Disclaimer
What follows is an excerpted, condensed rendition of the 2002 U.S. Department of Energy's "Final Environmental Impact Statement For a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada." The purpose of this document is to retain the structure and language of the original but in an abbreviated form to achieve greater accessibility for a wider audience. Whilst minor edits have been made in the interest of clarity, this should be considered an abridged reproduction of the original.

Final Environmental Impact Statement
For a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Volume I Chapter 4 (abridged)
Environmental Consequences of Repository Construction, Operation and Monitoring, and Closure
Pgs. 4-1 – 4-117 (400 – 526)

4. ENVIRONMENTAL CONSEQUENCES OF REPOSITORY CONSTRUCTION, OPERATION AND MONITORING, AND CLOSURE

This chapter describes short-term environmental consequences that could result from the implementation of the Proposed Action, which is to construct, operate and monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste at Yucca Mountain. Short-term refers to the period from the beginning of construction through final repository closure, and includes project phases of construction, operation and monitoring, and closure. For purposes of analysis, the repository would remain open from 115 to 341 years from the beginning of construction to final closure, depending upon the operating mode and operating parameters selected.

4.1 Short-Term Environmental Impacts of Performance Confirmation, Construction, Operation and Monitoring, and Closure of a Repository

PRECONSTRUCTION TESTING AND PERFORMANCE CONFIRMATION ACTIVITIES

The preconstruction testing and performance confirmation program would continue many of the same types of activities performed during site characterization—tests, experiments, and analyses—for as long as required. DOE would continue performance confirmation activities during all the phases of the repository project to evaluate the accuracy and adequacy of the information it used to determine with reasonable assurance that the repository would meet the performance objective for the period after permanent closure.

INITIAL CONSTRUCTION PHASE (STARTING IN 2005, LASTING 5 YEARS)

The construction of facilities would begin when and if the Nuclear Regulatory Commission authorized DOE to build the repository. For analysis purposes, this EIS assumed construction would begin in about 2005. Most surface facility construction would be completed during this phase, with the exception of the solar facility and aging pads, if built. Initial subsurface construction would excavate access mains, ventilation shafts, and the first emplacement drifts and prepare them for the start of emplacement activities, assumed for analysis purposes to begin in 2010.

OPERATION AND MONITORING PHASE

The operation and monitoring phase would last 100 to 324 years and would consist of an operations period and a monitoring period. The EIS analyses assumed that repository operations would begin in 2010. Development activities would last 22 years for all operating modes, concurrent with handling and emplacement. Handling and emplacement activities would last 24 years for the higher-temperature operating mode and for the lower-temperature operating mode if surface aging was not used. If surface aging was used, the operations period would last 50 years.

Monitoring of the emplaced material and maintenance of the repository would start with the first emplacement of waste packages and would continue through the closure phase. DOE would maintain

the repository in a configuration that would enable continued monitoring and inspection of the waste packages, continued investigations in support of predictions of long-term repository performance (the ability to isolate waste from the accessible environment), and the retrieval of waste packages, if necessary. This period would last from 76 to 300 years. The first 3 years of the monitoring period would include the radioactive decontamination of surface facilities used for handling radioactive materials.

Future generations would need to decide whether to continue to maintain the repository in this open monitored condition or to close it. However, the Department expects that a repository could be maintained in an open monitored condition, with appropriate maintenance, for the time periods evaluated in this chapter. For this analysis, the EIS evaluates closure starting 100 years after the start of emplacement for the higher-temperature operating mode, and 149 to 324 years for the lower temperature operating mode.

CLOSURE PHASE (LASTING 10 TO 17 YEARS)
Closure would take 10 years for the higher-temperature operating mode and from 11 to 17 years for the lower-temperature operating mode, depending on the operating parameters that had been employed.

4.1.1 IMPACTS TO LAND USE AND OWNERSHIP
4.1.1.1 Impacts to Land Use and Ownership During Preconstruction Testing and Performance Confirmation and from Land Withdrawal
To develop the proposed Yucca Mountain Repository, DOE would need to obtain permanent control of the land surrounding the repository site. The Department believes that an area of approximately 600 square kilometers (230 square miles) on Bureau of Land Management, U.S. Air Force, and DOE lands in southern Nevada would be sufficient. Nuclear Regulatory Commission licensing conditions for a repository include a requirement that DOE either own or have permanent control of the lands for which it is seeking a repository license. As noted above, portions of the area proposed for the repository are lands controlled by the Bureau of Land Management, the Air Force, and the DOE Nevada Operations Office.

4.1.1.2 Impacts to Land Use and Ownership from Construction, Operation and Monitoring, and Closure
Surface disturbance for the higher-temperature operating mode would be 4.3 square kilometers (1,000 acres). Surface disturbance for the lower-temperature operating mode would range from 4.5 square kilometers (1,100 acres) to approximately 6 square kilometers (1,500 acres). The surface disturbance represents a small amount of the 600 square kilometers (150,000 acres) of land withdrawn for the repository. Therefore, there would be small impacts to land use due to the implementation of the Proposed Action.

4.1.2 IMPACTS TO AIR QUALITY
Sources of nonradiological air pollutants at the proposed repository site would include fugitive dust emissions from land disturbances and excavated rock handling; nitrogen dioxide, sulfur dioxide, carbon monoxide, and particulate matter emissions from fossil fuel consumption; and fugitive dust emissions from concrete batch plant operations. Radiological air quality impacts could occur from releases of radionuclides, primarily naturally occurring radon-222 and its radioactive decay products, from the rock into the subsurface facility and then into the ventilation air during all phases of the repository project. Radioactive noble gases, principally krypton-85, would be released from surface facilities during the handling of spent nuclear fuel. Overall, the impacts to regional air quality from performance confirmation, repository construction, operation and monitoring, and closure would be small. Exposures of maximally exposed individuals to airborne pollutants would be a small fraction of applicable regulatory limits.

4.1.2.1 Impacts to Air Quality from Preconstruction Testing and Performance Confirmation
Preconstruction testing and performance confirmation activities would generate particulate and gaseous emissions. Particulates would be generated by drilling, blasting, rock removal and storage, batch concrete plant operation, surface grading and leveling, wind erosion, and vehicle travel on paved and unpaved roads. Gaseous air pollutant emissions would consist of carbon monoxide, nitrogen oxides,

sulfur oxides, and hydrocarbons. These pollutants would be produced by diesel- and gasoline-powered construction equipment and motor vehicles and by diesel-powered drilling engines and electric generators.

4.1.2.2 Impacts to Air Quality from Construction

4.1.2.2.1 Nonradiological Impacts to Air Quality from Construction

During the initial construction, repository activities would result in emissions of air pollutants. Subsurface excavation would release dust (particulate matter) from the ventilation exhaust. The excavation of rock would generate dust in the drifts. The dust would be vented from the subsurface through the South Portal. The analysis did not consider standard construction dust suppression measures, which DOE would implement and which would further lower projected PM10 concentrations by reducing fugitive dust from surface-disturbing activities. These measures would not have a major effect on concentrations of PM2.5 because fugitive dust is not a major source of PM2.5.

4.1.2.2.2 Radiological Impacts to Air Quality from Construction

No releases of manmade radionuclides would occur during the construction phase because such materials would not be present until the repository began operations. However, the air exhausted from the subsurface would contain naturally occurring radon-222 and its radioactive decay products.

4.1.2.3 Impacts to Air Quality from Operation and Monitoring

4.1.2.3.1 Nonradiological Impacts to Air Quality from Operation and Monitoring

The level of emissions would vary among the operating modes. The lower-temperature operating mode would result in larger excavated rock piles on the surface, which in turn would result in larger fugitive dust emissions and necessitate larger vehicle fleets for operation and maintenance.

Concentrations would differ between the construction phase and the emplacement and development activities. The rate of fugitive dust release and the subsequent PM10 concentrations would be higher during the construction phase than during emplacement and development activities because of the differing amount of land surface disturbance. Concentrations of cristobalite would be comparable in the construction and operation and monitoring phases. Concentrations of gaseous criteria pollutants would decrease during emplacement and development activities because vehicle emissions would decrease during emplacement and development. For all pollutants, the slight differences in estimated concentrations do not provide meaningful distinctions among the operating modes.

4.1.2.3.2 Radiological Impacts to Air Quality from Operation and Monitoring

Operations Period. The main radionuclide released to the atmosphere from the handling of spent nuclear fuel assemblies in the Waste Handling Building would be krypton-85. No releases of particulate or soluble radionuclides would be likely. A continuing source of dose to members of the public and noninvolved (surface) workers would be releases of naturally occurring radon-222 from the subsurface. Estimated radon emissions during the continuing construction, operation, and monitoring period would be greater than those during the initial construction period because of the larger repository size, with more surface area for radon flux from the repository walls and greater quantities exhausted by ventilation.

Monitoring Period. Monitoring would continue and maintenance would begin immediately after the completion of emplacement activities. One of the first activities would be the decontamination of the surface material handling facilities. Monitoring periods would range from 76 to 300 years depending on the repository operating mode and selected operating parameters.

4.1.2.4 Impacts to Air Quality from Closure

4.1.2.4.1 Nonradiological Impacts to Air Quality from Closure

During the closure phase, nonradiological air emissions would result from the backfilling and sealing of the repository subsurface and the reclamation of disturbed surface lands.

4.1.2.4.2 Radiological Impacts to Air Quality from Closure

During the closure phase the only doses from releases of radionuclides to the atmosphere would be from naturally occurring radon-222 and its radioactive decay products released from the continued ventilation of subsurface facilities. Highest doses for this phase—both total and annual—would be under conditions of largest waste package spacing, which would require the largest repository and the longest time (17 years) to close the repository.

4.1.2.5 Total Impacts to Air Quality from All Phases

The highest concentrations of all criteria pollutants except PM10 would be less than 1 percent of applicable standards in all cases. PM10 would also be less than 1 percent of the applicable limits except it would be less than 2 percent of the annual limit and 6 percent of the 24-hour limit during the construction phase; less than 2 percent of the 24-hour limit during the operation and monitoring phase; and less than 4 percent of the 24-hour limit during the closure phase.

4.1.3 IMPACTS TO HYDROLOGY

The analysis evaluated surface-water and groundwater impacts separately. The analysis assessed groundwater impacts to determine the potential for a change in infiltration rates that could affect groundwater, the potential for introduction of contaminants, the availability of groundwater for use during construction and operations, and the potential that such use would affect other users.

4.1.3.1 Impacts to Hydrology from Preconstruction Testing and Performance Confirmation

Preconstruction testing and performance confirmation activities would be unlikely to cause large impacts to the surface hydrology at the Yucca Mountain site, where there are no perennial streams or other permanent surface-water bodies.

4.1.3.2 Impacts to Surface Water from Construction, Operation and Monitoring, and Closure

Discharges of Water to the Surface

During the 5-year initial construction phase, and during the operations period that would follow (lasting 24 years or 50 years if surface aging was used), sources of surface water other than precipitation would be limited primarily to the water DOE would use for dust suppression on the surface and below ground (with accumulations pumped back to the surface). During the operations period, the quantity of water discharged would vary in proportion to the amount of subsurface excavation. Annual discharges under the lower-temperature operating mode would increase in comparison to those from the higher temperature operating mode because of increased waste package spacing and the associated increase in drift excavation.

Potential for Contaminant Spread to Surface Water

The potential for contaminants to reach surface water would generally be limited to the occurrence of a spill or leak followed by a rare precipitation or snow melt event large enough to generate runoff. Facilities would be designed and built to withstand a 100-year flood, consistent with common industrial practice. The primary sources of potential surface-water contaminants during both the construction and the operation and monitoring phases would be the fuels (diesel and gasoline) and lubricants (oils and greases) needed for equipment.

Radioactive materials present during the operation and monitoring phase would be managed in the Radiologically Controlled Area of the North Portal Operations Area. This would include the Carrier Parking Area and Carrier Preparation Building across Midway Valley Wash to the northeast, and the aging pads if used for the lower-temperature operating mode. The radiological materials would always be in containers or casks except when they were in the Waste Handling and Waste Treatment Buildings. In those buildings, facility system and component design would prevent inadvertent releases to the environment; drainlines would lead to internal tanks or catchments, air emissions would be filtered, fuel pools would have secondary containment and leak detection, and other features would have similar safety or control components.

Potential for Changes to Surface Water Runoff or Infiltration Rates

Construction activities that disturbed the land surface would alter the rate at which water could infiltrate the disturbed areas. A maximum of about 2.8 square kilometers (690 acres) of land would be disturbed during the construction and operation and monitoring phases of the higher-temperature operating mode. Most of the land disturbance during construction would result in surfaces with lower infiltration rates; that is, the surfaces would be less permeable than natural soil conditions and would cause an increase in runoff. Monitoring and maintenance activities would not disturb additional land and, therefore, would have no notable impacts to runoff rates in the area. Reclamation of previously disturbed land would restore preconstruction runoff rates. DOE anticipates that closure activities would disturb only land that had been previously disturbed during earlier phases.

Potential for Altering Natural Surface-Water Drainage
Repository-related structures could affect small drainage channels or washes. DOE expects to control surface-water drainage in these washes with minor diversion channels, culverts, or similar drainage control measures. Some transportation-related construction, operation, and maintenance actions would occur in the floodplains of as many as four washes in the Yucca Mountain vicinity.

4.1.3.3 Impacts to Groundwater from Construction, Operation and Monitoring, and Closure
The following impacts would be of primary concern while the repository was open:
• The potential for a change in infiltration rates that could increase the amount of water in the unsaturated zone and adversely affect the performance of waste containment in the repository, or decrease the amount of recharge to the aquifer;
• The potential for contaminants to migrate to the unsaturated or saturated groundwater zones;
• The potential for water demands associated with the repository to deplete groundwater resources to an extent that could affect downgradient groundwater use or users.

Infiltration Rate Changes
If construction activities resulted in disturbed land that was loose or broken up, local infiltration would increase and the amount of runoff reaching nearby drainage channels would decrease accordingly. Conversely, completed construction that involved either compacted soil or facility surfaces (concrete pads, asphalt surfaces, etc.) would result in less local infiltration and more water available to reach the drainage channels and then infiltrate into the ground. However, given the dry climate and relatively small amount of potentially disturbed area in relation to the surrounding unchanged areas, the net change in infiltration would be small.

Potential for Contaminant Migration to Groundwater
To pose a threat to groundwater, a contaminant would have to be spilled or released and then carried down either by its own volume or with infiltrating water. The depth to groundwater, the thickness of alluvium in the area, and the arid environment would combine to reduce the potential for a large contaminant migration, as would adherence to regulatory requirements and plans.

Groundwater Resources
The quantity of water necessary to support the Proposed Action would be greatest during the initial construction phase and the operation and monitoring phase. Peak demand would occur while DOE was emplacing nuclear material in completed drifts (tunnels) at the same time it was developing other drifts.

Groundwater Demand During Construction
The level of water demand during the construction phase probably would result in declines in water levels in the production wells and nearby. However, this decline would diminish to undetectable levels as the distance from the repository increased and would result in very small effects to the overall groundwater system.

Effect of Operations on Groundwater Perennial Yield
Perennial yield is the estimated quantity of groundwater that can be withdrawn annually from a basin without depleting the reservoir. The estimated perennial yield of the aquifer in the Jackass Flats hydrographic area is between 1.1 million and 4.9 million cubic meters (880 and 4,000 acre-feet). The

highest estimated water demand during the operation and monitoring phase would not exceed this lowest estimate of perennial yield, and it would represent only about 7 percent of the higher estimate of perennial yield.

Potential Changes to Groundwater Elevation
Results of the simulations indicated that there would be groundwater elevation differences (between conditions with and without the Proposed Action) as described in the following summary statements:
• The Thiel Engineering Consultants study predicted a water elevation decrease of up to 3 meters (10 feet) within about 1 kilometer (0.6 mile) of the Yucca Mountain production wells as a result of the Proposed Action's water demand;
• The models predicted water elevation decreases at the town of Amargosa Valley ranging from less than 0.4 meter (1.2 feet) to 1.1 meters (3.6 feet);
• Both models generated predictions of the reduction in underflow from the Jackass Flats hydrographic area to the Amargosa Desert hydrographic area that would result from the Proposed Action.

Monitoring Period
Water demand for monitoring and maintenance activities would be much less than that for emplacement and development activities, particularly after the completion of decontamination activities, which would take place during the first 3 years of the monitoring period. Routine monitoring and maintenance activities would involve minimal water needs.

Closure Phase
The annual demand during closure would vary by a small amount based on the operating mode used, but would be less than 30 percent of the maximum demand during the operation and monitoring phase and, similarly, would have minor impacts on groundwater resources.

Summary of Impacts to Hydrology
• Repository operation would result in minor changes to runoff and infiltration rates.
• The potential for flooding at the repository site is extremely small.
• Water demand under highest consumption conditions would be below the Nevada State Engineer's ruling of perennial yield (the amount that can be withdrawn annually without depleting reserves) for the Jackass Flats groundwater basin. The highest demand conditions in combination with ongoing Nevada Test Site demand from the same basin would also be below the lowest estimates of perennial yield.
• The combined water demand of the repository and the Nevada Test Site would, at most, have minor impacts on the availability of groundwater in the Amargosa Valley in comparison to the quantities of water already being withdrawn there.

DOE filed an application for permanent water rights with the State of Nevada for the projected water needs to meet DOE's responsibilities under the NWPA. Uses for the water would include, but not be limited to, road construction, facility construction, drilling, dust suppression, drift and pad construction, testing, culinary, domestic, and other related site uses. On February 2, 2000, the Nevada State Engineer denied the application on the basis that the proposed use threatens to prove detrimental to the public interest because the proposed use (that is, supporting the repository action) is prohibited by existing State law.

4.1.4 IMPACTS TO BIOLOGICAL RESOURCES AND SOILS
Neither the removal of vegetation from the small area required for the repository nor the very small impacts to some species would affect regional biodiversity and ecosystem function.

4.1.4.1 Impacts to Biological Resources and Soils from Preconstruction Testing and Performance Confirmation
The limited habitat loss from additional land disturbance would have little impact on plant and animal populations because habitats similar to those at Yucca Mountain are widespread locally and regionally. Similarly, the deaths of small numbers of individuals of some species, primarily burrowing species of

small mammals and reptiles, would have little impact on the regional populations of those species. The animal species at the Yucca Mountain site are generally widespread throughout the Mojave or Great Basin Deserts.

4.1.4.2 Impacts to Biological Resources from Construction, Operation and Monitoring, and Closure
Expected dose rates to plants and animals would be much less than 100 millirad per day. Therefore, no detectable impacts to biological resources would occur as a result of normal releases of radioactive materials from the repository, and the following sections do not consider these releases.

Impacts to Vegetation
The construction of surface facilities and the disposition of rock excavated during subsurface construction would remove or alter vegetation. Much of the construction would occur in areas in which site characterization activities had already disturbed the vegetation; however, construction would also occur in undisturbed areas near the previously disturbed areas. Repository construction, including the disposal of material in the excavated rock pile after the start of emplacement, would occur primarily in previously disturbed areas or areas dominated by creosote-bursage and Mojave mixed scrub.

Impacts to Wildlife
The construction of surface facilities and excavated rock disposal would lead to habitat losses for some terrestrial species; however, habitats similar to those at Yucca Mountain (identified by land cover type) are widespread locally and regionally.

The construction of new roads, surface facilities, and other infrastructure would lead to fragmentation of previously undisturbed habitat. Nevertheless, DOE anticipates impacts to wildlife populations to be very small because large areas of undisturbed and unfragmented habitat would be available away from disturbed areas. Animal species present at the repository location are generally widespread throughout the Mojave or Great Basin Deserts and the deaths of some individuals due to repository construction and habitat loss would have little impact on the regional populations of those species.

Impacts to Special Status Species
The desert tortoise is the only resident animal species in the analyzed land withdrawal area listed as threatened under the Endangered Species Act of 1973. Repository construction would result in the loss of a very small portion of the total amount of desert tortoise habitat at the northern edge of the range of this species in an area where the abundance of desert tortoises is low. Although these losses would cause a small decrease in the abundance of desert tortoises in the immediate vicinity of the repository site, they would not affect the long-term survival of the local or regional population of this species.

Impacts to Wetlands
There are no known naturally occurring jurisdictional wetlands (that is, wetlands subject to permitting requirements under Section 404 of the Clean Water Act) on the repository site, so no impacts to such wetlands would occur as a result of repository construction, operation and monitoring, or closure.

4.1.4.3 Evaluation of Severity of Impacts to Biological Resources
4.1.4.4 Impacts to Soils from Construction, Operation and Monitoring, and Closure
Soil-related issues associated with the Proposed Action include the following:
• Potential consequences of soil loss in disturbed areas, either from erosion or displacement
• Soil recovery from disturbances
• Potential for spreading contamination by relocating contaminated soils (if present).
Overall, impacts to soils would be minimal.

Soil Loss
Land disturbed at the repository site could, at least for a short period, experience increased erosion. Erosion is a two-step process of (1) breaking away soil particles or small aggregates and (2) transporting those particles or aggregates. Land disturbance that removed vegetation or otherwise broke up the

natural surface would expose more small materials to the erosion process, making the soil more susceptible to wind and water erosion.

Site characterization activities at Yucca Mountain included a reclamation program with a goal to return the disturbed land to a condition similar to its pre-disturbance state. One of the benefits of achieving such a goal would be the minimization of soil erosion. The program included the implementation and evaluation of topsoil stockpiling and stabilization efforts that would enable the use of topsoil removed during excavation in future reclamation activities.

Recovery
Natural succession on disturbed arid lands would be a very slow process. Left alone, and depending on the type or degree of disturbance and the site-specific environmental conditions, the recovery of pre-disturbance conditions in this area could take decades or even centuries.

Contamination
Radiological and nonradiological characteristics of the site soils are consistent with the area background. Therefore, there would be no need for restrictions or concerns about contamination migration during construction or as a result of soil erosion.

4.1.5 IMPACTS TO CULTURAL RESOURCES
4.1.5.1 Impacts to Cultural Resources from Preconstruction Testing and Performance Confirmation
Land disturbances associated with preconstruction testing and performance confirmation activities could have direct impacts to cultural resources in the Yucca Mountain region of influence. Before activities began, therefore, DOE would identify and evaluate archaeological or cultural resources sites in affected areas for their importance and eligibility for inclusion in the National Register of Historic Places. DOE would avoid such sites if practical or, if it was not practical, would conduct a data recovery program of the sites in accordance with applicable regulatory requirements and input from the official tribal contact representatives and document the findings. The artifacts from and knowledge about the site would be preserved. Improved access to the area could lead to indirect impacts, which could include unauthorized excavation or collection of artifacts. Workers would have required training on the protection of these resources from excavation or collection.

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4.2 Short-Term Environmental Impacts from the Implementation of a Retrieval Contingency or Receipt Prior to the Start of Emplacement
4.2.1 IMPACTS FROM RETRIEVAL CONTINGENCY
Section 122 of the Nuclear Waste Policy Act requires DOE to maintain the ability to retrieve emplaced waste for an appropriate period after the start of emplacement. Nuclear Regulatory Commission regulations at 10 CFR 63.111(e) specify a retrieval period of at least 50 years. This EIS evaluates retrieval as a contingency action and describes potential impacts if it were to occur. The analysis in this EIS assumes that under this contingency DOE would retrieve all the waste and would place it on a surface storage pad pending future decisions about its ultimate disposition.

4.2.1.1 Retrieval Activities
On the surface, the retrieved waste packages would be loaded on a vehicle for transport to a Waste Retrieval and Storage Area in Midway Valley, about 3.7 kilometers (2.3 miles) from the North Portal Operations Area, to which DOE would build a rail line or roadway. DOE based its selection of Midway Valley Wash as the site for retrieval activities on the following site selection criteria:
• Proximity to the repository North Portal Operations Area
• Retrieval of the waste in the shortest possible timeframe
• Adequate space for dry storage of 70,000 MTHM of waste
• No ground displacements due to earthquakes
• Siting outside the probable maximum flood zone
• Minimum costs for construction

• Minimum impacts to the environment

DOE performed an impact analysis for the retrieval contingency only for the higher-temperature repository operating mode. Since 70,000 MTHM of spent nuclear fuel and high-level radioactive waste would be emplaced under the Proposed Action for all operating modes, the analysis of impacts for this operating mode is sufficient to describe the types and magnitudes of impacts that would occur if DOE implemented the retrieval contingency.

4.2.1.2 Impacts of Retrieval

4.2.1.2.1 Impacts to Land Use and Ownership from Retrieval

Retrieval would cause no land use and ownership impacts during the construction of the Waste Retrieval and Storage area because the retrieval area would be on lands already withdrawn and under DOE control. DOE would develop the Waste Retrieval and Storage area on a 1.5-square-kilometer (380-acre) area approximately 3.7 kilometers (2.3 miles) north of the North Portal Operations Area in Midway Valley.

4.2.1.2.2 Impacts to Air Quality from Retrieval

The construction of the Waste Retrieval and Storage Area and the movement of the spent nuclear fuel and high-level radioactive waste to the surface would result in air quality impacts. Radon-222 would be released from the active ventilation of the subsurface.

Nonradiological Air Quality Impacts. DOE evaluated nonradiological air quality impacts from the retrieval of materials from the repository for (1) the construction of a Waste Retrieval and Storage Area and (2) the retrieval process. Construction and retrieval activities would result in releases of nitrogen dioxide, sulfur dioxide, carbon monoxide, and PM10.

Radiological Air Quality Impacts. During retrieval activities subsurface ventilation would continue, resulting in releases of naturally occurring radon-222 and its decay products in the ventilation exhaust.

4.2.1.2.3 Impacts to Hydrological Resources from Retrieval

4.2.1.2.3.1 Surface Water

Potential for Runoff Rate Changes. The total disturbed area would include areas cleared to support construction equipment and materials, facilities, and concrete storage pads. If DOE retrieved all the waste, the storage pad area would account for about 0.48 square kilometer (120 acres) of the disturbed land.

Potential for Altering Natural Drainage. The proposed location for the Waste Retrieval and Storage Area does not cross or intercept well-defined drainage channels with the exception of the northwest corner, which could be close to, or possibly overlay, a short stretch of the upper Midway Valley Wash.

Potential for Flooding. The Waste Retrieval and Storage Area would be outside the probable maximum flood zone, although natural drainage might be altered to ensure this is the case.

4.2.1.2.3.2 Groundwater.

Potential for Infiltration Rate Changes. About half of the disturbed land would be covered by facilities, roadways, queuing areas, and storage pads. These facilities would be relatively impermeable to water, and would cause an additional amount of runoff to drainage channels in comparison to natural conditions.

Impacts to Groundwater Resources. The estimated annual groundwater demand during retrieval would peak at about 170,000 cubic meters (140 acre-feet) a year. No adverse impacts would be likely from this demand, which would be well within historic use rates.

4.2.1.2.4 Impacts to Biological Resources and Soils

4.2.1.2.4.1 Impacts to Biological Resources from Retrieval.

Impacts to Vegetation. The construction of retrieval facilities would disturb vegetation in an area that is presently undisturbed.

Impacts to Wildlife. Impacts to wildlife from the retrieval contingency would be similar to those described for the construction and operation of the repository.

Impacts to Special Status Species. Impacts to special status species from the retrieval contingency would be similar, and in addition to, those described for repository construction.

Impacts to Wetlands. No wetlands would be affected by activities associated with retrieval.

4.2.1.2.4.2 Impacts to Soils from Retrieval.
Soil Loss. Erosion concerns during the construction of the retrieval facilities would be the same as those described for the construction of the repository facilities.

Recovery. DOE would reclaim disturbed lands when they were no longer needed for retrieval operations.

4.2.1.2.5 Impacts to Cultural Resources from Retrieval
Archaeological and Historic Resources. The results of earlier archaeological fieldwork indicate that there are no National Register-eligible archaeological resources on land recommended for the Waste Retrieval and Storage Area or near the proposed rail or road construction.

Native American Interests. A Waste Retrieval and Storage Area in Midway Valley would be 500 meters (1,600 feet) west of the Yucca Wash local use area and Alice Hill. These areas have cultural importance to Native Americans.

4.2.1.2.6 Impacts to Socioeconomics from Retrieval
Waste retrieval activities would increase the repository workforce above that for ongoing monitoring and maintenance activities. Retrieval would last about 14 years. Employment during retrieval would be less than during other project phases and would be unlikely to generate meaningful changes to the region of influence's employment or economic measures.

4.2.1.2.7 Occupational and Public Health and Safety Impacts from Retrieval
Radiological impacts to the public could occur during all 14 years of the retrieval period when radon-222 and its decay products would be released to the environment in the exhaust stream from the subsurface ventilation system. There would be no other source of radiation exposure to the public, and no differentiation between the construction and operations activities.

Radiological Health Impacts
Most of the radiation dose would be to subsurface workers during retrieval operations. Impacts would be small. The only source of radiation exposure to members of the public during construction and retrieval operations would be from releases of radon-222 and its decay products through the subsurface ventilation system exhaust.

4.2.1.2.8 Impacts from Accidents During Retrieval
Because the retrieval operations would be essentially the same as the emplacement operations (in reverse), the accident scenarios involving the waste package during operations would bound the retrieval operation. Recent analyses have found that the only credible accident with the potential for radiological consequences would be an aircraft crash into one of the above-ground storage facilities. However, the aircraft would not penetrate the thickness of the waste package.

4.2.1.2.9 Noise Impacts from Retrieval

Noise impacts associated with retrieval would be less than those associated with repository operations because of the reduced scope of activities and the smaller number of workers required. Thus, noise impacts from retrieval operations would be small.

4.2.1.2.10 Aesthetic Impacts from Retrieval
Retrieval activities would not be likely to produce adverse impacts on the visual quality of the landscape surrounding Yucca Mountain. Retrieval would essentially be the reverse of emplacement and would use the same types of equipment.

4.2.1.2.11 Impacts to Utilities, Energy, Materials, and Site Services from Retrieval
Utilities and Energy. The estimated electric power demand for retrieval would be less than 10 megawatts. This demand would be well within the capacity that would be available at the repository.

Materials. Material usage impacts would be small.

Site Services. The onsite emergency response capability and the security, medical, and fire protection units that would support operations would be available to support retrieval, so no additional impacts would be likely.

4.2.1.2.12 Impacts to Waste Management from Retrieval
Construction debris and sanitary and industrial solid waste would be disposed of at onsite facilities or at the Nevada Test Site. Sanitary sewage would be disposed of at onsite facilities. Low-level radioactive waste would be disposed of at the Nevada Test Site or another government or commercial facility in accordance with applicable Federal and state requirements.

4.2.1.2.13 Impacts to Environmental Justice from Retrieval
Workers at the Yucca Mountain site would be representative of the population mix in the surrounding areas of Nevada. Hence, there would be no disproportionate impacts to minority or low-income workers in the Yucca Mountain region during retrieval activities.

4.2.2 IMPACTS FROM RECEIPT PRIOR TO THE START OF EMPLACEMENT
Repository operations would begin after DOE received a license from the Nuclear Regulatory Commission to receive and possess spent nuclear fuel and high-level radioactive waste. DOE recognizes that regulatory changes would have to occur for the receipt of spent nuclear fuel and high-level radioactive waste before the start of emplacement, and would have to build a facility similar to that described as part of the retrieval contingency for the receipt of these materials pending their emplacement. Such a facility would consist of a series of concrete pads in the Midway Valley Wash area (the same area described for the retrieval contingency). The facility would be capable of storing as much as 40,000 MTHM of spent nuclear fuel and high-level radioactive waste in concrete storage modules. The types of impacts resulting from the construction and operation of a Waste Staging Facility would be similar to those from the implementation of a retrieval contingency.

4.1.10 AESTHETIC IMPACTS
Yucca Mountain has visual characteristics fairly common to the region (a scenic quality rating of C), and visibility of the repository site from publicly accessible locations is low or nonexistent. DOE would provide lighting for operation areas at the repository. This lighting could be visible from public access points, especially from the west due to the ventilation structures atop Yucca Mountain. The use of shielded or directional lighting at the repository would limit the amount of light that could be viewed from outside the repository operational area.

4.1.11 IMPACTS TO UTILITIES, ENERGY, MATERIALS, AND SITE SERVICES
Overall, DOE expects only small impacts to residential water, energy, materials, and site services from the Proposed Action. DOE would, however, have to enhance the electric power delivery system to the Yucca Mountain site for the operating modes considered.

4.1.11.1 Impacts to Utilities, Energy, Materials, and Site Services from Preconstruction Testing and Performance Confirmation

DOE would obtain utilities, energy, and materials for preconstruction testing and performance confirmation activities from existing sources and suppliers. Water would come from existing wells. Power would come from regional suppliers to the existing Nevada Test Site transmission system. Based on site characterization activities, these activities would not cause meaningful impacts to regional utility, energy, and material sources.

4.1.11.2 Impacts to Utilities, Energy, Materials, and Site Services from Construction, Operation and Monitoring, and Closure

Residential Water

Population growth associated with the Proposed Action could affect regional water resources. Whether domestic water needs were satisfied predominantly from surface-water sources, as is the case for most of Clark County, or from groundwater sources, as for most of Nye County, the relatively small increases in population due to workers at the repository would have very minor impacts on existing water demands. The maximum project-related population increase for Clark County would amount to about 0.4 percent of the 2000 population and less than 0.2 percent of the County's population in 2030.

Residential Sewer

Sewer utilities could be affected by population growth associated with the Proposed Action. In Clark County, where most of the population growth would take place, the fact that the maximum project related population increase would amount to about 0.4 percent of the 2000 population indicates that impacts to the populous areas of the county (that is, the Las Vegas Valley) would be very small.

Electric Power

During the construction phase, the demand for electricity would increase as DOE operated two or three tunnel boring machines and other electrically powered equipment. The repository demand for electricity would be well within the expected regional capacity for power generation. While the accuracy and viability of long term planning for electrical power demand is now more uncertain than in previous years, DOE expects that regional capacity planning would accommodate the future repository demand.

Repository Electric Power Supply Options

DOE eliminated consideration of onsite generation of electricity in conjunction with the onsite plant that would generate steam for heating because the steam plant would be much smaller than a plant needed for power generation. DOE would, however, construct and operate a solar power generating facility close to the North Portal to support repository operations.

The repository site receives electricity through a feeder line from the Canyon Substation, which is rated at 69 kilovolts and has a capacity of 10 megawatts. The minimum modification would be to upgrade this line to 40 to 54 megawatts, modify the Nevada Test Site power loop to support repository operations in conjunction with other Test Site activities, and upgrade utility feeder lines to the Nevada Test Site.

Fossil Fuels

Fossil fuels used during the construction phase would include diesel fuel and fuel oil. Diesel fuel would be used primarily to operate surface construction equipment and equipment to maintain the excavated rock pile. Fuel oil would fire a steam plant at the North Portal, which would provide building and process heat for the North Portal Operations Area. Yearly repository use during the construction phase would be less than 1 percent of the current regional consumption. Fossil-fuel use during the operation and monitoring phase would be for onsite vehicles and for heating. The annual use would be highest during the operations period and would decrease substantially during the monitoring period. The projected use of liquid fossil fuels would be within the regional supply capacity and would cause little impact.

Construction Material

The primary materials needed to construct the repository would be concrete, steel, and copper. The required quantity of concrete would not be expected to affect the regional supply system, which has been able to support the robust construction environment in Las Vegas. Because the markets for steel and copper are worldwide in scope, DOE expects little or no impact from increased demand for steel and copper in the region.

Overall Comparative Impacts
In general, the quantities of utilities, energy, and materials consumed over the life of the project would be small in comparison to the regional supply capacity, and would be unlikely to affect regional supplies or prices.

Site Services
The primary onsite response would occur through the onsite Fire Station, Medical Center, and Health Physics facilities after their construction at the North Portal was complete. The planned onsite emergency facilities should be able to respond to and mitigate most onsite incidents, including underground incidents, without outside support. Therefore, there would be no meaningful impact to the emergency facilities of surrounding communities or counties.

4.1.12 MANAGEMENT OF REPOSITORY-GENERATED WASTE AND HAZARDOUS MATERIALS
4.1.12.1 Waste and Materials Impacts from Preconstruction Testing and Performance Confirmation
DOE expects preconstruction testing and performance confirmation activities to generate waste similar to and in about the same quantities as that generated during characterization activities with the exception that low-level radioactive waste would be generated in minimal quantities.

4.1.5.2 Impacts to Cultural Resources from Construction, Operation and Monitoring, and Closure
Archaeological and Historic Resources Potential impacts to National Register-eligible cultural resources from surface facility construction could occur in areas where ground-disturbing activities would take place. Repository development would disturb a maximum of about 4.5 square kilometers (1,100 acres) of previously undisturbed land at the site. Archaeological investigations conducted in the immediate vicinity of the proposed surface facilities in support of previous and ongoing characterization studies and infrastructure construction have identified about 830 archaeological and historic sites. Several known archaeological sites in the vicinity of Midway Valley could be affected by ground-disturbing activities associated with the construction of the surface aging facility.

Even though there could be some indirect adverse impacts, the overall effect of the repository on the long-term preservation of the archaeological and historic sites in the analyzed land withdrawal area would be beneficial. Cultural resources in the area would be protected from most human intrusion.

Native American Viewpoints
The Native American view of resource management and preservation is holistic in its definition of “cultural resource,” incorporating all elements of the natural and physical environment in an interrelated context. Moreover, this view includes little or no differentiation between types of impacts (direct versus indirect), but considers all impacts to be adverse and immune to mitigation. The presence of a permanently entombed repository would represent an intrusion into what Native Americans consider an important cultural and spiritual place. Long-term monitoring features or activities would continue to affect these cultural viewpoints.

4.1.6 SOCIOECONOMIC IMPACTS
4.1.6.1 Socioeconomic Impacts from Preconstruction Testing and Performance Confirmation
The level of employment for preconstruction testing and performance confirmation activities would be similar to or less than the current level of employment for site characterization.

4.1.6.2 Socioeconomic Impacts from Construction, Operation and Monitoring, and Closure
4.1.6.2.1 Impacts to Employment

Incremental employment increases during the construction phase attributable to the repository would peak in 2006 with the addition of about 3,400 workers to the region of influence. This would increase overall employment in the region of influence from the projected baseline (employment without the repository project) of approximately 942,000 jobs to slightly less than 945,000 positions, a change of approximately 0.36 percent.

At the start of the monitoring period, a workforce of up to 1,160 workers would be involved in decontamination of surface facilities for a period of approximately 3 years.

DOE estimates that a workforce of approximately 120 workers would be needed to monitor and maintain the repository. Given the expected economic growth in the region of influence, the region could readily absorb declines in repository employment.

4.1.6.2.2 Impacts to Population

From 2010 through 2035 the projected regional population will grow from about 1.9 million residents to approximately 2.8 million. The peak year population contribution attributable to the repository would be approximately 6,200 people, or approximately 0.24 percent of the region of influence's estimated population baseline of 2.6 million people in 2030. As a result, the Yucca Mountain Repository Project would have only small effects on the population growth in the region of influence.

4.1.6.2.3 Impacts to Economic Measures

Increases in real disposable income within the region of influence would peak in 2007 with an increase of about $110 million, while increases in Gross Regional Product would peak in 2006 at about $160 million. Regional expenditures by State and local governments would peak at $11 million in 2009. Economic measures for the region of influence would increase by less than one-third of 1 percent over the projected baseline.

4.1.6.2.4 Impacts to Housing

Given the size of the regional employment, the number of workers in-migrating to work on the repository would be relatively small. Because the in migration would be small, the increased demand for housing would also be small.

4.1.6.2.5 Impacts to Public Services

Repository-generated impacts to public services from population changes in the region of influence would be small.

4.1.6.3 Summary of Socioeconomic Impacts

For all five socioeconomic parameters evaluated over construction, operations, and decontamination activities, the impacts would be very small, less than 1 percent of the baselines for the region of influence.

4.1.7 OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY IMPACTS

The types of potential health and safety impacts to repository workers include those from industrial hazards common to the workplace, those from exposure to naturally occurring and manmade radiation and radioactive materials present in the workplace, and those from exposure to naturally occurring nonradioactive airborne hazardous material.

4.1.7.1 Impacts to Occupational and Public Health and Safety from Preconstruction Testing and Performance Confirmation

Preconstruction testing and performance confirmation activities would be similar to the activities performed during Yucca Mountain site characterization. Potential health and safety impacts that could occur during preconstruction testing and performance confirmation activities include those common to an industrial work setting, radiological impacts to the public and workers from exposure to radon-222 and its decay products, external radiation exposure of workers in the subsurface environment, and the potential for exposure to naturally occurring hazardous materials generated by excavation activities.

Impacts are likely to be very small during preconstruction testing and performance confirmation activities.

4.1.7.2 Impacts to Occupational and Public Health and Safety from Initial Construction
4.1.7.2.1 Occupational Health and Safety Impacts
Industrial Hazards. No worker fatalities would be expected during construction for any of the operating modes. For the higher-temperature operating mode, the estimated fatalities are 0.21. The range for the lower-temperature operating mode is 0.21 to 0.23 fatality.

Naturally Occurring Hazardous Materials. Two types of naturally occurring hazardous materials could be encountered by workers at the Yucca Mountain site—cristobalite, a form of crystalline silica (silicon dioxide, SiO2), and erionite, a naturally occurring zeolite. Both are present in the subsurface rock at Yucca Mountain and have the potential to become airborne during repository excavation and activities involving excavated rock and would be released during tunneling operations. DOE would use engineering controls during subsurface work to control exposures of workers to silica dust.

Radiological Health Impacts. Spent nuclear fuel and high-level radioactive waste would not be present at the repository site during the construction phase and so would not contribute to radiological impacts. Potential radiological health impacts to involved and noninvolved workers in subsurface facilities during the initial construction phase would be from two sources: inhalation of naturally occurring radon-222 and its decay products following emanation of the radon from the surrounding rock, and external radiation dose from naturally occurring radionuclides in the drift walls, principally potassium-40 and radionuclides in the uranium decay series.

Measurements in the Exploratory Studies Facility indicated an underground ambient external dose rate from radionuclides in the drift walls of about 50 millirem per work year of 2,000 hours underground. This is slightly higher than the dose rate from the cosmic and cosmogenic components of natural background radiation on the surface of about 40 millirem per year in the Amargosa Valley region.

The estimated increase in the number of latent cancer fatalities for workers would be low (about 0.3); the estimated increase in the likelihood that an individual worker would die from a latent cancer fatality would also be small (about 0.0005).

4.1.7.2.2 Public Health Impacts
Naturally Occurring Hazardous Materials.
Concentrations of cristobalite at the site boundary are estimated concentrations of about 0.02 microgram per cubic meter for the operating modes, and health impacts to the public would be unlikely. Quantities and resultant concentrations of erionite, if present, would be much lower at locations of public exposure. Impacts would be very small.

Radiological Health Impacts. Potential radiological health impacts to the public during the construction phase would come from exposure to airborne releases of naturally occurring radon-222 and its decay products in the subsurface exhaust ventilation air.

4.1.7.3 Occupational and Public Health and Safety Impacts from Operation and Monitoring
4.1.7.3.1 Operations Period – Handling, Emplacement, and Continuing Development
This period would consist of a 24-year period for operations, including the receipt, handling, packaging, possible aging, and emplacement of spent nuclear fuel and high-level radioactive waste.

4.1.7.3.1.1 Occupational Impacts
Industrial Hazards. About 1.2 fatalities were estimated for the higher-temperature operating mode, with a range of 1.2 to 1.9 fatalities estimated for the lower-temperature operating mode.

Naturally Occurring Hazardous Material. DOE would use engineering controls and, if necessary, administrative worker protection measures to control and minimize impacts to workers from releases of cristobalite and erionite during the operations period.

Radiological Health Impacts. The estimated radiological health impacts to the worker population for the 24 or 50-year operations period would range from 3.1 to 4.8 latent cancer fatalities. The principal contributors to radiological health impacts would be surface facility operations, which would involve the receipt, handling, and packaging of spent nuclear fuel and high-level radioactive waste for emplacement and subsurface monitoring activities.

4.1.7.3.2 Monitoring Period
This period would last 76 years under the higher-temperature operating mode and up to 300 years under lower-temperature operating modes.

4.1.7.3.2.1 Occupational Impacts
Industrial Hazards. About 0.4 fatality would be expected to occur for the higher-temperature operating mode. The range of fatalities predicted for the lower-temperature operating mode is 0.44 to 1.1 fatalities with the largest value for long-term ventilation with aging of the spent nuclear fuel.

Naturally Occurring Hazardous Material. During monitoring and maintenance activities there would be little opportunity for large quantities of dust to be generated for extended periods of time.

Radiological Health Impacts. Occupational radiological health impacts during the monitoring period would be a combination of impacts to surface workers during facility decontamination and subsurface workers during monitoring and maintenance activities. The estimated radiological health impacts to the worker population for the 76- to 300-year monitoring period would range from 0.44 to 1.8 latent cancer fatalities.

4.1.7.3.2.2 Public Health Impacts
Naturally Occurring Hazardous Materials. Health impacts to the public would be unlikely. Quantities and resultant concentrations of erionite, if present, would be much lower than for cristobalite at locations of public exposure. Impacts would be very small.

Radiological Health Impacts. Potential radiological health impacts to the public from monitoring period activities would result from exposure to naturally occurring radon-222 and its decay products released in subsurface exhaust ventilation air.

4.1.7.4 Impacts to Occupational and Public Health and Safety from Closure
N/A
4.1.8.2 Nonradiological Accidents
A potential release of hazardous or toxic materials during postulated operational accidents involving spent nuclear fuel or high-level radioactive waste at the repository would be very unlikely. Some potentially nonradioactive hazardous or toxic substances would be present in limited quantities at the repository as part of operational requirements. Such substances would include liquid chemicals such as cleaning solvents, sodium hydroxide, sulfuric acid, and various solid chemicals.

4.1.8.3 Sabotage
Over the long term (after closure), deep geologic disposal of spent nuclear fuel and high-level radioactive waste would provide optimal security by emplacing the material in a geologic formation that would provide protection from inadvertent and advertent human intrusion, including potential terrorist activities. The use of robust metal waste packages to contain the spent nuclear fuel and high-level radioactive waste more than 200 meters (660 feet) below the surface would offer significant impediments to any attempt to retrieve or otherwise disturb the emplaced materials.

A trained, equipped, and qualified security force is required to conduct surveillance, assessment, access

control, and communications to ensure adequate response to any security threat. DOE believes that the safeguards applied to the proposed repository should involve a dynamic process of enhancement to meet threats, which could change over time. Repository planning activities would continue to identify safeguards and security measures that would further protect fixed facilities from terrorist attack and other forms of sabotage.

4.1.9 NOISE IMPACTS
4.1.9.1 Noise Impacts from Performance Confirmation
4.1.9.2 Noise Impacts from Construction, Operation and Monitoring, and Closure
Because the distance between repository noise sources and a hypothetical individual at the land area withdrawal boundary would be large enough to reduce the noise to background levels and because there would be no residential or community receptors at the withdrawal area boundary [the nearest housing is in Amargosa Valley about 22 kilometers (14 miles) from the repository site], DOE expects no noise impacts to the public from repository construction and operations.

Workers at the repository site could be exposed to elevated levels of noise. Small impacts such as speech interference between workers and annoyance to workers would occur. However, worker exposures during all repository phases would be controlled such that impacts (such as loss of hearing) would be unlikely. Engineering controls would be the primary method of noise control. Hearing protection would be required, as needed, as a supplement to engineering controls.

4.1.12.1 Waste and Materials Impacts from Preconstruction Testing and Performance Confirmation
DOE expects preconstruction testing and performance confirmation activities to generate waste similar to and in about the same quantities as that generated during characterization activities with the exception that low-level radioactive waste would be generated in minimal quantities.

4.1.12.2 Waste and Materials Impacts from Construction, Operation and Monitoring, and Closure
The construction phase would generate nonhazardous, nonradioactive wastes and some hazardous waste from the use of such materials as resins, paints, and solvents. Nonhazardous, nonradioactive wastes would include sanitary and industrial solid wastes, construction debris, industrial wastewater, and sanitary sewage. DOE could use existing Nevada Test Site landfills to dispose of nonrecyclable construction debris and sanitary and industrial solid waste. However, as part of the Proposed Action, DOE would construct a State-permitted landfill on the Yucca Mountain site to dispose of nonrecyclable construction debris and sanitary and industrial solid waste. DOE would package hazardous waste and ship it off the site for treatment and disposal.

Major waste-generating activities during the operation and monitoring phase would include the receipt and packaging of spent nuclear fuel and high-level radioactive waste and continued development of subsurface emplacement areas.

Monitoring and maintenance activities after the completion of emplacement would also generate wastes, but in much smaller quantities. The first few years after the completion of emplacement would generate greater quantities of waste due to the decontamination and decommissioning of surface nuclear facilities.

Overall Impacts to Waste Management
The overall impact of managing the Yucca Mountain repository waste streams would differ little among the operating modes, in part because DOE would build onsite facilities to accommodate construction and demolition debris, sanitary and industrial solid wastes, sanitary sewage, and industrial wastewater.

4.1.12.3 Impacts from Hazardous Materials
4.1.12.4 Waste Minimization and Pollution Prevention
DOE would develop a waste minimization and pollution prevention awareness plan similar to the plan it has used during site characterization activities at Yucca Mountain. DOE would recycle materials to the extent that it was cost-effective, feasible, and environmentally sound.

4.1.13 ENVIRONMENTAL JUSTICE

4.1.13.1 Methodology and Approach

DOE performs environmental justice analyses to identify whether any high and adverse impacts would fall disproportionately on minority and low-income populations. Nevada had a minority population of 34.8 percent in 2000. For this EIS, therefore, one focus of the environmental justice analysis is the potential for construction, operation and monitoring, and closure of the proposed repository to have disproportionately high and adverse impacts on the populations in census tracts in the region of influence (principally in Clark, Nye, and Lincoln Counties) having a minority population of 44.8 percent or higher.

4.1.13.2 Preconstruction Testing and Performance Confirmation, Construction, Operation and Monitoring, and Closure

Cultural Resources

DOE has implemented a worker education program on the protection of these resources to limit direct impacts to cultural resources, especially inadvertent damage and illicit artifact collecting.

Public Health and Safety

The EIS analyses determined that the impacts that could occur to public health and safety would be small on the population as a whole for all phases of the Proposed Action, and that no subsections of the population, including minority or low-income populations, would receive disproportionate impacts. The analysis considered an area that included Timbisha Shoshone Trust lands near Scottys Junction, Nevada.

Land Use

Direct land-use impacts from the Proposed Action would be low on members of the public because of the existing restriction on site access for most affected areas.

Air Quality

Impacts to air quality from the Proposed Action would be small.

Biological Resources and Soils

Impacts to biological resources and soils would be low to nonexistent.

Socioeconomics

Because of the large population and employment in the region of influence, socioeconomic impacts from repository construction and operation would be small.

Noise

Impacts to sensitive noise receptors from the Proposed Action would not be likely because no sensitive noise receptors live in the Yucca Mountain region.

4.1.13.3 Environmental Justice Impact Analysis Results

DOE has not identified any subsection of the population, including minority and low-income populations, that would receive disproportionate impacts, and no unique exposure pathways, sensitivities, or cultural practices that would expose minority or low-income populations to disproportionately high and adverse impacts. Accordingly, DOE has concluded that no disproportionately high and adverse impacts would result from the Proposed Action.

4.1.13.4 A Native American Perspective

In reaching the conclusion that there would be no disproportionately high and adverse impacts on minorities or low-income populations, DOE acknowledges that people from many Native American tribes have used the area proposed for the repository as well as nearby lands, that the lands around the site contain cultural, animal, and plant resources important to those tribes, and that the implementation of the Proposed Action would continue restrictions on free access to the repository site.

DOE recognizes that it could not undertake disposal of spent nuclear fuel and high-level radioactive waste in a repository at Yucca Mountain without conflict with the viewpoint expressed in the American Indian Writers Subgroup document.

4.1.14 IMPACTS OF REPOSITORY OPERATING MODES

In general, the EIS analyses found the lower-temperature operating mode would have higher environmental impacts than the higher-temperature operating mode.

4.1.15 IMPACTS FROM MANUFACTURING REPOSITORY COMPONENTS

4.1.15.1 Overview

DOE's evaluation focuses on ways in which the manufacture of the repository components could affect environmental attributes and resources at a representative manufacturing site. The analysis used a representative manufacturing site based on five facilities that produce casks, canisters, and related hardware for the management of spent nuclear fuel. The analysis assumed that the manufacturing facilities and processes being used are similar to the facilities and processes that would produce disposal containers, emplacement pallets, drip shields, dry storage cask shells, and shipping casks for the Yucca Mountain Repository.

4.1.15.2 Components and Production Schedule

Manufacturing activity would build up during the first 5 years, then would remain nearly constant through the remainder of the 24-year period.

4.1.15.3 Components

Disposal Containers

The disposal container would be the final outside container used to package the spent nuclear fuel and high-level radioactive waste emplaced in the repository.

Casks for Rail and Legal-Weight Truck Shipments

DOE would use two basic kinds of shipping cask designs—rail and truck—to ship spent nuclear fuel and high-level radioactive waste to the repository.

Emplacement Pallets

The emplacement pallet would support the waste packages emplaced and allow end-to-end placement of waste packages to within 10 centimeters (4 inches) of each other.

Drip Shields

The drip shield would be a rigid structure designed to divert water away from the waste packages.

Dry Storage Cask Shells

The dry storage cask shell would be fabricated from carbon steel. The shell would be the portion of the concrete dry storage cask system (used only for surface aging under the lower-temperature operating mode) that would be manufactured offsite.

4.1.15.4 Existing Environmental Settings at Manufacturing Facilities

Because there are facilities that could meet the projected manufacturing requirements, the assessment concluded that no new construction would be necessary and that there would be no change in land use for the offsite manufacture of repository components. Water consumption and effluent discharge during the manufacture of components would be typical of a heavy manufacturing facility and would represent only a small change, if any, from existing rates.

Air Quality

The principal criteria pollutants for cask manufacturing facilities are ozone, carbon monoxide, and particulate matter (PM10). Typical existing container and cask manufacturing facilities are in nonattainment areas for ozone and in attainment areas for carbon monoxide and particulate matter.

Health and Safety
The manufacture of hardware for each of the operating modes and packaging scenarios would be likely to be in facilities that have had years of experience in rolling, shaping, and welding metal forms, and then fabricating large containment vessels similar to the required repository components for nuclear materials. Because of this experience and training, DOE anticipates that the injury and illness rate would be equal to or lower than the industry rates.

Socioeconomics
N/A

4.1.15.5 Environmental Impacts
4.1.15.5.1 Air Quality
Potential emissions were evaluated for a representative manufacturing location using the ambient air quality characteristics of typical manufacturing facilities. The analysis assumed that the representative location used for this analysis would be in a nonattainment area for ozone and in attainment areas for carbon monoxide and particulate matter. Therefore, ozone was the only criteria pollutant analyzed.

4.1.15.5.2 Health and Safety
The required number of repository components would not place unusual demands on existing manufacturing facilities. Thus, none of the scenarios would be likely to lead to a deterioration of worker safety and a resultant increase in accidents.

4.1.15.5.3 Socioeconomics
Local Output
The average annual output impacts of each scenario would range from about $620 million to about $1,200 million depending on the operating mode and packaging scenario.

Local Income
The average annual income impacts of each packaging scenario would range from about $180 million to about $350 million depending on the operating mode and packaging scenario.

Local Employment
The average annual employment impacts of each packaging scenario would range from about 460 to about 1,100 work years depending on the operating mode and packaging scenario.

4.1.15.5.4 Impacts on Material Use
For each scenario the largest material requirement by weight would be steel, ranging from about 150,000 to about 330,000 metric tons (160,000 to 360,000 tons), depending on the operating mode and packaging scenario. The use of aluminum, copper, lead, molybdenum, depleted uranium or steel would not produce a noteworthy increased demand and should not have a meaningful effect on the supply of these materials.

4.1.15.5.5 Impacts of Waste Generation
The component materials used in the manufacture of repository components would be carbon steel, high-nickel alloy, stainless steel, aluminum, copper, and titanium with either depleted uranium or lead used for shielding. The manufacture of shielding would generate hazardous or low-level radioactive waste, depending on the material used.

Manufacturing to support the different flexible design operating modes and packaging scenarios would produce liquid and solid wastes at the manufacturing locations. To control the volume and toxicity of these wastes, manufacturers would comply with existing regulations. Pollution prevention and reduction practices would be implemented.

Liquid Waste

The liquid waste produced during manufacturing would consist of used lubricating and cutting oils from machining operations and the cooling of cutting equipment. This material is currently recycled for reuse. Ultrasonic weld testing would generate some unpotable water-containing glycerin. Water used for cooling and washing operations would be treated for release by filtration and ion exchange, which would remove contaminants and permit discharge of the treated water to the sanitary system.

Solid Waste
The annual average amount of solid waste would range from 0.57 to 0.88 metric ton (approximately 0.58 to 0.90 ton) per year during either the 24-year or the 10-year manufacturing periods. The primary waste constituents would be steel and components of steel including nickel, manganese, molybdenum, chromium, and copper. These chemicals could be added to existing steel product manufacturing waste streams for treatment and disposal or recycling.

4.1.15.5.6 Environmental Justice
The environmental justice assessment considered human health and environmental impacts from the examination of impacts on air quality, waste generation, and health and safety. DOE anticipates very small impacts for the total population from manufacturing activities associated with all the scenarios, so there would be no disproportionately high and adverse impacts to the minority population near this facility. The EIS analysis determined that only small human health and environmental impacts would occur from the manufacture of repository components. Disproportionately high and adverse impacts to minority or low-income populations similarly would be unlikely from these activities.

4.2 Short-Term Environmental Impacts from the Implementation of a Retrieval Contingency or Receipt Prior to the Start of Emplacement
4.2.1 IMPACTS FROM RETRIEVAL CONTINGENCY
Section 122 of the Nuclear Waste Policy Act requires DOE to maintain the ability to retrieve emplaced waste for an appropriate period after the start of emplacement. Although DOE does not anticipate retrieval and it is not part of the Proposed Action, DOE would maintain the ability to retrieve the waste for at least 100 years and possibly for as long as 324 years in the event of a decision to retrieve the waste either to protect the public health and safety or the environment or to recover resources from spent nuclear fuel.

4.2.1.1 Retrieval Activities
If there was a decision to retrieve spent nuclear fuel and high-level radioactive waste from the repository, DOE would move the waste packages from the emplacement drifts to the surface.

4.1.7.4.1 Occupational Impacts
Industrial Hazards. No workplace industrial fatalities (0.2 to 0.25) would be expected during closure.

Naturally Occurring Hazardous Material. During closure activities there would be potential for dust to be generated (for example, during preparation and emplacement of excavated rock for backfill).

Radiological Health Impacts. During the closure phase, subsurface workers would be exposed to radon-222 in the drift atmosphere, to external radiation from radionuclides in the drift walls, and to external radiation from the waste packages. Estimated radiological health impacts to the maximally exposed individual would range from 6.7 to 13 rem, with a corresponding probability of latent cancer fatality ranging from 0.0027 to 0.0052. The principal sources of exposure to subsurface workers would be from inhalation of radon-222 and its decay products.

4.1.7.4.2 Public Health Impacts
Naturally Occurring Hazardous Material. Potential impacts would be very small.

Radiological Health Impacts. Potential radiation-related health impacts to the public from closure activities would result from exposure to radon-222 and its decay products released in the subsurface

exhaust ventilation air. Potential radiological health impacts would be small. The probability of a latent cancer fatality occurring in the maximally exposed individual would be 0.0000047 or less.

4.1.7.5 Total Impacts to Occupational and Public Health and Safety for All Phases
In general, the highest potential health and safety impacts would occur during the operation and monitoring phase.

4.1.7.5.1 Total Impacts to Workers from Industrial Hazards for All Phases
4.1.7.5.2 Total Radiological Health Impacts to Workers for All Phases
The total estimated number of latent cancer fatalities that could occur in the repository workforce from the radiation dose received over the entire project would be about 4 for the 115 years of exposure during the higher-temperature operating mode. The number of latent cancer fatalities would range from 4.4 to 6.8, for the 171 to 341 years, respectively, of the lower-temperature operating mode.

4.1.7.5.3 Total Radiological Health Impacts to the Public for All Phases
Dose and the potential radiological impact are listed for the offsite maximally exposed individual, assumed to reside continuously for a 70-year lifetime at the southern boundary of the land withdrawal area. This individual would have a probability of latent cancer fatality of 0.000031 or less from exposure to radionuclides released from the repository during the preclosure period.

4.1.8 ACCIDENT SCENARIO IMPACTS
The impacts to offsite individuals from repository accidents would be small, with calculated doses of 0.038 rem or less to the maximally exposed offsite individual. Doses to a maximally exposed noninvolved worker would be higher than those to offsite individuals, up to 16 rem. Some of the very unlikely accidents would be expected to severely injure or kill involved workers.

4.1.8.1 Radiological Accidents
The spectrum of accident scenarios evaluated in the analysis is based on the current conceptual design of the facility. Final facility design details are not available; the final designs could affect both the frequency and consequences of postulated accidents.

In addition to the reasonably foreseeable accidents summarized in this section, DOE evaluated a hypothetical beyond-credible event (annual probability less than 1 in 10 million) involving an aircraft crash into the repository. It was determined that an aircraft crash into the Waste Handling Building would result in the maximum estimated consequences. DOE assumed that evacuation of potentially exposed individuals would occur one day after the event, and also that contaminated food and water would be monitored and confiscated if necessary. The dose to the maximally exposed individual was estimated to be 4.5 rem, with a 0.0023 probability of a latent cancer fatality. The dose to the population within 80 kilometers (50 miles) was estimated to be 78 person-rem, with 0.039 latent cancer fatality resulting from this dose.

(pgs 4-108 – 4-116 missing)