



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

Yucca Mountain Science and Engineering Report and Site Recommendation Process

**Presented to:
Advisory Committee on Nuclear Waste**

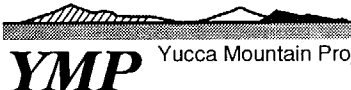
**Presented by:
Carol Hanlon
Yucca Mountain Site Characterization Office
U.S. Department of Energy**

June 20, 2001

**YUCCA
MOUNTAIN
PROJECT**

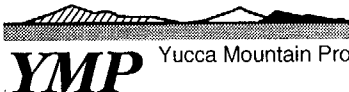
Presentation Outline

- **Background**
- **Introduction to Yucca Mountain Science and Engineering Report**
- **Site Recommendation Process**
- **Summary**



Presentation Purpose

- **Introduce Yucca Mountain Science and Engineering Report**
- **Provide additional information on site recommendation process**
- **Provide highlights on Science and Engineering Report to facilitate review and understanding**
- **Allow opportunity for questions on Science and Engineering Report**



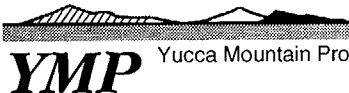
Background

- On May 4, 2001, DOE announced initiation of its consideration of Yucca Mountain Site for possible recommendation to the President for development as a geologic repository for spent nuclear fuel and high level waste
 - Initiated public comment period on possible site recommendation
 - Issued Yucca Mountain Science and Engineering Report
 - Issued Supplemental Draft Environmental Impact Statement

Background

(Continued)

- **May 4, 2001: Meeting of Affected Units of Government conducted to explain site consideration process and introduce documents**
 - **Yucca Mountain Science and Engineering Report**
 - **Supplementary Draft Environmental Impact Statement**



Background

(Continued)

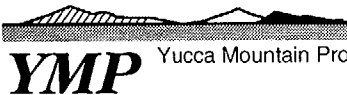
- **May 7, 2001: Federal Register Notice issued to initiate site consideration process and announce availability of Science and Engineering Report. This notice discussed process to be followed later in summer for release of additional information and scheduling of public hearings.**
 - **Release of additional information, including:**
 - ◆ **Supplementary Science and Performance Analyses**
 - ◆ **Preliminary Site Suitability Evaluation**
 - **Notification of dates, locations, and times for public hearings on possible recommendation of the site**
 - **Notification of date for end of public comment period**

Background

(Continued)

- **5712 copies of the Science and Engineering Report distributed to 464 parties**
- **Initial review copies of Science and Engineering Report provided to Advisory Committee on Nuclear Waste on May 4, 2001. Additional copies received May 23, 2001.**

Yucca Mountain Science and Engineering Report



Yucca Mountain Science and Engineering Report Purpose

- **Addresses several requirements of the Nuclear Waste Policy Act**
- **Provide technical information to aid the public and interested parties in preparing comments on the data underlying the Department's consideration of Yucca Mountain for possible recommendation to the President for further development**
- **Present technical information supporting analyses contained in the Supplement to the Draft Environmental Impact Statement**
- **Provide information to be considered, along with other information, in developing the Preliminary Site Suitability Evaluation**

Nuclear Waste Policy Act Requirements

- **Section 114(a)(1)(A), (B), and (C) of the Nuclear Waste Policy Act, requires inclusion of specific technical information as part of the basis for any recommendation**
 - **(A) a description of the proposed repository, including preliminary engineering specifications for the facility;**
 - **(B) a description of the waste form or packaging proposed for use at such repository, and an explanation of the relationship between such waste form or packaging and the geologic medium of such site;**
 - **(C) a discussion of data, obtained in site characterization activities, relating to the safety of such site**
- **The Yucca Mountain Science and Engineering Report addresses this information**

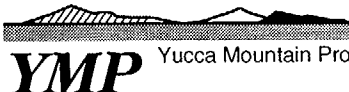
Discussion

- **Yucca Mountain Science and Engineering Report presents a summary of information and data collected to date by the Department during more than 20 years of study and characterization of Yucca Mountain as a potential repository site**
- **During this time, the Department has performed detailed scientific investigations of the geology, hydrology, geochemistry, and other characteristics of the site**
- **The Department has also developed a preliminary design for the potential repository and for the waste packages to be emplaced**
- **The results of these scientific investigations and the preliminary design have been analyzed to assess possible future performance of the potential repository in the geologic setting of the site**

Discussion

(Continued)

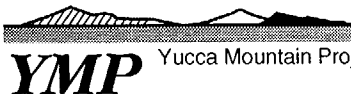
- **The Yucca Mountain Science and Engineering Report references an integrated series of documents, including**
 - **Analysis and Modeling Reports**
 - **Process Model Reports**
 - **System Description Documents**
 - **Total System Performance Assessment**
 - **Preliminary Preclosure Safety Evaluation**
 - **Yucca Mountain Site Description**
 - **Repository Safety Strategy**
- **655 references in total**



Discussion

(Continued)

- **As enhancements over earlier documents, the Yucca Mountain Science and Engineering Report discusses a possible range of operating modes, including a range of temperatures**
- **The Yucca Mountain Science and Engineering Report also discusses future studies and evaluations to address uncertainty and improve understanding of the possible future performance of a potential repository**



Yucca Mountain Science and Engineering Report Contents

Executive Summary

Section 1: Introduction

Section 2: Description of the Potential Repository

Section 3: Description of the Waste Form and Packaging

Section 4: Discussion of Data Relating to the Postclosure Safety of the Site

Section 5: Description of the Preclosure Safety Assessment

Summary – Science and Engineering Report

- **The Yucca Mountain Science and Engineering Report**
 - addresses the requirements of §114(a)(1)(A), (B), and (C) of the Nuclear Waste Policy Act
 - presents the results of over 20 years of detailed scientific investigations and design development
 - presents technical information supporting analyses in the Supplement to the Draft Environmental Impact Statement
 - will aid public and interested parties in providing comments on technical information underlying the Department's consideration of a possible site recommendation to the President for further development

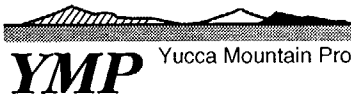
Summary – Science and Engineering Report

(Continued)

- **Yucca Mountain Science and Engineering Report and supporting references presently available at the Yucca Mountain Science Center**
- **Yucca Mountain Science and Engineering Report and supporting references are available on the Internet**

<http://www.ymmp.gov>

Site Recommendation Process



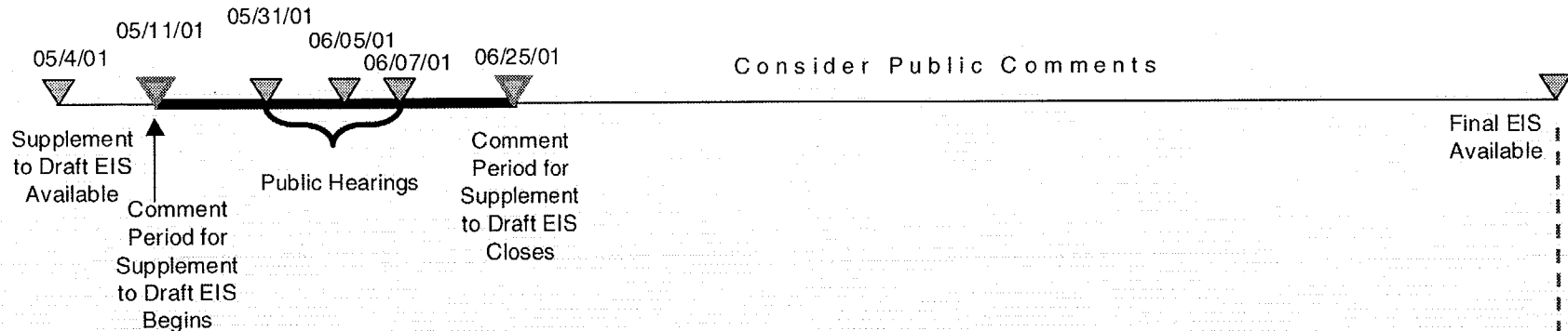
Site Recommendation Process

- **Later this summer, DOE will issue additional technical information that the Secretary may consider, including results of ongoing sensitivity studies and uncertainty analyses**
 - **Supplemental Science and Performance Analyses**
 - ◆ **Volume 1 - Scientific Bases and Analyses**
 - ◆ **Volume 2 - Performance Analyses**
- **DOE will also release a Preliminary Site Suitability Evaluation on the suitability of the Yucca Mountain site using DOE's guidelines proposed to be 10 Code of Federal Regulations Part 963**
 - **When the Preliminary Site Suitability Evaluation is released, DOE will announce dates, times, and locations for the public hearings on DOE's consideration of the Yucca Mountain site, and the date for the end of the public comment period**

YMP Public Involvement Opportunities in 2001

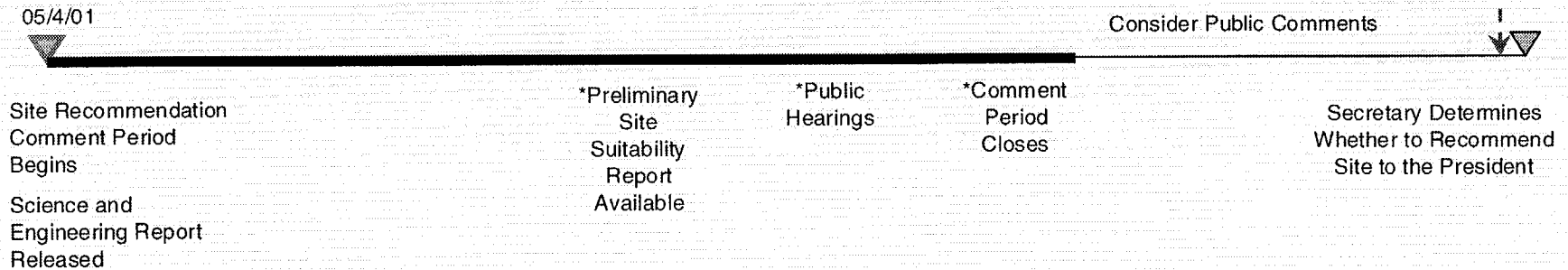
Environmental Impact Statement

Public comment period



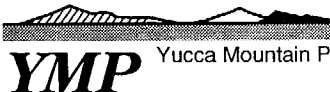
Site Recommendation Process

Public comment period



*Dates will be set by the Secretary

Figure not to scale



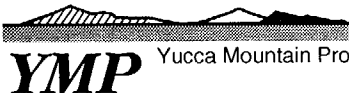
Steps in the Site Recommendation Process

- **Initiate public comment period on possible site recommendation and issue Yucca Mountain Science and Engineering Report – completed**
- **Issue Supplement to the Draft Environmental Impact Statement, open public comment period, and announce hearings – completed**
- **Close public comment period on Supplement to the Draft Environmental Impact Statement**
 - **Comments will be considered in preparation of Final Environmental Impact Statement**
- **Complete additional technical work on lower-temperature operating environments and unquantified uncertainties**
- **Release Preliminary Site Suitability Evaluation, announce hearings and closing date for public comment period**
- **Close site recommendation public comment period**
 - **Comments will be considered by Secretary as part of the basis for any recommendation decision**

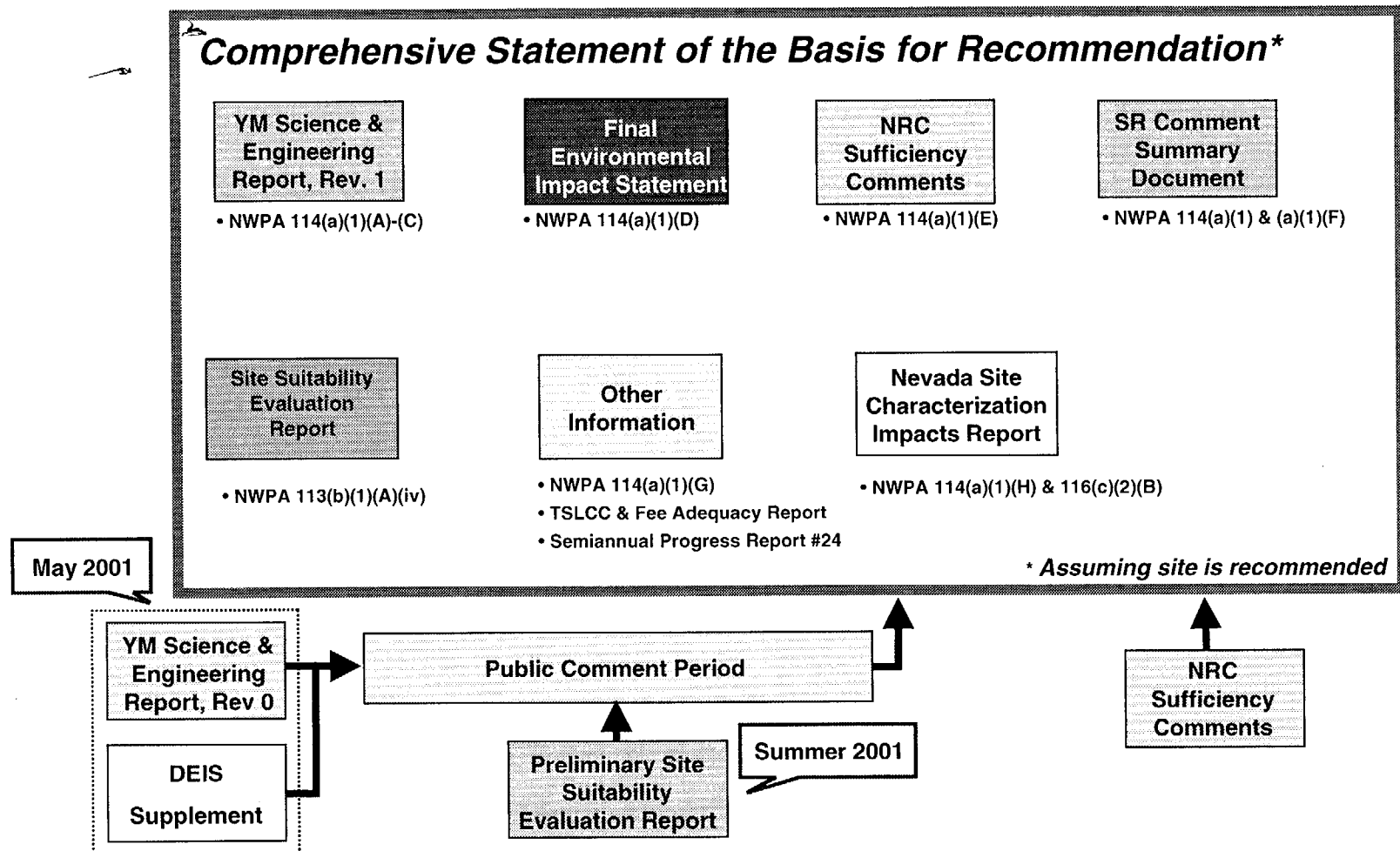
Steps in the Site Recommendation Process

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- **Receive Nuclear Regulatory Commission sufficiency comments**
- **Secretary makes site recommendation decision**
- **If recommended, Secretary notifies Governor and legislature of State of Nevada**
- **If recommended, site recommendation submitted to President no sooner than 30 days after Governor's notification**



Proposed Documentation Concept for any Site Recommendation

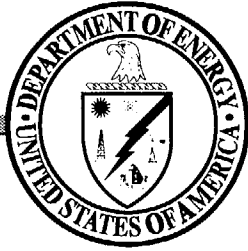


Site Recommendation Process

- **By making such a large amount of information available in stages, DOE intends to provide the public with**
 - **Ample time to review all available materials and formulate comments regarding a possible site recommendation**
 - **An open and transparent site recommendation process**

Summary – Site Recommendation Process

- **Additional technical documents available Summer 01**
- **Hearings to be conducted in the vicinity of the site to receive comments on possible site recommendation**
- **Multiple points of involvement available**



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

Highlights of the Science and Engineering Report

Presented to:
Advisory Committee on Nuclear Waste

Presented by:
Kathryn S. Knapp
Management Technical Services

June 20, 2001

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PROJECT**

Structure of the Science and Engineering Report

- **The Science and Engineering Report format addresses the information required by Nuclear Waste Policy Act (NWPA):**
 - **Executive Summary**
 - **Introduction**
 - **Section 2 - Description of the Potential Repository**
 - ◆ NWPA 114(a)(1)(A) a description of the proposed repository, including preliminary engineering specs
 - **Section 3 - Description of the Waste Form and Packaging**
 - ◆ NWPA 114(a)(1)(B) a description of the waste form and packaging and relationship of the form and packaging to the geologic medium
 - **Section 4 - Discussion of Data Relating to the Postclosure Safety of the Site**
 - ◆ NWPA114(a)(1)(C) a discussion of data relating to the safety of the site
 - **Section 5 - Description of the Preclosure Safety Assessment**
 - ◆ NWPA114(a)(1)(C) a discussion of data relating to the safety of the site

Enhancements Introduced in the Science and Engineering Report

- **The design incorporates flexibility of the operational mode to identify potential performance benefits of different environmental conditions (specifically temperature and humidity)**
 - **The Science and Engineering Report identifies operational parameters that can be varied to achieve different thermal goals**
 - **The design and performance assessment in the Science and Engineering Report is based on the higher temperature-operating mode**
- **The Science and Engineering Report identifies future studies and evaluations that address key unquantified uncertainties**

Executive Summary

- **Provides a general overview of the Science and Engineering Report**
- **Provides the reader with an understanding of the contents of the document including the geology of the site, the repository and waste package design, the processes important to long-term repository performance, and the results of the performance assessment**

Section 1 – Introduction

- **Presents the framework for the site recommendation process**
 - Provides the statutory and regulatory roadmap
- **Provides background information relevant to the project**
 - The sources of material for disposal and where they are located
 - The U.S. Policy for Geologic Disposal
- **Provides a description of the Site Characterization Program**
 - Overview of the Site Characterization Investigations
 - Description of the Yucca Mountain site
- **Provides a discussion of the responsibilities of the various organizations in the evaluation of the Yucca Mountain site**

Section 2 – Description of the Potential Repository

- **Design Process**
 - Provides the hierarchy for allocating requirements
 - Discusses the evolution and flexibility of the design
- **Surface Facility Design**
 - Waste handling building houses all systems to prepare waste for emplacement
 - Expanded-capacity spent nuclear fuel blending facility to support thermal management (from Viability Assessment)

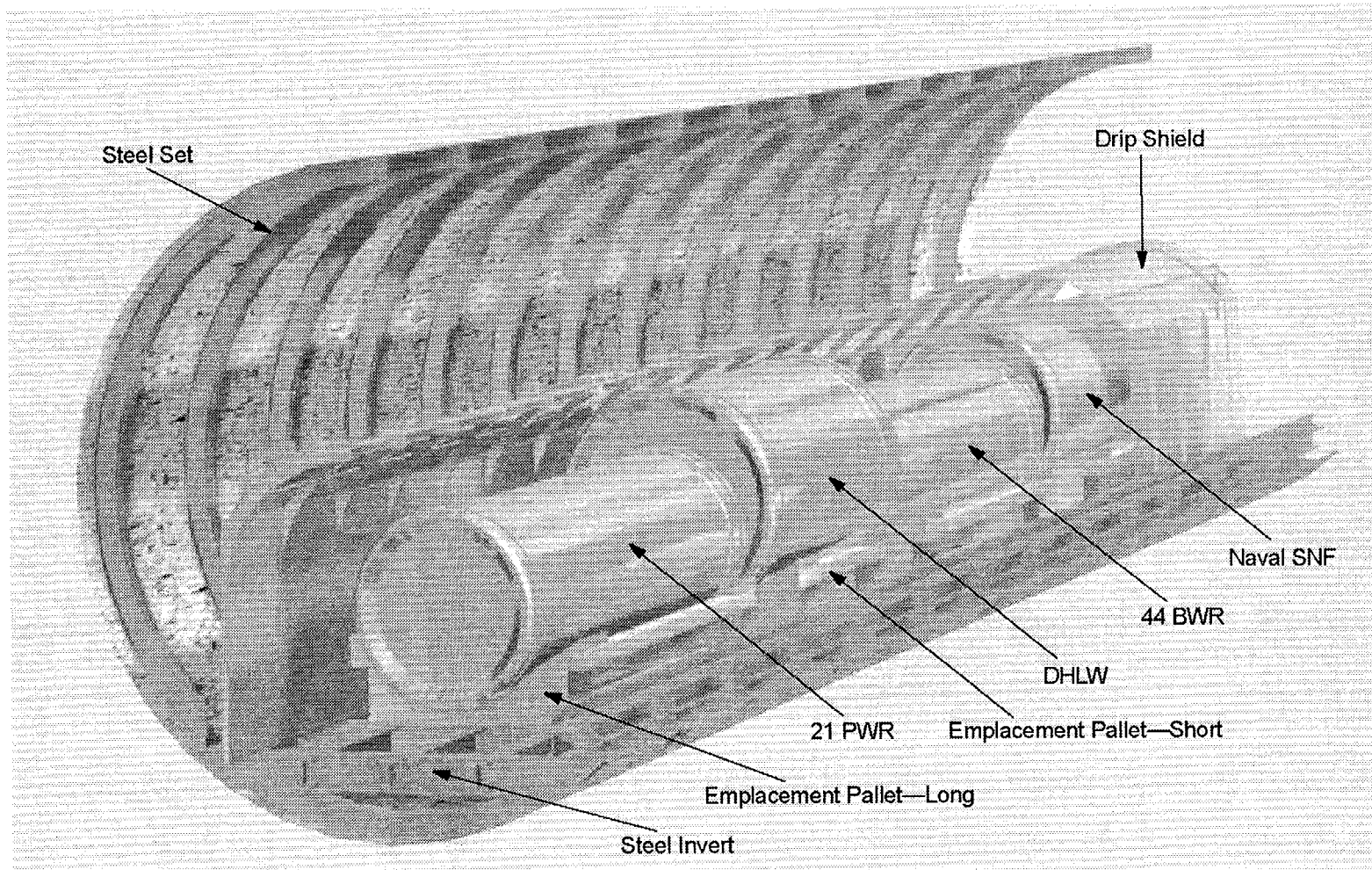
Section 2 – Description of the Potential Repository

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- **Subsurface Facility Design**
 - 58 emplacement drifts: 5.5 m in diameter at a drift spacing of 81 m
 - Waste packages line-loaded
 - Ventilation system maintains temperature and humidity
- **Engineered Barriers**
 - Drip shield
 - ◆ Corrosion-resistant material (titanium)
 - ◆ Material different from waste package protects against common mode failures
 - Drift invert

Section 2 – Description of the Potential Repository

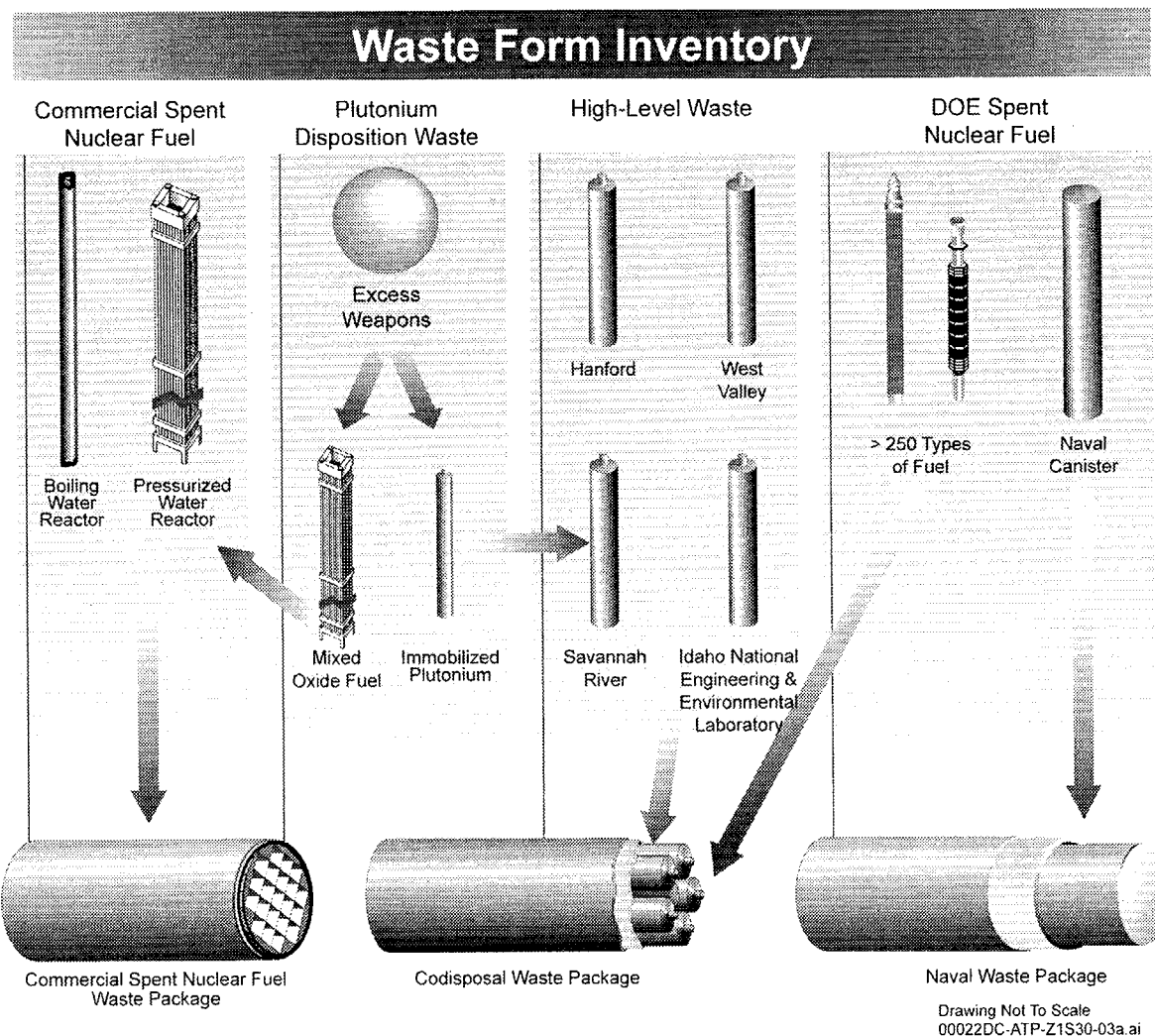
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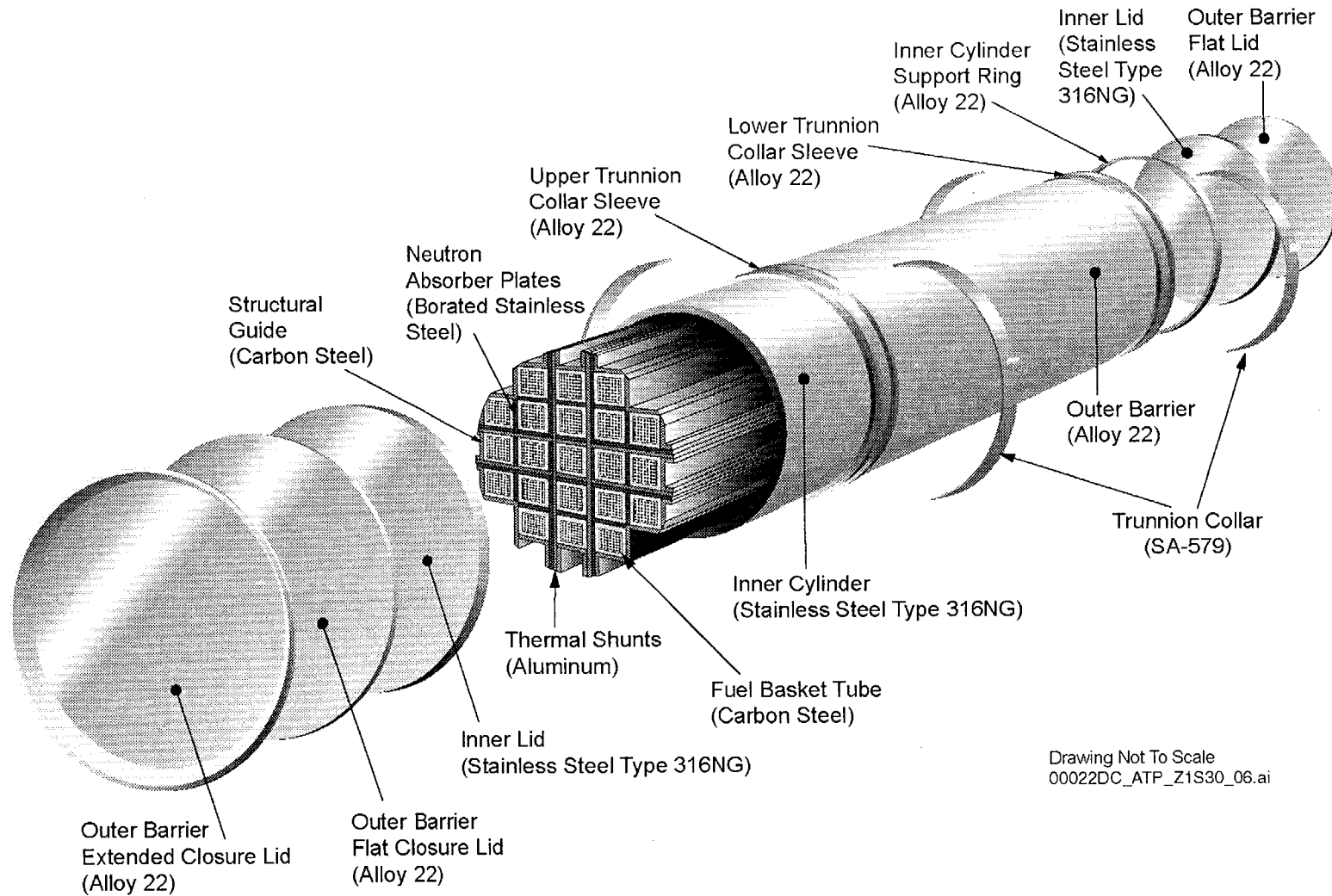
Section 3 – Description of the Waste Form and Packaging

- Presents a description of the waste form
 - Waste form characteristics that are important to design
 - Breakdown of the waste form inventory



Section 3 – Description of the Waste Form and Packaging

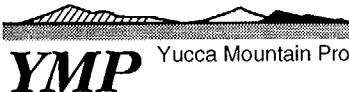
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Section 3 – Description of the Waste Form and Packaging

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- **Waste Packages**
 - **Dual-metal design: corrosion-resistant material (Alloy 22) outer barrier and stainless steel inner shell for structural support**
 - **Alloy 22 inner closure lid provides defense in depth against stress corrosion cracking**
 - **Laser peen inner closure lid and induction anneal outer closure lid to address stress corrosion cracking concerns**

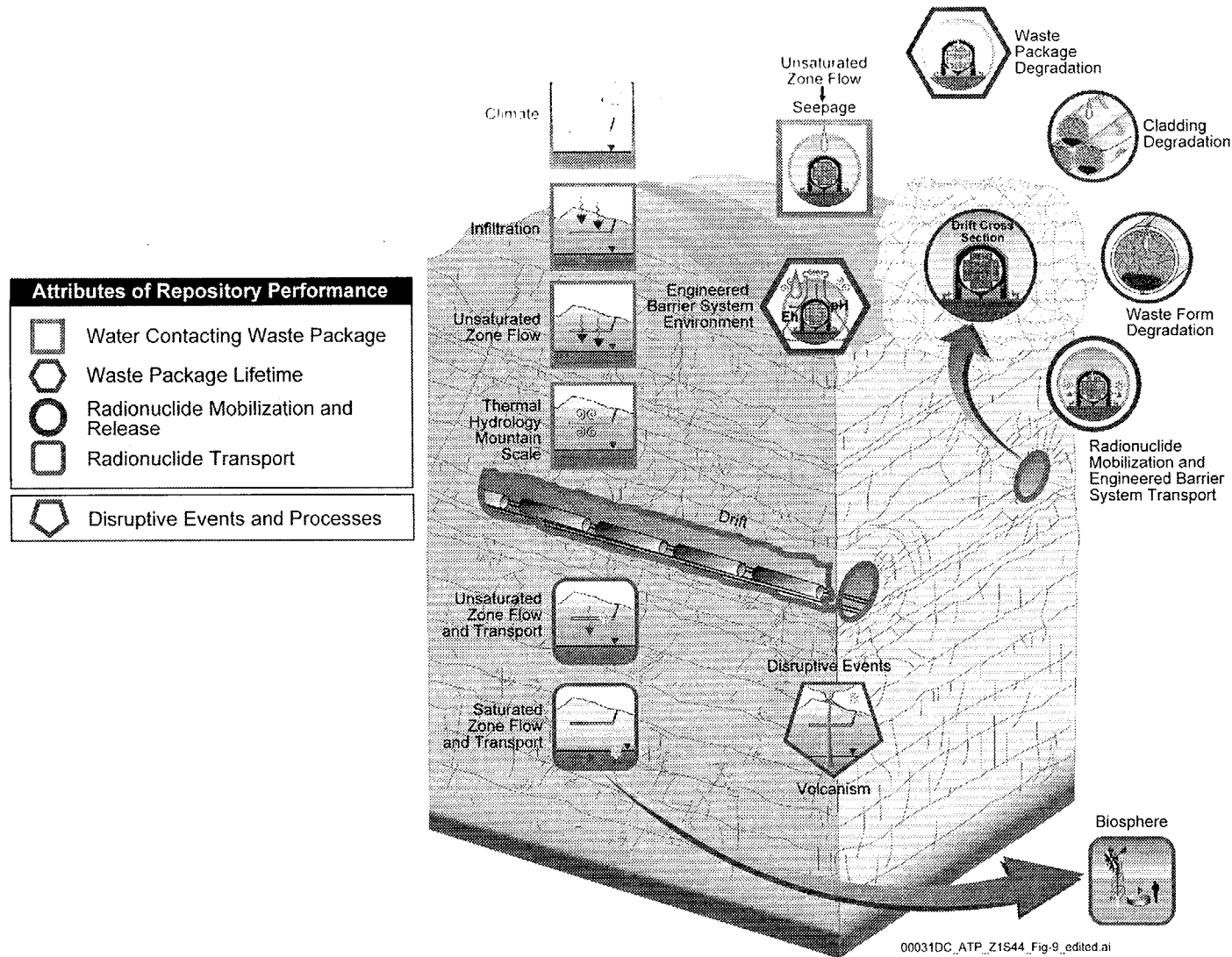


Section 4 – Discussion of Data Relating to the Postclosure Safety of the Site

- **Key attributes for long-term performance**
 - Limited water entering the emplacement drifts
 - Long-lived waste package and drip shield
 - Limited release of radionuclides from the engineered barriers
 - Delay and dilution of radionuclide concentration by the natural barriers
 - Low mean annual dose even considering potentially disruptive events
- **Natural Barriers include**
 - Surface soils and topography
 - Unsaturated rock layers above the repository
 - Unsaturated rock layers below the repository
 - Volcanic tuff and alluvial deposits below the water table
- **Natural Barriers contribute to waste isolation by**
 - Limiting the amount of water entering the drifts
 - Limiting the transport of radionuclides through the natural system

Section 4 – Discussion of Data Relating to the Postclosure Safety of the Site

(Continued)



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Section 4 – Discussion of Data Relating to the Postclosure Safety of the Site

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- **Performance assessment results**
 - **Three performance measures**
 - ◆ **Nominal scenario: The calculated result is that no dose occurs for more than 10,000 years after closure**
 - ◆ **Disruptive scenario: The overall probability-weighted mean dose from igneous event reaches a peak at 10,000 years and results in a dose rate of approximately 0.08 millirem per year**
 - ◆ **Human intrusion scenario: The peak mean total effective dose equivalent to the receptor is approximately 0.008 millirem per year during the proposed regulatory compliance period**

Section 5 – Discussion of the Preclosure Safety Assessment

- **Preclosure Safety Assessment**
 - Structures, systems, and components are being designed to provide safe handling of the waste and to prevent or reduce the impact of design basis events
- **Calculated Radiation Doses from Design Basis Event**
 - **Category 1**
 - ◆ Public - 0.06 mrem/yr
 - ◆ Worker - 0.01 mrem/yr
 - **Category 2**
 - ◆ Public - 0.02 mrem/yr

Summary

- **The Science & Engineering Report addresses NWPA 114(a)(1)(A), (B), and (C):**
 - the design concept of the proposed repository
 - the proposed waste package and waste form to be emplaced
 - the data and projection of long-term performance of the proposed repository operated in a higher thermal mode