The Environmental Protection Agency's

• 40 CFR Part 197

Public Health and Environmental Radiation Protection Standards for Yucca Mountain

Presentation to the U.S. Nuclear Waste Technical Review Board

September 11, 2001

Introduction

- June 5, 2001 - Administrator approved the final Yucca Mountain standards

- The Nuclear Regulatory Commission (NRC) will implement the standards by incorporating them into its licensing regulations

History of Part 197

- 1992 - Waste Isolation Pilot Plant Land Withdrawal Act exempted Yucca Mountain from EPA's generic standards
- 1992 - Energy Policy Act required EPA to:
  - Set standards for Yucca Mountain
  - Establish a limit on individual dose
  - Contract with National Academy of Sciences (NAS) to provide technical input
  - Make the standards consistent with the NAS findings and recommendations
- 1995 - EPA received NAS Report

Public Input

- Public comment period 8/27 – 11/26/99
- Public hearings
  - Washington, DC
  - Amargosa Valley, Nevada
  - Las Vegas, Nevada
  - Kansas City, Missouri
- Received about 800 comments
  - 28 testified
  - 69 sets of written comments

Outline of the Standards

- Subpart A – Storage
- Subpart B – Disposal
  - Individual-protection standard
  - Human-intrusion standard
  - Ground Water Protection standards
  - Other provisions

Storage Standards

- 15 millirem/year (mrem/yr) committed effective dose equivalent (CEDE) for any member of the public

- Applies outside of the Yucca Mountain Site, the Nevada Test Site, and the Nellis Air Force Range

Disposal Standards
Individual Protection

- 15 mrem CEDE/year
- Reasonably maximally exposed individual
  - Living in the accessible environment
  - Above the highest concentration in the plume of contamination
- 10,000 years dose projection
- All pathways (including ground water)

Reasonably Maximally Exposed Individual (RMEI)

- Hypothetical person
- Rural-residential living style (works elsewhere, eats some locally grown food)
- Has characteristics of people currently living in the Town of Amargosa Valley, Nevada
- Drinks 2 liters/day of ground water from wells tapping the highest level of contamination in the accessible environment

Accessible Environment

- Anywhere outside of the controlled area

- Controlled area
  - No larger than 300 square kilometers (km^2)
  - No farther south than the southern edge of NTS (i.e., north latitude 36° 40' 13.6661"), about 18 km from the repository
  - No farther than 5 km in any other direction

Disposal Standards
Human Intrusion

- Purpose is to test "resilience" of the disposal system
- 15 mrem CEDE/yr. from an intrusion and resulting dose within 10,000 yr.
- Occurs when package penetration not noticed by drillers (after package is well deteriorated)
- If intrusion/dose does not occur before 10,000 yr, post-10,000-yr analysis - results to be put into theYucca Mountain EIS (no quantitative limit)

Circumstances of the Intrusion

- Single intrusion resulting from water exploration
- Borehole through waste package to the aquifer
- Borehole is not carefully sealed
- Only releases through the borehole are analyzed
- No releases caused by unlikely natural features, events, or processes are to be considered (level of "unlikely" probability to be set by the Nuclear Regulatory Commission)

Disposal Standards
Ground Water Protection

- Applies EPA's existing maximum contaminant levels in the representative volume
- Representative volume
  - Annual withdrawal volume representing the current or planned ground water uses in Town of Amargosa Valley
  - 3,000 acre-feet
  - In the accessible environment
  - Contains the plume's highest concentration

Other Provisions

- Assume that society, the biosphere, human biology, technology and knowledge are as today - vary climate, geology/hydrology.
- Do not analyze events that have a probability of < 1 in 10,000 of occurring within 10,000 yrs.
- Post-10,000 yr analysis results, to the time of peak individual dose, in Yucca Mountain EIS

Approach to Developing the Standards

- EnPA mandated a site-specific standard, not an application of the generic Part 191standard
- EPA used a "cautious but reasonable" approach to standard development (as recommended by NAS)

Considerations for the Standards' Specifics

- Consistency with site-specific information
- The approach to public health and environment protection should be cautious but reasonable - not extreme
- Reduce uncertainty in regulatory decision-making

Persistent Question for Framing and Selecting Alternatives

- Long time frame for public health and environmental protection - a generic concern for geologic disposal
- Current conditions versus projected conditions/performance ?
- "Future States" assumption for performance projections

"Future States" Assumption

- Cannot reliably predict human actions and characteristics, or technology, over very long periods
- Assume the current situation, and short-term changes, for standards development and performance assessments
- Climate and geologic conditions required to vary in performance assessments

Some Specifics in the Standard

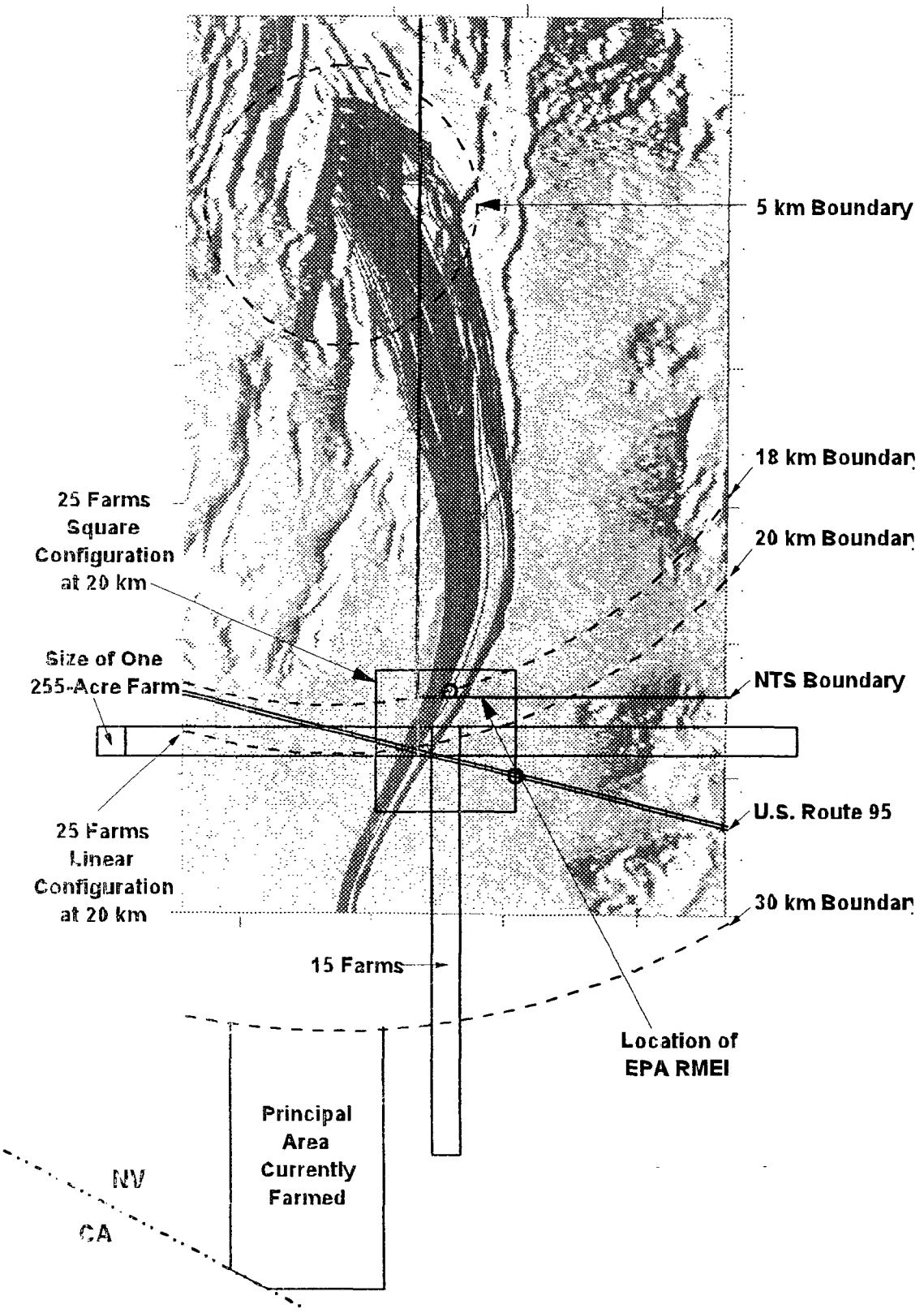
- RMEI versus Critical Group
- Compliance Point Location
- Controlled Area Size
- Regulatory Time Frame
- Representative Volume
- Reasonable Expectation

RMEI versus Critical Group for Individual Protection

- Alternatives - a representative individual (the RMEI) or a more diverse group (CG)?
- Site-specific situation:
  - small, widely dispersed population
  - narrow contamination plumes in fractured rocks
  - closest population "rural residential"

RMEI versus Critical Group

- Exact path of contamination plume will remain uncertain
- For small exposed populations, dose to the RMEI or Critical Group members expected to be very similar
- Less decision-making uncertainty with the RMEI in the path of the contamination plume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15 Farms
Location of
EPA RMEI
Principal
Area
Currently
Farmed
NV
CA

Compliance Point Location

- Location should reflect a cautious but reasonable approach to public health protection
- Be consistent with the site-specific situation for release projections and potentially exposed population

Compliance Point Location

- Repository release projections
  - to ground water migrating to Amargosa Valley
    - UZ - down and east
    - SZ - southward
- Location of potential receptors
  - closest now ~ 20 km distant
  - projected growth northward
  - Test Site is a restricted area

Compliance Point Location

- Nevada Test Site southern boundary is a "cautious but reasonable" southern limit consistent with the future states assumption

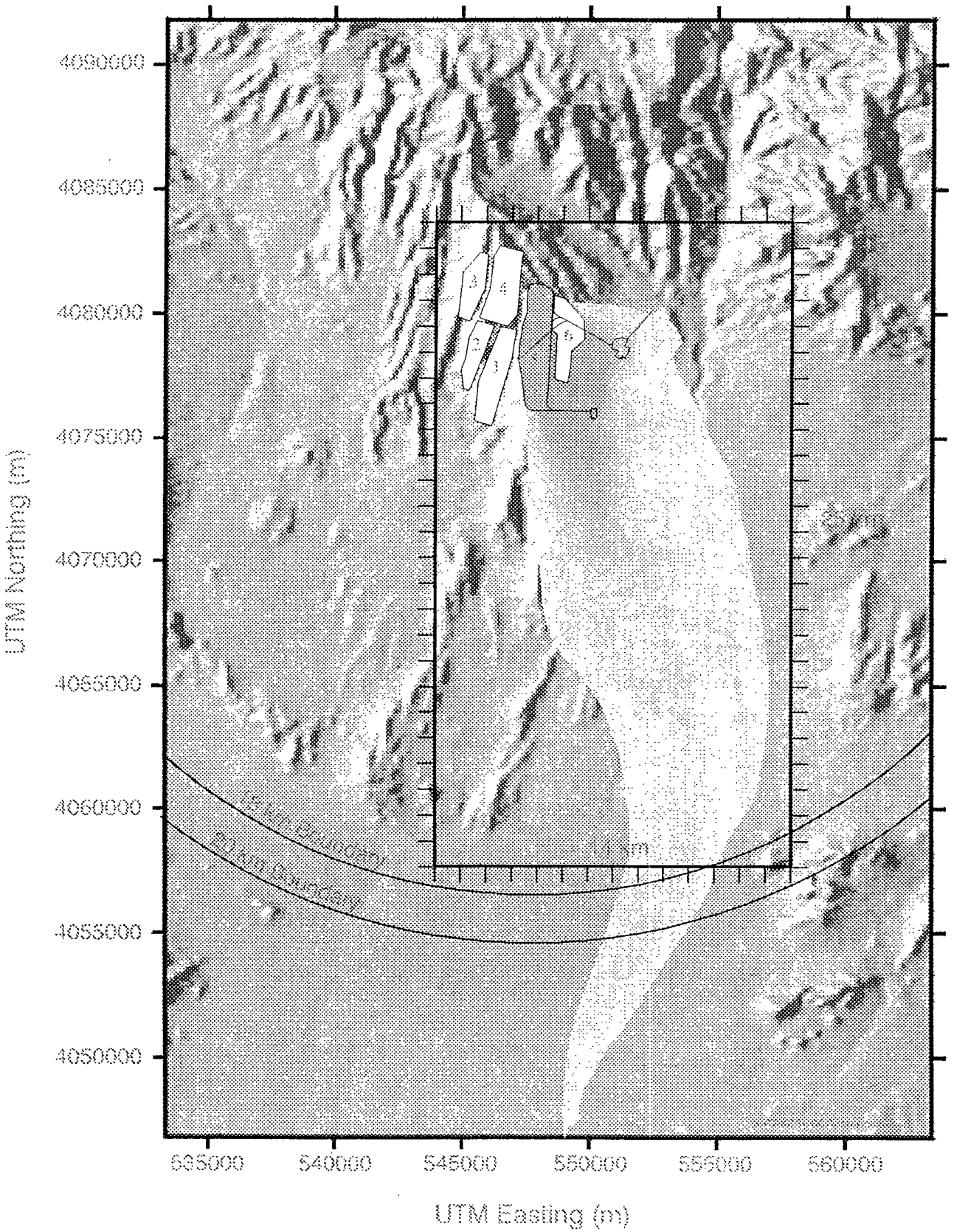
Disposal System Controlled Area

Two Major Regulatory Functions

- Compliance Measure- defines the natural barrier size - standards apply at the boundary
- Institutional Controls - minimum restricted area size - prevent inadvertent exposures

Controlled Area Considerations

- Controlled area concept a valid concept for the Yucca Mountain repository site
- Site-specific assessment based upon:
  - receptor locations - Test Site boundary
  - projected repository performance
  - normal and off-normal releases
- Maximum size ~ 300 km^2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3
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6
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1 km

Regulatory Time Frame

- Provide a reasonable expectation of long-term safety
- Decision must balance:
  - long time frame for performance protections
  - uncertainties in long-term performance projections
  - regulatory consensus

Regulatory Time Frame

TSPAs, Peak Dose Time and Waste Package Design		
TSPA	**Peak Dose Time**	**Waste Package Design**
Viability Assessment	~ 300 k yrs.	No drip shield CRM* inside Unrealistic model
Site Recommendation	~ 300 k yrs.	Drip shield CRM outside More realistic model

* corrosion resistant material

Regulatory Time Frame

- Peak dose time is relatively insensitive to the waste package design and modeling assumptions
- Very long-term dose assessments assume:
  - uncertain projections of site characteristics
  - simplest source-term release model
- Uncertainties in very long-term site performance confound decision-making

Very Long-Term Uncertainties

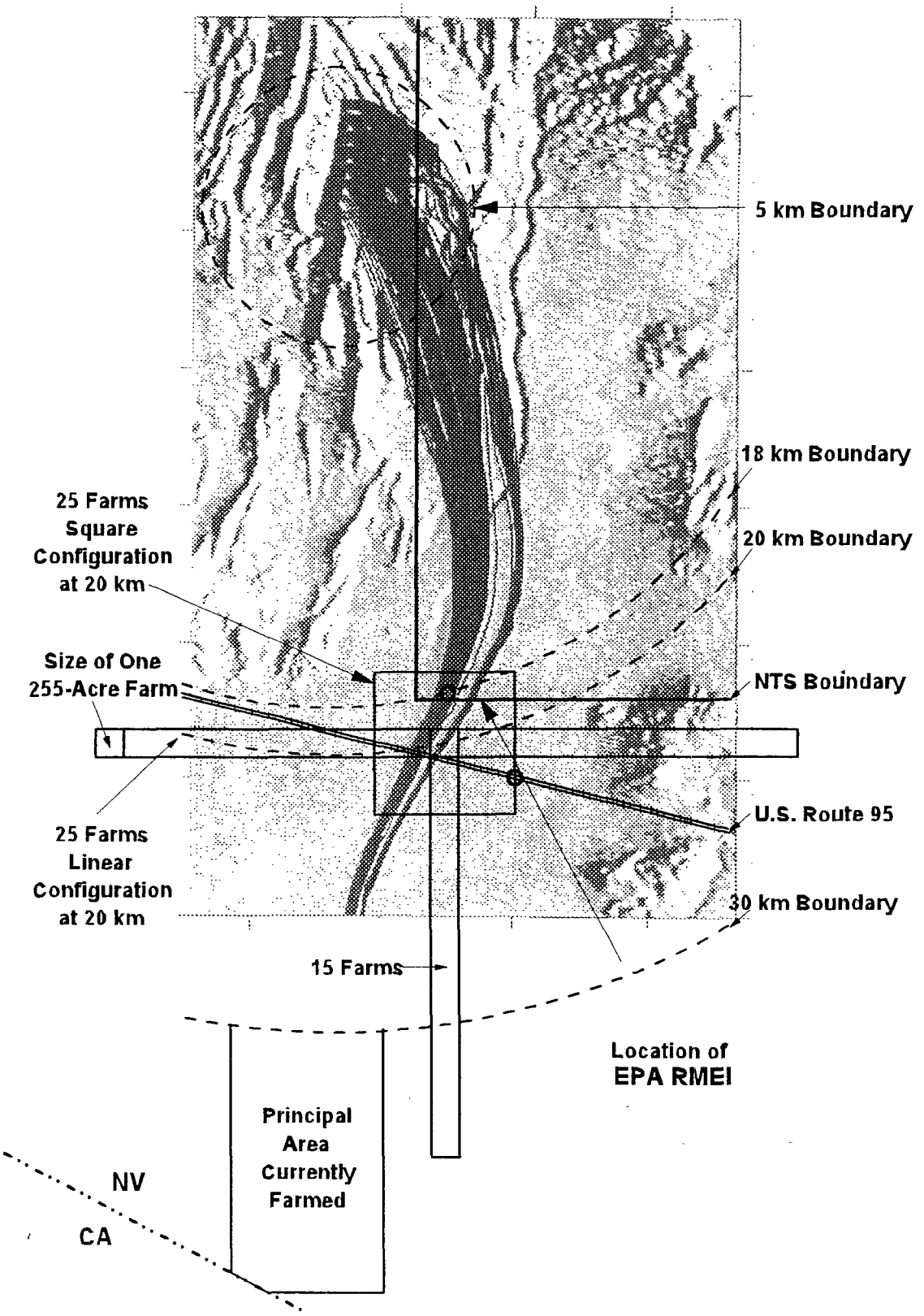
- Will the hydrologic regime be unchanged?
- How reliable are climate projections?
- How will the heat pulse alter the near-field?
- How will ground water react with and transport wastes after the waste package is substantially gone?

Regulatory Time Frame

- A 10,000 year regulatory time frame is the cautious but reasonable choice:
  - Consistent with existing precedents in regulations
  - Avoids speculative performance scenarios for decision-making
- Very long-term performance assessments still required

Representative Volume

- Volume of ground water for resource protection
- Represents the spectrum of resource uses
  - agricultural uses (alfalfa farming the largest use)
  - residential/municipal and industrial uses
- Calculational approaches focus on the contamination plume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Reasonable Expectation

- Consistent with the "cautious but reasonable" approach to developing the standard:
  - recognize and evaluate all uncertainties
  - emphasis on assessments being as realistic as practical
  - avoid extreme assumptions to simplify calculations