U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: OVERVIEW OF EARLY SITE SUITABILITY EVALAUTION OF THE POTENTIAL REPOSITORY SITE AT YUCCA MOUNTAIN, NEVADA

PRESENTER: DR. JEAN L. YOUNKER

PRESENTER'S TITLE AND ORGANIZATION: MANAGER OF SYSTEMS
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DALLAS, TX
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ESSE Core Team

Team Member	Organization	Responsibility
Dr. Jean L. Younker	T&MSS	Task Manager
Mr. Robert C. Murray	T&MSS	Deputy Task Manager & Peer Review Chairman
Mr. William B. Andrews	T&MSS	Transportation
Dr. Lyndon B. Ballou	LLNL	Rock Properties, Engr. Sys.
Dr. Jan A. Docka	WESTON	Petrology
Dr. Arthur A. Ducharme	SNL	Risk Assessment/Seismic Hazard
Dr. William W. Dudley	USGS	Tectonics, Erosion
Mr. Gregory A. Fasano	T&MSS	Environmental Quality
Dr. Richard J. Herbst	LANL	Geochemistry
Dr. Dwight T. Hoxie	USGS	Climate
Dr. Steven R. Mattson	T&MSS	Natural Resources
Dr. Edward S. Patera	LANL	Geochemistry
Dr. Michael A. Revelli	LLNL	Systems Engineering
Dr. Lawrence D. Rickertsen	WESTON	Total Systems Performance
Dr. Les E. Shephard	SNL	Hydrology
Dr. Bruce R. Judd	Decision Analysis Company	Consensus Building, Expert Assessments
Dr. Jane R. Stockey	DOE/HQ	Technical Monitor
Dr. Jeremy M. Boak	DOE/YMP	Technical Monitor

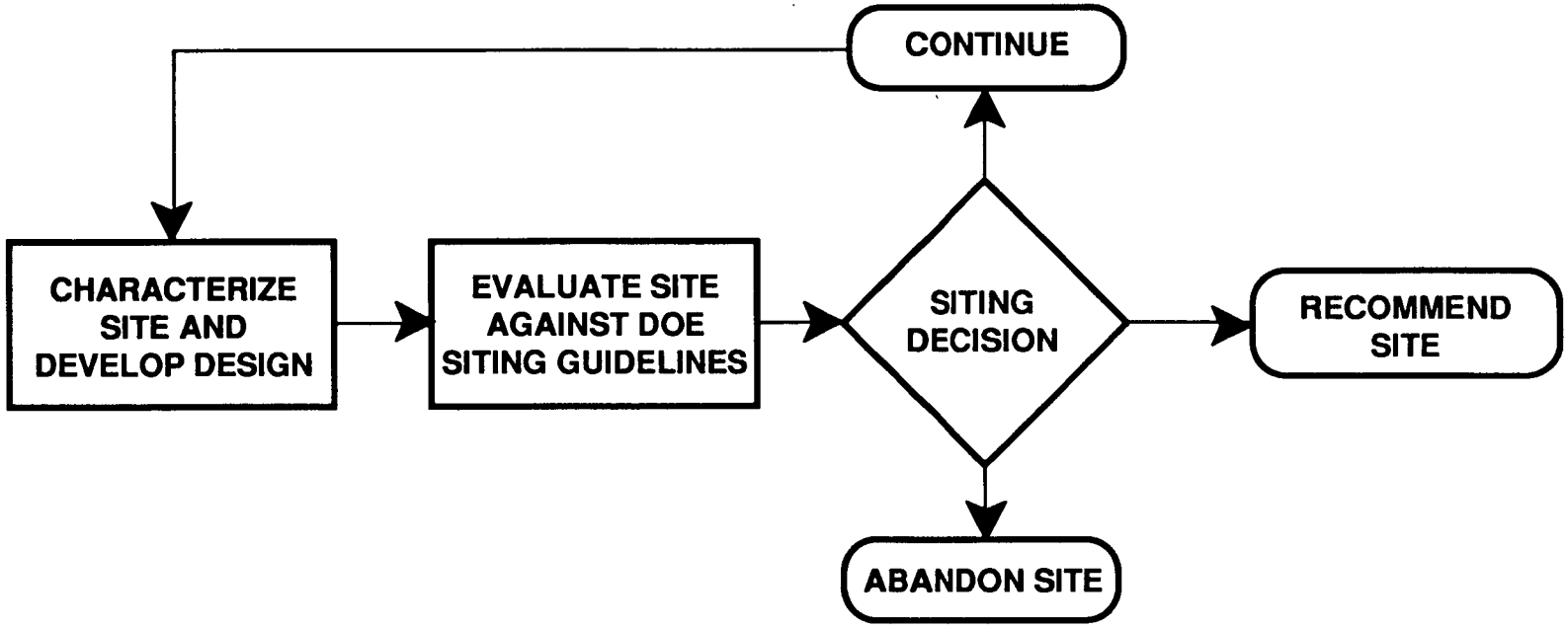
Overview

- General background of ESSE task
- Approach for evaluating site against DOE general siting guidelines (10 CFR Part 960)
- Structure of peer review
- Summary of guideline evaluations

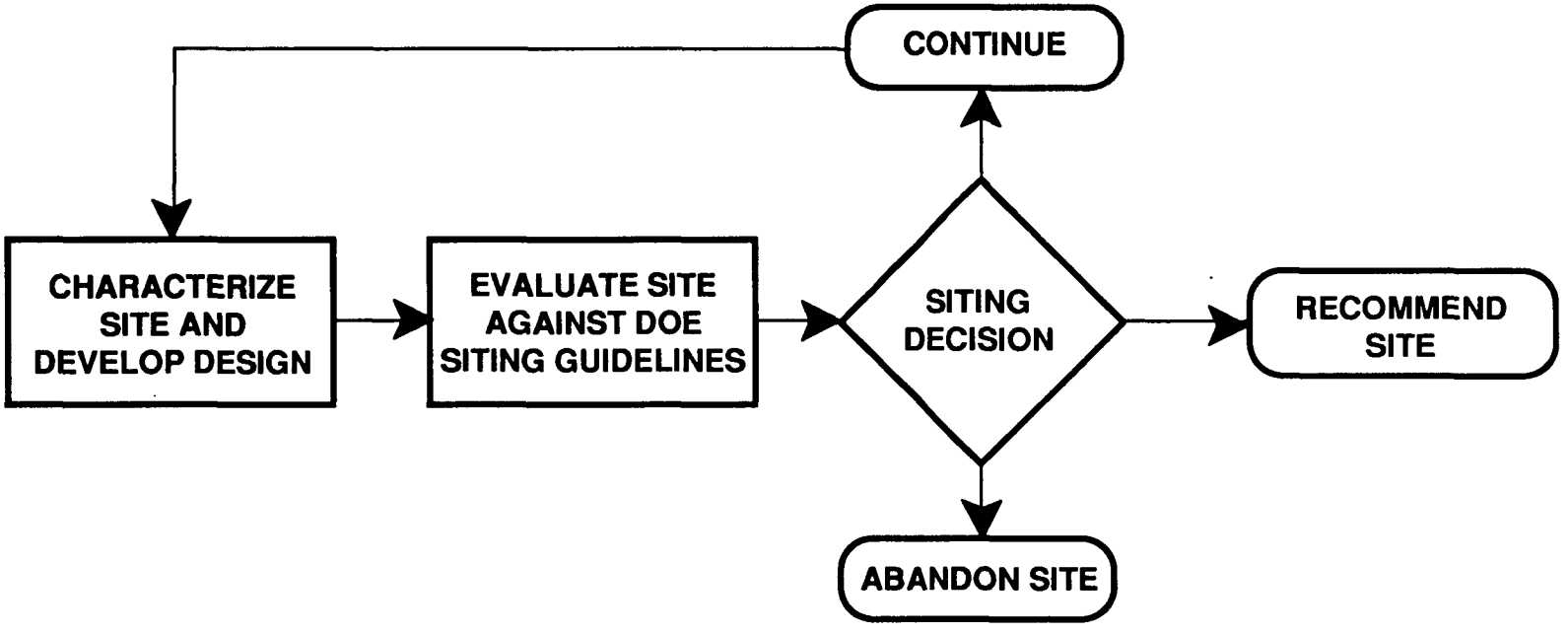
Objectives of Early Site-Suitability Evaluation

- Develop an approach within the framework of the siting guidelines (10 CFR Part 960) for evaluating site suitability during site characterization
- Provide guideline-by-guideline status of suitability of Yucca Mountain

General Logic for Evaluating Site Suitability



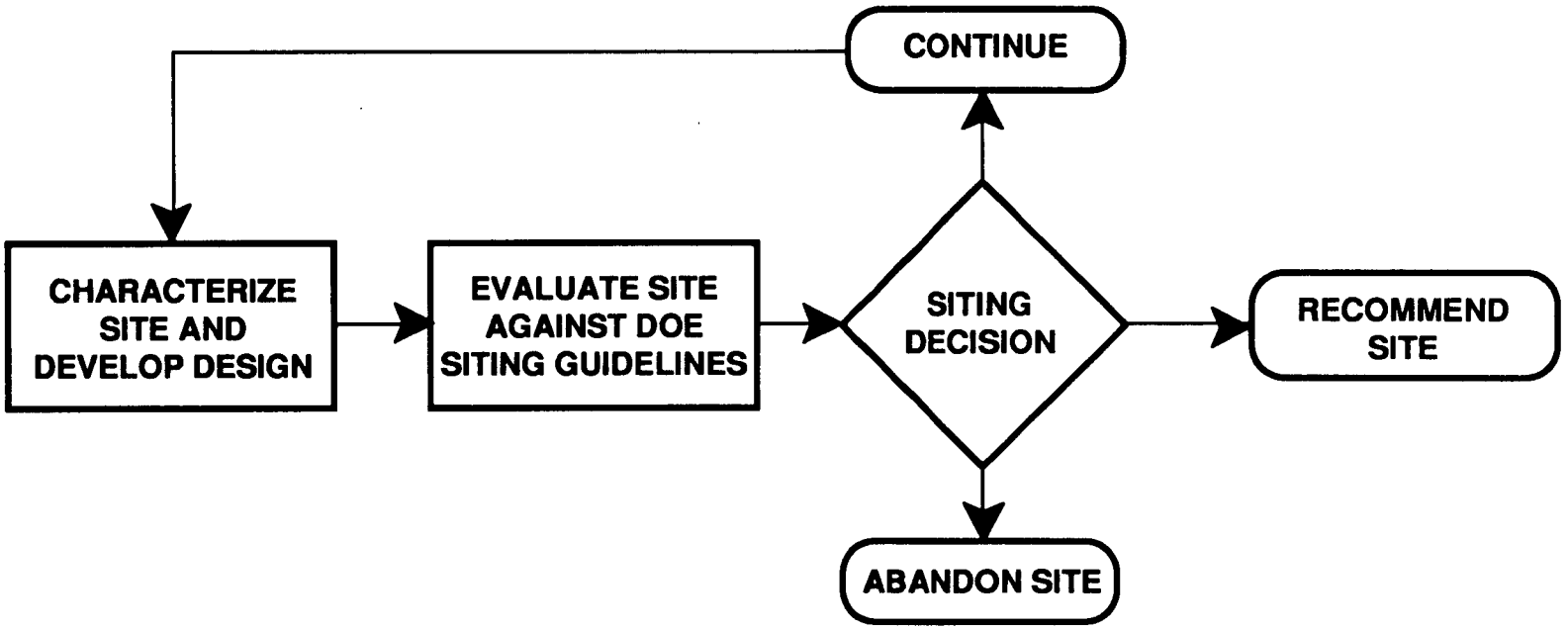
Evaluations are Based on Available Information About the Site and Design



Information that is evaluated

- Present understanding of site characteristics
- Available design of engineered system
- Present regulations

Siting Decisions are Likely to Incorporate Additional Factors



Considerations when making decisions

- Status with regard to siting guidelines
- Availability of tests or activities to obtain needed information
- Sufficiency of analyses for licensing purposes
- Other management considerations

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DOE Siting Guidelines are Organized to Focus on Key Requirements

There are four groups of guidelines

- Postclosure performance
- Preclosure radiological safety
- Environmental, socioeconomic, and transportation impacts
- Ease and cost of siting, construction, operation, and closure

Each group has

- "Systems guidelines" that provide general requirements (e.g., separation of radioactive waste from the accessible environment after closure)
- "Technical guidelines" that identify factors to be considered (e.g., geohydrology, geochemistry, rock characteristics)

10 CFR Part 960 Provides Twenty-Four Siting Guidelines in Four Groups

Postclosure Performance

- System behavior
- Geohydrology
- Geochemistry
- Rock characteristics
- Climate changes
- Erosion
- Dissolution
- Tectonics
- Human interference
  - Natural resources
  - Site ownership and control

Environmental, Socioeconomic, and Transportation Impacts

- System behavior
- Environmental quality
- Socioeconomic impacts
- Transportation

Preclosure Radiological Safety

- System behavior
- Population density and distribution
- Site ownership and control
- Meteorology
- Offsite installations and operations

Ease and cost of siting, construction, operation, and closure

- System behavior
- Surface characteristics
- Rock characteristics
- Hydrology
- Tectonics

Each Technical Guideline Specifies A Qualifying Condition and May Specify Disqualifying Conditions for the Site

Example: Human Interference

Qualifying condition

" This site shall be located such that....the natural resources, including ground water....will not be likely to give rise to interference activities that would lead to radionuclide releases greater than those allowable under the requirements specified in ¶ 960.4-1."

Disqualifying condition

" Previous exploration, mining, or extraction activities for resources of commercial importance at the site have created significant pathways between the projected underground facility and the accessible environment ..."

The site shall be disqualified if evidence supports a finding that any disqualifying condition is present or any qualifying condition cannot be met

Definitions Adapted from 10 CFR Part 960 and Used by the Core Team

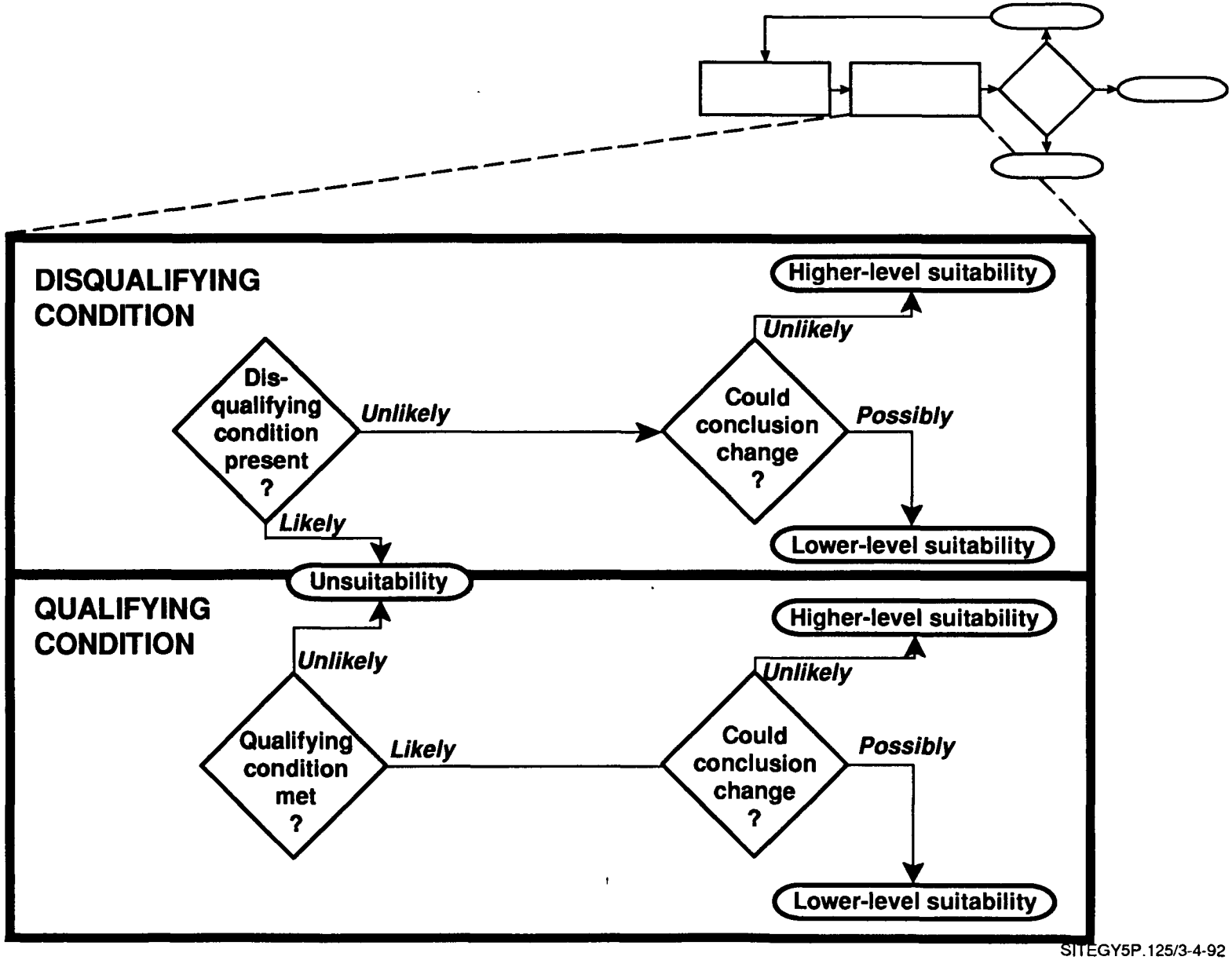
Disqualifying conditions	Evaluation result
• Condition is present or likely to be present	Unsuitability
• Condition not present but additional information could change conclusion	Lower-level suitability
• Condition not present and it is unlikely that conclusion will change with additional information	Higher-level suitability

Definitions Adapted from 10 CFR Part 960 and Used by the Core Team

(Continued)

Qualifying conditions	Evaluation result
• Site cannot meet condition or not likely to meet condition	Unsuitability
• Site likely to meet condition but additional information could change conclusion	Lower-level suitability
• Site meets condition and it is unlikely that conclusion will change with additional information	Higher-level suitability

Decision Logic for Suitability and Unsuitability Conclusions



Evaluations May be Either Qualitative or Quantitative

Qualitative		Quantitative
	Lower-level suitability	
"The weight of evidence indicates behavior is acceptable"	**OR**	"The probability that behavior meets a threshold is greater than .9*"
	Higher-level suitability	
"Conclusions are unlikely to change"	**OR**	"There is less than .1* probability that additional information will change conclusions"

*.1 and .9 are provided as examples only.

Basis for Consensus by Core Team

- **Higher-level suitability: conclusion required unanimous support of voting members of core team**

- **Lower-level suitability: voting Core Team members**
  - **Agreed unanimously that suitability is likely, but**
  - **Did not agree unanimously that new information is unlikely to change conclusion**

Reviews Conducted Prior to External Peer Review

- Documented independent technical review by 20 technical staff not involved in the evaluation
- DOE policy review prior to release of report to external peer review

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- Summary of guideline evaluations

Composition of the Peer Review Panel

- 14 panel members chosen based on their
  - Technical qualifications
  - Independence from the DOE Office of Civilian Radioactive Waste Management and the Yucca Mountain Site Characterization Project

Peer Review Panel for the Early Site Suitability Evaluation

NAME	ORGANIZATION	SPECIALTY
Dr. Stan L. Albrecht	Brigham Young University	Socioeconomic Impacts
Dr. Walter J. Arabasz	University of Utah	Tectonics/Seismic Hazards
Dr. John H. Bell	University of Nevada, Las Vegas	Health Physics & Radiological Safety
Dr. F. William Cambray	Michigan State University	Structural Geology & Tectonics
Dr. Steven W. Carothers	Southwest Environmental Consultants, Inc.	Environmental Quality
Dr. James Drever	University of Wyoming	Geochemistry
Dr. Marco T. Einaudi	Stanford University	Economic Geology
Mr. Donald E. French	Private Consultant	Petroleum Geology
Dr. Kip V. Hodges	MIT	Tectonics - Geochronology
Mr. Robert H. Jones	Private Consultant	Transportation Impacts
Dr. David K. Kreamer	University of Nevada, Las Vegas	Hydrology
Dr. William G. Pariseau	University of Utah	Rock Characteristics - Engineering Geology
Dr. Thomas A. Vogel	Michigan State University	Tectonics - Volcanology
Dr. Thompson Webb, III	Brown University	Climate Change

Instructions to the Peer Review Panel

- **Perform a documented, in-depth critique of the ESSE report**
  - **Evaluate the adequacy of information presented**
  - **Review the approach used in the analyses**
- **Determine whether the report presents an objective and technically defensible view of the suitability of the Yucca Mountain site with regard to 10 CFR Part 960**

Overview

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Status of all Technical and System Guidelines was Reviewed According to Approach just Discussed

- Review data and conclusion of the Environmental Assessment (EA)
- Review new information and analysis developed since the EA
- Determine if disqualifying conditions are present or qualifying conditions cannot be met
- Identify information needed to support higher-level suitability conclusions
- Provide peer-reviewed evaluation results to the DOE

What were the Conclusions of the Evaluation?

- For the disqualifying conditions of DOE siting guidelines
  - 13 of 17 disqualifying conditions are not present and new information is unlikely to change this conclusion
  - 4 of 17 disqualifying conditions are not likely to be present but further information is needed

These conclusions were not changed as a result of the peer review

What were the Conclusions of the Evaluation?

(Continued)

- For the qualifying conditions of DOE siting guidelines
  - 13 of 32 qualifying conditions are present and new information is unlikely to change this conclusion
  - 19 of 32 qualifying conditions are likely to be present but further information is needed

Three conclusions were changed as a result of the peer review: (1) postclosure rock characteristics; (2) preclosure radiological safety; (3) offsite installations and operations

Conclusions of Early Site Suitability Evaluation

DOE Siting Guideline	Conclusion
Postclosure Guidelines	
Postclosure system: EPA & NRC standards can be met	* Condition is likely to be present
Geohydrology	
QC: Compatible with waste containment & isolation	*** Condition is likely to be present**
DC: <1000 year ground-water travel time	*** Condition is not likely to be present**
Geochemistry	
QC: Compatible with waste containment and isolation	* Condition is likely to be present
Rock Characteristics	
QC: Accommodate thermal, chemical, mechanical stresses	* Condition is likely to be present
Climate Changes	
QC: No unacceptable releases due to climate change	* Condition is likely to be present
Erosion	
QC: No unacceptable releases due to erosion	Condition present: new information unlikely to change conclusion
DC: Burial cannot be >200m	Condition not present: new information unlikely to change conclusion
Dissolution	
QC: No unacceptable releases due to dissolution	Condition present: new information unlikely to change conclusion
DC: Loss of isolation due to dissolution expected	Condition not present: new information unlikely to change conclusion
Tectonics	
QC: No unacceptable releases due to tectonics	*** Condition is likely to be present**
DC: Fault movement expected to cause loss of waste isolation	**Condition not present: new information unlikely to change conclusion**
Human Interference: Natural Resources	
QC: Interference due to resources will not lead to unacceptable releases	* Condition is likely to be present
DC1: Significant pathways exit from previous mining	Condition not present: new information unlikely to change conclusion
DC2: Mining activities expected to lead to loss of waste isolation	Condition not present: new information unlikely to change conclusion
Human Interference: Site Ownership and Control	
QC: DOE can obtain land ownership and rights	Condition present: new information unlikely to change conclusion

*** Higher-level finding not recommended**

Conclusions of Early Site Suitability Evaluation
(continued)

DOE Siting Guideline	Conclusion
Preclosure Guidelines: Radiological Safety	
System: Radiological safety standards can be met	* Condition is likely to be present
Population Density	
QC1: Doses to highly populated areas meet limits	Condition present: new information unlikely to change conclusion
QC2: Doses to public in unrestricted areas meet limits	Condition present: new information unlikely to change conclusion
DC1: Population density too high	Condition not present: new information unlikely to change conclusion
DC2: Adjacent area with >1,000 population	Condition not present: new information unlikely to change conclusion
DC3: DOE cannot develop emergency preparedness program	Condition not present: new information unlikely to change conclusion
Site Ownership and Control	
QC: DOE can obtain land ownership and rights	Condition present: new information unlikely to change conclusion
Meteorology	
QC: Conditions will not lead to unacceptable release	Condition present: new information unlikely to change conclusion
Offsite Installations and Operations	
QC: Offsite facilities will not lead to unacceptable releases	* Condition is likely to be present
DC: Irreconcilable conflicts expected with atomic energy defense activities	Condition not present: new information unlikely to change conclusion

*** Higher-level finding not recommended**

Conclusions of Early Site Suitability Evaluation
(continued)

DOE Siting Guideline	Conclusion
Preclosure Guidelines: Environment-Socioeconomic Impacts-Transportation	
System Guideline: Public and environment can be protected	* Condition is likely to be present
Environmental Quality	
QC: Environmental quality adequately protected	* Condition is likely to be present
DC1: Environment cannot be protected and impacts cannot be mitigated	* Condition is not likely to be present
DC2: Facilities located in federally protected areas	Condition not present: new information unlikely to change conclusion
DC3: Irreconcilable conflicts with protected areas expected	* Condition is not likely to be present
Socioeconomic Impacts	
QC: Impacts can be offset by reasonable mitigation or compensation	* Condition is likely to be present
DC: Water quality/quantity expected to be significantly impacted	* Condition is not likely to be present
Transportation	
QC1: No conflicts due to location of access routes	* Condition is likely to be present
QC2: Technology adequate to develop system	* Condition is likely to be present
QC3: Extreme performance standards not required	* Condition is likely to be present
QC4: No unacceptable risks or environmental impacts	* Condition is likely to be present

*** Higher-level finding not recommended**

Conclusions of Early Site Suitability Evaluation
(continued)

DOE Siting Guideline	Conclusion
Ease and Cost of Siting, Construction, Operation, and Closure	
System Guideline: Technology available to accommodate site conditions	* Condition is likely to be present
Surface Characteristics	
QC: Technology available for terrain & flood control	Condition present: new information unlikely to change conclusion
Rock Characteristics	
QC1: Adequate rock thickness and lateral extent	* Condition is likely to be present
QC2: Conditions will cause undue hazards to personnel	Condition present: new information unlikely to change conclusion
QC3: Technology available to accommodate conditions	Condition present: new information unlikely to change conclusion
DC: Significant risk to health and safety expected conclusion	Condition not present: new information unlikely to change
Hydrology	
QC1: Conditions allow repository development	Condition present: new information unlikely to change conclusion
QC2: Liners and seals will function as intended	Condition present: new information unlikely to change conclusion
QC3: Technology available to accommodate hydrology	Condition present: new information unlikely to change conclusion
DC: Technology not available for ground-water conditions expected	Condition not present: new information unlikely to change conclusion
Tectonics	
QC: Technology adequate for expected conditions	* Condition is likely to be present
DC: Technology not available to accommodate expected fault movement or ground motion conclusion	Condition not present: new information unlikely to change conclusion

*** Higher-level finding not recommended**

Summary

Additional information most critical to evaluate suitability

- Effects of climate change expected in 10,000 yrs
- Effects of tectonic disturbance over 10,000 yr
- Source term for gaseous release
- Potential for and consequences of fast flow paths
- Potential for natural resources to attract human interference
- Potential for unacceptable environmental quality, socioeconomic and transportation related impacts
- Vertical and lateral extent of potential rock host
- Seismic risks