utility function is shown in Figure 2. Although the utility function in Figure 2 is linear, utility functions are often nonlinear, reflecting, for example, a judgment of the diminishing utility of increments of performance beyond some satisfactory level.

Several techniques can be used to establish weighting factors. The simplest approach is to interpret the weighting factors as the relative importance of the objectives that underlie the performance measures. Subjects may be asked to allocate 100 percentage points among the various objectives, according to their judged importance. Although this method is simple, it is difficult to make declarative statements about the relative importance of competing objectives, and inaccuracies are likely to be produced. A preferred method for determining the weighting factors is to establish a series of "indifference" points between different combinations of performance-measure values. If the points are of equal preference, their utilities are equal, and a series of linear equations relating the utilities of the indifference points can be developed. If the indifference points are established so that only two performance measures vary at a time, the resulting equations can be easily solved for the weighting factors. A simple example is given in Section III. A detailed example that illustrates the assessment and equation-solution process is given by Keeney (1980).

## Probability Theory

The concept of probability is used in the decision-aiding methodology to account for uncertainty. Following the perspective of decision analysis, probabilities (numbers between 0 and 1) represent an individual's degree of belief concerning some uncertain quantity. In the decision-aiding methodology, descriptors (e.g., ground-water travel time), performance measures (e.g., the total preclosure costs of the repository), and utilities (numbers between 0 and 100) may be uncertain. Probabilities may therefore be assigned to reflect the uncertainty about the appropriate value for descriptors, performance measures, and utilities. Where possible, historical data and statistics should be used in assigning probabilities, but if such information is not available, expert judgment can be substituted.

Probabilities can be displayed in several ways, depending on whether the uncertain variable is discrete (i.e., it can have only a finite number of possible values) or continuous (i.e., it can have any value within some range). Three alternative displays for an uncertain variable--the tree form, a cumulative probability distribution, and a probability density function--are shown in Figure 3, which illustrates uncertainty about the uncertain descriptor ground-water travel time.

In practice, probabilities for uncertain variables can be elicited from experts, using probability encoding techniques (Spetzler and Stael von Holstein, 1975). Experience has shown a number of encoding procedures to be effective. The three basic types of encoding methods are (1) probability methods, which require the subject to respond by specifying points on the probability scale while the values remain fixed; (2) value methods, which require the subject to respond by specifying points on the value scale while

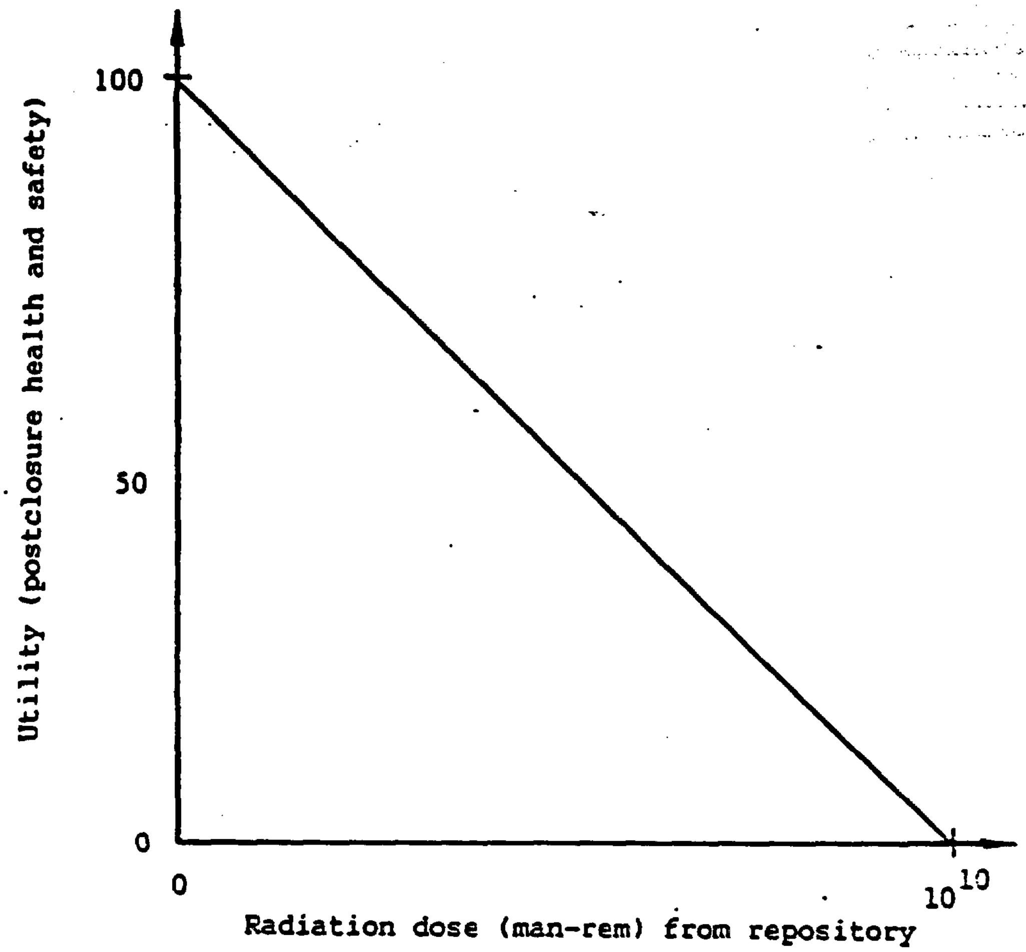


Figure 2. Sample utility function.

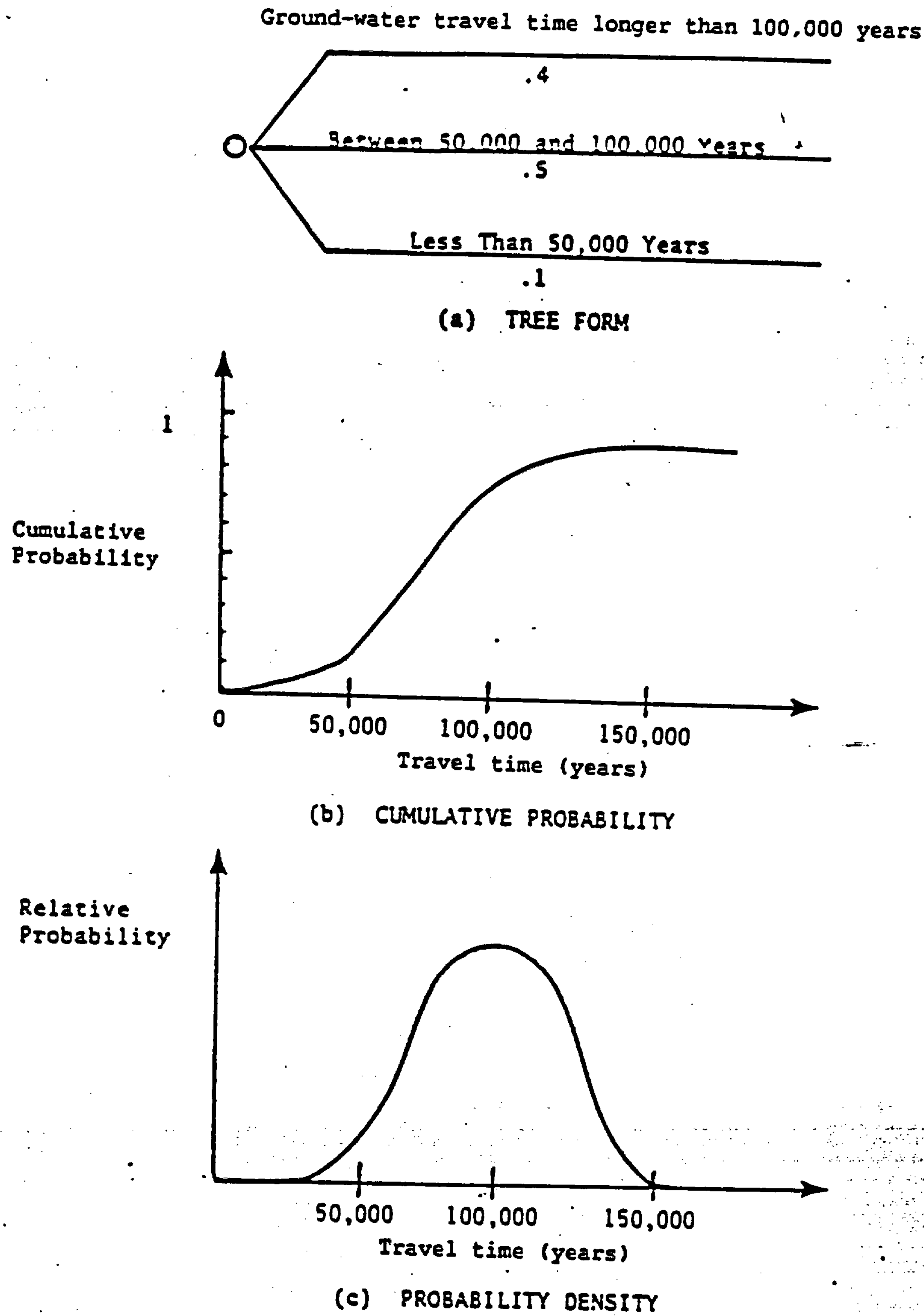


Figure 3. Alternative representations of probabilities: (a) tree form, (b) cumulative probability, and (c) probability density.

the probabilities remain fixed; and (3) probability/value methods, which ask questions that must be answered on both scales jointly (the subject essentially describes points on the cumulative distribution). Each of these encoding procedures can be presented either in a direct-response mode, in which the subject is asked questions that require numbers as answers, or in the indirect-response mode, in which the subject is asked to choose between two or more lotteries. The lotteries are adjusted until the subject is indifferent to choosing between them. Either external reference events (alternative lotteries defined on some external event, such as a probability wheel) or internal reference events (events defined on the same value scale as the uncertain quantity) can be used in the indirect mode.

Uncertain variables are often dependent on one another in the sense that knowledge of one influences information about the others. In such cases, the probability assigned to any one variable must be conditional on the values of the others. The tree form is useful for displaying such conditional probabilities. To illustrate, Figure 4 shows a probability tree with conditional probabilities that might be assigned to reflect the dependences between two descriptors--the average fault density in the vicinity of a site and the average rate of faulting. Gathering conditional probability assignments amounts to asking such questions as, "What are the odds that the rate of faulting exceeds X cm/year, given that the current density is Y $cm^2/m^3$?"

An important question involving the algebra of probability theory is how to compute the probabilities associated with an uncertain variable that is assumed to be related to other uncertain variables. Occasionally, an equation may be defined that permits a performance measure to be approximately calculated from values provided for descriptors. Similarly, an equation may be defined for relating utilities to performance measures. If probabilities can be assigned to the uncertain variables that serve as the inputs to such equations, then techniques exist for computing the probabilities for the output variables. The two principal techniques are Monte Carlo analysis and probability-tree analysis--well-known techniques that are discussed by Holloway (1979). When properly applied, both methods give essentially the same result.

The extent to which these techniques will be required in the application of the methodology to the problem of determining which sites should be recommended for characterization will depend on, among other things, whether simpler techniques like sensitivity analyses prove adequate.

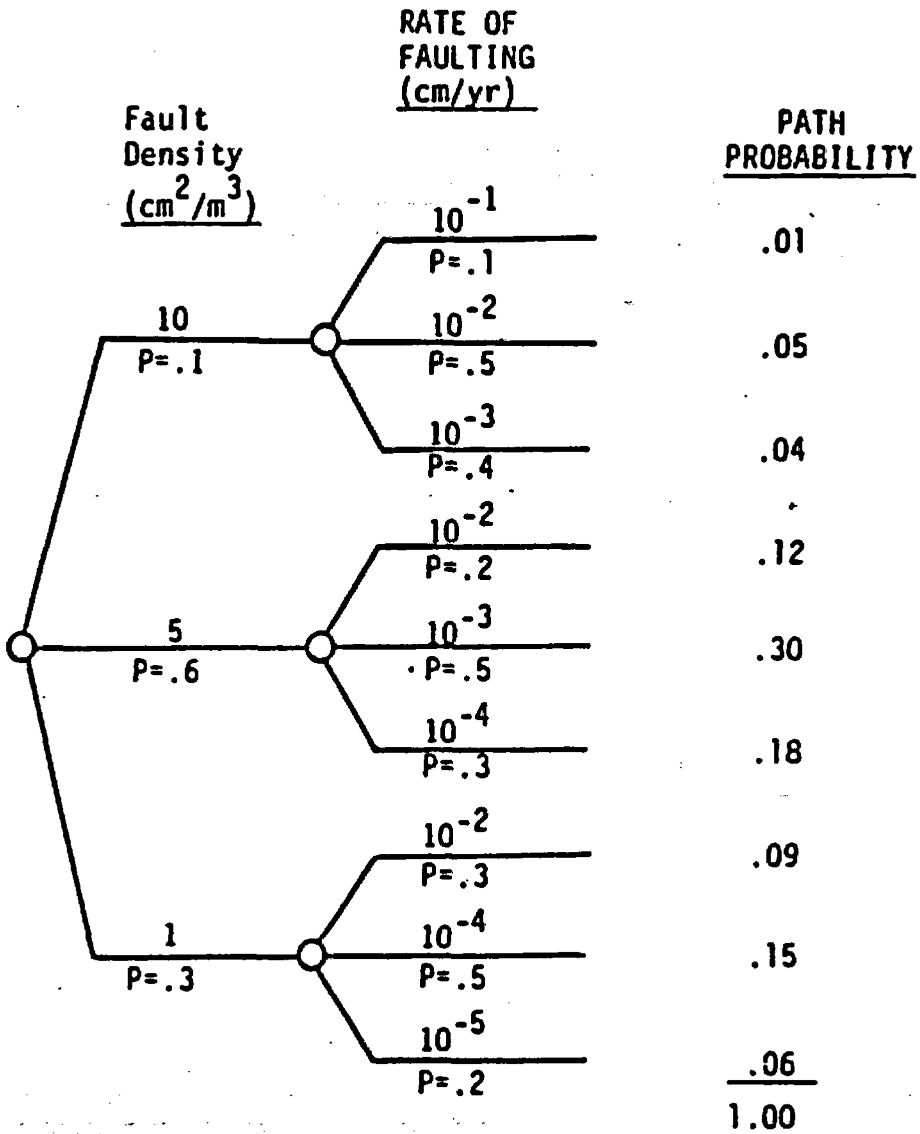


Figure 4. Probability tree illustrating probabilistic dependences.

## III. DETAILED DESCRIPTION OF THE METHODOLOGY

This section describes and illustrates the steps required to apply the decision-aiding methodology being used by the DOE in the site-recommendation process. To simplify the presentation, a full theoretical justification of some of the steps has been omitted. Where such omissions occur, references to discussions of the theory in the literature are provided.

### Step 1: Identify and Organize Objectives

The relative desirability of a candidate site is assumed to depend on the extent to which the selection of that site for recommendation would achieve the various objectives of site selection. Thus, the first step in the analysis is to explicitly identify siting objectives. These objectives are being generated iteratively, beginning with generic top-level objectives and proceeding with the various lower-level objectives that provide the means for achieving the higher-level objectives. The identification of objectives is based on the siting guidelines.

Objectives are being organized in a hierarchy to show the relationship between overall objectives and more-specific subobjectives. The process is being continued until specific technical guidelines or considerations represented within guidelines are identified. An illustration of a possible hierarchy of objectives is given in Figure 5, which shows "minimize impacts of the repository" as the overall objective and various lower-level subobjectives. Figure 5 will be used as the basis for generating examples for illustrating the remaining steps of the methodology. The reader should bear in mind, however, that the objectives hierarchy of Figure 5 is under revision and is provided for illustration only.

With the illustrative objectives hierarchy of Figure 5, the overall objective of minimizing the impacts of the repository (relative to the available and comparable siting options) is related to five lower-level objectives:

1. Maximize the protection of postclosure health and safety.
2. Maximize the protection of preclosure health and safety.
3. Minimize impacts on the environment.
4. Minimize adverse socioeconomic impacts.
5. Minimize economic costs.

The objectives dealing with postclosure and preclosure health and safety and the objective dealing with economic costs are divided further. For postclosure health and safety, three subobjectives are identified:

1. Minimize the health effects associated with nondisruptive geologic processes and events.

2. Minimize the health effects associated with disruptive geologic processes and events.

3. Minimize the health effects associated with human interference.

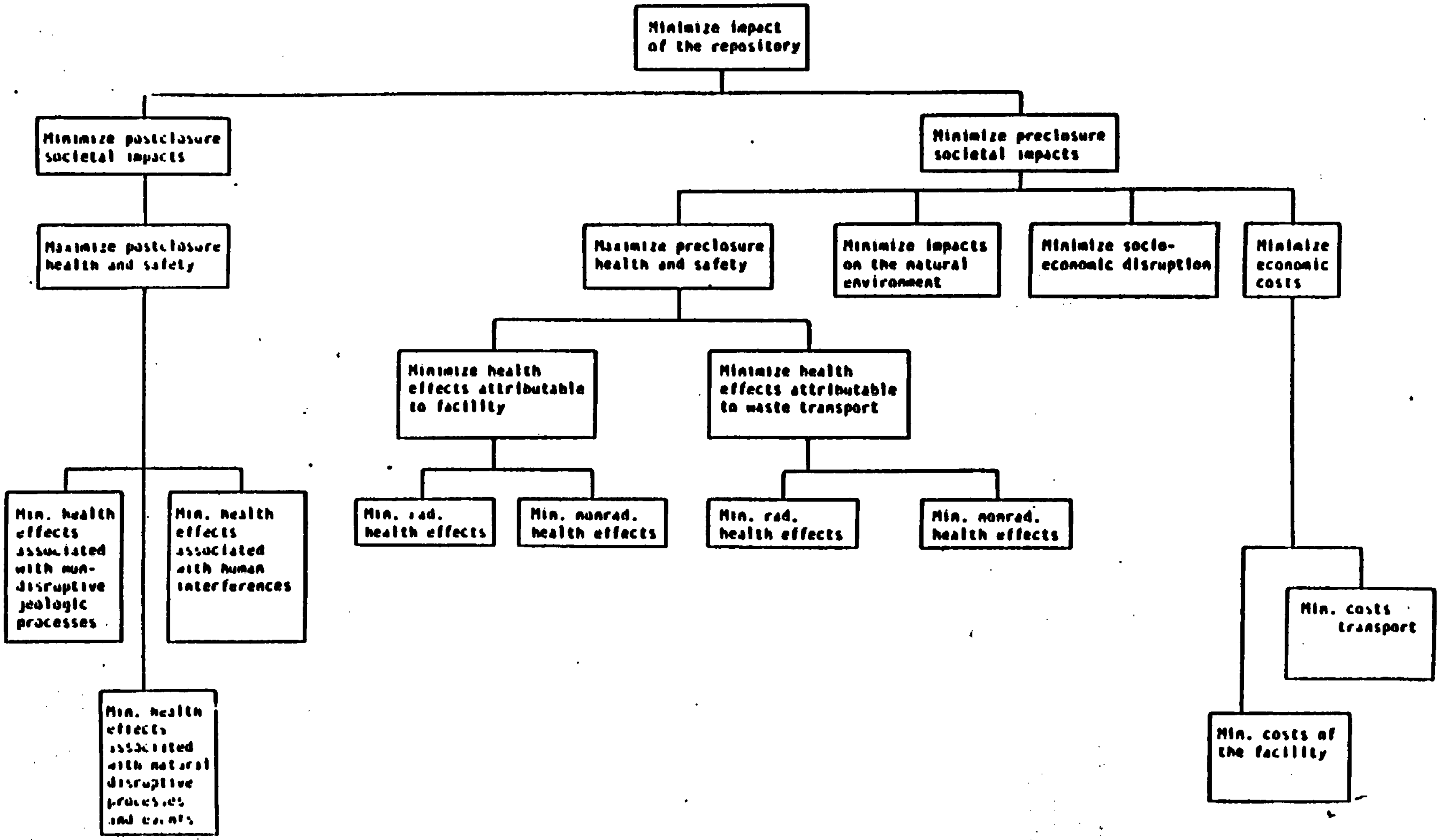


Figure 5. Objectives hierarchy showing various major and lower-level siting objectives.

For preclosure health and safety, four subobjectives are identified:

1. Minimize the health effects attributable to the repository.

2. Minimize the nonradiological health effects incurred by workers from the repository.

3. Minimize the radiological health effects attributable to waste transportation.

4. Minimize the nonradiological health effects attributable to waste transportation.

For costs, two subobjectives are identified:

1. Minimize the total economic costs associated with the repository.

2. Minimize the total economic costs associated with waste transportation.

Constructing a hierarchy of objectives, such as the example of Figure 5, aids the development of performance measures in several important ways. Performance measures need be defined only for the subobjectives at the bottom of the hierarchy. Because these lower-level subobjectives are more specific, it is easier to identify reasonable performance measures for them. Systematically constructing the hierarchy helps to ensure completeness and helps to eliminate situations where overcounting or undercounting might result (because omissions and redundancies should be fairly easily identified). The hierarchy puts the various subobjectives in perspective and provides a qualitative basis for screening out lesser concerns as not important to the overall goal.

The system guidelines provide a good starting point in developing the higher-level objectives. Most of the technical guidelines, however, cannot be directly used as subobjectives in the multiattribute-utility approach because of dependences among the guidelines. As the full hierarchy of objectives is being developed, it is being checked against the technical guidelines to ensure that all the objectives implied by the guidelines are included.

## Step 2: Establish Performance Measures

The second step in the decision-aiding methodology is to establish performance measures for indicating how well each subobjective is met. Defining performance measures and their scales is essentially a creative process requiring professional judgment, knowledge, and experience. If the objectives hierarchy of Figure 5 were used, for example, three postclosure and eight preclosure performance measures would be needed. These might be denoted by the following symbols:

| Symbol | Postclosure measure |
|---|---|
| $x_1$ | Performance with respect to nondisruptive geologic processes |
| $x_2$ | Performance with respect to disruptive geologic processes and events |
| $x_3$ | Performance with respect to human interference |
| | **Preclosure measure** |
| $y_1$ | Radiological safety of repository operation |
| $y_2$ | Nonradiological safety of repository workers |
| $y_3$ | Radiological safety of waste transportation |
| $y_4$ | Nonradiological safety of waste transportation |
| $y_5$ | Performance with respect to the natural environment |
| $y_6$ | Performance with respect to socioeconomics |
| $y_7$ | Performance with respect to repository costs |
| $y_8$ | Performance with respect to transportation costs |

To help establish the factors that must logically be represented by performance measures, influence diagrams are being constructed. An influence diagram is a directed graph displaying relationships (influences) among various factors (see, for example, Howard and Matheson, 1980, and Owen, 1978). The influence diagrams make explicit the relationship between the siting objectives and the guidelines (or considerations represented in the siting guidelines). Figures 6, 7, and 8 show sample influence diagrams for several of the siting objectives shown in Figure 5.

The process being used to construct influence diagrams involves both analysts and technical experts. Starting with a given siting objective--for example, minimize the postclosure public health effects resulting from nondisruptive geologic processes--the analyst asks the expert to identify the key variables whose values influence the degree to which this objective is met. In Figure 6, for example, the key variable is expected radionuclide releases to the accessible environment. Factors strongly influencing this variable are the effectiveness of the natural barriers and the effectiveness of the engineered barriers. These factors are in turn influenced by the pre-waste-emplacement characteristics of the host rock and the reactivity of the waste package and other engineered barriers. This filling-out process continues until all the factors on the bottom tiers can be readily assessed or until the point at which further decomposition is unlikely to facilitate assessment.

The bottom-tier factors basically determine the degree to which a particular objective is likely to be met. They represent considerations that are addressed by various technical guidelines. For example, Figure 6 shows that the guidelines on geohydrology, geochemistry, and rock characteristics (natural barriers) are of primary importance in determining the extent to which a site achieves postclosure subobjective $x_1$ (minimize the health effects due to nondisruptive geologic processes). Figure 7 shows that both these natural-barrier guidelines and the guidelines on climatic changes, dissolution, erosion, and tectonics influence the ability of a site to meet subobjective $x_2$ (minimize the health effects due to disruptive geologic processes and events). Figure 8 indicates that three groups of guidelines--those on natural barriers, disruptive geologic processes, and natural resources and site ownership and control--influence the achievement of subobjective $x_3$ (minimize the postclosure health effects due to human interference).

Because the influence diagrams indicate the factors that must logically be taken into account in judging the degree to which a site achieves each siting objective, they show the guidelines that are relevant to the various objectives and the logical relationships between the scores a site achieves on technical guidelines and the degree to which that site meets siting objectives. Coupled with the hierarchy of objectives, the influence diagrams help avoid overcounting and undercounting the importance of the various considerations represented in the guidelines because the logical significance of factors can be inferred from the relationships between these factors and the lower- and higher-level objectives that they influence. Figures 6, 7, and 8 show, for example, that considerations represented by the natural-barrier guidelines (rock characteristics, geochemistry, and geohydrology) have great importance because these considerations influence all three postclosure subobjectives.

After the construction of influence diagrams, it is necessary to specify the attributes that define the performance measures and the associated scales. Technical experts familiar with the objectives and goals of repository siting are undertaking the development of performance measures as a joint effort with analysts who are experienced in the development of such measures and knowledgeable in the role and purpose of performance measures in decision-aiding methodology. Careful attention is being given to establishing the performance measures because they serve as criteria for representing how well a particular site meets the objectives of the repository program. Care must be taken to ensure that, to the extent practicable, performance measures are complete (to cover all repository siting objectives), operational, nonredundant (to avoid doublecounting possible impacts), and minimal (to reduce the time and cost of their application). The influence diagrams show the basic site characteristics that must be logically reflected in the performance measures and provide the basis for relating a site's score on a performance measure to its scores on various guidelines.

In theory, performance measures can be either direct or indirect measures of objectives, and either natural or constructed scales can be used. Natural scales are established scales that enjoy common usage and interpretation. For instance, the objective to "minimize construction costs" might be associated with the direct performance measure of total costs. The appropriate natural

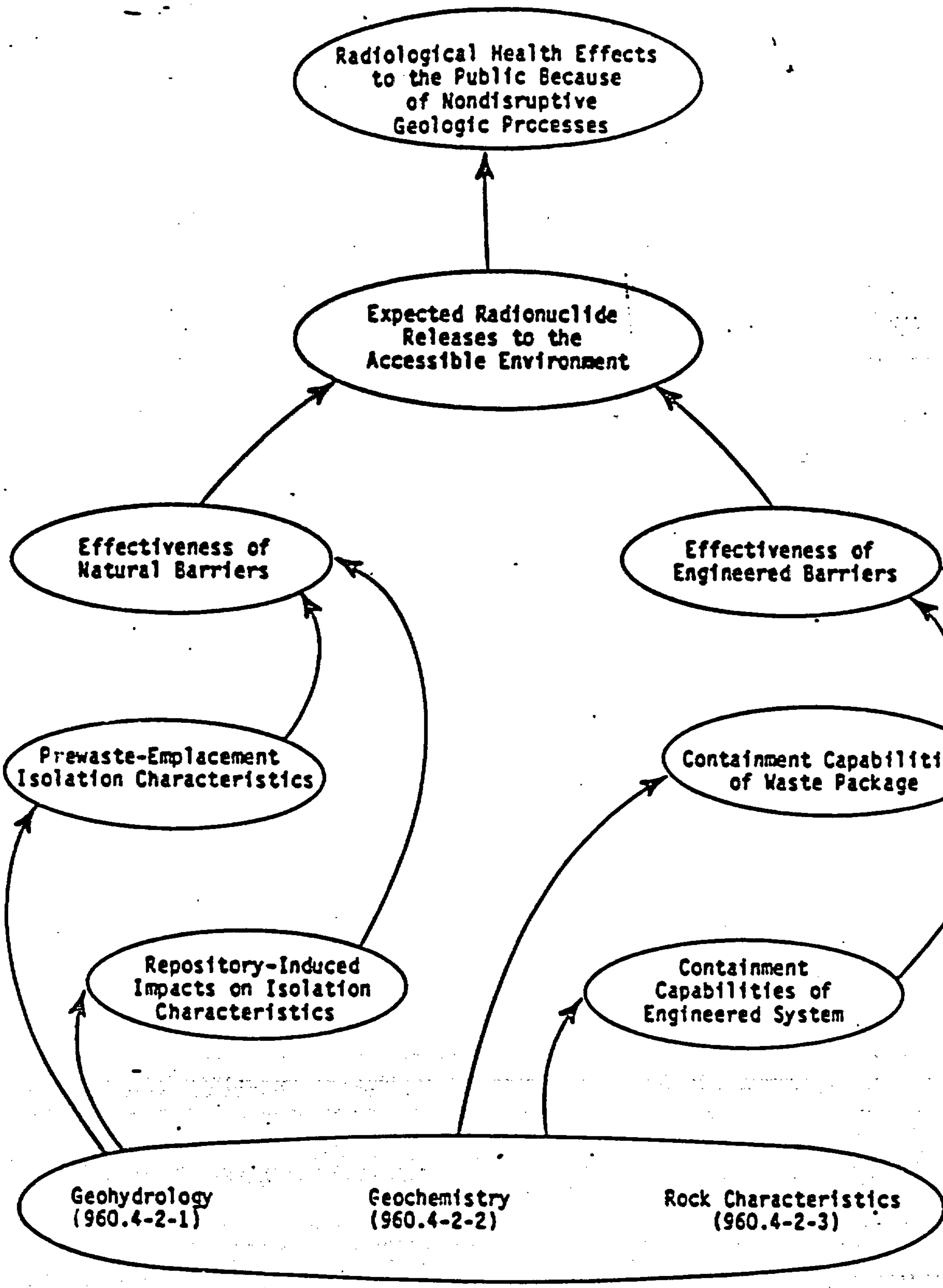


Figure 6. Factors influencing postclosure health effects due to nondisruptive geologic processes.

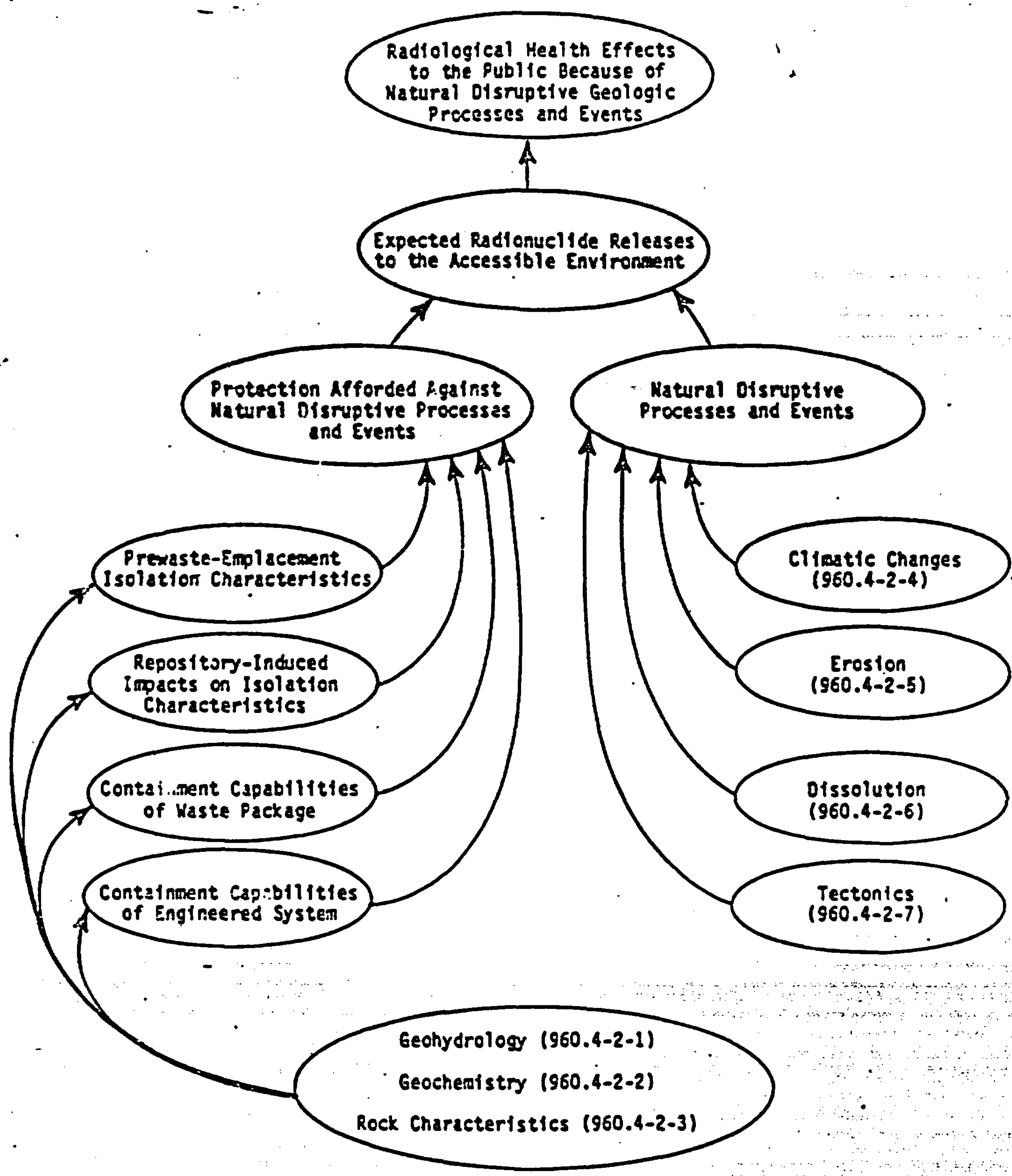


Figure 7. Factors influencing postclosure health effects due to disruptive geologic processes and events.

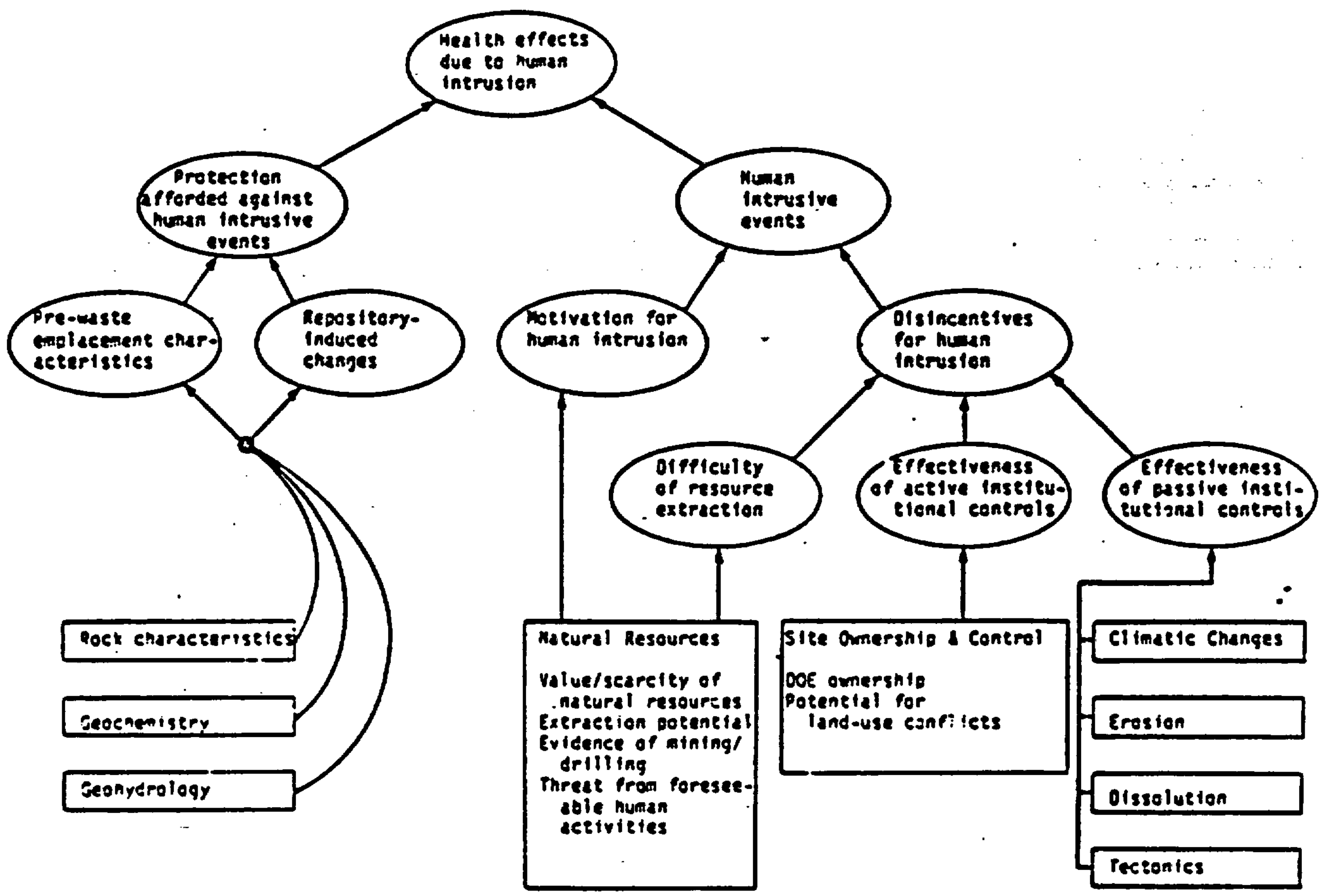


Figure 8. Factors influencing postclosure health effects due to human interference.

scale of measurement would be dollars. Constructed scales, on the other hand, are developed specifically for the problem at hand and are necessary when no natural scale of impact is available.

For maximum consistency with the aggregation method used in the draft EAs, constructed scales of 1 to 10 are being defined for each measure. These constructed scales are being defined in terms of either natural measures like dollars (e.g., a score of 4 on the performance measure "costs of the repository" ($y_7$) might mean that repository costs are estimated to be $6.33 billion) or in terms of collections of qualitative and quantitative descriptions (e.g., a score of 3 on the performance measure "environmental impact" ($y_5$) might mean "no significant conflicts with environmental requirements, but many environmental impacts, a few of which are difficult to mitigate").

Figure 9 shows sample definitions for two possible performance measures. In general, scores of 1 and 10 represent, respectively, the worst and the best levels of performance judged to be reasonably conceivable.

The performance measures in Figure 9 are described in terms of radiation releases to the accessible environment. Surrogates for these particular radiological performance measures and for others will be developed in terms of site characteristics traceable to individual technical guidelines. For example, a score of "1" on the performance measure "performance with respect to nondisruptive geologic processes" might represent a site with very short ground-water travel times and a complex geologic setting that could be extremely difficult to model (guideline on geohydrology), strongly oxidizing ground-water conditions and poor sorption characteristics (guideline on geochemistry), and thermal properties such that the heat generated by the waste could decrease the isolation provided by the host rock (guideline on rock characteristics), etc. Such steps are necessary because the data required to calculate reliably cumulative releases and release rates are not available before site characterization.

Step 3: Verify Independence Assumptions

As described in Section II, independence assumptions are necessary for an accurate overall evaluation of a site to be obtained by weighting and adding evaluations against distinct performance measures. The general approach for verifying the necessary independence assumptions is to consider special cases that would contradict the assumption. If none are found, independence is taken as a reasonable assumption.

One condition that permits the additive form to be valid is that the performance measures are "additive independent" of one another. Performance measures $Z_1$ and $Z_2$ are said to be additive independent if the "preference order for lotteries (gambles in which possible values for $Z_1$ and $Z_2$ occur with specified probabilities) does not depend on the joint probability distributions of these lotteries, but depends only on their marginal probability distributions" (Keeney, 1980, page 231). To illustrate this condition in more concrete terms, suppose that $Z_1$ and $Z_2$ are performance measures representing environmental impacts and economic costs, respectively, and suppose that there are two possible lotteries that are compared. The

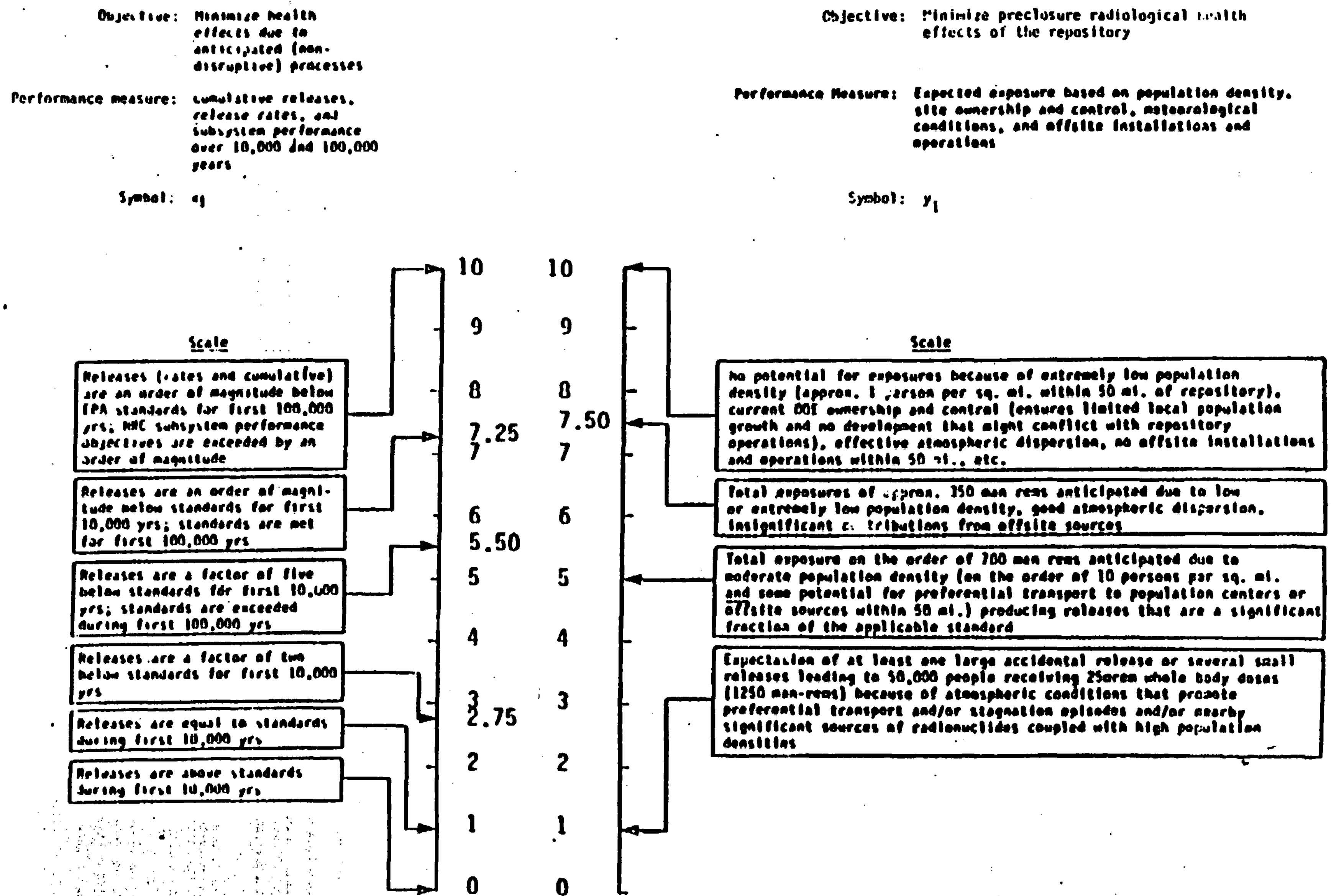


Figure 9. Sample performance measures.

first yields equal chances for the favorable outcome ($Z_1$ low, $Z_2$ low) and the unfavorable outcome ($Z_1$ high, $Z_2$ high). The second yields equal chances for the mixed outcomes ($Z_1$ low, $Z_1$ high) and ($Z_1$ high, $Z_1$ low). Note that both lotteries have an equal (namely, 0.5) chance at either ($Z_1$ low, $Z_1$ high) and that both also have an equal 0.5 chance at ($Z_2$ low, $Z_2$ high). Both lotteries are therefore said to have the same marginal probability distributions.

If $Z_1$ and $Z_2$ are additive independent, then one must be indifferent between the first lottery and the second.

Assuming additive independence among all performance measures, it is possible to express a site's postclosure utility, denoted $U_{post}$, by an additive equation. For example, if there are three postclosure-performance measures, $x_1$, $x_2$, and $x_3$, then

$$U_{post} = w_1U_1(x_1) + w_2U_2(x_2) + w_3U_3(x_3) \tag{1}$$

where $w_1$, $w_2$, and $w_3$ are weights (scaling factors) and $U_1$, $U_2$, and $U_3$ are single-attribute utility functions defined over the respective performance measures $x_1$, $x_2$, and $x_3$. Similarly, if there are 11 preclosure-performance measures, then the preclosure utility of a site can be computed from an additive equation of the form

$$U_{pre} = k_1V_1(y_1) + k_2V_2(y_2) + k_3V_3(y_3) + k_4V_4(y_4) + k_5V_5(y_5) + k_6V_6(y_6) + k_7V_7(y_7) + k_8V_8(y_8) \tag{2}$$

where $k_1$ through $k_8$ are weights and $V_1$ through $V_8$ are single-attribute utility functions defined over the preclosure-performance measures $y_1$ through $y_8$, respectively. The overall utility is then given by

$$U_{overall} = k_{post}\,U_{post} + k_{pre}\,U_{pre} \tag{3}$$

## Step 4. Assess Single-Attribute Utility Functions

Performance measures are important proxies for determining how well a site meets a particular objective. However, by themselves, these measures do not quantify performance against a particular objective. For example, it does not follow that an objective is 90 percent met just because the level of performance is 90 percent of its maximum value (i.e., the site is assigned a score of 9). Depending on the objective, it might be, for example, that most of the intent of the objective is met when the performance measure reaches only 20 percent of its maximum possible value (i.e., achieves a score of 2). Therefore, a scale is needed to represent the relative desirability of achieving different scores for the performance measures. The concept of a single-attribute (marginal) utility function provides such a scale. As noted in Section II, an extensive literature has been developed on the meaning and uses of utility functions.

Simply stated, a utility function is a mathematical expression for the subjective tradeoffs that are inherent in any judgment that one site is better than another for a repository. Logically, the values that are represented in a utility function should be those of the decisionmaker--in this case the DOE. The DOE will incorporate as appropriate the values of others in the value structure. For example, public comments on the weighting allocations among guideline sets and groups presented in Chapter 7 of the draft EAs will be considered. Methods for accomplishing this integration are discussed by Keeney and Raiffa (1976) and Keeney (1980).

Marginal utility functions that reflect the preferences of an individual can be derived by assessing a few points on the function corresponding to various values of the performance measure and then fitting a smooth curve. Using techniques recommended in the decision-analysis literature, decision analysts experienced in utility assessment are constructing utility functions in interviews with DOE management, staff, and consultants. For example, a technique being used to assess the single-attribute utility function $U_1$ is the midpoint method (Changkong and Haimes, 1983). This procedure involves successively identifying levels of performance whose utilities (desirabilities) seem to be halfway between already established utilities. To illustrate, consider a utility function for measuring performance with respect to nondisruptive processes ($x_1$). Arbitrary utilities of 0 and 100 may be assigned to performance levels for $x_1$ of 1 and 10, respectively. Various intermediate performance levels are then selected until a level, denoted $x'$, is found such that it is judged to be equally desirable to change a site whose performance level is $x_1 = 1$ to the level $x_1 = x'$ as it would be to change a site whose performance level is $x_1 = x'$ to the level $x_1 = 10$. The resulting performance level is called "the midpoint" because the utility function evaluated at this point is midway between the utilities of the other two outcome levels that were considered. This same process is repeated to find other midpoints (e.g., the midpoint between $x_1 = 1$ and $x_1 = x'$) until enough are identified to permit fitting a smooth curve. A sample utility curve for $U_1$ is shown in Figure 10. For comparison, a sample utility curve for $U_2$ is shown in Figure 11.

## Step 5: Assess Scaling Factors or Weights

The constants $w_1, w_2, \ldots, k_1, k_2, \ldots, k_{pre}$, and $k_{post}$ in Equations 1, 2, and 3 represent scaling factors or weights designed to account for the relative value of trading off performance on one performance measure for another. The scaling factor assigned to a given performance measure defines the increment of overall utility associated with increasing that measure's performance outcome from a score of 1 to a score of 10. Clearly, the scaling factor must depend on the definitions of "1" and "10," which, as described in step 2, must be consistent with the siting guidelines. In other words, the scaling factors must be consistent with the definitions established for performance-measure scores.

As outlined in Section II, the method generally recommended for establishing scaling factors that reflect preferences is to fix all but two of the performance measures and then to allow these two to vary, in order to find combinations that the policymaker finds equally preferable. In this case, the multiattribute utilities will be equal by definition, and therefore it is possible to generate equations in which the weights are unknowns. The solution of these equations then yields the values for the weights.

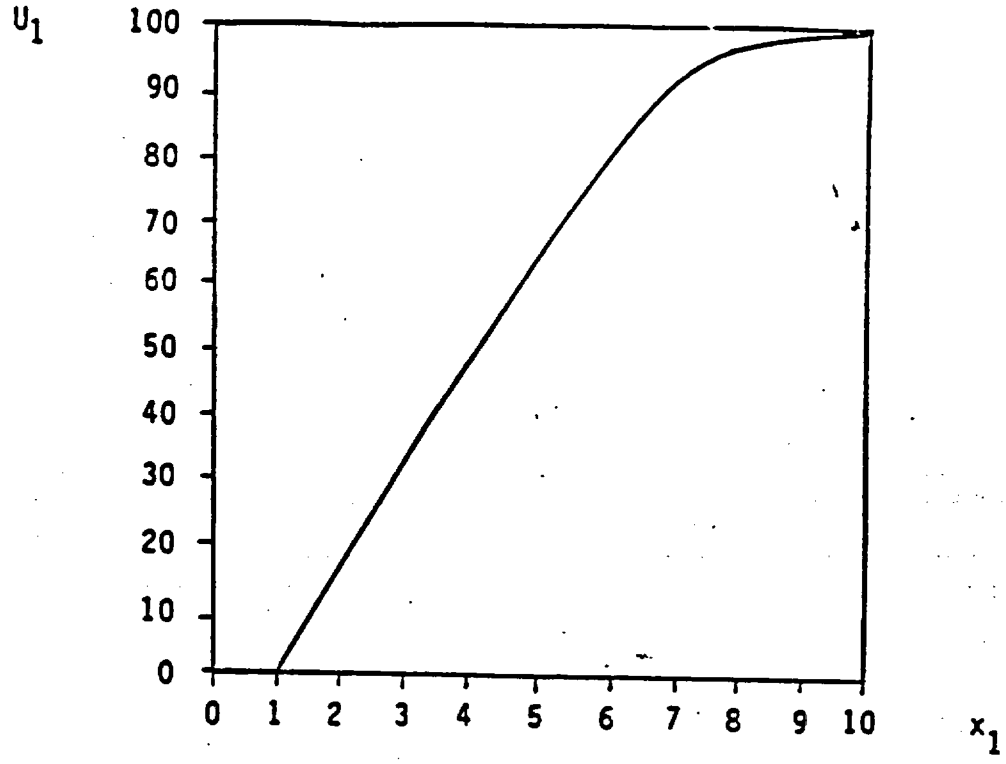


Figure 10. Sample single-attribute utility curve for postclosure performance with respect to nondisruptive events.

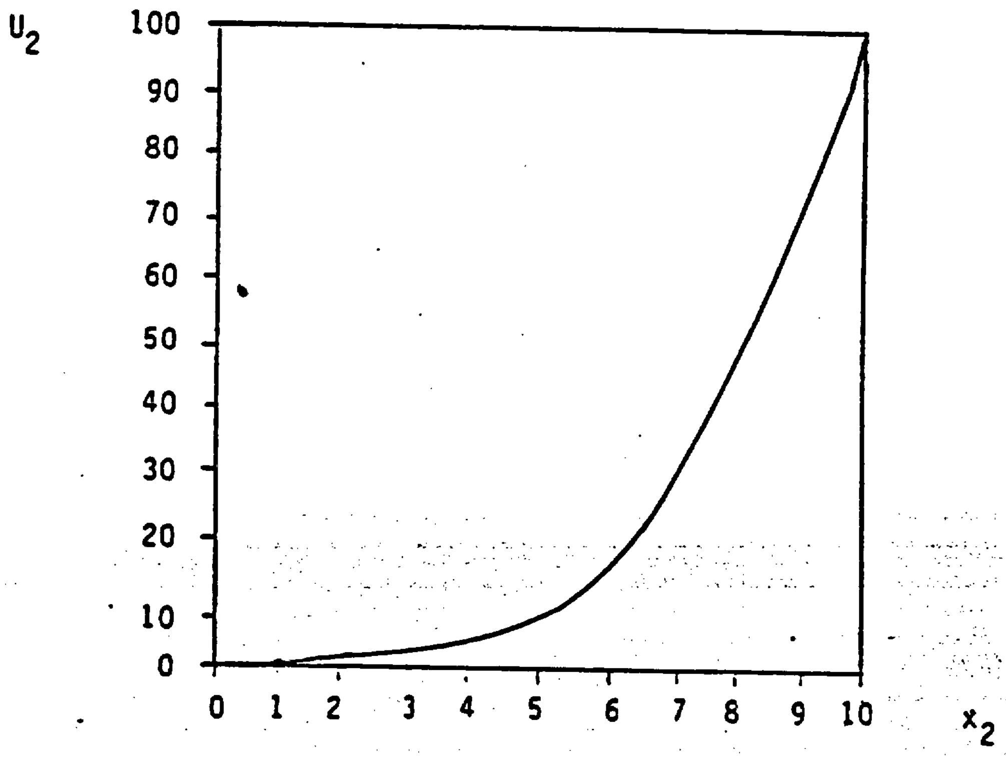


Figure 11. Single-attribute utility curve for performance under disruptive geologic events and processes.

To illustrate the methods, consider preferences for trading off performance between performance measures $x_1$ and $x_2$. As shown in the example below, different radionuclide-release scenarios may be considered until two are found that are regarded as equally undesirable:

| | Site A | | Site B | |
|---|---|---|---|---|
| $x_1$ | 10 | (Releases from nondisruptive processes are 10 times lower than the standard during the first 100,000 years) | 1 | (Releases from nondisruptive processes are equal to the standard during the first 10,000 years) |
| $x_2$ | 1 | (Releases from disruptive geologic events are 10 times higher than the allowable releases for the first 10,000 years) | 4 | (Releases from disruptive geologic events are three times higher than the allowable releases for the first 10,000 years) |
| $x_3$ | 1 | | 1 | |

From Equation 1 and Figures 10 and 11 (and the fact that utilities are defined to equal 0 and 100 for scores of 1 and 10, respectively), the postclosure utility of site A is

$$U^A_{post} = w_1U_1(10) + w_2U_2(1) + w_3U_3(1) = 100w_1$$

Similarly, the postclosure utility of site B is

$$U^B_{post} = w_1U_1(1) + w_2U_2(4) + w_3U_3(1) = 5w_2$$

Because indifference between point A and point B implies equal utility,

$$100w_1 = 5w_2$$

To obtain additional relationships among the weights, other tradeoffs among various levels of performance measures must be considered.

As mentioned previously, in the case of preclosure, the scaling factors are partially constrained by the requirements of the siting guidelines. The guidelines specify that the order of importance for the three preclosure-guideline groups, from greater to lesser importance, is (1) preclosure radiological safety; (2) environment, socioeconomics, and transportation; and (3) ease and cost of siting, construction, operation, and closure. Suppose the correspondence between performance measures and preclosure-guideline groups were as follows:

| Guideline group | Performance measure |
|---|---|
| Preclosure radiological safety (repository) | Radiological safety of repository operation ($y_1$) |
| Environment, socioeconomics, and transportation | Radiological safety of waste transportation ($y_3$) |
| | Nonradiological safety of waste transportation ($y_4$) |
| | Performance with respect to the natural environment ($y_5$) |
| | Performance with respect to socioeconomics ($y_6$) |
| | Performance with respect to transportation costs ($y_8$) |
| Ease and cost of siting, construction, operation, and closure | Nonradiological safety of repository workers ($y_2$) |
| | Performance with respect to repository costs ($y_7$) |

The relative-importance stipulation in the guidelines is interpreted as requiring that the total weight given to the utility of performance for measures associated with preclosure radiological safety must be greater than the total weight given to the utility of performance for measures associated with the environment, socioeconomics, and transportation. Similarly, the total weight given to the utility of performance for the environment, socioeconomics, and transportation must be greater than the total weight given to the utility associated with the ease and cost of siting, construction, operation, and closure. Thus,

$$k_1 > k_3 + k_4 + k_5 + k_6 + k_8 > k_2 + k_7 \qquad (4)$$

The approach for generating the scaling factors consists of deriving tentative values, using methods similar to that described above, and then checking whether those values satisfy the above equation. In all cases, the tradeoff judgments are being provided by DOE management and staff most familiar with repository-siting objectives and are chosen, wherever possible, so as to be consistent with tradeoffs established by other social decisions. To the extent that judgmental value tradeoffs produce scaling factors that violate Equation 4, these tradeoffs are adjusted until consistency with Equation 4 is obtained.

Step 6: Assign Site Performance Scores, Compute Utilities, and Perform Sensitivity Analysis

After the development of single-attribute utility functions and nominal scaling factors, Equations 1, 2, and 3 are applied to compute preclosure, postclosure, and overall utilities for each site. Sensitivity studies are then undertaken to identify critical numerical assumptions and the sensitivity of the overall utilities to these assumptions.

The information contained in the final EAs is being used to summarize the expected performance of each site by estimating appropriate values for the performance measures established in step 2. In the absence of complete models for simulating site performance, performance-measure scores are being obtained as judgments provided by panels of experts. The scores assigned by each panel must be consistent with the definition of the performance-measure scales and must logically account for all characteristics of the site represented in the associated influence diagram. If there is substantial uncertainty about the value of a performance measure for a given site, alternative scores may be specified with associated probabilities.

For an example of how utilities are being computed, consider the evaluation of overall postclosure utilities. Given the example used throughout this section, and assuming that independence is verified in step 3, the multiattribute utility theory suggests that a measure of postclosure performance that takes into account nondisruptive geologic processes, disruptive geologic events, and human interference can be obtained by using Equation 1 to calculate the expected utility. Mathematically, the calculation of expected utility can be expressed as

$$E(U_{post}) = \int [w_1U_1(x_1) + w_2U_2(x_2) + w_3U_3(x_3)] \, dP \qquad (5)$$

where the symbols $\int$ and dP denote the process of computing all possible performance outcomes, computing the resulting utility values, weighting these values by their probabilities, and taking the resulting weighted average.

To simplify the application of Equation 5, it might be assumed that there is no significant uncertainty in the specification of the performance outcome $x_1$ for a site. Furthermore, uncertainty in the specification of performance outcomes $x_2$ and $x_3$ might be assumed to be due only to uncertainty in the occurrence of disruptive geologic events and human interference. The occurrences of disruptive geologic events and human interference might be assumed to be probabilistically independent. With these assumptions, Equation 5 can be expressed as

$$E(U_{post}) = w_1U_1(x_1) + w_2\int_{S_2} U_2[x_2(S_2)]p_2(S_2)dS_2 + w_3\int_{S_3} U_3[<_3(S_3)]p_3(S_3)dS_3 \qquad (6)$$

where $x_2(S_2)$ represents the performance outcome with respect to disruptive geologic events given a disruptive-event scenario $S_2$; $x_3(S_3)$ is the performance outcome with respect to human interference given a human-interference scenario $S_3$; $p_2(S_2)$ is a probability density function describing the likelihood of various disruptive-event scenarios; and $p_3(S_3)$ is a probability density function describing the likelihood of various human-interference scenarios.

Similarly, the expected utility of preclosure, assuming 8 preclosure performance measures, as in the previous examples, would be given by

$$E(U_{pre}) = \int [k_1V_1(y_1) + k_2V_2(y_2) + k_3V_3(y_3) + k_4V_4(y_4) + k_5V_5(y_5) + k_6V_6(y_6) + k_7V_7(y_7) + k_8V_8(y_8)]dP \quad (7)$$

If there is no significant uncertainty in the assignment of performance scores, Equation 2 could be used directly to compute preclosure utilities.

The single-attribute utility scores and associated probabilities assessed for each siting objective are being aggregated to obtain an overall expected utility and associated probability distribution on utility summarizing overall site attractiveness.

The output of this final step for each site will be a point estimate if there is little uncertainty about the performance-measure scores that represent the ultimate attractiveness (total utility) of the site. Alternatively, the final results could be presented as probability distributions, which would permit both the expected values and the uncertainty in the values to be compared among sites.

Sensitivity studies will be performed to explore the effect of changing assumptions and differences of opinion. For example, significant differences in the utility functions assessed by different individuals can be organized, and a sensitivity analysis can be used to determine the extent to which such differences alter the relative evaluation of sites.

Different weights representing a range of different views will be developed. In particular, a range of postclosure versus preclosure weights, consistent with an assumption that postclosure be assigned greater importance than preclosure, will be considered. In addition, the weighting relationship among the three preclosure-guideline groups will be varied, again consistent with the siting guidelines (see the discussion of step 5). The significance of these differing opinions will be investigated through sensitivity analyses. An important advantage of the decision-aiding methodology is that extensive sensitivity analyses representing differing value judgments can be developed quickly and inexpensively. This ability to answer many "what if" questions decreases the likelihood that inappropriate values will be used in the decision process and increases the likelihood that the most advantageous group of sites will be identified and recommended for characterization.

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# EA STATUS

## ROAD MAP

- SCHEDULE AND STATUS
- DOE/STATE EA ISSUE RESOLUTION MEETING 10-1-85
- EA MANAGEMENT PLAN

Get copy of EA mngt Plan

# EA STATUS

## SCHEDULE AND STATUS

- SCHEDULE
- OCTOBER 4 SUBMITTAL
  - CRA
  - EA CHAPTERS 2-5
  - EA CHAPTER 6
  - EA CHAPTER 7
- TOC REVIEW
- HQ WORKSHOP
- REMAINING UNCERTAINTIES

# EA STATUS

- OCTOBER 4 SUBMITTAL
  - "FINAL" CRA
  - LINE IN/LINE OUT EA CHAPTERS 2-6
  - SELECTED EA SECTIONS (CHAPTERS 5 & 6) TO BE "PRELIMINARY DRAFTS" OR "MARK-UPS"
  - EXECUTIVE SUMMARY TO BE WRITTEN AFTER OCTOBER 25

## C.5.8 HUMAN INTERFERENCE (NATURAL RESOURCES)

The Human Interference technical guideline deals with the potential for the site to contain natural resources that could be economically attractive and thereby cause future interference with the repository. Forty-one comments received in this category have been subdivided into four sub-issues: (1) Mineral Resources, (2) Water Resources, (3) Geothermal Resources, and (4) Miscellaneous.

Mineral resources

| | | | |
|---|---|---|---|
| Comment Numbers: | 10004-170 | Comment Numbers: | 10050-028 |
| | 10020-023 | | -029 |
| | 10025-012 | | -030 |
| | 10026-011 | | -031 |
| | -012 | | -033 |
| | -122 | | -034 |
| | 10043-399 | | -035 |
| | -401 | | -037 |
| | -403 | | -039 |
| | 10044-001 | | -045 |
| | 10050-003 | | -046 |
| | | | -047 |

Twenty-three comments were received on the Mineral Resources sub-issue. These comments address the potential for mining operations at or near the Yucca Mountain site to exploit the mineral resources of the area. The topics addressed include the potential for mineral resource exploitation, Mineralization of calderas, Economic mining contributions, Geochemical sample reporting, and Editorial changes.

Mineral resource potential. Several commentors indicated that the DOE had no basis for concluding, through literature review that Yucca Mountain does not have an economically feasible potential for mineral resource exploitation. In addition these comments indicated that all relevant data had not been considered and that other data were misrepresented.

Response. The DOE developed its position regarding the mineral resources of Yucca Mountain by assessing the results of the following activities:

1. Mineral inventories were conducted by literature review (Bell and Larson, 1982) and by combined literature review and field investigation (Quade and Tingley, 1983). The results indicated that there is no evidence of past mining activity at Yucca Mountain nor any evidence of existing economic mineralization. Results also indicated that there are no economically significant non-metallic mineral deposits located at Yucca Mountain that cannot be found in economical deposits elsewhere in Nevada.

2. Field exploration and geologic mapping was conducted by the U.S. Geological Survey (Christiansen and Lipman, 1965; Lipman and McKay, 1965; Scott and Bonk, 1984) for Yucca Mountain and surrounding areas. No evidence of economic mineralization was reported or mapped.

extend slightly beyond the proposed depth of the repository. The underground testing areas would be excavated from breakout rooms at three levels. A main test facility with drifts and rooms would be excavated into the host rock from the middle breakout room. The secondary egress shaft would be used for ventilation and would provide another means of egress from the underground areas. It would be connected to the exploratory shaft by a drift. Exploratory holes would also be drilled as a part of the exploratory shaft testing program.

The exploratory shaft facility would be located in Coyote Wash on the eastern side of Yucca Mountain at an elevation of about 1,300 **meters** (4,150 **feet**). Figure 4-2 shows the proposed site, utility lines, and the access road. It also shows the administrative boundaries of the Nevada Test Site (NTS), the Nellis Air Force Range (NAFR), and the Bureau of Land Management (BLM). **Currently, the planned coordinates of the exploratory shaft are N765995, E563265. This site was selected from five sites that were considered as possible locations for the exploratory shaft (Bertram, 1984). The secondary egress shaft would be located about 85 meters (280 feet) southwest of the exploratory shaft.** The site plan at Coyote Wash is shown in Figure 4-3.

Facility design and construction specifications require that equipment and systems meet the requirements set forth by the DOE (1983); applicable local, State, and Federal regulations (**Section 6.2.1.6**); and national standards. It is also required that construction disturb only the minimum amount of land necessary to accomplish the project. Design criteria include considerations of site restoration; the site would be restored to approximately its original condition if Yucca Mountain is eliminated from the list of potential repository locations. The following sections describe the exploratory shaft facility, the plans for testing, and the practices being considered to minimize environmental damage.

### 4.1.2.1 Surface facilities

Construction of the surface facilities is expected to take from six to seven months to complete. The site would first be cleared and graded; then it would be stabilized with 15 **centimeters** (6 **inches**) of gravel.

As shown on Figure 4-3, two existing natural drainage channels would be diverted to control potential runoff from a probable **maximum precipitation** [~~100-year storm~~] event. In 1982 the drill pad for the principal borehole, USW G-4, was constructed at the exploratory shaft location. Site preparation would require cut and fill to provide a level pad (exploratory shaft site pad) for the surface structures and for the parking area. About [~~57,000 m$^3$ (2,000,000 ft$^3$)~~] **70,000 cubic meters (2,500,000 cubic feet)** of fill material would be removed from borrow areas east and west of the pad. [~~In addition, a 30 by 30 meters (100 by 100 feet) pad would be required to support surface activities associated with the 1.8-m (6-ft) diameter secondary egress shaft. Approximately 280 m$^3$ (10,000 ft$^3$) of soil would be moved (cut and fill) to construct this pad.~~] **Both the exploratory shaft and the secondary egress shaft would be located on this exploratory shaft site pad. In addition, an auxiliary**

# EA STATUS

## "FINAL" CRA

- COMMENT NUMBERS TO BE DELETED
- SECTIONS NOT FINAL
  - GEOHYDROLOGY
  - TECTONICS
  - CLIMATOLOGY
  - PERFORMANCE ASSESSMENT
  - SOCIOECONOMIC IMPACTS OF REPOSITORY
- SECTIONS NEEDING ADDITIONAL REVIEW
  - OFFSITE INSTALLATIONS AND OPERATIONS

# EA STATUS

## CHAPTER 5

REPOSITORY DESCRIPTION: COMPLETE REWRITE

ENVIRONMENTAL IMPACTS: LINE IN/LINE OUT REVISIONS

TRANSPORTATION IMPACTS: COMPLETE REWRITE

- NON RAD PRELIMINARY DRAFT
- RAD PRELIMINARY DRAFT WITH TABLES TO BE COMPLETED NEXT WEEK

SOCIOECONOMIC IMPACTS: COMPLETE REWRITE PRELIMINARY DRAFT

# EA STATUS

## CHAPTER 6

- LINE IN/LINE OUT REVISIONS
- EXCEPTIONS: COMPLETE REWRITE AND PRELIMINARY DRAFT
  - GEOHYDROLOGY
  - TECTONICS
  - CLIMATOLOGY
- EXCEPTIONS: OTHER PRELIMINARY DRAFTS
  - PERFORMANCE ASSESSMENT
  - POSTCLOSURE SYSTEMS

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# EA STATUS

## CHAPTER 7:

- DECISION METHODOLOGY HAS BEEN REVIEWED BY STATES/AFFECTED TRIBES AND NAS
- NAS REVIEW MEETING THIS WEEK
- CHAPTER 7 SUMMARY OF EACH SITE'S COMPLIANCE WITH GUIDELINES WAS EXPECTED AT POs SEPTEMBER 27
- HQ WORKSHOP WITH POs TO REVIEW CHAPTER 7
  Oct. 10

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Technical Overview Committee

# EA STATUS

## TOC REVIEW

- OBJECTIVE: NNWSI MANAGEMENT AND POLICY REVIEW OF THE FINAL EA INCLUDING THE CRA

- FEATURES:

1. HELD CONCURRENT WITH HQ REVIEW.

   - ALLOWED MAXIMUM TIME FOR TECHNICAL INPUT
   - ALLOWED REVIEW OF HQ SECTIONS; APPENDIX A, CHAPTER 1, SECTIONS 6.1 AND 6.4.1, AND CHAPTER 7 GUIDELINE DISCUSSION
   - PROVIDED FOR TIMELY INPUT TO PROJECT AND HQ

2. REVIEW OF TECHNICAL APPROACH
   TECHNICAL ACCURACY
   CONSISTENCY
   CLARITY

3. PREPARE FOR FINAL HQ EA WORKSHOP OCTOBER 21-24

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# EA STATUS

## HQ WORKSHOP

FORMAT: STEERING GROUP
ENVIRONMENTAL WORKING GROUP
SOCIOECONOMIC WORKING GROUP
TRANSPORTATION WORKING GROUP
DESIGN WORKING GROUP
PERFORMANCE ASSESSMENT WORKING GROUP
GEOSCIENCES WORKING GROUP
PRODUCTION WORKING GROUP

OBJECTIVE: FINAL INFORMAL REVIEW OF EAS. PROVIDE HQ AND POs AN UNDERSTANDING OF WHAT IS EXPECTED FOR HQ CONCURRENCE REVIEW

NNWSI OBJECTIVE TO MAKE AS FEW CHANGES AS POSSIBLE BEFORE NOVEMBER 15 CAMERA READY DATE

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# EA STATUS

## REMAINING UNCERTAINTIES

1. RESULTS OF BAUGHMAN VISIT TO RUSCHE

2. WATER RIGHTS ISSUE

# Nevada State Briefing on the Environmental Assessment for Yucca Mountain

# RANKING METHODOLOGY TO BE USED IN THE FINAL EAs

- THREE RANKING METHODS USED IN DRAFT EAs
- NAS CRITICISM LED TO ONE METHOD BEING USED IN FINAL EAs
- REVISED RANKING METHODOLOGY SUBMITTED TO NAS FOR REVIEW AND PROVIDED TO AFFECTED STATES/TRIBES

# GEOHYDROLOGY (960.4-2-1)

- GROUND-WATER TRAVEL TIME
  - UNCERTAINTIES OF ASSUMPTIONS
  - UNCERTAINTIES OF DATA
  - USE OF BOUNDING STUDIES
- CHANGES IN GEOHYDROLOGIC PROCESSES AND CONDITIONS
  - ALTERNATIVE EXPLANATIONS FOR VARIATIONS IN SATURATION
  - EVIDENCE OF LOCALIZED SATURATION
  - EVAPORATION ESTIMATES
  - PALEOCLIMATIC AND PALEOHYDROLOGIC EVIDENCE

# GEOCHEMISTRY (960.4-2-2)

GEOCHEMICAL PROPERTIES AFFECTING RADIONUCLIDE TRANSPORT

- GROUND-WATER CHEMISTRY
- FLOW DIRECTION AND TRAVEL TIME
- RADIONUCLIDE RETARDATION
- DISSOLUTION RATES
- WATER CHEMISTRY
- FRACTURE FLOW

GEOCHEMICAL EFFECTS ON HOST ROCK SORPTION AND STRENGTH

- STABILITY OF MINERAL ASSEMBLAGES
- THERMAL EFFECTS OF REPOSITORY ON HOST ROCK GEOCHEMISTRY

# ROCK CHARACTERISTICS (960.4-2-3)

- IMPACT OF REPOSITORY-INDUCED HEAT
  - — HOST ROCK DUCTILITY
  - — STABILITY OF HYDROUS ZEOLITES
  - — MATRIX DIFFUSION
  - — PERMEABILITY CHANGES
- COMPLEX ENGINEERING MEASURES
  - — BOREHOLE SEALS
  - — CONTINGENCY FOR WATER TABLE DIFFERENCES
- HOST ROCK FLEXIBILITY
  - — LITHOPHYSAE PROBLEMS
  - — VERTICAL THICKNESS
  - — LATERAL EXTENT

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# CLIMATIC CHANGE (960.4-2-4)

- IMPACT OF CLIMATIC CHANGES ON SURFACE WATER SYSTEM
  - PRECIPITATION
- IMPACT OF CLIMATIC CHANGES ON GROUND-WATER SYSTEM
  - PRECIPITATION
  - RISE IN WATER TABLE
  - MOISTURE FLOW THROUGH UNSATURATED ZONE
  - GEOMORPHIC EVIDENCE OF QUATERNARY CLIMATIC CYCLES

# EROSION (960.4-2-5)

- DEPTH OF REPOSITORY
  — POSSIBLE EXHUMATION
- EROSION RATES AND PROCESSES
  — LITTLE DATA ON EROSION

# DISSOLUTION (960.4-2-6)

**NO MAJOR ISSUES WERE RAISED UNDER THIS GUIDELINE FOR THE YUCCA MOUNTAIN SITE**

# POSTCLOSURE TECTONICS (960.4-2-7)

- NATURE AND RATES OF TECTONIC AND IGNEOUS ACTIVITY
  - — UNCERTAINTIES OVER EVIDENCE OF ACTIVE TECTONICS
  - — POSSIBLE DEVELOPMENT OF HYDROTHERMAL SYSTEMS
- LEVEL AND MAGNITUDE OF SEISMICITY
  - — EVIDENCE OF ALL FAULT DISPLACEMENT
  - — CONSISTENCY OF FAULTING ANALYSIS
  - — GROUND ACCELERATION
  - — TECTONIC EFFECTS ON HYDROLOGIC REGIME
  - — GREAT BASIN SEISMICITY DATA
  - — SIERRA NEVADA AND WHITE MOUNTAIN TECTONIC RATES
  - — POSSIBLE SURFACE FAULTING NEAR SITE

# HUMAN INTERFERENCE (960.4-2-8)

NO MAJOR ISSUES WERE RAISED UNDER THIS GUIDELINE
FOR THE YUCCA MOUNTAIN SITE

# NATURAL RESOURCES (960.4-2-8-1)

- SUBSURFACE MINING AND DRILLING
  - — ANALYSIS OF PAST AND PRESENT MINES AT NTS
- GROUND-WATER CONDITIONS
  - — CONSIDERATION OF DEEP REGIONAL AQUIFER
- PRESENCE OF NATURAL RESOURCES
  - — UNCERTAINTIES OVER GEOTHERMAL POTENTIAL
  - — PRESENCE OF GOLD AND SILVER IN USW G-1

# POSTCLOSURE SITE OWNERSHIP AND CONTROL (960.4-2-8-2)

NO MAJOR ISSUES WERE RAISED UNDER THIS GUIDELINE FOR THE YUCCA MOUNTAIN SITE

# POPULATION DENSITY AND DISTRIBUTION (960.5-2-1)

**NO MAJOR ISSUES WERE RAISED UNDER THIS GUIDELINE FOR THE YUCCA MOUNTAIN SITE**

# SITE OWNERSHIP AND CONTROL (960.5-2-2)

**NO MAJOR ISSUES WERE RAISED UNDER THIS GUIDELINE FOR THE YUCCA MOUNTAIN SITE**

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# METEOROLOGY (960.5-2-3)

**NO MAJOR ISSUES WERE RAISED UNDER THIS GUIDELINE FOR THE YUCCA MOUNTAIN SITE**

# OFFSITE INSTALLATIONS AND OPERATIONS (960.5-2-4)

- **PRESENCE OF NEARBY HAZARDOUS FACILITIES OR OPERATIONS**
  - — IMPACT OF NUCLEAR WEAPONS TESTING
  - — IMPACT OF USAF ACTIVITIES

# ENVIRONMENTAL QUALITY (960.5-2-5)

- ENVIRONMENTAL IMPACTS
  - THREATENED AND ENDANGERED SPECIES
  - DEVIL'S HOLE GROUND WATER
  - ARCHAEOLOGICAL, CULTURAL, AND HISTORIC SITES
- FEDERAL/STATE ENVIRONMENTAL COMPLIANCE
  - ENVIRONMENTAL STATUTORY AND REGULATORY REQUIREMENTS
- GUIDELINE FINDINGS
  - DC-1 DC-2 REDUCED TO A LEVEL 1 FINDING

# SOCIOECONOMIC IMPACTS (960.5-2-6)

- COMMUNITY SERVICES AND HOUSING
  - ABILITY OF AREA TO ABSORB POPULATION CHANGES
  - EFFECT ON COMMUNITY SERVICES AND INFRASTRUCTURE
- EMPLOYMENT AND BUSINESS SALES
  - AVAILABILITY OF ADEQUATE WORKFORCE
  - PROJECTED INCREASES IN ECONOMIC ACTIVITY
- PRIMARY SECTORS OF THE ECONOMY
  - POTENTIAL FOR DISRUPTION
- PUBLIC AGENCY REVENUES AND EXPENDITURES
  - PROJECTED INCREASES IN GOVERNMENT REVENUES
- PURCHASE OR ACQUISITION OF WATER RIGHTS
  - POTENTIAL EFFECTS OF ACQUIRING WATER RIGHTS
  - POTENTIAL EFFECTS ON WATER QUALITY AND QUANTITY

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# TRANSPORTATION (960.5-2-7)

- EFFECTS OF TRANSPORTATION SYSTEM DEVELOPMENT
  — SIZE OF AFFECTED AREA OF THE RAILROAD SYSTEM TO SITE

- OBSTACLES TO TRANSPORTATION SYSTEM DEVELOPMENT
  — ACQUIRING RIGHT-OF-WAYS FOR ACCESS ROUTES
  — LEGAL IMPEDIMENTS TO WASTE TRANSPORTATION
  — WEATHER-RELATED TRANSPORTATION IMPACTS

# SURFACE CHARACTERISTICS (960.5-2-8)

- SURFACE WATER SYSTEMS CAPABLE OF FLOODING THE REPOSITORY
  - POTENTIAL FLOODING OF REPOSITORY SURFACE FACILITIES
  - POSSIBLE MITIGATION MEASURES
  - POSSIBLE MAXIMUM FLOOD ANALYSES

# PRECLOSURE ROCK CHARACTERISTICS
# (960.5-2-9)

- SAFETY HAZARDS OR DIFFICULTIES
  - RETRIEVABILITY DISCUSSION
- ENGINEERING MEASURES
  - PERCHED WATER ZONES
- NEED FOR ARTIFICIAL SUPPORT
  - DATA ADEQUACY TO REACH FINDING
  - DRILLING TECHNOLOGY
- HOST ROCK FLEXIBILITY
  - NEED FOR COMPARISION TO GROUSE CANYON AND TOPOPAH SPRINGS
  - SUPPORT FOR HOST ROCK FLEXIBILITY
  - VERTICAL FLEXIBILITY
  - DATA ADEQUACY NEEDED FOR FINDING
  - IN SITU DATA
  - ZEOLITE DATA
  - SECONDARY MINERAL DISTRIBUTION DATA

# PRECLOSURE HYDROLOGY (960.5-2-10)

- SURFACE WATER SYSTEMS CAPABLE OF FLOODING THE REPOSITORY
  - POTENTIAL FLOODING OF REPOSITORY SURFACE FACILITIES
  - POSSIBLE MITIGATION MEASURES
  - POSSIBLE MAXIMUM FLOOD ANALYSES

# PRECLOSURE TECTONICS (960.5-2-11)

- EXPECTED IMPACT OF GROUND MOTION
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## Part II

# Environmental Protection Agency

**40 CFR Part 191**

**Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes; Final Rule**

**ENVIRONMENTAL PROTECTION AGENCY**

**40 CFR Part 191**

**[AH-FRL 2870-3]**

## Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

**AGENCY:** Environmental Protection Agency.

**ACTION:** Final rule.

**SUMMARY:** The Environmental Protection Agency (EPA) is promulgating generally applicable environmental standards for the management and disposal of spent nuclear fuel and high-level and transuranic radioactive wastes. The standards apply to management and disposal of such materials generated by activities regulated by the Nuclear Regulatory Commission (NRC) and to disposal of similar materials generated by atomic energy defense activities under the jurisdiction of the Department of Energy (DOE). These standards have been developed pursuant to the Agency's authorities and responsibilities under the Atomic Energy Act of 1954, as amended; Reorganization Plan No. 3 of 1970; and the Nuclear Waste Policy Act of 1982.

Subpart A of these standards limits the radiation exposure of members of the public from the management and storage of spent fuel or high-level or transuranic wastes prior to disposal at waste management and disposal facilities regulated by the NRC. Subpart A also limits the radiation exposures to members of the public from waste emplacement and storage operations at DOE disposal facilities that are not regulated by the NRC.

Subpart B establishes several different types of requirements for disposal of these materials. The primary standards for disposal are long-term containment requirements that limit projected releases of radioactivity to the accessible environment for 10,000 years after disposal. These release limits should insure that risks to future generations from disposal of these wastes will be no greater than the risks that would have existed if the uranium ore used to create the wastes had not been mined to begin with. A set of six qualitative assurance requirements is an equally important element of Subpart B designed to provide adequate confidence that the containment requirements will be met. The third set of requirements are limitations on exposures to individual members of the public for 1,000 years after disposal. Finally, a set of ground water protection requirements limits radionuclide concentrations for 1,000 years after disposal in water withdrawn from most Class I ground waters to the concentrations allowed by the Agency's interim drinking water standards (unless concentrations in the Class I ground waters already exceed the limits in 40 CFR Part 141, in which case this set of requirements would limit the increases in the radionuclide concentrations to those specified in 40 CFR Part 141). Subpart B also contains informational guidance for implementation of the disposal standards to clarify the Agency's intended application of these standards, which address a time frame without precedent in environmental regulations. Although disposal of these materials in mined geologic repositories has received the most attention, the disposal standards apply to disposal by any method, except disposal directly into the oceans or ocean sediments.

This notice describes the final rule that the Agency developed after considering the public comments received on the proposed rule published on December 29, 1982, and the recommendations of a technical review conducted by the Agency's Science Advisory Board (SAB). The major comments received on the proposed standards are summarized together with the Agency's responses to them. Detailed responses to all the comments received are discussed in the Response to Comments Document prepared for this final rule.

**DATE:** These standards shall be promulgated for purposes of judicial review at 1:00 p.m. eastern time on October 3, 1985. These standards shall become effective on November 18, 1985.

**ADDRESSES:** *Background Information*—The technical information considered in developing this rule, including risk assessments of disposal of these wastes in mined geologic repositories, is summarized in the Background Information Document (BID) for 40 CFR Part 191, EPA 520/1-85-023. Single copies of both the BID and the Response to Comments Document, as available, may be obtained from the Program Management Office (ANR-458), Office of Radiation Programs, Environmental Protection Agency, Washington, DC 20460; telephone number (703) 557-9351.

*Docket*—Docket Number R-82-3 contains the rulemaking record for 40 CFR Part 191. The docket is available for inspection between 8 a.m. and 4 p.m. on weekdays in the West Tower Lobby, Gallery 1, Central Docket Section, 401 M Street, SW., Washington, DC. A reasonable fee may be charged for copying.

**FOR FURTHER INFORMATION CONTACT:** Dan Egan or Ray Clark, Criteria and Standards Division (ANR-460), Office of Radiation Programs, Environmental Protection Agency, Washington, DC 20460; telephone number (703) 557-8610.

**SUPPLEMENTARY INFORMATION:** Fissioning of nuclear fuel in nuclear reactors creates a small quantity of highly radioactive materials. Virtually all of these materials are retained in the "spent" fuel elements when they are removed from the reactor. If the fuel is then reprocessed to recover unfissioned uranium and plutonium, most of the radioactivity goes into acidic liquid wastes that will later be converted into various types of solid materials. These highly radioactive liquid or solid wastes from reprocessing spent nuclear fuel have traditionally been called "high-level wastes." If it is not to be reprocessed, the spent fuel itself becomes a waste. The nuclear reactors operated by the nation's electrical utilities currently generate about 2,000 metric tons of spent fuel per year. The relatively small physical quantity of these wastes is apparent when compared to the chemically hazardous wastes regulated under the Resource Conservation and Recovery Act, which are produced at a rate of about 150,000,000 metric tons per year.

Although they are produced in small quantities, proper management and disposal of high-level wastes and spent nuclear fuel are essential because of the inherent hazard of the large amounts of radioactivity they contain. Spent fuel from commercial nuclear power reactors contains about 1.6 billion curies of radionuclides with half-lives greater than 20 years. Over the next decade, this inventory is projected to grow at a rate of about 300 million curies per year from reactors currently licensed to operate. Most of this spent fuel is currently stored at reactor sites. Reprocessing reactor fuel used for national defense activities has produced about 700 million curies of radionuclides with half-lives greater than 20 years. Most of these wastes are stored in various liquid and solid forms on three Federal reservations in Idaho, Washington, and South Carolina.

In addition, a wide variety of wastes contaminated with man-made radionuclides heavier than uranium have been created by various processes, mostly from the atomic energy defense activities conducted by the DOE and its predecessor agencies (the Atomic Energy Commission and the Energy

Research and Development Administration). These wastes are usually called "transuranic" wastes. Most of them are stored at Federal reservations in Idaho, Washington, New Mexico, and South Carolina.

### National Programs for Disposal of These Wastes

Since the inception of the nuclear age in the 1940's, the Federal government has assumed ultimate responsibility for the care and disposal of these wastes regardless of whether they are produced by commercial or national defense activities. In October 1976, President Ford ordered a major expansion of the Federal program to demonstrate a permanent disposal method for high-level wastes. The Agency was directed to develop generally applicable environmental standards to govern the management and disposal of these wastes as part of this initiative. Among EPA's first activities in response to this directive were a series of public workshops conducted in 1977 and 1978 to better understand the various public concerns and technical issues associated with radioactive waste disposal.

In 1981, the DOE, after completing a comprehensive programmatic environmental impact statement, decided to focus the national program on disposal in mined geologic repositories (46 FR 26677). In 1982, Congress passed the Nuclear Waste Policy Act (henceforth designated "NWPA"), which President Reagan signed into law on January 7, 1983. The NWPA contains several provisions that are relevant to this rulemaking. First, it affirmed the DOE's 1981 decision that mined repositories should receive primary emphasis in the national program, although research on some other technologies would be continued. Second, it established formal procedures regarding the evaluation and selection of sites for geologic repositories, including steps for the interaction of affected States and Indian tribes with the Federal Government regarding site selection decisions. Third, the NWPA levied a fee on utilities that generate electrical power with nuclear reactors in order to pay for Federal management and disposal of their spent fuel or high-level wastes. Fourth, the NWPA reiterated the existing responsibilities of the Federal agencies involved in the national program to develop mined geologic repositories, and it assigned some additional tasks regarding site evaluation. Finally, the Act provided a timetable for several key milestones that the Federal agencies were to meet in carrying out the program.

Section 121 of the NWPA reiterated the Agency's responsibility for developing the overall framework of requirements needed to assure protection of public health and the environment, in accordance with the Agency's authorities under the Atomic Energy Act of 1954 and Reorganization Plan Number 3 of 1970. Section 121 also called for the Agency to promulgate these standards by January 7, 1984. The Agency did not meet this deadline. On February 8, 1985, the Natural Resources Defense Council and four other environmental interest groups filed suit to bring about compliance with the NWPA mandate. This litigation was settled by the Agency and the plantiffs agreeing to a consent order requiring promulgation not later than August 15, 1985. The generally applicable environmental standards promulgated by this notice satisfy the terms of this consent order. However, they also represent the culmination of an effort that began almost nine years ago and that has included frequent interactions with the public to help formulate standards responsive to the concerns about disposal of these dangerous materials.

### Objective and Implementation of the Standards

In developing the standards for disposal of spent nuclear fuel and high-level and transuranic radioactive wastes, the Agency has carefully evaluated the capabilities of mined geologic repositories to isolate the wastes from the environment. Because such repositories are capable of performing so well, it has been possible to choose containment requirements that will provide exceptionally good protection to current and future populations for at least 10,000 years after disposal. In fact, EPA's analyses indicate that the small residual risks allowed by the disposal standards would be comparable to the risks that future populations would have been exposed to if the uranium ore used to produce the high-level wastes had not been mined to begin with.[1] The Agency believes that achieving this protection should not significantly increase the cost or difficulty of carrying out the national program for disposing of the wastes from commercial nuclear power plants. In addition, the containment requirements in the final rule are complemented by six qualitative assurance requirements designed to provide confidence that the containment requirements will be met, given the substantial uncertainties inherent in predictions of systems performance over 10,000 years. Because of this comprehensive framework, the Agency is confident that the national program to dispose of these wastes will be carried out with exceptional protection of public health and the environment.

The Nuclear Regulatory Commission (NRC) and the DOE are responsible for implementing these standards. The NRC has already promulgated procedural and technical requirements in 10 CFR Part 60 for disposal of high-level wastes in mined geologic repositories (46 FR 13971, 48 FR 28194). The NRC will obtain compliance with 40 CFR Part 191 for disposal of all high-level wastes by issuing licenses to the DOE, in accordance with 10 CFR Part 60, at various steps in the construction and operation of a repository. The NWPA directs the DOE to select a number of potential sites for geologic repositories, successively reducing this set of alternatives from five to three to one, in consultation with affected States and Indian Tribes and with participation by the public in key steps in the selection process. The DOE will accomplish this through use of site selection guidelines (10 CFR Part 960) that it has developed in accordance with section 112 of the NWPA. Both NRC's 10 CFR Part 60 and DOE's 10 CFR Part 960 incorporate the standards the Agency is promulgating today as the overall performance requirements for a geologic repository. Both of these other rules were designed in concert with EPA's ongoing development of 40 CFR Part 191. However, both the NRC and DOE must now review these regulations to determine what specific changes will be needed to properly implement the final version of 40 CFR Part 191.

### Review of the Proposed Standards

On December 29, 1982, shortly before the NWPA was enacted, the Agency published 40 CFR Part 191 for public review (47 FR 58196) and asked that comments be received by May 2, 1983. Eighty-three substantive replies were received from a broad spectrum of private citizens, public interest groups, members of the scientific community,

[1] Specifically, the Agency estimates that compliance with the disposal standards would allow no more than 1,000 premature deaths from cancer in the first 10,000 years after disposal of the high-level wastes from 100,000 metric tons of reactor fuel, an average of no more than one premature death every ten years. As this residual risk level is referred to in the following discussion, it should be remembered that it is a speculative calculation that is primarily intended as a tool for comparing risk levels; it should not be considered a reliable projection of the "real" number of health effects resulting from compliance with the disposal standards.

representatives of industry, and State and Federal agencies. These responses contained information and recommendations regarding seven issues on which the Agency sought further public comment (48 FR 21666). Questions concerning these issues were directed to all of the witnesses at two public hearings held during May 1983 in Washington, D.C. and in Denver (48 FR 13444). Copies of these questions were also sent to all those who responded to the initial request for comment, and the availability of these questions was announced in the Federal Register (48 FR 21666). The comment period was then held open until June 20, 1983, to receive responses to these additional questions. Responses to major comments—including all those specifically highlighted for public review—are summarized below. Detailed responses to the full range of comments received is described in the Response to Comments Document prepared for the final rule.

### Review of the Technical Basis of the Standards

In parallel with this public review and comment, the Agency conducted an independent scientific review of the technical basis for the proposed 40 CFR Part 191 through a special Subcommittee of the Agency's Science Advisory Board (SAB) (48 FR 509). This Subcommittee held nine public meetings from January 18, 1983, through September 21, 1983, and prepared a final report that was transmitted on February 17, 1984. While finding that the Agency had generally prepared comprehensive and scientifically competent technical analyses to support the proposed standards, the SAB review developed 46 findings and recommendations regarding specific improvements in the technical analyses and in the standards themselves. Since many of the SAB recommendations were to be considered in developing the final rule, the Agency sought public comment on the information and recommendations presented in the final SAB report (49 FR 19604).

Most of the SAB recommendations involve specific details of the technical assessments and judgments the Agency made in developing these standards. After evaluating the public comments received on the SAB report, the Agency agrees with almost all of the SAB's technical recommendations and has made corresponding changes in the technical basis of the final rule. A few of the Subcommittee's recommendations have implications that involve broader policy judgments. These recommendations have been treated as part of the public comment record and are described below as the major comments on the proposed 40 CFR Part 191 are discussed. A complete itemization of the Agency's responses to each of the findings and recommendations of the SAB is contained in the Response to Comments Document, together with a synopsis of the public comments on the SAB report.

### Summary of the Final Rule

The rule being promulgated today establishes generally applicable environmental standards for the management and disposal of spent nuclear fuel, high-level radioactive wastes, and transuranic radioactive wastes. The final rule differs in a number of ways from the proposed rule because of changes the Agency has made in response to public comments and in response to the recommendations of the technical review by the Agency's Science Advisory Board. This section provides an overview of the major provisions of the final rule, and changes from the proposed rule are noted. More detail on many of these provisions is provided later as part of the discussion of the comments considered in development of 40 CFR Part 191. The final rule:

(1) Applies to management and disposal of spent nuclear fuel, high-level radioactive wastes as defined by the NWPA, and transuranic wastes containing more than 100 nanocuries per gram of alpha-emitting transuranic isotopes, except for wastes that either the NRC or the Administrator determines do not need the degree of isolation required by this rule. (The proposed rule applied to spent nuclear fuel, high-level wastes exceeding a specific set of concentration limits, and to transuranic wastes containing more than 100 nanocuries per gram.)

(2) Through Subpart A, "Standards for Management and Storage," establishes limits on annual doses to members of the public of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ from exposures associated with management, storage, and preparation for disposal of any of these materials at facilities regulated by the NRC. These limits apply to the combined exposures from all NRC-licensed facilities covered by this Part or 40 CFR Part 190, the Agency's standards for the commercial uranium fuel cycle. Subpart A also limits annual doses to members of the public from management and storage operations at DOE disposal facilities that are not regulated by the NRC to 25 millirems to the whole body and 75 millirems to any other organ. (The proposed rule applied to the combined exposures from operations regulated by 40 CFR Part 190, waste management and storage operations regulated by the NRC or Agreement States, *and* waste management and storage operations conducted at all DOE facilities.) Subpart A also contains a provision that allows the Administrator to issue alternative standards for waste management and storage operations at DOE disposal facilities that are not regulated by the NRC. (The proposed rule contained a provision to allow the implementing agency, either the NRC or the DOE, to grant variances for unusual operating conditions.)

(3) Establishes several sets of requirements for disposal of these wastes through Subpart B, "Standards for Disposal." The primary standards are *containment requirements* that limit projected releases of radioactivity to the accessible environment for 10,000 years after disposal. Equally important is a set of six *assurance requirements* chosen to provide adequate confidence that the containment requirements will be met. In addition, Subpart B of the final rule includes *individual protection requirements* that limit annual exposures from the disposal facility to members of the public in the accessible environment to 25 millirems to the whole body and 75 millirems to any organ for 1,000 years after disposal. The Subpart also contains *ground water protection requirements* that limit radioactivity concentrations in water withdrawn from most Class I ground waters near a disposal system (as defined in conjunction with the Agency's Ground Water Protection Strategy published in August 1984) for 1,000 years after disposal. Finally, Subpart B provides *guidance for implementation* that indicates how the Agency intends the various numerical standards to be applied. (The proposed rule contained only containment requirements, assurance requirements, and procedural requirements; this last category provided some of the basis for the "guidance for implementation" in the final rule.) Major provisions of each of these sets of requirements include the following:

(a) The containment requirements (Section 191.13) limit the total projected release of specific radionuclides over the entire 10,000-year period after disposal. Releases from all expected and accidental causes are included, except for releases from conceivable events that are judged to have an incredibly small likelihood of occurrence. Quantitative terms are used to identify the probabilities of the releases to which the containment requirements apply; however, the final rule acknowledges that determination of compliance will have to tolerate much larger uncertainties than would be appropriate for short-term estimates and that judgments may have to be substituted for quantitative predictions in certain situations. Disposal in compliance with the containment requirements is projected to cause no more than 1,000 premature cancer deaths over the entire 10,000-year period from disposal of all existing high-level wastes and most of the wastes yet to be produced by currently operating reactors—an average of 0.1 fatality per year. This level of residual risk to future generations would be comparable to the risks that those generations would have faced from the uranium ore used to create the wastes if the ore had never been mined. Actual risks will probably be significantly less because of the conservative approach called for by the other parts of Subpart B. (The quantitative probabilities in the proposed rule were an order of magnitude smaller than those incorporated into the final rule. The release limits in the final rule are different than those in the proposed rule due to changes in EPA's technical analyses that were recommended by the SAB Subcommittee; however, the level of residual risk is the same as for the proposed rule.)

(b) The assurance requirements (Section 191.14) call for cautious steps to be taken in disposing of these wastes because of the inherent uncertainties in selecting and designing disposal systems that must be very effective for more than 10,000 years. The assurance requirements incorporate the following principles:

(i) Although active institutional controls, such as guarding and maintaining a disposal site, should be encouraged, they cannot be relied upon to isolate these wastes from the environment for more than 100 years after disposal. (The proposed rule limited reliance to "a few hundred years" after disposal.)

(ii) Disposal systems must be monitored to detect substantial changes from their expected performance until the implementing agency determines that there are no significant concerns to be addressed by further monitoring. (This requirement was not included in the proposed rule.)

(iii) The sites where disposal systems are located must be identified by permanent markers, widespread records, and other passive institutional controls to warn future generations of the dangers and location of the wastes.

(iv) Disposal systems must use several different types of barriers, including both engineered and natural ones, to isolate the wastes from the environment to help guard against unexpectedly poor performance from one type of barrier.

(v) Sites for disposal systems should be selected to avoid places where resources have previously been mined, where there is a reasonable expectation of exploration for scarce or easily accessible resources, or where there is a significant concentration of any material which is not otherwise available. (The wording in the proposed rule would have ruled out sites with a significant possibility of being considered for resource exploration in the future. The final rule revises this requirement to allow use of sites with some resource potential if they have other significant advantages compared to potential alternative sites.)

(vi) Recovery of most of the wastes must not be precluded for a reasonable period after disposal if unforeseen events require this in the future.

(c) The individual protection requirements (Section 191.15) limit annual exposures to members of the public in the accessible environment from the disposal system to 25 millirems to the whole body and 75 millirems to any organ. These requirements apply to undisturbed performance of the disposal system for 1,000 years after disposal. All potential pathways of radiation exposure from the disposal system to people must be considered, including the assumption that individuals consume all of their drinking water (2 liters per day) from any "significant source of ground water" located outside the "controlled area" established around a disposal system. A "significant source" is identified by several parameters intended to describe an aquifer sufficient to meet the needs of a "community water system" as defined in the Agency's National Interim Primary Drinking Water Regulations (40 CFR Part 141). (No explicit individual protection requirements were included in the proposed rule.)

(d) The ground water protection requirements (Section 191.16) limit the concentrations of radioactivity (or the *increases* in concentrations, if preexisting concentrations already exceed these limits) in waters withdrawn from most Class I sources of ground water near a disposal system to no more than 15 picocuries per liter of alpha-emitting radionuclides (including no more than 5 picocuries per liter of radium-226 and radium-228 but excluding radon) and to no more than the combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems if individuals consumed all of their drinking water from that source of ground water. These concentration limits are similar to those set in 40 CFR Part 141 for community water systems. Like the individual protection requirements, the ground water protection requirements apply to undisturbed behavior of the disposal system for a period of 1,000 years after disposal. (No explicit ground water protection requirements were included in the proposed rule.)

(e) Section 191.17 of the final rule establishes minimum procedural requirements that the Administrator must follow if additional information considered in the future indicates that it would be appropriate to modify any portion of the disposal standards through further rulemaking. (No similar provision was included in the proposed rule.)

(f) The "guidance for implementation" included as Appendix B to the final rule describes certain analytical approaches and assumptions through which the Agency intends the various long-term numerical standards of Subpart B to be applied. This guidance is particularly important because there are no precedents for the implementation of such long-term environmental standards, which will require consideration of extensive analytical projections of disposal system performance. (The proposed rule contained a corresponding, but less extensive, section entitled "procedural requirements.")

## Overall Approach of the Final Rule

In general, the Agency developed the various elements of this rule by balancing several perspectives. One set of considerations was the expected capabilities of the waste management and disposal technologies to reduce both short- and long-term risks to public health and the environment. These capabilities were examined through a number of performance assessments of the waste management, storage, and disposal facilities planned for the wastes generated by commercial nuclear power plants. Since detailed plans have not yet been determined for disposition of the wastes generated by atomic energy defense activities, similar assessments were generally not performed for these materials. A second consideration, where applicable, was consistency with related environmental standards for radiation exposure. A third factor was evaluation of various benchmarks to assess the acceptability of the residual risks that might be allowed by the rule. This was particularly important for the disposal standards, where there were few precedents to guide the Agency's judgments. Finally, the Agency placed considerable emphasis on the public concerns expressed during the various phases of this rulemaking, particularly where these concerns involved addressing the substantial uncertainties inherent in the unprecedented time periods of interest.

The final rule reflects a combination of all these perspectives—no single factor predominated. For instance, no portion of this rule is based solely on projections of the "best" protection that technology might provide. If this had been the case, the rule would have been significantly different. On the other hand, the rule cannot be interpreted as setting precedents for "acceptable risk" levels to future generations that should not be exceeded regardless of the circumstances. Instead, because of a number of unique circumstances, the Agency has been able to develop standards for the management and disposal of these wastes that are both reasonably achievable—with little, if any, effort beyond that already planned for commercial wastes—and that limit risks to levels that the Agency believes are clearly acceptably small. The following paragraphs describe how these various perspectives were used in developing the final rule.

*Standards for Management and Storage (Subpart A)*

Upon surveying the expected performance of the technologies planned for the management, storage, and preparation of these wastes for disposal, the Agency found that the likely exposures to members of the public would generally be very small. Therefore, compatibility with related radiation protection standards became a more important perspective for Subpart A.

For waste management and storage operations to be regulated by the NRC, the most relevant existing standards are those provisions of 40 CFR Part 190 that limit annual exposures of members of the public to 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ from uranium fuel cycle facilities. Accordingly, the Agency has decided to extend this coverage to include such waste management and storage operations so that the *combined* exposure from all of the NRC-licensed facilities covered under Part 190 and Subpart A of Part 191 shall not exceed these limits. This will include all operations prior to final closure at high-level waste disposal facilities, since these are to be regulated by the NRC.

For waste management and storage operations conducted at atomic energy defense facilities operated for the Department of Energy (which are not regulated by the NRC), the most relevant existing standards are the 40 CFR Part 61 limitations on air emissions of radionuclides that were recently promulgated under the Agency's Clean Air Act authorities (50 FR 5190). These standards limit annual exposures to members of the public to 25 millirems to the whole body and 75 millirems to any organ, with less stringent alternative standards available if it can be shown that no member of the public will receive a continuous exposure of more than 100 millirems per year or an infreqent exposure of more than 500 millirems per year from all sources (excluding natural background and medical exposures.) These Clean Air Act standards are applicable to those facilities *not* covered by 40 CFR Parts 190, 191 or 192. For DOE waste disposal facilities covered by this rule but not regulated by NRC (i.e., those for defense transuranic wastes), the Agency has included standards in Subpart A similar to those included in the Clean Air Act rule.

For other DOE waste management and storage operations, which are usually conducted on large facilities with many other potential sources of radionuclide emissions, the Agency believes that continued regulation under the broader scope of 40 CFR Part 61 is the most effective and practical approach. Otherwise, similar types of emissions from adjoining operations would have to be assessed and regulated through separate rules developed under different authorities; this would cause complex implementation practices without providing any additional protection.

*Standards for Disposal (Subpart B)*

Developing the standards for disposal of spent fuel and high-level and transuranic wastes involved much more unusual circumstances than those for waste management and storage. Because these materials are dangerous for so long, very long time frames are of interest. Standards must be implemented in the design phase for these disposal systems because active surveillance cannot be relied upon over such periods. At the same time, the standards must accommodate large uncertainties, including uncertainties in our current knowledge about disposal system behavior and the inherent uncertainties regarding the distant future. Subpart B addresses these issues by combining several different types of standards. The primary objective of these standards is to isolate most of the wastes from man's environment by limiting long-term releases and the associated risks to populations. In addition, Subpart B limits risks to individuals in ways compatible with this primary objective.

Although developed primarily through consideration of mined geologic repositories, these disposal standards apply to disposal of spent fuel and high-level and transuranic radioactive wastes by any method—with one exception. The standards do not apply to ocean disposal or disposal in ocean sediments because such disposal of high-level waste is prohibited by the Marine Protection, Research, and Sanctuaries Act of 1972. If this law is ever changed to allow such disposal (DOE continues to study the feasibility of this technology, consistent with the NWPA), the Agency will develop appropriate regulations in accordance with the different authorities that would apply.

Also, these disposal standards do not apply to wastes that have already been disposed of. The various provisions of Subpart B are intended to be met through a combination of steps involving disposal system site selection, design, and operational techniques (i.e., engineered barriers). Therefore, the Agency believes it appropriate that these disposal standards only apply to disposal occuring after the standards have been promulgated—so that they can be taken into consideration in devising the proper selection of controls. Some transuranic wastes produced in support of national defense programs were disposed of before the current DOE procedures for transuranic waste management were adopted in 1970. The exclusion of wastes already disposed of applies to these transuranic wastes, for which selection of disposal system sites, designs, and operational techniques are no longer options.

*Containment Requirements (Section 191.13)*

To develop the containment requirements, the Agency assumed that some aspects of the future can be predicted well enough to guide the selection and development of disposal systems for these wastes. A period of 10,000 years was considered because that appears to be long enough to distinguish geologic repositories with relatively good capabilities to isolate wastes from those with relatively poor capabilities. On the other hand, this period is short enough so that major geologic changes are unlikely and repository performance might be reasonably projected.

The Agency assessed the performance of a number of model geologic repositories similar to those systems now being considered by DOE. Potential radionuclide releases over 10,000 years were evaluated, and very general models of environmental transport and a linear, non-threshold dose-effect relationship were used to relate these releases to the incidence of premature cancer deaths they might cause. For the various repository types, these assessments indicate that disposal of the wastes from 100,000 metric tons of reactor fuel would cause a population risk ranging from no more than about ten to a little more than one hundred premature deaths over the entire 10,000-year period, assuming that the existing provisions of 10 CFR Part 60 regarding engineered barriers are met.

The Agency also evaluated the health risks that future generations would be exposed to from the amount of uranium ore needed to produce 100,000 metric tons of reactor fuel, if this ore had not been mined to begin with. Population risks ranging between 10 and 100,000 premature cancer deaths over 10,000 years were associated with this much unmined uranium ore, depending upon the analytical assumptions made.

These analyses, which have been updated from those prepared for the proposed standards, reinforce the Agency's conclusion that limiting radionuclide releases to levels associated with no more than 1,000 premature cancer deaths over 10,000 years from disposal of the wastes from 100,000 metric tons of reactor fuel satisfies two important objectives. First, it provides a level of protection that appears reasonably achievable by the various options being considered within the national program for commercial wastes. Second, the Agency believes that such a limitation would clearly keep risks to future populations at acceptably small levels, particularly because it appears to limit risks to no more than the midpoint of the range of estimated risks that future generations would have been exposed to if the uranium ore used to create the wastes had never been mined. Thus, because mined geologic repositories appear capable of providing such good protection, the Agency has decided to establish containment requirements that meet these two objectives.

The specific release limits for different radionuclides in Table 1 of the final rule were developed by estimating how many curies of each radionuclide would cause 1,000 premature deaths over 10,000 years if released to the environment. The limits were then stated in terms of the allowable release from 1,000 metric tons of reactor fuel (so that the actual curie values in Table 1 correspond to a risk level of 10 premature deaths over 10,000 years). All of these limits have been rounded to the nearest order of magnitude because of the approximate nature of these calculations. For particular disposal systems, release limits based upon the amount of waste in the system will be developed and will be used in a formula that insures that the desired risk level will not be exceeded if releases of more than one type of radionuclide are predicted. For some of the wastes covered by this rule, 1,000 metric tons of reactor fuel is not an appropriate unit of waste. In these situations, the various Notes to Table 1 provide instructions on how to calculate the proper release limits. In particular, the final rule includes provisions for high-level wastes from reactor fuels that have received substantially different uses in national defense applications (and contain much different amounts of radioactivity) than is typical of most reactor fuel used to generate electricity. The proposed rule would have allowed releases for these different types of fuels to occur in much different proportions to their total radioactivity than the Agency intended.

The release limits apply to radionuclides that are projected to move into the "accessible environment" during the first 10,000 years after disposal. The accessible environment includes all of the atmosphere, land surface, surface waters, and oceans. However, it does not include the lithosphere (and the ground water within it) that is below the "controlled area" surrounding a disposal system. The standards are formulated this way because the properties of the geologic media around a mined repository are expected to provide much of the disposal system's capability to isolate these wastes over these long time periods. Thus, a certain area of the natural environment is envisioned to be dedicated to keeping these dangerous materials away from future generations and may not be suitable for certain other uses. In the final rule, this "controlled area" is not to exceed 100 square kilometers and is not to extend more than five kilometers in any direction from the original emplacement of the wastes in the disposal system. The implementing agencies may choose a smaller area whenever appropriate.

The containment requirements apply to accidental disruptions of a disposal system as well as to any expected releases. Accordingly, they are stated in terms of the probability of releases occurring. This is done in two steps.

First, the release limits calculated in accordance with Notes 1 through 5 to Table 1 apply to those release levels that are projected to occur with a cumulative probability greater than 0.1 for the entire 10,000-year period over which these disposal standards apply. This includes the total releases from those processes that are expected to occur as well as relatively likely disruptions (which the Agency assumes will primarily include predictions of inadvertent human intrusion).

Second, these release limits multiplied by ten apply to all of the releases projected to occur with a cumulative probability greater than 0.001 over the 10,000-year period. The Agency expects that this will include releases that might occur from the more likely natural disruptive events, such as fault movement and breccia pipe formation (near soluble media such as salt formations). This range of probabilities was selected to include the anticipated uncertainties in predicting the likelihood of these natural phenomena. Greater releases are allowed for these circumstances because they are so unlikely to occur.

Finally, the containment requirements place no limits on releases projected to occur with a cumulative probability of less than 0.001 over 10,000 years. Probabilities this small would tend to be limited to phenomena such as the appearance of new volcanos outside of known areas of volcanic activity, and the Agency believes there is no benefit to public health or the environment from trying to regulate the consequences of such very unlikely events.

The containment requirements call for a "reasonable expectation" that their various quantitative tests be met. This phrase reflects the fact that unequivocal numerical proof of compliance is neither necessary nor likely to be obtained. A similar qualitative test, that of "reasonable assurance," has been used with NRC regulations for many years. Although the Agency's intent is similar, the NRC phrase has not been used in 40 CFR Part 191 because "reasonable assurance" has come to be associated with a level of confidence that may not be appropriate for the very long-term analytical projections that are called for by 191.13. The use of a different test of judgment is meant to acknowledge the unique considerations likely to be encountered upon implementation of these disposal standards.

*Assurance Requirements (Section 191.14)*

In contrast to the containment requirements, the assurance requirements were developed from that point of view that there may be major uncertainties and gaps in our knowledge of the expected behavior of disposal systems over many thousands of years. Therefore, no matter how promising the analytical projections of disposal system performance appear to be, these materials should be disposed in a cautious manner that reduces the likelihood of unanticipated types of releases. Because of the inherent uncertainties associated with these long time periods, the Agency believes that the principles embodied in the assurance requirements are important complements to the containment requirements that should insure that the level of protection desired is likely to be achieved.

Each of the assurance requirements was chosen to reduce the potential harm from some aspect of our uncertainty about the future. Designing disposal systems with limited reliance on active institutional controls reduces the risks if future generations do not maintain surveillance of disposal sites. On the other hand, planning for long-term monitoring helps reduce the chances that unexpectedly poor performance of a disposal system would go unnoticed. Using extensive markers and records and avoiding resources when selecting disposal sites both serve to reduce the chances that people may inadvertently disrupt a disposal system because of incomplete understanding of its location, design, or hazards. Designing disposal systems to include multiple types of barriers, both engineered and natural, reduces the risks if one type of barrier performs more poorly than current knowledge indicates. Finally, designing disposal systems so that it is feasible for the wastes to be located and recovered gives future generations an opportunity to rectify the situation if new discoveries indicate compelling reasons (which would not be foreseeable now) to change the way these wastes are disposed of.

The proposed standards contained two other assurance requirements intended to reduce the risks of uncertainty. One of them called for these wastes to be disposed of promptly to reduce the uncertainties associated with storing these materials for indefinitely long times with methods that require active human involvement. However—after this rule was published for public comment—the NWPA was enacted, setting up mandates and procedures intended to insure development of the necessary disposal systems for spent fuel and high-level wastes. Furthermore, the Department has made substantial progress towards developing a repository for disposal of the transuranic wastes from atomic energy defense activities. Because of these steps, the Agency decided that the call for prompt disposal was no longer needed, and this assurance requirement has not been included in the final rule.

The other proposed assurance requirement deleted from the final rule is the provision that called for releases to be kept as small as reasonably achievable even when the numerical containment requirements have been complied with. This would have increased the confidence of achieving the desired level of protection even if there were major uncertainties in analytical projections of long-term isolation. However, the Agency does not believe that it is necessary to retain this assurance requirement in the final standards because of two aspects of the related rules subsequently promulgated by the NRC and DOE for disposal of spent fuel and high-level wastes.

First, NRC's 10 CFR Part 60 implemented the multiple barrier principle by requiring very good performance from two types of engineered components: A 300 to 1,000-year lifetime for waste packages during which there would be essentially no expected release of waste, and a subsequent long-term release rate from the waste form of no more than one part in 100,000 per year. The Agency fully endorses this approach and believes that it represents the best performance reasonably achievable for currently foreseeable engineered components. Second, the DOE has included a provision in its site selection guidelines (10 CFR Part 960) that calls for significant emphasis to be placed on selecting sites that demonstrate the lowest releases over 100,000 years compared to the other alternatives available. Particularly because of the longer time frame involved in this comparison, the Agency believes that this provides adequate encouragement to choose sites that provide the best isolation capabilities available. Therefore, the concept of keeping long-term releases as small as reasonably achievable has been embodied by other agencies' regulations for both the engineered and natural components of disposal systems.

The final rule incorporates the five remaining assurance requirements plus the requirement for long-term monitoring, but it makes them applicable only to disposal facilities that are not regulated by the NRC. In its comments on the proposed rule, the NRC objected to inclusion of the assurance requirements, asserting that they were not properly part of the Agency's authorities assigned by Reorganization Plan No. 3 of 1970. The Agency continues to believe that provisions such as the assurance requirements are an appropriate part of generally applicable standards where they are necessary to establish the regulatory context for numerical standards—as they are in these circumstances because of the major uncertainties involved. However, the two agencies have agreed to resolve this issue by having the Commission modify 10 CFR Part 60 where necessary to incorporate the intent of the assurance requirements, rather than have them included in 40 CFR Part 191 for NRC-licensed disposal facilities. Thus, 10 CFR Part 60 will establish the context needed for appropriate implementation of 40 CFR Part 191.

The NRC staff is preparing the appropriate revisions to Part 60 and has told the Agency that they will be published in the Federal Register for public review and comment within approximately 120 days of today's promulgation of 40 CFR Part 191. EPA has provided NRC with all of the comments received on the assurance requirements during the 40 CFR Part 191 rulemaking, and the Agency will participate in the NRC rulemaking to facilitate our objective of having the intent of all of the assurance requirements embodied in Federal regulation. Finally, the Agency will review the record and outcome of the Part 60 rulemaking to determine if any subsequent modifications to 40 CFR Part 191 are needed.

*Individual and Ground Water Protection Requirements (Sections 191.15 and 191.16)*

While the primary objective of both the proposed and final disposal standards has been to limit potential long-term releases from disposal systems (and the population risks associated with such releases), these two sections have been added to the final rule to provide protection for those individuals in the vicinity of a disposal system. There are a number of difficult issues involved in formulating standards for individual protection in this situation, as discussed later in the "Release Limits vs. Individual Dose Limits" section. However, after evaluating the various comments received on this topic, the Agency believes that there are also important advantages in providing for individual protection in ways compatible with the containment and assurance requirements. In discussing this issue, the SAB Subcommittee stated that: "We support the use of a population risk criteria. We believe it is impractical to provide absolute protection to every individual for all postulated events or for very long periods. On the other hand, in our view it is important that, for the first several hundred years, residents of the region immediately outside the accessible environment have very great assurance that they will suffer no, or negligible, ill effects from the repository."

The individual protection requirements in the final rule limit the annual exposure from the disposal system to a member of the public in the accessible environment, for the first 1,000 years after disposal, to no more than 25 millirems to the whole body or 75 millirems to any organs. These limitations apply to the predicted behavior of the disposal system, including consideration of the uncertainties in predicted behavior, assuming that the disposal system is not disrupted by human intrusion or the occurrence of unlikely natural events. The Agency chose the limits of 25 millirem/year to the whole body and 75 millirem/year to any organ because it believes that they represent a sufficiently stringent level of protection for situations where no more than a few individuals are likely to receive this exposure. If such an individual were exposed to this level over a lifetime (which seems particularly unlikely given the localized pathways through which waste might escape from a geologic repository), the Agency estimates this would cause a $5 \times 10^{-4}$ chance of incurring a premature fatal cancer.

In choosing a time period for these requirements to protect individuals nearby disposal systems, the Agency took into account concerns such as those expressed by the SAB by examining the effects of choosing different time frames. As 10,000 years was chosen for the containment requirements because it is long enough to encourage use of disposal sites with natural characteristics that enhance long-term isolation, 1,000 years was chosen for the individual protection provisions because the Agency's assessments indicate it is long enough to insure that particularly good engineered barriers would need to be used at potential sites where some ground water would be expected to flow through a mined geologic repository. Use of a time much shorter than 1,000 years would not call for substantial engineered barriers even at disposal sites with a lot of ground water flow.

On the other hand, demonstrating compliance with individual exposure limits for times much longer than 1,000 years appears to be quite difficult because of the analytical uncertainties involved. It would require predicting radionuclide concentrations—even from releases of tiny portions of the waste—in all the possible ground water pathways flowing in all directions from the disposal system, at all depths down to 2,500 feet, as a function of time over many thousands of years. At some of the sites being considered (and possibly all of them, depending upon what is discovered during site characterization) the only certain way to comply with such requirements for periods on the order of 10,000 years appears to be to use very expensive engineered barriers that would rule out any potential releases over most of this period. While such barriers could provide longer-term protection for individuals, they would not provide substantial benefits to populations because the containment and assurance requirements already reduce population risks to very small levels.

Based on all of these considerations, the Agency has decided that a 1,000-year duration is adequate for quantitative limits on individual exposures after disposal. For longer time periods, several of the qualitative assurance requirements should help to reduce the chances that individuals will receive serious radiation exposures. In addition, 40 CFR Part 191 in no way limits the future applicability of the Agency's drinking water standards (40 CFR Part 141)—which protect community water supply systems through institutional controls—or of similar standards that future generations may choose to adopt.

In assessing the performance of a disposal system with regard to individual exposures, all pathways of radioactive material or radiation from the disposal system to people shall be considered. In particular, the assessments must assume that individuals consume all of their drinking water (2 liters per day) from any portion of a "significant source of ground water" anywhere outside of the "controlled area" surrounding the disposal system. Significant sources of ground water are defined to include underground formations that are likely to be able to provide enough water for a community water system as defined in 40 CFR Part 141. (More information regarding this definition is provided later in the "Release Limits vs. Individual Dose Limits" discussion.) Formations that could only provide smaller amounts of potable water have not been included because the Agency wants to avoid discriminating against the use of low-productivity geologic formations that might provide very good long-term isolation as disposal sites. The Agency believes this is reasonable for these standards because of the very small number of such disposal facilities that are contemplated (no more than three or four over the next 100 years.) However, the Agency has no plans to use this classification for other ground water related standards, which usually affect a far greater number of situations.

The Agency has not required these individual protection provisions to assume ground water use within the controlled area because geologic media within the controlled area are an integral part of the disposal system's capability to provide long-term isolation. (But if the implementing agency plans to allow individuals to use ground water within the controlled area, such planned use would have to be considered within the pathways evaluated to determine compliance with § 191.15.) The potential loss of ground water resources is very small because of the small number of such disposal facilities contemplated. Nevertheless, the Agency has also added ground water protection requirements to the final rule (Section 191.16) that protect certain sources of ground water even within the controlled area. These ground water protection requirements are similar to the individual protection requirements because they apply to undisturbed performance for 1,000 years after disposal. However, the ground water protection requirements apply only to those Class I ground waters, as they are identified in accordance with the Agency's Ground-Water Protection Strategy published in August 1984, that meet the following three conditions: (1) They are within the controlled area or near (less than five kilometers beyond) the controlled area; (2) they are supplying drinking water for thousands of persons as of the date that the Department selects the site for extensive exploration as a potential location of a disposal system; and (3) they are irreplaceable in that no reasonable alternative source of drinking water is available to that population.

For such Class I ground waters, § 191.16 limits the radionuclide concentrations in water withdrawn from any portion of them to no more than concentration limits similar to those established for the output of community water systems in 40 CFR Part 141. However, if the preexisting concentrations of radioactivity in the Class I aquifer already exceed any of these limits at a particular site, § 191.16 then limits any *increases* in the preexisting concentrations to these same concentration limits. The Agency believes these provisions are necessary and adequate to avoid any significant degradation of the important drinking water resources provided by these Class I ground waters.

*Alternative Provisions for Disposal (Section 191.17)*

In developing the disposal standards, the Agency has had to make many assumptions about the characteristics of disposal systems that have not been built, about plans for disposal that are only now being formulated, and about the probable adequacy of technical information that will not be collected for many years. Thus, although the Agency believes that the disposal standards being promulgated today are appropriate based upon current knowledge, we cannot rule out the possibility that future information may indicate needs to modify the standards.

In recognition of this possibility, § 191.17 of the final rule sets forth procedures under which the Administrator may develop modifications to Subpart B, should the need arise. Any such changes would have to proceed through the usual notice-and-comment rulemaking process, and § 191.17 stipulates that such a rulemaking would require a public comment period of at least 90 days, to include public hearings in affected areas of the country. Although such procedures are common practice in rulemakings of this type, they are not required by the statutes relevant to this rule (Administrative Procedures Act mandates can be satisfied by a comment period as short as 14 days). Thus, § 191.17 insures an opportunity for significant public interaction regarding any proposed changes to the disposal standards.

There are several areas of uncertainty the Agency is aware of that might cause suggested modifications of the standards in the future. One of these concerns implementation of the containment requirements for mined geologic repositories. This will require collection of a great deal of data during site characterization, resolution of the inevitable uncertainties in such information, and adaptation of this information into probabilistic risk assessments. Although the Agency is currently confident that this will be successfully accomplished, such projections over thousands of years to determine compliance with an environmental regulation are unprecedented. If—after substantial experience with these analyses is acquired—disposal systems that clearly provide good isolation cannot reasonably be shown to comply with the containment requirements, the Agency would consider whether modifications to Subpart B were appropriate.

Another situation that might lead to suggested revisions would be if additional information were developed regarding the disposal of certain wastes that appeared to make it inappropriate to retain generally applicable standards addressing all of the wastes covered by this rule. For example, the DOE is considering disposal of some defense wastes by stabilizing them in their current storage tanks, rather than relocating them to a mined repository. The Agency has not assessed the ramifications of such disposal yet, and it is certainly possible that it could be carried out in compliance with all the provisions of Subpart B being promulgated today. However, it is also possible that there may be benefits associated with such disposal that would warrant changes in Subpart B for these types of waste. If so, § 191.17 would govern the consideration of any such revisions.

Other examples of developments that might offer reasons to consider alternative provisions in the future include: The use of reactor fuel cycles or utilizations substantially different than today's; new models of the environmental transport and biological effects of radionuclides that indicate major changes (i.e., approaching an order of magnitude) in the relative risks associated with different radionuclides and the level of protection sought by the disposal standards; or information that indicates that particular assurance requirements might not be needed in certain situations to insure adequate confidence of long-term environmental protection.

*Guidance for Implementation (Appendix B)*

This supplement to the final rule is based upon some of the analytical assumptions that the Agency made in developing the technical basis used for formulating the numerical disposal standards. These analytical assumptions incorporate information assembled as part of the technical basis used to develop the proposed rule. In particular, Appendix B discusses: (1) The consideration of all barriers of a disposal system in performance assessments; (2) reasonable limitations on the scope of performance assessments; (3) the use of average or "mean" values in expressing the results of performance assessments; (4) the types of assumptions regarding the effectiveness of institutional controls; and (5) limiting assumptions regarding the frequency and severity of inadvertent human intrusion into geologic repositories.

The implementing agencies are responsible for selecting the specific information to be used in these and other aspects of performance assessments to determine compliance with 40 CFR Part 191. However, the Agency believes it is important that the assumptions used by the implementing agencies are compatible with those used by EPA in developing this rule. Otherwise, implementation of the disposal standards may have effects quite different than those anticipated by EPA. The final rule to be published in the Code of Federal Regulations will include this informational appendix as guidance to the implementing agencies. Although the other agencies are not bound to follow this guidance, EPA recommends that it be carefully considered in planning for the application of 40 CFR Part 191. The Agency will monitor implementation of the disposal standards as it develops over the next several years to determine whether any changes to the rule are called for to meet the Agency's objectives for these standards.

**Comments on Issues Highlighted for Public Review**

The Agency particularly requested public comment on six issues associated with the proposed rule (47 FR 58196). After these comments were received, additional comments and information were requested on seven issues raised by the initial comments (48 FR 21668). Two of these seven issues (the definition of high-level waste and the use of individual dose limitations in the disposal standards) had been included among the first six issues that were highlighted. Thus, a total of eleven questions received particular attention during the public review and comment process. The following paragraphs summarize the comments received on each of these issues and the Agency's responses to them, including descriptions of any resulting changes made in the final rule.

*Definition of "High-Level Waste"*

Traditionally, the term "high-level waste" has meant the highly radioactive liquid wastes remaining from the recovery or uranium and plutonium in a nuclear fuel reprocessing plant, and other liquid or solid forms into which such liquid wastes are converted to facilitate managing them. This traditional use of the term has not included radioactive materials from other sources, no matter how radioactive they are. However, somewhat different definitions of high-level waste have appeared in certain laws and regulations affecting specific aspects of radioactive waste management. Most notably, some of these definitions have included unreprocessed spent fuel as the prospects for a commercial fuel reprocessing industry became more uncertain.

In the proposed rule, high-level waste was defined in the traditional sense, including spent fuel if disposed of without reprocessing. But the proposed definition also included minimum radioactivity concentrations below which such materials would not be subject to the stringent isolation requirements of 40 CFR Part 191. To identify these minimum concentrations, the maximum concentrations that the NRC determined that it would generally accept in near-surface disposal facilities under 10 CFR Part 61 (47 FR 57446) were adapted. Since this represented a modification of the traditional meaning of high-level waste, the Agency particularly sought comment on this aspect of the proposed rule.

Shortly after 40 CFR Part 191 was published for public review, the NWPA was enacted. The NWPA distinguished between spent nuclear fuel and high-level waste, and it defined high-level waste to include both: "(A) The highly radioactive material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and (B) other highly radioactive material that the Commission, consistent with existing law, determines by rule requires permanent isolation." This definition allow for inclusion of highly radioactive material not related to reprocessing of spent nuclear fuel, and it reflects the concept that some derivatives of nuclear fuel reprocessing may not contain sufficient radioactivity to warrant exceptional isolation.

Many of the comments regarding the proposed definition suggested that EPA adopt the definition in the NWPA, although in response to the specific questions distributed in conjunction with the Agency's public hearings, many responders thought that the Agency should define the phrase "sufficient concentrations" contained in part A of the NWPA definition. However, several commenters argued that the proposed lower limits for high-level waste concentrations had been improperly taken out of the context of 10 CFR Part 61 and could require expensive disposal of wastes with relatively small hazards.

After considering these comments and other information currently available, the Agency decided to incorporate the NWPA definition of high-level waste in the final 40 CFR Part 191 without further elaboration of the phrase "sufficient concentrations." The Agency recognizes that this introduces some uncertainty regarding the applicability of this rule. However, the Commission is now beginning a rulemaking that should assemble the technical information needed to develop a more specific definition of high-level wastes. Since the NRC definition would not necessarily apply to all the situations covered by 40 CFR Part 191 (e.g., management and storage of defense high-level wastes prior to disposal is not regulated by NRC), the Agency will follow the Commission's rulemaking to determine what appropriate elaborations of the NWPA definition should be incorporated into 40 CFR Part 191. Upon completion of the NRC rulemaking, the Agency will initiate steps to appropriately modify this rule. In addition, EPA will address disposal of any radioactive wastes that are not covered by 40 CFR Part 191 or 40 CFR Part 192 (the Agency's standards for disposal of uranium mill tailings) as it considers standards for disposal of low-level radioactive wastes (48 FR 39563).

Finally, incorporating the NWPA definition of high-level waste also includes the phrase "consistent with existing law" when describing the NRC's responsibilities to identify materials as high level waste. Promulgation of 40 CFR Part 191 with this definition does not signify Agency acceptance or endorsement of any particular interpretation of the phrase "consistent with existing law." The Agency presumes that the Commission will specify the applicability of its existing authorities as it conducts the relevant rulemaking efforts.

*The Level of Protection*

In the proposed rule, the containment requirements for disposal systems limited the residual risks to no more than an estimated 1,000 premature cancer deaths over the first 10,000 years after disposal of the wastes from 100,000 metric tons of heavy metal (MTHM) used as fuel in a nuclear reactor. The Agency pointed out that a variety of mined repository designs using different combinations of geologic media and engineered controls were expected to meet these requirements. It was also estimated that the residual risks to future generations appeared to be no greater than if the uranium ore used to create the wastes had not been mined. EPA particularly asked for comment on whether it had taken an appropriate and reasonable approach in choosing this level of protection based upon these considerations.

Most of the public comments found this approach satisfactory. However, some commenters argued that the risks from unmined uranium ore did not necessarily define an acceptably low level of residual risks. They pointed out that such risks may vary from place to place (and a high-level waste repository could "redistribute" them) and that society sometimes does take measures to clean-up naturally-occurring radioactivity, implying that such natural risks are not always "acceptable."

On the other hand, some commenters felt that the level of protection sought in the proposed rule was far too stringent when compared to risks allowed and accepted by society from other activities. For example, the SAB Subcommittee recommended that the desired level of protection be relaxed by at least a factor of ten for this reason, coupled with the Subcommittee's concern that the uncertainties in analytical projections over thousands of years could make it difficult to demonstrate compliance with the proposed containment requirements.

After evaluating the public comments and updated performance assessments of geologic repositories, the Agency has retained the proposed level of protection as the basis for the long-term containment requirements in the final rule—even though it is true that long-term assessments of repository performance will encounter substantial uncertainties, as the SAB Subcommittee pointed out. Three reasons support this decision.

First, revising the performance assessments in accordance with many of the technical recommendations of the SAB has reinforced the Agency's conclusion that the proposed level of protection can reasonably be achieved by a variety of combinations of repository sites and designs—and EPA's regulatory impact analyses indicate that this level of protection can be achieved without significant effects on the cost of disposing of these wastes.

Second, comparing this level of protection with the comparable risks from equivalent amounts of unmined uranium ore continues to reinforce the Agency's belief that this is an acceptably small residual risk for future generations. Therefore, the Agency believes that this level of protection represents a reasonable basis for these disposal standards.

Third, rather than relax the level of protection, the Agency has chosen to address the uncertainties that concerned the SAB Subcommittee by adding § 191.13(b) and by providing a more detailed "Guidance for Implementation" section to replace the proposed "Procedural Requirements." For example, this guidance points out that the entire range of possible projections of releases need not meet the containment requirements. Rather, compliance should be based upon the projections that the implementing agencies believe are more realistic. Furthermore, these revisions acknowledge that the quantitative calculations needed may have to be supplemented by reasonable qualitative judgments in order to appropriately determine compliance with the disposal standards.

In retaining the proposed level of protection, the Agency emphasizes that it is making a decision applicable only to the circumstances involving disposal of spent nuclear fuel and high-level and transuranic wastes. This rule cannot be used to establish precedents such as "no incremental risk to future generations" for extrapolation to other disposal problems. For other situations, evaluations of technological feasibility and cost-effectiveness must be considered for the particular set of circumstances. If mined geologic repositories were not capable of providing such good protection, the Agency might have chosen considerably different standards.

*Time Period for Containment Requirements*

Many commenters addressed the 10,000-year period used for the proposed containment requirements. A few argued that this period was too long and that EPA should only be concerned with a few hundred to a thousand years. A number of commenters supported the focus on 10,000 years. However, many commenters felt that it was inappropriate for the standards to ignore the period after 10,000 years. Some suggested that the containment requirements should address periods ranging from 50,000 to 500,000 years.

In the proposed rule, the Agency indicated that 10,000 years was chosen, in part, because compliance with quantitative standards for a substantially longer period would have entailed considerably more uncertain calculations. There was no intention to indicate that times beyond 10,000 years were unimportant, but the Agency felt that a disposal system capable of meeting the proposed containment requirements for 10,000 years would continue to protect people and the environment well beyond 10,000 years. The SAB Subcommittee reviewed and supported these technical arguments for limiting the containment requirements to a 10,000-year period. Those commenters who argued for longer periods did not suggest effective ways that might compensate for the substantially greater uncertainties inherent in longer projections of disposal system performance.

However, many of the commenters and the SAB Subcommittee suggested that more qualitative or comparative assessments beyond 10,000 years might be appropriate. The Agency agreed with these comments and worked with the DOE to formulate comparative assessment provisions that have been incorporated into the final version of the Department's site selection guidelines (10 CFR Part 960). These provisions call for comparisons of the projected releases from undisturbed performance of alternative repository sites over 100,000 years to be a significant consideration in site selection. Since natural barriers are expected to provide the primary protection for such long time frames, this provision should allow for appropriate consideration of longer time periods without requiring the absolute values of these very uncertain calculations to meet a specific quantitative test. With the inclusion of this comparative test in 10 CFR Part 960, the Agency believes that no modification is needed in 40 CFR Part 191.

*Use of Quantitative Probabilities in the Containment Requirements*

The containment requirements in the proposed rule applied to two categories of potential releases ("reasonably foreseeable" and "very unlikely") based upon their projected probabilities of occurrence over the first 10,000 years after disposal. In its comments on the proposed rule, the NRC objected to the proposed quantitative definitions of these probabilities on the basis that calculation of such probabilities could be so uncertain that it would be impractical to determine whether the standards had been complied with. Instead, the NRC suggested substitution of qualitative terms to identify the two categories of potential releases. The wording proposed by the NRC was formulated in terms of releases that might be caused by geologic processes and events.

In the second round of comment, the Agency sought information on whether to adopt the NRC's recommended wording or to retain definitions based on quantitative probabilities. Although a number of commenters agreed with the NRC position, the preponderance of comments supported retention of the quantitative probabilities. The SAB Subcommittee strongly supported retention of the probabilistic structure, but with substantially less restrictive probabilities and with the proviso that the Agency be sure that such conditions would be ". . . practical to meet and [would] not lead to serious impediments, legal or otherwise, to the licensing of high-level waste repositories." After considering all of this information, the Agency has revised the structure of the containment requirements in several ways that will retain quantitative objectives for long-term containment while allowing the implementing agencies enough flexibility to make qualitative judgments when necessary.

First, the final rule does not use the terms "reasonably foreseeable" and "very unlikely" releases. Instead, the permissible probabilities for two different levels of cumulative releases (over 10,000 years after disposal) are now incorporated directly into the containment requirements.

Second, the numerical probabilities associated with the two release categories have been increased by an order of magnitude to reflect further assessments of the uncertainties associated with projecting the probabilities of geologic events such as fault movement.

Third, the final rule clearly indicates that comprehensive performance assessments, including estimates of the probabilities of various potential releases whenever meaningful estimates are practicable, are needed to determine compliance with the containment requirements.

Fourth, a paragraph has been added to the final containment requirements (Section 191.13) to emphasize that unequivocal proof of compliance is neither expected nor required because of the substantial uncertainties inherent in such long-term projections. Instead, the appropriate test is a reasonable expectation of compliance based upon practically obtainable information and analysis. This paragraph was patterned after a paragraph that considered similar issues in NRC's 10 CFR Part 60.

Finally, the "Guidance for Implementation" section has been added (Appendix B). This part of the rule describes the Agency's assumptions regarding performance assessments and uncertainties and should discourage overly restrictive or inappropriate implementation of the containment requirements.

The Agency believes that these revisions to the proposed rule preserve an objective framework for application of the containment requirements that requires very stringent isolation while allowing the implementing agencies adequate flexibility to handle specific uncertainties that may be encountered.

Within this framework, the possibility of inadvertent human intrusion into or nearby a repository requires special attention. Such intrusion can significantly disrupt the containment afforded by a geologic repository (as well as being dangerous for the intruders), and repositories should be selected and designed to reduce the risks from such potential disruptions. However, assessing the ways and the reasons that people might explore underground in the future—and evaluating the effectiveness of passive controls to deter such exploration near a repository—will entail informed judgment and speculation. It will not be possible to develop a "correct" estimate of the probability of such intrusion. The Agency believes that performance assessments should consider the possibilities of such intrusion, but that limits should be placed on the severity of the assumptions used to make the assessments. Appendix B to the final rule describes a set of parameters about the likelihood and consequences of inadvertent intrusion that the Agency assumed were the most pessimistic that would be reasonable in making performance assessments. The implementing agencies may adopt these assumptions or develop similar ones of their own. However, as indicated under the discussion of institutional controls, the Agency does not believe that institutional controls can be relied upon to completely eliminate the possibility of inadvertent intrusion.

*Definition of "Accessible Environment"*

The containment requirements limit releases to the "accessible environment" for 10,000 years after disposal. In the proposed rule, ground water within 10 kilometers of a disposal system was excluded from the definition of accessible environment. This definition was intended to reflect the concept that the geologic media surrounding a mined repository are part of the long-term containment system, with disposal sites being selected so that the surrounding media prevent or retard transport of radionuclides through ground water. Such surrounding media would be dedicated for this purpose, with the intention to prohibit incompatible activities (either those that might disrupt the disposal system or those that could cause significant radiation exposures) in perpetuity. Applying standards to the ground water contained within these geologic media surrounding a repository would ignore the role of this natural barrier, and it could reduce the incentive to search for sites with characteristics that would enhance long-term containment of these wastes. (At the same time, the Agency recognized that the institutional controls designed to reserve this area around a disposal system cannot be considered infallible, and other provisions of the rule are designed to reduce the consequences of potential failures.)

Many commenters objected to the definition of accessible environment incorporated in the proposed rule. Some recommended that all ground water, or all "potable" ground water, should be included. Others agreed that it was appropriate to exclude some ground water in the immediate vicinity of a repository, but argued that the proposed 10-kilometer distance was too long—particularly for ground water sources that were likely to be used in the future. A few commenters thought that the proposed definition was too restrictive by including all ground water beyond 10 kilometers; they suggested that poor quality ground water sources unlikely to be used in the future should not be part of the accessible environment at all.

After considering these comments, the Agency has decided to make several changes in the definition of the "accessible environment." First, the concept of a "controlled area" has been adopted from NRC's 10 CFR Part 60. This establishes an area around a disposal system that is to be identified by markers, records, and other passive institutional controls intended to prohibit incompatible activities from the area. Consistent with the proposed 40 CFR Part 191, the current NRC definition of "controlled area" limits its distance from the edge of a repository to no more than 10 kilometers. The final 40 CFR Part 191 defines "accessible environment" to include: (1) The atmosphere, land surfaces, surface waters, and the oceans, wherever they are located; and (2) portions of the lithosphere—and the ground water within it—that are beyond the controlled area.

Second, the Agency has made the definition of the "controlled area" more restrictive than that currently incorporated in 10 CFR Part 60. This revised definition limits the controlled area to a distance no greater than five kilometers from the original emplacement of wastes in a disposal system, rather than 10 kilometers. Furthermore, the revised definition limits the area encompassed by the controlled area to no more than 100 square kilometers, which is approximately the area that would be encompassed by a controlled area at a distance of three kilometers from all sides of a typical repository configuration. (A distance of five kilometers from all sides of a typical repository would correspond to an area of about 200 square kilometers, whereas a distance of ten kilometers from all sides corresponds to an area of almost 500 square kilometers.) This revised definition substantially reduces the area of the lithosphere that would have been removed from the "accessible environment" defined in the proposed rule, and it somewhat reduces the distance used in the proposed rule. The five-kilometer distance was chosen to retain reasonable compatibility with the NRC's requirement for a preemplacement ground water travel time of 1,000 years to the accessible environment (one of the 10 CFR Part 60 requirements developed in concert with the proposed rule), while still providing for greater isolation than called for by the proposed rule. This definition of the accessible environment will allow a controlled area to be established asymmetrically around a repository based upon the particular characteristics of a site.

*Release Limits vs. Individual Dose Limits*

The Agency believes that the containment requirements in § 191.13 will insure that the overall population risks to future generations from disposal of these wastes will be acceptably small. However, the situation with regard to potential individual doses is more complicated. Even with good engineering controls, some waste may eventually (i.e., several hundreds or thousands of years after disposal) be released into any ground water that might be in the immediate vicinity of a geologic repository. Since ground water generally provides relatively little dilution, anyone using such contaminated ground water in the future may receive a substantial radiation exposure (e.g., several rems per year or more). This possibility is inherent in collecting a very large amount of radioactivity in a small area.

The proposed rule did not contain any numerical restrictions on such potential individual doses after disposal. Rather, the proposal relied on several of the qualitative assurance requirements to greatly reduce the likelihood of such exposures. In particular, the assurance requirement calling for extensive permanent markers and records was intended to perpetuate information to future generations about the dangers of intruding into the vicinity of a repository. The assurance requirement to avoid sites with significant resources was intended to reduce the incentive to explore around a repository even if the information passed on was ignored or misunderstood. And the assurance requirements to use multiple barriers, both engineered and natural, and to keep releases as small as reasonably achievable were intended to encourage reduction of releases to ground water beyond that needed to meet the containment requirements—further reducing the potential for harmful individual exposures.

This approach to potential individual exposures was highlighted for comment when 40 CFR Part 191 was proposed. After receiving many recommendations to incorporate a limitation on individual doses after disposal, the Agency sought comment on further details of such a limitation in the second round of comments. For example, EPA asked whether such a limitation should apply to ground water use, whether it should apply only for ground water at some distance from a geologic repository or for any ground water source, and whether reliance on existing individual dose limitations (such as 40 CFR Part 141 or 10 CFR Part 20) for protection regarding ground water would be adequate.

The responses resulting from these questions offered a wide range of suggestions. A number of commenters opposed inclusion of an individual dose limitation for disposal on the grounds that calculations to judge compliance with such a standard would be highly speculative and not an appropriate basis upon which to judge the adequacy of a disposal system. In contrast, some other commenters argued that an individual dose standard in the 5 to 25 millirems per year range should apply to use of ground water in the accessible environment for an indefinitely long period into the future. Another group of commenters supported inclusion of some limitation on individual exposure, but only to the extent that it would not compromise the primary intent of long-term isolation and containment of the wastes.

These comments did not offer information that changed the Agency's perception of some of the problems associated with individual dose limitations for disposal. First, relying *only* upon an individual dose standard for disposal could encourage disposal methods that would enhance dilution of any wastes released. Thus, disposal sites near bodies of surface water or large sources of ground water might be preferred—which the Agency believes is an inappropriate policy that would usually increase overall population exposures.

This concern could be met by *adding* an individual dose limitation to the proposed containment requirements, rather than replacing them. However, the Agency's performance assessments of geologic repositories indicate that doses from using ground water close to a repository can become substantial (e.g., several rems per year) after a few hundred or thousand years, because the geological and geochemical characteristics of appropriate sites tend to concentrate eventual releases of wastes in any ground water that is close to the site. A study published by the National Academy of Sciences in April 1983 confirms this potential for large individual doses if flowing ground water can contact the wastes after the waste canisters are presumed to start leaking. Although it might be possible to find certain geologic settings that avoid this problem, such restrictive siting prerequisites could substantially delay development of disposal systems without providing significantly more protection to populations. Furthermore, even if reasonable limitations on individual exposure might be met at certain sites for very long times, demonstrating compliance with such limitations could be very difficult because of the additional complexities involved in estimating individual exposures rather than amounts of radioactivity released. The SAB Subcommittee report generally agreed with the technical aspects of these conclusions.

On the other hand, analyses of repository systems with good engineering controls show that they should be able to prevent significant doses from ground water use for at least a thousand years after disposal. Such protection would be compatible with both the proposed containment and assurance requirements. Accordingly, the SAB Subcommittee recommended that the Agency include a requirement limiting individual doses for the first 500 years after disposal, and one of the States that commented on the proposed rule suggested an individual dose limit for 1,000 years after disposal.

After considering all of this information, the Agency has decided to include two new sections in the final rule. The first (Section 191.15) limits exposures to members of the public after disposal, while the second (Section 191.16) limits concentrations in water withdrawn from certain important sources of ground water after disposal.

The individual protection requirements in § 191.15 limit exposures from a disposal system to individuals in the accessible environment to 25 millirems per year to the whole body and 75 millirems per year to any organ. These limits apply only to undisturbed performance of the disposal system (i.e., without any consideration of human intrusion or disruption by unlikely natural events), and they apply for the first 1,000 years after disposal. All potential pathways of radiation or radioactive material from the disposal system to people (associated with undisturbed performance) shall be considered, including the assumption that an individual drinks two liters per day of water from any "significant source of ground water" outside of the "controlled area" surrounding a disposal system. If the implementing agency plans to allow individuals to use ground water within the controlled area, such planned use would also have to be considered within the pathways evaluated to determine compliance with § 191.15.

"Significant sources of ground water" are defined to include any aquifer currently providing the primary source of water for a community water system or any aquifer that satisfies all of the following five conditions: (1) It is saturated with water containing less than 10,000 milligrams per liter of total dissolved solids; (2) it is within 2,500 feet of the land surface; (3) it has a transmissivity of a least 200 gallons per day per foot, provided that (4) each of the underground formations or parts of underground formations included within the aquifer must have an individual hydraulic conductivity greater than 2 gallons per day per square foot; and (5) it must be capable of providing a sustained yield of 10,000 gallons per day of water to a pumped or flowing well.

Although such quantitative distinctions are inevitably somewhat arbitrary, the Agency believes that they provide reasonable demarcations to identify underground formations that could meet the needs of community water systems in the future. The selected transmissivity of 200 gallons per day per foot and the sustained yield of 10,000 gallons per day roughly correspond to the size of a ground water source required to support the needs of about 20 households; this is similar to the size of the community water system considered in 40 CFR Part 141. The water quality criterion of 10,000 milligrams per liter of total dissolved solids has been used in several previous Agency regulations and is based upon congressional guidance in the legislative history of the Safe Drinking Water Act. The maximum depth criterion of 2,500 feet was chosen because almost all of the wells used to provide water to significant numbers of people do not extend below this depth. The minimum hydraulic conductivity criterion of 2 gallons per day per square foot was chosen to insure that only reasonably permeable formations are considered, rather than including unproductive formations that might be in the vicinity of a "significant source of ground water."

The ground water protection requirements in § 191.16(a) limit the concentrations in water withdrawn from any "special source of ground water" in the vicinity of a disposal system to concentrations similar to those established for the output of community water systems by 40 CFR Part 141: (1) 5 picocuries per liter of radium-226 and radium-228; (2) 15 picocuries per liter of alpha-emitting radionuclides (including radium-226 and radium-228 but excluding radon); or (3) the combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year if an individual continuously consumed 2 liters per day of drinking water from that source of water. However, if the preexisting radionuclide concentrations in the special source of ground water already exceed any of these limits, then § 191.16(b) limits any *increases* in the preexisting concentrations to the concentration limits set in § 191.16(a). Like the individual protection requirements, the ground water protection requirements apply only for undisturbed performance of the disposal system and apply for the first 1,000 years after disposal. Unlike the individual protection requirements, the ground water requirements would apply to a "special source" if it was within the controlled area.

"Special sources" are defined to include only those Class I ground waters—to be identified in accordance with the Agency's Ground-Water Protection Strategy published in August 1984—that meet the following three conditions: (1) They are within the controlled area or near (less than five kilometers beyond) the controlled area; (2) they are supplying drinking water for thousands of persons as of the date that the Department selects the site for extensive exploration as a potential location of a disposal system; and (3) they are irreplaceable in that no reasonable alternative source of drinking water is available to that population.

*Need for the Assurance Requirements*

The preceding issues dealt with the quantitative requirements of the disposal standards. While numerical standards are important to bring about appropriate selection and design of disposal systems, the Agency has long recognized that the numerical standards chosen for Subpart B, by themselves, do not provide either an adequate context for environmental protection or a sufficient basis to foster public confidence in the national program. There are too many uncertainties in projecting the behavior of natural and engineered components for many thousands of years—and too many opportunities for mistakes or poor judgments in such calculations—for the numerical requirements on overall system performance in Subpart B to be the sole basis to determine the acceptability of disposal systems for these very hazardous wastes. These uncertainties and potential errors in quantitative analysis could ultimately prevent the degree of protection sought by the Agency from being achieved. (Theoretically, it might be possible to develop adequate confidence in achieving this level of protection by choosing much more stringent numerical standards, but this could lead to substantial difficulties in implementation.) Therefore, the proposed standards also included qualitative assurance requirements chosen to ensure that cautious steps are taken to reduce the problems caused by these uncertainties. The proposed rule emphasized that the assurance requirements were an essential complement to the quantitative containment requirements that were selected.

In its comments on the proposed rule, the NRC argued that the assurance requirements were not properly part of the Agency's generally applicable standards. The Commission agreed that the overall numerical performance standards were not sufficient, but suggested that its regulations and procedures were the appropriate vehicle to provide the necessary confidence that the inherent uncertainties would not compromise environmental protection. The Agency believes that it does have the authority to give regulatory expression to the context within which it has chosen to establish one set of numerical standards rather than another. However, because it might not be appropriate to exercise this authority, the Agency sought public comment on the need for the assurance requirements in the second round of comments.

The preponderance of comments received on this question strongly supported retention of the assurance requirements in 40 CFR Part 191. In particular, virtually all of the various State governments that commented on the rule described the assurance requirements as an essential part of the regulations governing disposal of these wastes. Subsequently, two of these States, Nevada and Minnesota, petitioned the Commission to incorporate the assurance requirements proposed as part of 40 CFR Part 191 into its own rules (50 FR 18267).

Based upon these comments, the Agency and the NRC have reached an agreement that should accomplish the desired regulatory goals while avoiding the jurisdictional issue. EPA has included the assurance requirements in the final rule, modified as appropriate in response to other comments. However, these requirements will not be applicable to disposal facilities to be licensed by the Commission. Instead, as discussed previously, the NRC staff plans to propose modifications to 10 CFR Part 60, developed in consultation with EPA, for public review and comment within approximately 120 days to insure that the objectives of all of the assurance requirements in 40 CFR Part 191 will be accomplished through compliance with 10 CFR Part 60. The Agency has provided the Commission with all of the comments received by EPA regarding the assurance requirements, so that the NRC can use them in its rulemaking. In addition, the Agency will participate in the NRC rulemaking to facilitate incorporation of the principles of all of the assurance requirements in Federal regulation. Finally, the Agency will review the record and outcome of the Part 60 rulemaking to determine if any subsequent modifications to 40 CFR Part 191 are needed.

*Approach Toward Institutional Controls*

The Agency particularly sought comment on its proposed approach to reliance on institutional controls. The proposed rule limited reliance on "active institutional controls" (such as controlling access to a disposal site, performing maintenance operations, or cleaning up releases) to a reasonable period of time after disposal, described as on the order of a "few hundred years." On the other hand, "passive institutional controls" (such as permanent markers, records, archives, and other methods of preserving knowledge) were considered to be at least partially effective for a longer period of time.

Few commenters argued with the distinction between active and passive institutional controls, or with the amount of reliance the proposed rule envisioned for passive controls. However, many commenters felt that "a few hundred years" was too long a period to count on active controls. Accordingly, the final rule limits reliance on active institutional controls to no more than 100 years after disposal. This was the time period the Agency considered in criteria for radioactive waste disposal that were proposed for public comment in 1978 (43 FR 53262), a period that was generally supported by the commenters on that proposal. After this time, no contribution from any of the active institutional controls can be projected to prevent or limit potential releases of waste from a disposal system.

The concept of passive institutional controls has now been incorporated into the definition of "controlled area" that is used to establish one of the boundaries for applicability of the containment requirements and the individual protection requirements in the final rule. Because the assumptions made about the effectiveness of passive institutional controls can strongly affect implementation of the containment requirements, the Agency's intent has been elaborated in the "guidance for implementation" section. The Federal Government is committed to retaining control over disposal sites for these wastes as long as possible. Accordingly (and in compliance with one of the assurance requirements), an extensive system of explanatory markers and records will be instituted to warn future generations about the location and dangers of these wastes. These passive controls have not been assumed to prevent all possibilities of inadvertent human intrusion, because there will always be a realistic chance that some individuals will overlook or misunderstand the markers and records. (For example, exploratory drilling operations occasionally intrude into areas that clearly would have been avoided if existing information had been obtained and properly evaluated.) However, the Agency assumed that society in general will retain knowledge about these wastes and that future societies should be able to deter systematic or persistent exploitation of a disposal site.

The Agency also assumed that passive institutional controls should reduce the chance of inadvertent intrusion compared to the likelihood if no markers and records were in place. Specific judgments about the chances and consequences of intrusion should be made by the implementing agencies when more information about particular disposal sites and passive control systems is available. The parameters described in the "guidance for implementation" represent the most severe assumptions that the Agency believed were reasonable to use in its analyses to evaluate the feasibility of compliance with this rule (analyses that are summarized in the BID). The implementing agencies are free to use other assumption if they develop information considered adequate to support those judgments.

The role envisioned for institutional controls in this rulemaking has been adapted from the general approach the Agency has followed in its activities involving disposal of radioactive wastes since the initial public workshops conducted in 1977 and 1978. The Agency's overall objective has been to protect public health and the environment from disposal of radioactive wastes without relying upon institutional controls for extended periods of time—because such controls do not appear to be reliable enough over the very long periods that these wastes remain dangerous. Instead, the Agency has pursued standards that call for isolation of the wastes through the physical characteristics of disposal system siting and design, rather than through continuing maintenance and surveillance. This principle was enunciated in the general criteria published for public comment in 1978 (43 FR 53262), and it has been incorporated into the Agency's standards for disposal of uranium mill tailings (48 FR 590, 48 FR 45926).

This approach has been tailored to fit two circumstances associated with mined geologic repositories. First, 40 CFR Part 191 places containment requirements on a broad range of potential unplanned releases as well as the expected behavior of the disposal system. Therefore, determining compliance with the standards involves performance assessments that consider the probabilities and consequences of a variety of disruptive events, including potential human intrusion. Not allowing passive institutional controls to be taken into account to some degree when estimating the consequences of inadvertent human intrusion could lead to less protective geologic media being selected for repository sites. The Agency's analyses indicate that repositories in salt formations have particularly good capabilities to isolate the wastes from flowing ground water and, hence, the accessible environment. However, salt formations are also relatively easy to mine and are often associated with other types of resources. If performance assessments had to assume that future societies will have no way to ever recognize and limit the consequences of inadvertent intrusion (from solution mining of salt, for example), the scenarios that would have to be studied would be more likely to eliminate salt media from consideration than other rock types. Yet, this could rule out repositories that may provide the best isolation, compared to other alternatives, if less pessimistic assumptions about survival of knowledge were made.

The second circumstance that the Agency considered in evaluating the approach towards institutional controls taken in this rule is the fact that the mined geologic repositories planned for disposal of the materials covered by 40 CFR Part 191 are different from the disposal systems evisioned for any other types of waste. The types of inadvertent human activities that could lead to significant radiation exposures or releases of material from geologic repositories appear to call for much more intensive and organized effort than those which could cause problems at, for example, an unattended surface disposal site. It appears reasonable to assume that information regarding the disposal system is more likely to reach (and presumably deter) people undertaking such organized efforts than it is to inform individuals involved in mundane activities.

These considerations led the Agency to conclude that a limited role for passive institutional controls would be appropriate when projecting the long-term performance of mined geologic repositories to judge compliance with these standards. However, such assumptions would not necessarily be applicable to other Agency actions where different issues are involved.

*Avoiding Sites With Natural Resources*

The proposed rule contained an assurance requirement that would have prohibited use of sites where there is a reasonable expectation that future exploration for scarce or easily accessible resources might occur. The comments received on this issue generally agreed that sites with resources should be avoided. However, some commenters suggested that the requirement should be more restrictive, to include "potentially accessible" resources. Other commenters argued that the Agency should be less restrictive regarding sites with possible resource potential—discouraging but not prohibiting their use—because other attributes of the site might overcome the relative disadvantages presented by resource potential.

After considering these comments, the Agency agreed with the latter viewpoint. This judgment was reinforced by the belief that disposal sites should be chosen after comparative evaluation of a variety of alternatives, and the proposed assurance requirement could have inhibited this process. Therefore, this assurance requirement has been revised in the final rule to identify resource potential as a disincentive but not as an outright prohibition for site selection. Instead, the revised assurance requirement states that places with resource potential shall not be used "unless the favorable characteristics of such places compensate for their greater likelihood of being disturbed in the future."

This wording implies a qualitative comparison, because the Agency is not aware of quantitative formulas comprehensive enough to provide adequate comparisons to govern site selection. However, the Agency does not intend that sites with resource potential can be used merely upon identification of a few features that might be more favorable than at a site without significant resources. Rather, sites with resources should only be used if it is reasonably certain that they would provide better *overall* protection than the practical alternatives that are available.

The following example illustrates the effect of the change in this assurance requirement. When discussing the proposed assurance requirement, the Agency implied that disposal in salt domes might not be acceptable because such formations seemed more likely than others to attract exploration in the future. The modification of this assurance requirement in the final rule means that salt domes should not be peremptorily removed from consideration, but should be compared against all of the characteristics of alternative sites in terms of the overall environmental protection expected.

*Long-Term Monitoring*

The proposed rule addressed active institutional controls over a disposal site only in a negative sense—to prohibit reliance upon them for more than a few hundred years after disposal. The Agency's intent was to be sure that long-term protection of the environment did not depend upon positive actions by future generations. Almost all commenters agreed with this intent, although many suggested a shorter period of reliance was appropriate (see the preceding discussion under "Approach Towards Institutional Controls").

However, several commenters (including most of the States) also urged addition of a requirement for long-term monitoring of a repository after disposal. This view did not deny the need to select and design disposal systems without depending upon active controls in the future. However, it broadened this perspective by arguing that a disposal system so designed should still be monitored for a long time after disposal to guard against unexpected failures.

The Agency had not considered this viewpoint in developing the proposed rule. Accordingly, further information on this idea was sought during the "second round" of public comment, and the Agency surveyed the capabilities and expectations of long-term monitoring approaches. Evaluating this information led the Agency to several conclusions:

(1) Perhaps most importantly, the techniques used for monitoring after disposal must not jeopardize the long-term isolation capabilities of the disposal system. Furthermore, plans to conduct monitoring after disposal should never become an excuse to relax the care with which systems to isolate these wastes must be selected, designed, constructed, and operated.

(2) Monitoring for radionuclide releases to the accessible environment is not likely to be productive. Even a poorly performing geologic repository is very unlikely to allow measurable releases to the accessible environment for several hundreds of years of more, particularly in view of the engineered controls needed to comply with 10 CFR Part 60. A monitoring system based only on detecting radionuclide releases—a system which would almost certainly not be detecting anything for several times the history of the United States—is not likely to be maintained for long enough to be of much use.

(3) Within the above constraints, however, there are likely to be monitoring approaches which may, in a relatively short time, significantly improve confidence that a repository is performing as intended. Two examples are of particular interest. One involves the concept of monitoring ground water sources at a variety of distances for benign tracers intentionally released to the ground water in the repository; this approach can evaluate the delay involved in ground water movement from the repository to the environment and can serve to validate expectations of the performance expected from the system's natural barriers. Another concept involves monitoring the small uplift of the land surface over the repository in order to validate predictions of the system's thermal behavior. Both of these approaches can be carried out without enhancing pathways for the wastes to escape from the repository.

Based on these conclusions and the public comments on this question, the Agency has included a provision for long-term monitoring after disposal in the assurance requirements of the final rule: "Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance. This monitoring shall be done with techniques that do not jeopardize the isolation of the wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring." This new provision is consistent with the overall intent of the assurance requirements: To take prudent and cautious steps necessary to minimize the risks posed by the inherent uncertainties in expectations of the future. Beyond this broad mandate, however, the Agency has not specified the details of a monitoring program. That is properly left to the implementing agencies. Furthermore, the precise objectives of an appropriate monitoring program probably should not be spelled out until much more information is gathered about the characteristics and expected behavior of specific sites and designs.

*Ability To Recover Wastes After Disposal*

The proposed rule included an assurance requirement that recovery of these wastes be feasible for "a reasonable period of time" after disposal. The Agency specifically sought comment on whether this was a desirable provision, since it would rule out certain disposal concepts, such as deep-well injection of liquid wastes. The comments received were split about evenly between those who thought the provision should be retained and those who thought it was detrimental to the overall rule. Many of those who opposed the requirement argued that it would encourage designing a geologic repository to make retrieving waste relatively easy—which might compromise the isolation capabilities of the repository or which might encourage recovery of the waste to make use of some intrinsic value it might retain (the potential energy content of spent nuclear fuel, for example).

The intent of this provision was not to make recovery of waste easy or cheap, but merely possible in case some future discovery or insight made it clear that the wastes needed to be relocated. EPA reiterates the statement in the preamble to the proposal that *any* current concept for a mined geologic repository meets this requirement *without* any additional procedures or design features. For example, there is no intent to require that a repository shaft be kept open to allow future recovery. To meet this assurance requirement, it only need be technologically feasible (assuming current technology levels) to be able to mine the sealed repository and recover the waste—albeit at substantial cost and occupational risk. The Commission's requirements for multiple engineered barriers within a repository (10 CFR Part 60) adequately address any concerns about the feasibility of recovering wastes from a repository.

Therefore, this provision should not have any effect upon plans for mined geologic repositories. Rather, it is intended to call into question any other disposal concept that might not be so reversible—because the Agency believes that future generations should have options to correct any mistakes that this generation might unintentionally make. Almost all of the commenters agreed with the validity of this objective. Accordingly, the Agency has decided to retain this assurance requirement in the final rule as proposed.

### Health Impacts of 40 CFR Part 191

*Waste Management and Storage.* Waste management and storage activities conducted in accordance with Subpart A would limit the maximum risk to a member of the public in the general environment to a $5 \times 10^{-4}$ chance of incurring a premature fatal cancer over a lifetime. Of course, a risk this large would exist only for an individual continuously exposed to the full amount of the dose limits over his or her lifetime. Because the Agency believes that such continuous exposure is very unlikely, the actual risks to individuals are expected to be much lower. It is theoretically possible under the final rule that an individual could be exposed to 25 millirems per year (to the whole body) from *both* an NRC-licensed facility and a DOE facility not licensed by NRC, for a total of 50 millirem/year. However, the Agency believes that this is particularly improbable and does not foresee a significant public health impact from this possibility.

*Waste Disposal.* A disposal system complying with Subpart B would confine almost all of the radioactive wastes to the immediate vicinity of the repository for a very long time. Because the wastes would be so well isolated from the environment, the Agency is confident that any risks to future populations would be very small. Similarly, risks to most future individuals would also be very small (and effectively zero in almost all cases)—except for the possibility that an individual in the distant future might use ground water from the vicinity of a repository. In this case, there is a chance that such an individual might receive a substantial exposure. The following paragraphs describe the possible health impacts of the residual risks from a disposal system that would be in compliance with 40 CFR Part 191.

*Population Risks:* With regard to exposure of populations, the Agency has estimated the potential long-term health risks to future generations from various types of mined geologic repositories using very general models of environmental transport and a linear, nonthreshold dose-effect relationship between radiation exposures and premature deaths from cancer. Food chains, ways of life, and the size and geographical distributions of populations will undoubtedly change over a 10,000-year period. Unlike geological processes, factors such as these cannot be usefully predicted over such long periods of time. Thus, in making these health effects projections, the Agency found it necessary to depend upon very general models of environmental pathways and to assume current population distributions and death rates. The SAB Subcommittee evaluated these models carefully, and, although a number of specific changes were recommended for particular parameters, the Subcommittee endorsed the general approach. As a consequence of using these generalized models, EPA's projections are intended to be used primarily as a tool for comparing the performance of one waste disposal system to another and for comparison of the risks of waste disposal with those of undisturbed ore bodies. The results of these analyses should not be considered a reliable projection of the "real" or absolute number of health effects resulting from compliance with the disposal standards.

These health risk models were used to assess the long-term health risks from several different model repositories containing the wastes from 100,000 MTHM—which could include all existing wastes and the future wastes from all currently operating reactors. The Agency estimates that this quantity of waste, when disposed of in accordance with the proposed standards, would cause no more than 1,000 premature deaths from cancer in the first 10,000 years after disposal: an average of no more than one premature death every 10 years. Most of the model repositories considered had projected population risks at least a factor of ten below this, or about 100 deaths over 10,000 years. The projections for the actual repositories that are constructed are expected to be closer to this lower figure. Any such increase in the number of cancer deaths would be very small compared to today's incidence of cancer, which kills about 350,000 people per year in the United States. Similarly, any such increase would be much less than the approximately 6,000 premature cancer deaths per year that the same linear, non-threshold dose-effect relationship predicts for the nation due to natural background radiation.

*Individual Risks:* With regard to exposures of individuals, the Agency examined the potential doses to persons who might use ground water from the immediate vicinity of a repository at various times in the future. For these analyses, only the expected undisturbed performance of a repository was considered (e.g. there was no evaluation of exposures that might occur if a repository was disrupted by movement of a fault). In most of the cases studied, no exposures occurred for more than one thousand years after disposal. After that, these analyses predict that significant exposures (on the order of a few rems per year in the vicinity of the repository over the next several thousands of years) may appear for some of the geologic media considered. These projections are similar to those contained in the April 1983 report published by the National Academy of Sciences. The BID contains more detailed descriptions of the Agency's individual dose calculations.

*Intergenerational Risk:* As described earlier, the Agency has chosen to rely on provisions that limit risks to populations as the primary standards for the long-term performance of disposal systems. Although the projections of the residual population risk are clearly very small, the discontinuity between when the wastes are generated and when the projected health effects manifest themselves made it difficult to determine what level of residual risk should be allowed by these disposal standards. The difficulty arose because most of the benefits derived in the process of waste production fall upon the current generation, while most of the risks fall upon future generations. Thus, a potential problem of intergenerational equity with respect to the distribution of risks and benefits became apparent. This problem is sometimes referred to as the intergenerational risk issue, and it is not unique to the disposal of high-level radioactive wastes. If the Agency tried to insure that these standards fully satisfied a criterion of intergenerational equity with respect to the distribution of risks and benefits, it might appear that no risk should be passed on to future generations. This is a condition which the Agency believes cannot be met by disposal technologies foreseeable within this century. However, there is one particular factor which has reinforced EPA's decision about the reasonableness of the risks permitted under the disposal standards. This is the following evaluation of the risks associated with undisturbed uranium ore bodies. Additionally, for the purpose of comparing the risks permitted under the standards to other radiation risks which people are currently exposed to, a brief discussion of the risks from other natural sources of radiation is also included.

*Uranium Ore:* Most uranium ore in the United States occurs in permeable geologic strata containing flowing ground water. Radionuclides in the ore, particularly uranium and radium, continuously enter this ground water. EPA estimated the potential risks from these undisturbed ore bodies using the same generalized environmental models that were used for releases from a waste repository. The effects associated with the amount of ore needed to produce the high-level wastes that would fill the model geologic repository can vary considerably. Part of this variation corresponds to actual differences from one ore body to another: part can be attributed to uncertainties in the assessment. After revising the population risk models in accordance with the recommendations of the SAB Subcommittee, these estimates of the risks from unmined ore bodies ranged from about 10 to more than 100,000 excess cancer deaths over 10,000 years. Thus, leaving the ore unmined appears to present a risk to future generations comparable to the risks from disposal of wastes covered by these standards.

*Variations in Natural Background:* Radionuclides occur naturally in the earth in very large amounts, and are produced in the atmosphere by cosmic radiation. Everyone is exposed to natural background radiation from these natural radionuclides and from direct exposure to cosmic radiation. Individual exposures average about 100 millirems per year, with a range of about 60 to 200 millirem/year. These natural background radiation levels have remained relatively constant for a very long time. According to the same linear, nonthreshold dose effect relationship used in EPA's other analyses, an increase of one millirem per year (about one percent) in natural background in the United States would result in about 60 additional deaths per year, or 600,000 over a 10,000-year period.

*Natural Radionuclide Concentrations in Ground Water:* One source of this exposure to natural background radiation comes from naturally occurring radionuclides found in ground water. Radium is the most important of the naturally occurring radioactive materials likely to occur in public water supply systems, but uranium is also found in ground waters due to its natural occurrence. Surveys of radionuclides in ground water systems indicate: a United States range of 0.1 to 50 picocuries (pCi) per liter for radium-226 (with isolated sources exceeding 100 pCi/liter); up to 74 pCi/liter for all alpha-emitting radionuclides other than uranium (although most of the alpha-emitting concentrations are below 3 pCi/liter); and up to 650 pCi/liter for total uranium concentrations. Elevated radium-226 concentrations are found along the Atlantic coastal region and the Midwest; low levels are usually found in the treated water supplies in the western States. Elevated uranium and alpha-emitting radionuclide concentrations are generally limited to the Rocky Mountain region and Maine and Pennsylvania in the east.

The Agency's primary drinking water regulations (40 CFR Part 141) limit the contamination levels for radium-226 and radium-228 to 5 pCi/liter and the levels for total alpha-emitting contamination (excluding radon and uranium) to 15 pCi/liter. Elevated concentrations of radium in drinking water are generally a problem associated with smaller community water systems, with an estimated 500 systems exceeding 5 pCi/liter. The Agency's risk assessments indicate that continuous consumption of water containing the maximum amount of radium allowed may cause between 0.7 and 3 cancers per year per million exposed persons.

**Environmental Impacts**

A Draft Environmental Impact Statement (EIS) was prepared for the proposed rule, in accordance with the Agency's procedures for the voluntary preparation of EIS's (30 FR 37419). However, section 121(c) of the NWPA subsequently exempted this action from preparation of an EIS under section 102(2)(C) of the National Environmental Policy Act of 1969 (NEPA) and from any environmental review under subparagraph (E) or (F) of section 102(2) of the NEPA. Accordingly, a Final EIS has not been prepared for promulgation of this rule. The potential health impacts of this action are summarized above, and much of the information that would have been contained in a Final EIS is documented in the Background Information Document that accompanies this final version of 40 CFR Part 191.

**Regulatory Impacts**

This rule was submitted to the Office of Management and Budget (OMB) for review as required by Executive Order 12291. The final rule has not been classified as a "major rule" in accordance with the guidelines provided by the Executive Order. Any comments received from OMB and EPA's responses to those comments are available for public inspection in the docket cited above under the heading "ADDRESSES."

The Agency has had to take an unusual approach in considering the regulatory impacts of this proposed action—as required by Executive Order 12291. In most cases, a regulation concerns an ongoing activity and may be considered a burden whose costs should be judged against the regulatory benefits. Here, it was not possible to quantify the costs and benefits of this action compared to the consequences of no regulation because there is no specific "baseline" program to consider. The appropriate regulations must be established before the regulated activity can even begin. Thus, the typical perspectives on costs and benefits are altered. Instead, the Agency evaluated how the costs of commercial waste management and disposal might change in response to different levels of protection from the containment requirements. Similar evaluations were not performed for the wastes from atomic energy defense activities because sufficient information was not available.

To evaluate the effects of different levels of protection, EPA considered the performance of different repository designs in several different geologic media. The costs of the various engineering controls that might be needed to meet different levels of protection were estimated. In addition, allowances were made for the increased research and development costs that might be needed to demonstrate compliance with the standards if projected performance for a particular disposal system indicated releases less than an order of magnitude below the long-term radionuclide release limits in § 191.13.

Since the regulatory impact analyses that supported the proposed rule were performed, the NRC has promulgated minimum requirements for the engineered barriers of a disposal system (in 10 CFR Part 60), more data concerning disposal sites being considered by the Department have become available, and the Agency has reviewed its performance assessments to reduce overestimates of long-term risks in accordance with the SAB review. After evaluating all of this new information, the Agency believes that there need not be any significant additional costs to the national program for disposal of commercial wastes caused by retaining the proposed level of protection in the final rule, compared to the costs of choosing levels considerably less stringent. In other words, all of the disposal sites being evaluated by the Department, assuming compliance with the existing requirements of 10 CFR Part 60, are expected to be able to meet these disposal standards without additional precautions beyond those already planned.

## List of Subjects in 40 CFR Part 191

Environmental protection, Nuclear energy, Radiation protection, Uranium, Waste treatment and disposal.

## Regulatory Flexibility Certification

In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Administrator hereby certifies that this rule will not have any significant impact on small businesses or other entitites, and that a Regulatory Flexibility Analysis is not required. This rule will affect only a small number of facilities, most of which are or will be operated by the United States Government.

Dated: August 15, 1985.

Lee M. Thomas,

*Administrator.*

A new Part 191 is hereby added to Title 40, Code of Federal Regulations, as follows:

## SUBCHAPTER F—RADIATION PROTECTION PROGRAMS

## PART 191—ENVIRONMENTAL RADIATION PROTECTION STANDARDS FOR MANAGEMENT AND DISPOSAL OF SPENT NUCLEAR FUEL, HIGH-LEVEL AND TRANSURANIC RADIOACTIVE WASTES



Authority: The Atomic Energy Act of 1954, as amended; Reorganization Plan No. 3 of 1970; and the Nuclear Waste Policy Act of 1982.

## Subpart A—Environmental Standards for Management and Storage

### § 191.01 Applicability.

This Subpart applies to:

(a) Radiation doses received by members of the public as a result of the management (except for transportation) and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at any facility regulated by the Nuclear Regulatory Commission or by Agreement States, to the extent that such management and storage operations are not subject to the provisions of Part 190 of title 40; and

(b) Radiation doses received by members of the public as a result of the management and storage of spent nuclear fuel or high-level or transuranic wastes at any disposal facility that is operated by the Department of Energy and that is not regulated by the Commission or by Agreement States.

### § 191.02 Definitions.

Unless otherwise indicated in this Subpart, all terms shall have the same meaning as in Subpart A of Part 190.

(a) "Agency" means the Environmental Protection Agency.

(b) "Administrator" means the Administrator of the Environmental Protection Agency.

(c) "Commission" means the Nuclear Regulatory Commission.

(d) "Department" means the Department of Energy.

(e) "NWPA" means the Nuclear Waste Policy Act of 1982 (Pub. L. 97-425).

(f) "Agreement State" means any State with which the Commission or the Atomic Energy Commission has entered into an effective agreement under subsection 274b of the Atomic Energy Act of 1954, as amended (68 Stat. 919).

(g) "Spent nuclear fuel" means fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated by reprocessing.

(h) "High-level radioactive waste," as used in this Part, means high-level radioactive waste as defined in the Nuclear Waste Policy Act of 1982 (Pub. L. 97-425).

(i) "Transuranic radioactive waste," as used in this Part, means waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes, with half-lives greater than twenty years, per gram of waste, except for: (1) High-level radioactive wastes; (2) wastes that the Department has determined, with the concurrence of the Administrator, do not need the degree of isolation required by this Part; or (3) wastes that the Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

(j) "Radioactive waste," as used in this Part, means the high-level and transuranic radioactive waste covered by this Part.

(k) "Storage" means retention of spent nuclear fuel or radioactive wastes with the intent and capability to readily retrieve such fuel or waste for subsequent use, processing, or disposal.

(l) "Disposal" means permanent isolation of spent nuclear fuel or radioactive waste from the accessible environment with no intent of recovery, whether or not such isolation permits the recovery of such fuel or waste. For example, disposal of waste in a mined geologic repository occurs when all of the shafts to the repository are backfilled and sealed.

(m) "Management" means any activity, operation, or process (except for transportation) conducted to prepare spent nuclear fuel or radioactive waste for storage or disposal, or the activities associated with placing such fuel or waste in a disposal system.

(n) "Site" means an area contained within the boundary of a location under the effective control of persons possessing or using spent nuclear fuel or radioactive waste that are involved in any activity, operation, or process covered by this Subpart.

(o) "General environment" means the total terrestrial, atmospheric, and aquatic environments outside sites within which any activity, operation, or process associated with the management and storage of spent nuclear fuel or radioactive waste is conducted.

(p) "Member of the public" means any individual except during the time when that individual is a worker engaged in any activity, operation, or process that is covered by the Atomic Energy Act of 1954, as amended.

(q) "Critical organ" means the most exposed human organ or tissue exclusive of the integumentary system (skin) and the cornea.

§ 191.03 Standards.

(a) Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities regulated by the Commission or by Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from: (1) Discharges of radioactive material and direct radiation from such management and storage and (2) all operations covered by Part 190; shall not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other critical organ.

(b) Management and storage of spent nuclear fuel or high-level or transuranic radioactive wastes at all facilities for the disposal of such fuel or waste that are operated by the Department and that are not regulated by the Commission or Agreement States shall be conducted in such a manner as to provide reasonable assurance that the combined annual dose equivalent to any member of the public in the general environment resulting from discharges of radioactive material and direct radiation from such management and storage shall not exceed 25 millirems to the whole body and 75 millirems to any critical organ.

§ 191.04 Alternative standards.

(a) The Administrator may issue alternative standards from those standards established in 191.03(b) for waste management and storage activities at facilities that are not regulated by the Commission or Agreement States if, upon review of an application for such alternative standards:

(1) The Administrator determines that such alternative standards will prevent any member of the public from receiving a continuous exposure of more than 100 millirems per year dose equivalent and an infrequent exposure of more than 500 millirems dose equivalent in a year from all sources, excluding natural background and medical procedures; and

(2) The Administrator promptly makes a matter of public record the degree to which continued operation of the facility is expected to result in levels in excess of the standards specified in 191.03(b).

(b) An application for alternative standards shall be submitted as soon as possible after the Department determines that continued operation of a facility will exceed the levels specified in 191.03(b) and shall include all information necessary for the Administrator to make the determinations called for in 191.04(a).

(c) Requests for alternative standards shall be submitted to the Administrator, U.S. Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460.

§ 191.05 Effective date.

The standards in this Subpart shall be effective on November 18, 1985.

## Subpart B—Environmental Standards for Disposal

§ 191.11 Applicability.

(a) This Subpart applies to:

(1) Radioactive materials released into the accessible environment as a result of the disposal of spent nuclear fuel or high-level or transuranic radioactive wastes;

(2) Radiation doses received by members of the public as a result of such disposal; and

(3) Radioactive contamination of certain sources of ground water in the vicinity of disposal systems for such fuel or wastes.

(b) However, this Subpart does not apply to disposal directly into the oceans or ocean sediments. This Subpart also does not apply to wastes disposed of before the effective date of this rule.

§ 191.12 Definitions.

Unless otherwise indicated in this Subpart, all terms shall have the same meaning as in Subpart A of this Part.

(a) "Disposal system" means any combination of engineered and natural barriers that isolate spent nuclear fuel or radioactive waste after disposal.

(b) "Waste," as used in this Subpart, means any spent nuclear fuel or radioactive waste isolated in a disposal system.

(c) "Waste form" means the materials comprising the radioactive components of waste and any encapsulating or stabilizing matrix.

(d) "Barrier" means any material or structure that prevents or substantially delays movement of water or radionuclides toward the accessible environment. For example, a barrier may be a geologic structure, a canister, a waste form with physical and chemical characteristics that significantly decrease the mobility of radionuclides, or a material placed over and around waste, provided that the material or structure substantially delays movement of water or radionuclides.

(e) "Passive institutional control" means: (1) Permanent markers placed at a disposal site, (2) public records and archives, (3) government ownership and regulations regarding land or resource use, and (4) other methods of preserving knowledge about the location, design, and contents of a disposal system.

(f) "Active institutional control" means: (1) Controlling access to a disposal site by any means other than passive institutional controls; (2) performing maintenance operations or remedial actions at a site, (3) controlling or cleaning up releases from a site, or (4) monitoring parameters related to disposal system performance.

(g) "Controlled area" means: (1) A surface location, to be identified by passive institutional controls, that encompasses no more than 100 square kilometers and extends horizontally no more than five kilometers in any direction from the outer boundary of the original location of the radioactive wastes in a disposal system; and (2) the subsurface underlying such a surface location.

(h) "Ground water" means water below the land surface in a zone of saturation.

(i) "Aquifer" means an underground geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to a well or spring.

(j) "Lithosphere" means the solid part of the Earth below the surface, including any ground water contained within it.

(k) "Accessible environment" means: (1) The atmosphere; (2) land surfaces; (3) surface waters; (4) oceans; and (5) all of the lithosphere that is beyond the controlled area.

(l) "Transmissivity" means the hydraulic conductivity integrated over the saturated thickness of an underground formation. The transmissivity of a series of formations is the sum of the individual transmissivities of each formation comprising the series.

(m) "Community water system" means a system for the provision to the public of piped water for human consumption, if such system has at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

(n) "Significant source of ground water," as used in this Part, means: (1) An aquifer that: (i) Is saturated with water having less than 10,000 milligrams per liter of total dissolved solids; (ii) is within 2,500 feet of the land surface; (iii) has a transmissivity greater than 200 gallons per day per foot, provided that any formation or part of a formation included within the source of ground water has a hydraulic conductivity greater than 2 gallons per day per square foot; and (iv) is capable of continuously yielding at least 10,000 gallons per day to a pumped or flowing well for a period of at least a year; or (2) an aquifer that provides the primary source of water for a community water system as of the effective date of this Subpart.

(o) "Special source of ground water," as used in this Part, means those Class I ground waters identified in accordance with the Agency's Ground-Water Protection Strategy published in August 1984 that: (1) Are within the controlled area encompassing a disposal system or are less than five kilometers beyond the controlled area; (2) are supplying drinking water for thousands of persons as of the date that the Department chooses a location within that area for detailed characterization as a potential site for a disposal system (e.g., in accordance with Section 112(b)(1)(B) of the NWPA); and (3) are irreplaceable in that no reasonable alternative source of drinking water is available to that population.

(p) "Undisturbed performance" means the predicted behavior of a disposal system, including consideration of the uncertainties in predicted behavior, if the disposal system is not disrupted by human intrusion or the occurrence of unlikely natural events.

(q) "Performance assessment" means an analysis that: (1) Identifies the processes and events that might affect the disposal system; (2) examines the effects of these processes and events on the performance of the disposal system; and (3) estimates the cumulative releases of radionuclides, considering the associated uncertainties, caused by all significant processes and events. These estimates shall be incorporated into an overall probability distribution of cumulative release to the extent practicable.

(r) "Heavy metal" means all uranium, plutonium, or thorium placed into a nuclear reactor.

(s) "Implementing agency," as used in this Subpart, means the Commission for spent nuclear fuel or high-level or transuranic wastes to be disposed of in facilities licensed by the Commission in accordance with the Energy Reorganization Act of 1974 and the Nuclear Waste Policy Act of 1982, and it means the Department for all other radioactive wastes covered by this Part.

**§ 191.13 Containment requirements.**

(a) Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation, based upon performance assessments, that the cumulative releases of radionuclides to the accessible environment for 10,000 years after disposal from all significant processes and events that may affect the disposal system shall:

(1) Have a likelihood of less than one chance in 10 of exceeding the quantities calculated according to Table 1 (Appendix A); and

(2) Have a likelihood of less than one chance in 1,000 of exceeding ten times the quantities calculated according to Table 1 (Appendix A).

(b) Performance assessments need not provide complete assurance that the requirements of 191.13(a) will be met. Because of the long time period involved and the nature of the events and processes of interest, there will inevitably be substantial uncertainties in projecting disposal system performance. Proof of the future performance of a disposal system is not to be had in the ordinary sense of the word in situations that deal with much shorter time frames. Instead, what is required is a reasonable expectation, on the basis of the record before the implementing agency, that compliance with 191.13 (a) will be achieved.

**§ 191.14 Assurance requirements.**

To provide the confidence needed for long-term compliance with the requirements of 191.13, disposal of spent nuclear fuel or high-level or transuranic wastes shall be conducted in accordance with the following provisions, except that these provisions do not apply to facilities regulated by the Commission (see 10 CFR Part 60 for comparable provisions applicable to facilities regulated by the Commission):

(a) Active institutional controls over disposal sites should be maintained for as long a period of time as is practicable after disposal; however, performance assessments that assess isolation of the wastes from the accessible environment shall not consider any contributions from active institutional controls for more than 100 years after disposal.

(b) Disposal systems shall be monitored after disposal to detect substantial and detrimental deviations from expected performance. This monitoring shall be done with techniques that do not jeopardize the isolation of the wastes and shall be conducted until there are no significant concerns to be addressed by further monitoring.

(c) Disposal sites shall be designated by the most permanent markers, records, and other passive institutional controls practicable to indicate the dangers of the wastes and their location.

(d) Disposal systems shall use different types of barriers to isolate the wastes from the accessible environment. Both engineered and natural barriers shall be included.

(e) Places where there has been mining for resources, or where there is a reasonable expectation of exploration for scarce or easily accessible resources, or where there is a significant concentration of any material that is not widely available from other sources, should be avoided in selecting disposal sites. Resources to be considered shall include minerals, petroleum or natural gas, valuable geologic formations, and ground waters that are either irreplaceable because there is no reasonable alternative source of drinking water available for substantial populations or that are vital to the preservation of unique and sensitive ecosystems. Such places shall not be used for disposal of the wastes covered by this Part unless the favorable characteristics of such places compensate for their greater likelihood of being disturbed in the future.

(f) Disposal systems shall be selected so that removal of most of the wastes is not precluded for a reasonable period of time after disposal.

**§ 191.15 Individual protection requirements.**

Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the annual dose equivalent from the disposal system to any member of the public in the accessible environment to exceed 25 millirems to the whole body or 75 millirems to any critical organ. All potential pathways (associated with undisturbed performance) from the disposal system to people shall be considered, including the assumption that individuals consume 2 liters per day of drinking water from any significant source of ground water outside of the controlled area.

§ 191.16 Ground water protection requirements.

(a) Disposal systems for spent nuclear fuel or high-level or transuranic radioactive wastes shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the radionuclide concentrations averaged over any year in water withdrawn from any portion of a special source of ground water to exceed:

(1) 5 picocuries per liter of radium-226 and radium-228;

(2) 15 picocuries per liter of alpha-emitting radionuclides (including radium-226 and radium-228 but excluding radon); or

(3) The combined concentrations of radionuclides that emit either beta or gamma radiation that would produce an annual dose equivalent to the total body or any internal organ greater than 4 millirems per year if an individual consumed 2 liters per day of drinking water from such a source of ground water.

(b) If any of the average annual radionuclide concentrations existing in a special source of ground water before construction of the disposal system already exceed the limits in 191.16(a), the disposal system shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not increase the existing average annual radionuclide concentrations in water withdrawn from that special source of ground water by more than the limits established in 191.16(a).

§ 191.17 Alternative provisions for disposal.

The Administrator may, by rule, substitute for any of the provisions of Subpart B alternative provisions chosen after:

(a) The alternative provisions have been proposed for public comment in the Federal Register together with information describing the costs, risks, and benefits of disposal in accordance with the alternative provisions and the reasons why compliance with the existing provisions of Subpart B appears inappropriate;

(b) A public comment period of at least 90 days has been completed, during which an opportunity for public hearings in affected areas of the country has been provided; and

(c) The public comments received have been fully considered in developing the final version of such alternative provisions.

§ 191.18 Effective date.

The standards in this Subpart shall be effective on September 19, 1985.

## Appendix A—Table for Subpart B

TABLE 1.—RELEASE LIMITS FOR CONTAINMENT REQUIREMENTS

[Cumulative releases to the accessible environment for 10,000 years after disposal]

| Radionuclide | Release limit per 1,000 MTHM or other unit of waste (see notes) (curies) |
|---|---|
| Americium-241 or -243 | 100 |
| Carbon-14 | 100 |
| Cesium-135 or -137 | 1,000 |
| Iodine-129 | 100 |
| Neptunium-237 | 100 |
| Plutonium-238, -239, -240, or -242 | 100 |
| Radium-226 | 100 |
| Strontium-90 | 1,000 |
| Technetium-99 | 10,000 |
| Thorium-230 or -232 | 10 |
| Tin-126 | 1,000 |
| Uranium-233, -234, -235, -236, or -238 | 100 |
| Any other alpha-emitting radionuclide with a half-life greater than 20 years | 100 |
| Any other radionuclide with a half-life greater than 20 years that does not emit alpha particles | 1,000 |

### Application of Table 1

Note 1: *Units of Waste.* The Release Limits in Table 1 apply to the amount of wastes in any one of the following:

(a) An amount of spent nuclear fuel containing 1,000 metric tons of heavy metal (MTHM) exposed to a burnup between 25,000 megawatt-days per metric ton of heavy metal (MWd/MTHM) and 40,000 MWd/MTHM;

(b) The high-level radioactive wastes generated from reprocessing each 1,000 MTHM exposed to a burnup between 25,000 MWd/MTHM and 40,000 MWd/MTHM;

(c) Each 100,000,000 curies of gamma or beta-emitting radionuclides with half-lives greater than 20 years but less than 100 years (for use as discussed in Note 5 or with materials that are identified by the Commission as high-level radioactive waste in accordance with part B of the definition of high-level waste in the NWPA);

(d) Each 1,000,000 curies of other radionuclides (i.e., gamma or beta-emitters with half-lives greater than 100 years or any alpha-emitters with half-lives greater than 20 years) (for use as discussed in Note 5 or with materials that are identified by the Commission as high-level radioactive waste in accordance with part B of the definition of high-level waste in the NWPA); or

(e) An amount of transuranic (TRU) wastes containing one million curies of alpha-emitting transuranic radionuclides with half-lives greater than 20 years.

Note 2: *Release Limits for Specific Disposal Systems.* To develop Release Limits for a particular disposal system, the quantities in Table 1 shall be adjusted for the amount of waste included in the disposal system compared to the various units of waste defined in Note 1. For example:

(a) If a particular disposal system contained the high-level wastes from 50,000 MTHM, the Release Limits for that system would be the quantities in Table 1 multiplied by 50 (50,000 MTHM divided by 1,000 MTHM).

(b) If a particular disposal system contained three million curies of alpha-emitting transuranic wastes, the Release Limits for that system would be the quantities in Table 1 multiplied by three (three million curies divided by one million curies).

(c) If a particular disposal system contained both the high-level wastes from 50,000 MTHM *and* 5 million curies of alpha-emitting transuranic wastes, the Release Limits for that system would be the quantities in Table 1 multiplied by 55:

$$\frac{50{,}000\ \text{MTHM}}{1{,}000\ \text{MTHM}} + \frac{5{,}000{,}000\ \text{curies TRU}}{1{,}000{,}000\ \text{curies TRU}} = 55$$

Note 3: *Adjustments for Reactor Fuels with Different Burnup.* For disposal systems containing reactor fuels (or the high-level wastes from reactor fuels) exposed to an average burnup of less than 25,000 MWd/MTHM or greater than 40,000 MWd/MTHM, the units of waste defined in (a) and (b) of Note 1 shall be adjusted. The unit shall be multiplied by the ratio of 30,000 MWd/MTHM divided by the fuel's actual average burnup, except that a value of 5,000 MWd/MTHM may be used when the average fuel burnup is below 5,000 MWd/MTHM and a value of 100,000 MWd/MTHM shall be used when the average fuel burnup is above 100,000 MWd/MTHM. This adjusted unit of waste shall then be used in determining the Release Limits for the disposal system.

For example, if a particular disposal system contained only high-level wastes with an average burnup of 3,000 MWd/MTHM, the unit of waste for that disposal system would be:

$$1{,}000\ \text{MTHM} \times \frac{(30{,}000)}{(5{,}000)} = 6{,}000\ \text{MTHM}$$

If that disposal system contained the high-level wastes from 60,000 MTHM (with an average burnup of 3,000 MWd/MTHM), then the Release Limits for that system would be the quantities in Table 1 multiplied by ten:

$$\frac{60{,}000\ \text{MTHM}}{6{,}000\ \text{MTHM}} = 10$$

which is the same as:

$$\frac{60{,}000\ \text{MTHM}}{1{,}000\ \text{MTHM}} \times \frac{(5{,}000\ \text{MWd/MTHM})}{(30{,}000\ \text{MWd/MTHM})} = 10$$

Note 4: *Treatment of Fractionated High-Level Wastes.* In some cases, a high-level waste stream from reprocessing spent nuclear fuel may have been (or will be) separated into two or more high-level waste components destined for different disposal systems. In such cases, the implementing agency may allocate the Release Limit multiplier (based upon the original MTHM and the average fuel burnup of the high-level waste stream) among the various disposal systems as it chooses, provided that the total Release Limit multiplier used for that waste stream at all of its disposal systems may not exceed the Release Limit multiplier that would be used if the entire waste stream were disposed of in one disposal system.

Note 5: *Treatment of Wastes with Poorly Known Burnups or Original MTHM.* In some cases, the records associated with particular high-level waste streams may not be adequate to accurately determine the original metric tons of heavy metal in the reactor fuel that created the waste, or to determine the average burnup that the fuel was exposed to. If the uncertainties are such that the original amount of heavy metal or the average fuel burnup for particular high-level waste streams cannot be quantified, the units of waste derived from (a) and (b) of Note 1 shall no longer be used. Instead, the units of waste defined in (c) and (d) of Note 1 shall be used for such high-level waste streams. If the uncertainties in such information allow a range of values to be associated with the original amount of heavy metal or the average fuel burnup, then the calculations described in previous Notes will be conducted using the values that result in the smallest Release Limits, except that the Release Limits need not be smaller than those that would be calculated using the units of waste defined in (c) and (d) of Note 1.

Note 6: *Uses of Release Limits to Determine Compliance with 191.13* Once release limits for a particular disposal system have been determined in accordance with Notes 1 through 5, these release limits shall be used to determine compliance with the requirements of 191.13 as follows. In cases where a mixture of radionuclides is projected to be released to the accessible environment, the limiting values shall be determined as follows: For each radionuclide in the mixture, determine the ratio between the cumulative release quantity projected over 10,000 years and the limit for that radionuclide as determined from Table 1 and Notes 1 through 5. The sum of such ratios for all the radionuclides in the mixture may not exceed one with regard to 191.13(a)(1) and may not exceed ten with regard to 191.13(a)(2).

For example, if radionuclides A, B, and C are projected to be released in amounts $Q_a$, $Q_b$, and $Q_c$, and if the applicable Release Limits are $RL_a$, $RL_b$, and $RL_c$, then the cumulative releases over 10,000 years shall be limited so that the following relationship exists:

$$\frac{Q_a}{RL_a} + \frac{Q_b}{RL_b} + \frac{Q_c}{RL_c} < 1$$

## Appendix B—Guidance for Implementation of Subpart B

[Note: The supplemental information in this appendix is not an integral part of 40 CFR Part 191. Therefore, the implementing agencies are not bound to follow this guidance. However, it is included because it describes the Agency's assumptions regarding the implementation of Subpart B. This appendix will appear in the Code of Federal Regulations.]

The Agency believes that the implementing agencies must determine compliance with §§ 191.13, 191.15, and 191.16 of Subpart B by evaluating long-term predictions of disposal system performance. Determining compliance with § 191.13 will also involve predicting the likelihood of events and processes that may disturb the disposal system. In making these various predictions, it will be appropriate for the implementing agencies to make use of rather complex computational models, analytical theories, and prevalent expert judgment relevant to the numerical predictions. Substantial uncertainties are likely to be encountered in making these predictions. In fact, sole reliance on these numerical predictions to determine compliance may not be appropriate; the implementing agencies may choose to supplement such predictions with qualitative judgments as well. Because the procedures for determining compliance with Subpart B have not been formulated and tested yet, this appendix to the rule indicates the Agency's assumptions regarding certain issues that may arise when implementing §§ 191.13, 191.15, and 191.16. Most of this guidance applies to any type of disposal system for the wastes covered by this rule. However, several sections apply only to disposal in mined geologic repositories and would be inappropriate for other types of disposal systems.

*Consideration of Total Disposal System.* When predicting disposal system performance, the Agency assumes that reasonable projections of the protection expected from all of the engineered and natural barriers of a disposal system will be considered. Portions of the disposal system should not be disregarded, even if projected performance is uncertain, except for portions of the system that make negligible contributions to the overall isolation provided by the disposal system.

*Scope of Performance Assessments.* Section 191.13 requires the implementing agencies to evaluate compliance through performance assessments as defined in § 191.12(q). The Agency assumes that such performance assessments need not consider categories of events or processes that are estimated to have less than one chance in 10,000 of occurring over 10,000 years. Furthermore, the performance assessments need not evaluate in detail the releases from all events and processes estimated to have a greater likelihood of occurrence. Some of these events and processes may be omitted from the performance assessments if there is a reasonable expectation that the remaining probability distribution of cumulative releases would not be significantly changed by such omissions.

*Compliance with Section 191.13.* The Agency assumes that, whenever practicable, the implementing agency will assemble all of the results of the performance assessments to determine compliance with § 191.13 into a "complementary cumulative distribution function" that indicates the probability of exceeding various levels of cumulative release. When the uncertainties in parameters are considered in a performance assessment, the effects of the uncertainties considered can be incorporated into a single such distribution function for each disposal system considered. The Agency assumes that a disposal system can be considered to be in compliance with § 191.13 if this single distribution function meets the requirements of § 191.13(a).

*Compliance with Sections 191.15 and 191.16.* When the uncertainties in undisturbed performance of a disposal system are considered, the implementing agencies need not require that a very large percentage of the range of estimated radiation exposures or radionuclide concentrations fall below limits established in §§ 191.15 and 191.16, respectively. The Agency assumes that compliance can be determined based upon "best estimate" predictions (e.g., the mean or the median of the appropriate distribution, whichever is higher).

*Institutional Controls.* To comply with § 191.14(a), the implementing agency will assume that none of the active institutional controls prevent or reduce radionuclide releases for more than 100 years after disposal. However, the Federal Government is committed to retaining ownership of all disposal sites for spent nuclear fuel and high-level and transuranic radioactive wastes and will establish appropriate markers and records, consistent with § 191.14(c). The Agency assumes that, as long as such passive institutional controls endure and are understood, they: (1) can be effective in deterring systematic or persistent exploitation of these disposal sites; and (2) can reduce the likelihood of inadvertent, intermittent human intrusion to a degree to be determined by the implementing agency. However, the Agency believes that passive institutional controls can never be assumed to eliminate the chance of inadvertent and intermittent human intrusion into these disposal sites.

*Consideration of Inadvertent Human Intrusion into Geologic Repositories.* The most speculative potential disruptions of a mined geologic repository are those associated with inadvertent human intrusion. Some types of intrusion would have virtually no effect on a repository's containment of waste. On the other hand, it is possible to conceive of intrusions (involving widespread societal loss of knowledge regarding radioactive wastes) that could result in major disruptions that no reasonable repository selection or design precautions could alleviate. The Agency believes that the most productive consideration of inadvertent intrusion concerns those realistic possibilities that may be usefully mitigated by repository design, site selection, or use of passive controls (although passive institutional controls should not be assumed to completely rule out the possibility of intrusion). Therefore, inadvertent and intermittent intrusion by exploratory drilling for resources (other than any provided by the disposal system itself) can be the most severe intrusion scenario assumed by the implementing agencies. Furthermore, the implementing agencies can assume that passive institutional controls or the intruders' own exploratory procedures are adequate for the intruders to soon detect, or be warned of, the incompatibility of the area with their activities.

*Frequency and Severity of Inadvertent Human Intrusion into Geologic Repositories.* The implementing agencies should consider the effects of each particular disposal system's site, design, and passive institutional controls in judging the likelihood and consequences of such inadvertent exploratory drilling. However, the Agency assumes that the likelihood of such inadvertent and intermittent drilling need not be taken to be greater than 30 boreholes per square kilometer of repository area per 10,000 years for geologic repositories in proximity to sedimentary rock formations, or more than 3 boreholes per square kilometer per 10,000 years for repositories in other geologic formations. Furthermore, the Agency assumes that the consequences of such inadvertent drilling need not be assumed to be more severe than: (1) Direct release to the land surface of all the ground water in the repository horizon that would promptly flow through the newly created borehole to the surface due to natural lithostatic pressure—or (if pumping would be required to raise water to the surface) release of 200 cubic meters of ground water pumped to the surface if that much water is readily available to be pumped; and (2) creation of a ground water flow path with a permeability typical of a borehole filled by the soil or gravel that would normally settle into an open hole over time—not the permeability of a carefully sealed borehole.

[FR Doc. 85-20331 Filed 9-18-85; 8:45 am]
BILLING CODE 6560-50-M

SAIC

Science Applications International Corporation

L85-PMSD-JHF-007

September 18, 1985

To: Distribution

Subject: September 1985 PM-TPO Meeting

Enclosed is an agenda for the September Project Manager-Technical Project Officers meeting which will be held on October 2-3 in Room 450 at SAIC, 101 Convention Center Drive (Valley Bank Center). Parking is available in the parking garage that can be entered by taking Channel 8 Drive. Go to the ground level of the parking garage on the elevator and walk to the Valley Bank Center Building elevators. The conference room is on the fourth floor. You will be notified if any significant changes are made that would affect presentors' appearances.

Mini-agendas will be faxed to the TPOs prior to the meeting or will be posted during the meeting for some selected items as noted in the agenda.

SCIENCE APPLICATIONS
INTERNATIONAL CORPORATION

Joy H. Fiore, Manager
Project Services Branch

JHF:md

Enclosure:
As Stated

Valley Bank Center, 101 Convention Center Drive, Suite 407, Las Vegas, Nevada 89109, (702) 295-1204
Technical & Management Support Services Contractor Nevada Nuclear Waste Storage Investigations
Other SAIC Offices: Albuquerque, Chicago, Dayton, Denver, Huntsville, Los Angeles, Oak Ridge, Orlando, San Diego, San Francisco, Tucson and Washington, D.C.

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C. S. Jonson, SAIC, Las Vegas, NV
S. M. Jones, SAIC, Las Vegas, NV
F. R. Huckabee, DOE/NTSO
J. A. Tegtmeier, H&N/Mercury
J. A. Cross, F&S, Las Vegas, NV
D. L. Koss, REECo, Mercury, NV
Project File 9.2.1.8.2

AGENDA

LOCATION: 101 Convention Center Dr., Room 450

Las Vegas, NV



DATE:

NNWSI PROJECT MANAGER-TECHNICAL PROJECT OFFICER MEETING

| TIME | WHAT | HOW | WHO | EXPECTED OUTCOME | REF MATERIAL & COMMENTS |
|---|---|---|---|---|---|
| Wednesday, October 2 | | | | | |
| 8:00-8:10 | Introductions/Roles | Introductions as necessary, review roles. | Joy | | |
| 8:10-8:20 | Agenda/Outcomes | Review agenda, outcomes for day. | Joy/Don/TPOs | | |
| 8:20-8:30 | July Minutes | Approve. | Joy/Don/TPOs | | Minutes sent August 6. |
| 8:30-9:45 | FYIs<br>o Bureau of Reclamation Proposal<br>o Others TBA | Status | Don | | |
| 9:45-10:00 | Break | | | | |
| 10:00-11:30 | Coring vs. Drifting Cost/Benefit Study | Present results and recommendations; discuss impact of alternatives; decide on recommended course of action. | Paul/Don/TPOs | Agree to course of action. | |
| 11:30-12:00 | FY 86 Budget | Identify what's needed, status of budget formulations | Don/TPOs | Understand status. | |
| 12:00-1:30 | Lunch | | | | |
| 1:30-2:30 | SCP | Mini-agenda to come. | Mike T. | | |

AGENDA

LOCATION: 101 Convention Center Dr., Room 450

Las Vegas, NV



DATE:

NNWSI PROJECT MANAGER-TECHNICAL PROJECT OFFICER MEETING

| TIME | WHAT | HOW | WHO | EXPECTED OUTCOME | REF MATERIAL & COMMENTS |
|---|---|---|---|---|---|
| Wednesday, October 2 (continued) | | | | | |
| 2:30-3:00 | EA | | | | |
| 3:00-3:15 | BREAK | | | | |
| 3:15-4:15 | Systems Engineering Integration Group | Present proposed charter for group; present SEMP Annotated outine draft; discuss planned Oct. 22-24 OGR Peer Review of NNWSI systems engineering activities. Discuss what Project must do if meeting is held. | Gary Y. and/or Clint S. | Feedback on Charter; feedback on draft SEMP AO; agree on whether Project agrees to Oct. 22-24 OGR meeting. Agree to what Project must do following that peer review. | Draft Charter and SEMP AO sent 9/25 to TPOs. |
| | EXECUTIVE SESSION | | | | |
| 4:15-5:30 | o Meet Rick Wall | Talk with Rick to determine if he'd be the best retreat conductor. | Don/TPOs | Get to know Rick to form basis for making decision. | |

AGENDA

LOCATION: 101 Convention Center Dr., Room 450

Las Vegas, NV



DATE:

NNWSI PROJECT MANAGER-TECHNICAL PROJECT OFFICER MEETING

| TIME | WHAT | HOW | WHO | EXPECTED OUTCOME | REF MATERIAL & COMMENTS |
|---|---|---|---|---|---|
| Thursday, October 3 | | | | | |
| 8:00-8:10 | Agenda/Outcomes | | | | |
| 8:10-9:45 | CCB MEETING | | | | |
| 9:45-10:00 | Break | | | | |
| 10:00-10:30 | Retreat | Revisit location, discuss conductors. | | Agree to location select retreat conductors. | |
| 10:30-11:15 | Schedule for TPO meeting technical presentations. | Discuss schedule for at least the November meeting. | Joy/Don/TPOs | Agree to schedule for November meeting. | |
| 11:15-12:00 | QA Update | Mini agenda to come. | Stan | | |
| 12:00-1:00 | Lunch | | | | |
| 1:00-2:00 | Licensing update | Mini agenda to come. | Mike G. | | |
| 2:00-3:00 | Open Items | | Don/TPOs | | |
| 3:00-3:15 | Review Action Items | Review items, dates, responsible parties. | Joy/Don/TPOs | | |
| 3:15-3:25 | November agenda | Identify agenda items. | Joy/Don/TPOs | | |
| 3:25-3:30 | Meeting Evaluation | | Joy/Don/TPOs | | |

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# LICENSING UPDATE

- o WASHINGTON LIAISON - M. J. WISE
- o NRC/DOE MEETING STATUS - M. GLORA
- o REGULATORY COMPLIANCE PLAN - GLORA/WISE

PM/TPO MEETING
OCTOBER 2, 1985
LAS VEGAS, NV

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# UPDATE ON
# WASHINGTON LIAISON

PRESENTATION TO THE
TPO MEETING
OCTOBER 2, 1985

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# WASHINGTON LIAISON

MAJOR TOPICS:

- o EPA STANDARD FINALIZED
- o MISSION PLAN FINALIZED
- o ACRS ROLE IN HLW MATTERS
- o SYSTEM REQUIREMENTS FOR LIMS
- o STATE CONCERNS EXPRESSED IN CONGRESSIONAL HEARINGS

## WASHINGTON LIAISON

### MISSION PLAN

- o SOURCE
  - PRESENTATION BY BEN RUSCHE TO NRC (7/29/85)
  - CONGRESSIONAL HEARING -- HOUSE OF REPRESENTATIVES SUBCOMMITTEE ON ENERGY AND ENVIRONMENT (9/13/85)
  - CONGRESSIONAL HEARING -- SENATE SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT (9/12/85)

- o TIMING OF PRELIMINARY DETERMINATION (SEC. 114(F) OF NWPA)
  - DOE's POSITION ON TIMING CHALLENGED
  - NRC's POSITION UNCLEAR -- WILL CONSIDER POSITION IN THE NEXT FEW WEEKS
  - SUBJECT OF CONGRESSIONAL INQUIRIES

- o 27 MONTH LICENSING PERIOD
  - NRC REMAINS UNCONVINCED THAT THIS CAN BE ACHIEVED

WASHINGTON LIAISON

ACRS ROLE IN HLW MATTERS

- ACRS PROVIDES OVERSIGHT FUNCTION IN REACTOR SAFETY MATTERS
- A SUBCOMMITTEE ON HLW HAS BEEN ESTABLISHED AND PERFORMS A LIMITED OVERVIEW ROLE
- NRC STAFF PROPOSAL
  - MAINTAIN ACRS ROLE, INCREASE FUNDING FOR HLW OVERSIGHT, ADD MEMBERS WITH APPROPRIATE TECHNICAL BACKGROUND
  - SUPPLEMENT ACRS WITH REVIEWS BY THE NATIONAL ACADEMY OF ENGINEERING
- LIKELY OUTCOME: STATUS QUO

SYSTEM REQUIREMENTS FOR LIMS

- o SOURCE
  - PRESENTATION BY BEN RUSCHE TO NRC (7/29/85)
  - NRC INFORMATION MANAGEMENT STATUS MEETING (9/18/85)
- o RUSCHE PROMOTES ONE COMMON SYSTEM, PROBABLY WITH FULL TEXT RECOVERY CAPABILITY
- o NRC IS DEVELOPING A PROTOTYPE SYSTEM -- SELECTED NNWSI PROJECT ISSUES WILL BE USED IN THE DEMONSTRATION PROJECT
- o NRC IS ADVOCATING USE OF "REGULATORY NEGOTIATION" TO DEFINE SYSTEM REQUIREMENTS

## CONCERNS EXPRESSED DURING CONGRESSIONAL HEARINGS

- SOURCES - CONGRESSIONAL HEARINGS
  - HOUSE OF REPRESENTATIVES SUBCOMMITTEE ON ENERGY AND ENVIRONMENT (9/13/85)
  - SENATE SUBCOMMITTEE ON ENERGY RESEARCH AND DEVELOPMENT (9/12/85)
  - HOUSE OF REPRESENTATIVES SUBCOMMITTEE ON ENERGY CONSERVATION AND POWER (8/1/85)

- DOE PROGRAM IS SCHEDULE-DRIVEN

- DISAGREE WITH DOE POSITION ON PRELIMINARY DETERMINATION

- OBJECT TO DOE's LIMITATIONS ON STATE PARTICIPATION (E.G., CONDUCTING SITE INVESTIGATIONS)

- ADVOCATE A NEW NATIONAL SCREENING AND SELECTION PROGRAM

- STATES DO NOT HAVE THE OPPORTUNITY TO INFLUENCE DECISIONS

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NRC/DOE

MEETING STATUS

2-OCT-85

## SCHEDULED DOE/NRC MEETINGS

- MEETINGS SCHEDULED (AS OF 9/6/85)
  - SUBSYSTEM PERFORMANCE ALLOCATION 9/26-27
  - SRP SURFACE BASED TEST PLAN 11/5-7
  - SRP ES DESIGN 11/19-21

# DOE/NRC MEETINGS
# TENTATIVE SCHEDULE

- o BASED ON HOLDING GENERIC SCP CHAPTER 8 MEETING (ISSUES & PLANS)
  - TENTATIVELY SCHEDULED FOR OCTOBER

A. NNWSI PROJECT
- HYDROLOGY & GEOCHEMISTRY
- PERFORMANCE ASSESSMENT PLAN
- ESTP

B. GENERIC
- SEISMIC/TECTONICS (DECEMBER ?)

C. OTHER PROJECTS - BY CATEGORY
- EXPLORATORY SHAFT DESIGN (SRP/BWIP)
- ESTP (BWIP)
- HYDROLOGY/GEOLOGY (BWIP)
- REPOSITORY DESIGN (SRP/BWIP)
- WASTE PACKAGE (SRP/BWIP)

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## DOE/NRC MEETINGS
## NNWSI PROJECT COVERAGE POLICY

- o SAIC WILL ATTEND ALL GENERIC & "OTHER PROJECT" MEETINGS
  - LICENSING/REGULATORY PERSPECTIVE & CONTINUITY
  - TECHNICAL ASPECTS AS APPROPRIATE
- o OTHER PARTICIPANTS ATTEND MEETINGS OF INTEREST IN THEIR AREA OF RESPONSIBILITY
  - NOTIFY WMPO/SAIC
  - MEETING REPORT TO WMPO WITH COPY TO SAIC

2-OCT-85

# DOE/NRC MEETINGS
## HQ GUIDANCE

- o ANNOUNCEMENT OF MEETINGS BETWEEN DOE AND FEDERAL AGENCIES (IN ADDITION TO NRC)
  - EPA, USGS, BLM, ETC.
  - ANNOUNCE ON "800" NUMBER PREVIOUSLY USED FOR NRC MEETINGS
  - PROJECT OFFICE RESPONSIBLE FOR NOTIFYING DOE/HQ (C. HEAD) OF MEETING DETAILS

- o "PRE-ISSUE REVIEW" OF MEETING MATERIAL
  - DOE/HQ REVIEW OF PROJECT MATERIAL TO BE PRESENTED PRIOR TO MEETING
  - BASIS IS CONSISTANCY
  - POTENTIAL FOR OGR PROJECT MEETING PRIOR TO NRC/PROJECT MEETING
  - IMPACTS
    - o PREPARATION SCHEDULE
    - o SCOPE/CONTENT OF REVIEW PACKAGE

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# REGULATORY COMPLIANCE PLAN

PRESENTATION TO THE
TPO MEETING
OCTOBER 3, 1985

2-OCT-85

## NNWSI PROJECT
## DRAFT REGULATORY COMPLIANCE PLAN

- PURPOSE & SCOPE

  THE PURPOSE OF THE REGULATORY COMPLIANCE PLAN IS TO PROVIDE A COMPREHENSIVE VIEW OF THE REPOSITORY LICENSING PROCESS AND REGULATORY REQUIREMENTS, TO ESTABLISH A FRAMEWORK FOR ACHIEVING COMPLIANCE WITH THOSE REQUIREMENTS, AND TO ASSESS THE IMPACT OF THOSE REQUIREMENTS ON PROJECT TECHNICAL ACTIVITIES AND SCHEDULES. THIS PLAN WILL FOCUS ON THOSE ACTIONS WHICH ARE NECESSARY TO OBTAIN A CONSTRUCTION AUTHORIZATION AND A LICENSE TO RECEIVE AND POSSESS SOURCE, SPECIAL NUCLEAR OR BYPRODUCT MATERIAL (I.E., WASTE); THEREFORE, THE SCOPE OF THE PLAN IS LIMITED TO DISCUSSIONS OF THE LICENSING PROCESS ASSOCIATED WITH NUCLEAR REGULATORY COMMISSION (NRC) REGULATIONS, AND PROJECT ACTIVITIES DIRECTED TOWARD DEMONSTRATING COMPLIANCE WITH NRC REGULATIONS. THE REGULATORY PROCESS IS DIVIDED INTO TWO PHASES, THE PRE-APPLICATION PHASE AND THE LICENSING OR POST-APPLICATION PHASE. BECAUSE REQUIREMENTS, ACTIVITIES, AND THE ROLES OF THE DEPARTMENT OF ENERGY (DOE) AND NRC DIFFER AS THE PROCESS MOVES FROM ONE PHASE TO THE OTHER, MUCH OF THE DISCUSSION IN THIS PLAN IS SEPARATED ACCORDING TO PHASE.

- WILL REQUIRE IMPLEMENTING PROCEDURES

- TO WMPO FOR REVIEW ON 9/27

## STRUCTURE OF THE RCP

- PRESENTS BACKGROUND INFORMATION ON REGULATORY PROCESS AND REQUIREMENTS (CHAPTERS I-VI)
- DESCRIBES PROJECT LICENSING TEAM AND FUNCTIONS (CHAPTER VII)
- DEFINES ISSUE RESOLUTION PROCESS (CHAPTER VIII)
- PROVIDES BROAD SYSTEM DESCRIPTION OF LICENSING INFORMATION MANAGEMENT SYSTEM (CHAPTER IX)
- ASSIGNMENT OF QUALITY LEVELS TO PLAN AND IMPLEMENTATION OF PLAN (CHAPTER X)

TABLE OF CONTENTS

# LIST OF APPENDICES

PROJECT LICENSING TEAM (CHAPTER VII)

- o LED BY WMPO
- o SUPPORTED BY REPRESENTATIVES FROM PARTICIPATING ORGANIZATIONS

## PROJECT LICENSING TEAM -- RESPONSIBILITIES (CHAPTER VII)

- DEVELOPING AND IMPLEMENTING LICENSING STRATEGY
- MONITORING REGULATORY CHANGES AND DISSEMINATING REGULATORY INFORMATION
- DEFINING SCHEDULES FOR REGULATORY-RELATED ACTIVITIES
- MANAGING THE ISSUE RESOLUTION PROCESS
- ORGANIZING AND DOCUMENTING REGULATORY AGENCY INTERACTIONS
- SUPPORTING DOE/HQ IN GENERIC ISSUE RESOLUTION
- PREPARING REGULATORY DOCUMENTS

REGULATORY COMPLAINCE PLAN

LICENSING DEMONSTRATION BASIS (CHAPTER VIII)

- DEFINES THE PROJECT STRATEGY FOR DEMONSTRATING COMPLIANCE WITH REGULATORY REQUIREMENTS

- GOAL: RESOLVE ISSUES BEFORE LICENSING USING STRUCTURED, WELL-DOCUMENTED PROCESS

ISSUE RESOLUTION PROCESS (CHAPTER VIII)

- o TWO CATEGORIES OF ISSUES:
  - COMPLIANCE ISSUES -- QUESTIONS DIRECTLY RELATED TO REGULATORY REQUIREMENTS (10 CFR 960, 10 CFR 60, 40 CFR 191)
  - INTERNAL ISSUES -- PROGRAMMATIC QUESTIONS WHICH MAY AFFECT PROJECT DECISIONS ON SCHEDULING AND ALLOCATION OF RESOURCES FOR COMPLIANCE-RELATED ACTIVITIES (FOR EXAMPLE: INTERACTION CONTROLS, NON-HLW STANDARDS APPLICABILITY)
- o RESOLUTION PROCESS IS DESCRIBED SEPARATELY FOR THE TWO CATEGORIES

## ISSUE RESOLUTION PROCESS - COMPLIANCE ISSUES (CHAPTER VIII)

- STAGED PROCESS
- LICENSING TEAM PLAYS KEY ROLE IN MANAGING PROCESS
- EMPHASIS PLACED ON ASSESSING LEVEL OF CONFIDENCE IN RESULTS
- THOROUGH DOCUMENTATION REQUIRED IN EACH STAGE
- LIMS WILL BE USED TO TRACK PROCESS

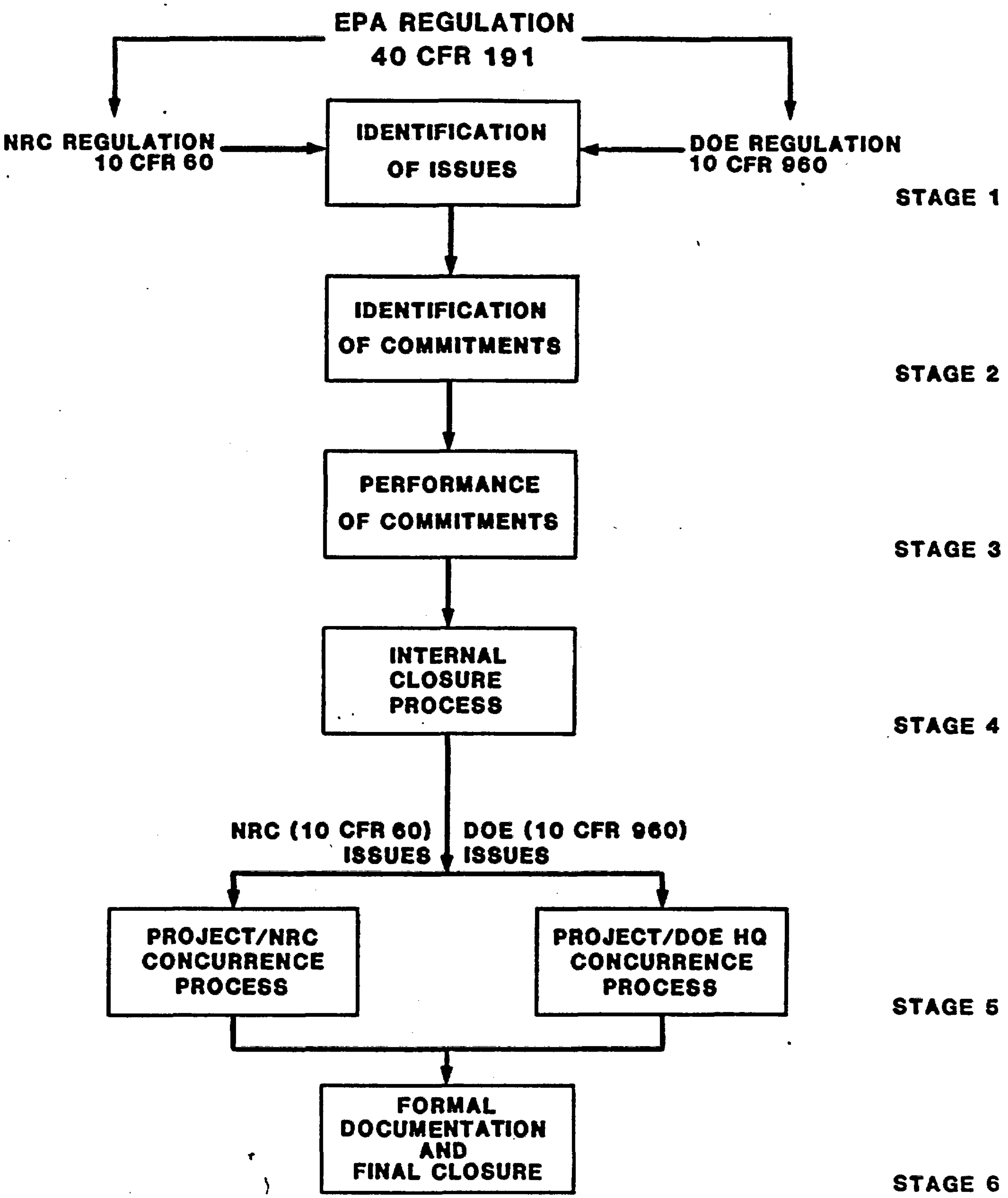


Figure 8. Resolution Process for Compliance Issues

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# REGULATORY COMPLIANCE PLAN

- o LICENSING DEMONSTRATION METHODOLOGY (CHAPTER IX)
- o TRACKING & HISTORICAL RECORD MAINTENANCE - LIMS
  - ISSUE TRACKING
  - BIBLIOGRAPHIC FILE