rec'd with letter dtd. 9/27/96

WBS: 1.2.1.5
QA: N/A

Civilian Radioactive Waste Management System
Management & Operating Contractor

NEVADA POTENTIAL REPOSITORY PRELIMINARY TRANSPORTATION STRATEGY STUDY 2

VOLUME I

B00000000-01717-4600-00050 REV 01

February 1996

Prepared for:

U.S. Department of Energy
Yucca Mountain Site Characterization Project
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102,8

Under Contract Number
DE-AC01-91RW00134

9603200051

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ACKNOWLEDGMENTS

This report was prepared from work performed by the Civilian Radioactive Waste Management System Management and Operating (M&O) contractor under Contract Number DE-AC01-91RW00134 for the U.S. Department of Energy Yucca Mountain Site Characterization Project. This report represents a culmination of a concerted effort by task leaders and personnel from the following M&O contractor organizations:

Integrated Resources Group (IRG), Morrison-Knudsen Company, Inc. (M-K), Science Applications International Corporation (SAIC), E.R. Johnson Associates, EG&G Energy Measurements, Inc., TRW Environmental Safety Systems Inc. Outside support to the M&O study team was provided by the Desert Research Institute (DRI).

The study team task leaders, support personnel and their area of expertise include the following:

Jeff Pullen, M-K, task leader, provided cost input, engineering input and coordination for engineering analysis regarding rail and heavy haul truck. Jim Ingram and Ken McFarland performed the technical analysis of the rail corridors. Willard Keeney, MK, provided input on national and state rail transportation operations.

Paul Standish, IRG task leader, provided institutional input regarding future planning activities within the rail corridors.

Bill Jacobs, SAIC task leader, provided coordination and research for land use within the rail corridors, including the interface activities with DRI. Tracey Bunch provided land use research, obtained from the U.S. Bureau of Land Management and county sources.

Bill Teer, E.R. Johnson Associates task leader, provided coordination with evaluating the rail interface in Nevada. Larry Green, TRW, performed the rail analysis using the INTERLINE routing code.

Susan Ross, EG&G, task leader, provided coordination and logistics for the land use and engineering data for automation of the four rail corridors, and the production of the supporting GIS maps. Analysts involved in the digitization of the land use and engineering data were Darryl Lattimore, Sheri Geherty, Maria Gonzalez, and Jeff Donovan. Analysts involved in the map production were Matthew Walo and Craig Callison.

Dave Rhode, DRI task leader, provided coordination in the research of archaeology information applicable to the rail corridors. Paul Buck and Lisa Hooper documented the archaeological findings applicable to the rail corridors.

Syed Obaid, TRW, assisted in the heavy haul engineering analysis and overall study planning and coordination activities. Dave Morag, TRW, provided cost information and assisted in heavy haul truck evaluation.

John Carlson, SAIC task leader, provided coordination to Barbara Pinkston on population data and future planning projects.

Thanks are extended to the Technical Publications Management (TRW) for word processing, coordination, and technical editing.

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EXECUTIVE SUMMARY

The U.S. Department of Energy is in the early stages of the Environmental Impact Statement (EIS)[1] process of determining the environmental impacts of a potential repository for spent nuclear fuel and high-level nuclear waste at Yucca Mountain, Nevada. This study seeks to identify reasonable and representative transportation alternatives to aid in the EIS process, and should be considered a resource document.

A 1995 systems study, *Nevada Potential Repository Preliminary Transportation Strategy Study 1,* recommended four rail routes and three heavy haul truck routes for detailed evaluation (CRWMS M&O 1995b). During this study, the routes were evaluated for fatal flaws, and all are still recommended as reasonable representative alternatives within the State of Nevada.

This study devoted substantial research to identifying current land usage along the four rail routes, including archaeological and historical sites. As a result, rail corridors were adjusted and refined to minimize land use conflicts. Numerous minor and incidental land use constraints were documented. Existing information was used in this evaluation and no actual land surveys were performed. Sources included the U.S. Bureau of Land Management, the Desert Research Institute, and county records. Field investigations were conducted to acquire data concerning the feasibility of each of the potential routes.

Portions of the currently proposed rail corridors overlap federal lands such as the perimeters of the Desert National Wildlife Range and Nellis Air Force Range, which have been withdrawn from public use. Further detailed evaluation and refinement may eliminate these overlaps.

Engineering analysis refined the rail route corridors to approximately one to five miles wide, using land use research as well as engineering criteria established in the study. Engineering analysis also ensured that each corridor supports a reasonable representative branch line alternative.

The total costs decreased for most of the rail corridors compared to the costs for rail in Study 1, primarily due to a decrease, from 24 to 15 percent, in the estimated engineering costs. A second factor was a decrease in the estimated mileage for most corridors, which resulted from examination of larger-scale quadrangle maps than were used in Study 1. Capital cost figures range from approximately $250 million for the Valley Modified route to $950 million for the Carlin and Caliente routes. Life cycle costs range from approximately $300 million to $1 billion.

Heavy haul truck costs in Study 1 were estimated at $173 million over a 24-year period. This estimate assumed contract hauling and approximately $3 million for an intermodal transfer facility. No cost was estimated for pavement replacement. In this study, the three routes evaluated range from 104 to 321 miles, and have been estimated to include a cost penalty of 10 percent decrease in pavement life. By including this cost penalty with the capital and operations and maintenance costs, the life cycle cost for the longest route (Caliente) was estimated at $180 million. This estimate

[1] Required by the National Environmental Policy Act

assumes that the U.S. Department of Energy would purchase the trucking equipment, because this method would be slightly less expensive than contracting on a per shipment basis, as was assumed in Study 1.

Secondary uses of the rail line, including passenger and early rail support of repository construction activities, were addressed to provide information for future comparative evaluation of the routes. The study found that the Valley Modified route was the only reasonable rail route for passenger use, and concluded that the new system would be, at best, only as convenient as the current bus system to the Nevada Test Site. The study also reviewed the shared use of the rail line for non-Department of Energy uses. Communities expressed interest as a draw for economic development, but railroad company contacts indicated that they have received no inquiries from private industry for additional branch lines. Support of repository construction would require construction of the rail line by 2004 (as opposed to 2010 for shipment of spent nuclear fuel). The study compared the cost of constructing the branch line by 2004, including six years of operations and maintenance costs, to the cost of transporting equipment and construction materials by truck. The findings indicate that the difference in repository construction support costs between rail transport and truck transport is minimal and is within the uncertainty of the current estimating capability.

The three heavy haul truck transport routes identified in Study 1 remain reasonable alternatives after additional analysis in this study. More detailed logistics and cost information on heavy haul transport are included to allow future comparative evaluation of truck routes. An optional route among the three alternatives that originated between Caliente and Elgin and traversed State Route 317 (Kane Springs Road), continuing on U.S. Route 93 to Hiko, was re-evaluated and eliminated due to distance, costly road upgrades, and routing concerns in Rainbow Canyon.

This study reviewed the 13 rail routes that were re-evaluated in the *Preliminary Transportation Strategy Study 1* (CRWMS M&O 1995b). The routes were categorized in tabular form and are shown in the Rail Route Status table. As in Study 1, the status categories are:

Recommended for Detailed Evaluation – These rail routes constitute the most reasonable route alternatives based on conclusions of Study 1. They are considered reasonable based on minimal land use conflicts, maximal use of favorable topography and Federal lands, avoidance of land Federally withdrawn from public use, direct access to a major regional rail carrier, and conditions allowing design in accordance with rail engineering practices.

Eliminated From Detailed Evaluation – Monitor – These rail routes fail to meet one or more of the evaluation criteria listed in the previous paragraph. They are considered technically feasible, but known or potential land use conflicts, only indirect access to a major regional rail carrier, or conflict with land Federally withdrawn from public use significantly reduce the potential for these routes to be successfully developed. The routes will be maintained at the present level of development and the conditions that caused the route to be placed in this category will be monitored. Should conditions change that would significantly increase the potential for any of the routes to be successfully developed, the route status will be re-evaluated.

Eliminated From Further Study – These rail routes fail to meet one or more of the evaluation criteria listed in the recommended status category, and Study 1 determined that the unfavorable condition eliminates any potential for the route to be successfully developed. The routes will continue to be maintained at the present level of development.

As a follow-up to Study 1, three rail routes that were placed in the category of *Eliminated from Detailed Evaluation – Monitor* were re-evaluated. Mina and Cherry Creek remain in this category; Dike was eliminated from further study.

Rail Route Status

Route Status	**Recommended for Detailed Evaluation**	**Eliminated From Detailed Evaluation – Monitor**	**Eliminated From Further Study**
Caliente	●		
Carlin	●		
Jean	●		
Valley Modified	●		
Lincoln County A and B			●
Mina		●	
Cherry Creek		●	
Dike			●
Arden			●
Valley			●
Ludlow			●
Crucero			●
Lincoln County C			●

The study examined population growth forecasts and planned land use projects on the federal, state, county, and community level to determine major impacts on the four rail corridors and three truck routes. Study findings indicate a continued significant population growth forecast for Nye County (Pahrump) may affect the Jean rail route. State Route 160 has been proposed as a scenic highway, also affecting the Jean route. The dramatic increase in population in Clark County may become an issue in the Valley Modified rail route. The government of Clark County has solicited the development of 4,000 acres at Apex, approximately five to ten miles northeast of Las Vegas, for use as an industrial park to relocate hazardous operations away from heavily-populated or residential areas. This development could impact the Valley Modified route and the intermodal transfer facility option. The proximity of the Valley Modified route to the proposed North Las Vegas master planned community is an important consideration.

The study found no major impacts to the Carlin and Caliente routes from population growth or planned land use projects.

Preliminary criteria that will be used to solicit public comments during EIS scoping were developed. These criteria may also be further developed for use in selecting a preferred rail corridor:

- Stakeholder acceptance: Economics, quality of life
- Cost: Construction, operation, and maintenance
- Regulatory: Construction permits, approvals, and concurrences; operation permits, approvals, and concurrences; published environmental impacts; evaluation of the impacts of the Endangered Species Act, flood plain, and wetlands
- Construction/operation: Complexity of construction, operational safety, security areas, operation and maintenance efficiency.

The study also evaluated the effect on the national rail transportation system of routing spent nuclear fuel and high-level radioactive waste to each of the four branch lines within Nevada. From a national perspective, there appear to be no advantages or disadvantages relative to any specific branch line, as determined by the set of effectiveness measures used in the analysis.

Only one of the cases examined (with the national shipments avoiding the Las Vegas metropolitan area) resulted in a notable change to the routes used to reach Nevada.

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1. INTRODUCTION

1.1 STUDY OBJECTIVES

The objectives of this study were to build on the findings of the *Nevada Potential Repository Preliminary Transportation Strategy Study 1* (CRWMS M&O 1995b), and to provide additional information for input to the repository environmental impact statement (EIS) process. In addition, this study supported the future selection of a preferred rail corridor and/or heavy haul route based on defensible data, methods, and analyses. Study research did not consider proposed legislation. Planning was conducted according to the *Civilian Radioactive Waste Management Program Plan* (DOE 1994a). The specific objectives of Study 2 were to

- Eliminate or reduce data gaps, inconsistencies, and uncertainties, and strengthen the analysis performed in Study 1.
- Develop a preliminary list of rail route evaluation criteria that could be used to solicit input from stakeholders during scoping meetings. The evaluation criteria will be revised based on comments received during scoping.
- Restrict and refine the width of the four rail corridors identified in Study 1 to five miles or less, based on land use constraints and engineering criteria identified and established in Study 2. In some areas the corridor may be less than one mile. The corridor boundaries are flexible and will be better defined for routing purposes at a later stage in project development, if so warranted. Reduction of the corridor widths allows future data collection activities (for EIS development) to focus on the most reasonable rail corridors for each route.
- Evaluate national-level effects of routing spent nuclear fuel and high-level waste to the four identified branch lines, including the effects of routing through or avoiding Las Vegas.
- Continue to gather published land use information and environmental data to support the repository EIS.
- Continue to evaluate heavy haul truck transport over three existing routes as an alternative to rail and provide sufficient information to support the repository EIS process.
- Evaluate secondary uses for rail (passenger use, repository construction, shared use).

1.2 ENVIRONMENTAL IMPACT STATEMENT RELATED PROGRAM MODIFICATIONS

Strategic planning for the Yucca Mountain Site Characterization Project is an evolving process that often results in modifications to the approaches considered for various programs. The *Nevada Potential Repository Preliminary Transportation Strategy Study 1* (CRWMS M&O 1995b) was completed prior to development of the repository Environmental Impact Statement (EIS) Notice of Intent, issued in the *Federal Register* on August 7, 1995. Because the EIS planning process has matured, some statements made in Study 1 are inconsistent with the current repository EIS approach. These inconsistencies are described below.

- In the Notice of Intent to prepare the repository EIS, the Department of Energy has preliminarily identified a range of implementation alternatives for construction, operation and closure of the repository. As part of each implementation alternative, national and regional transportation options would also be evaluated in the EIS.

- Highway routes for spent nuclear fuel and high-level radioactive waste are selected in accordance with 49 CFR Part 397, Subpart D. These regulations require carriers to use interstate highways and the shortest route to the destination from an interstate. The regulations also give states the authority to select preferred alternative routes that may or may not satisfy the interstate and shortest distance criteria, but the regulations do not *require* a state to select a preferred route.

- Study 1 emphasized use of the multi-purpose canister for all rail shipments. The repository EIS would evaluate the impacts of several different types of canisters.

- Study 1 used the term *preferred* in discussions relating to EIS alternatives and transportation routing alternatives. To clarify, a preferred alternative, as defined by the National Environmental Protection Act, would be selected only after a thorough analysis of all reasonable alternatives as part of preparing the EIS, and preferred highway routes for transportation purposes are those designated by carriers or states.

- Study 1 implied that the EIS would examine multiple corridors. It is possible that the EIS could select a single corridor for detailed evaluation depending on information and public input received during EIS scoping.

- The Department of Energy does not currently plan to request that the Bureau of Land Management (BLM) become a formal cooperating agency in preparing the EIS, although BLM would be an agency consulted during the EIS preparation process.

- The schedules for EIS development shown in Figures 8-1 and 8-2 of Study 1 may be modified depending on information received during EIS scoping, funding or programmatic changes.

1.3 APPROACH

1.3.1 Study Approach to Collecting and Displaying Data

Land use was extensively researched at BLM offices, county courthouses, and other data sources to obtain the most current information available. BLM master title plats were obtained for every township within the proposed corridors and known significant constraints were documented for evaluation by rail design engineers. Existing environmental impact statements and resource management plans from BLM resource areas were studied and potential problem areas were noted.

Land ownership data from county assessor's offices were consulted and dāta of interest recorded. Detailed land use constraints are reported in the Route Section Description, Appendix C.

The Desert Research Institute, part of the university and community college system of Nevada, obtained archaeological information by reviewing existing data.

Computer software was used to compile and manage spatial data. The existing Geographic Information System (GIS) assisted in rail corridor placement by providing the capability to examine many thematic layers of information, and by providing the cartographic tools to manipulate and display the data. This system enabled compilation of a revised rail corridor in digital format; corridor boundaries are defined in Nevada State Plane coordinates. Rail corridors identified in Study 1 (CRWMS M&O 1995b) served as the basis for land use and engineering evaluation.

U.S. Geological Survey (USGS) quadrangle maps were used by engineers to establish a basemap series of the affected lands. The maps are scaled at 7.5 and 15 minutes and represent the best available scale. The engineering group requested basemapping using 15 minute maps as a minimum.

The USGS standard edition topographic map series was chosen because it conforms to established specifications for size, content and symbolization. These maps also provided the bases for established ground control for use in the digitization process.

In addition to full coverage at 1:24,000 and 1:62,500, this map series provides topographic isolines and geographic features, existing infrastructure (including but not limited to roads, transmission lines, pipelines, buildings, and other man-made features), drainage features, and administrative boundary features.

Mylar overlays displaying land ownership and land use data were prepared using the GIS for each of the topographic quadrangles. The mylar was produced to scale and register to supplement the USGS basemap. The mylars became the "manuscript" map upon which researchers mapped and recorded data to be digitized. Researchers used the basemap and manuscript to map additional features applicable to the rail corridors, and refined preliminary reasonable, representative corridors for each route based on a thorough study of land use information as the primary reason for corridor location, and engineering criteria constraints as a secondary reason. An engineering analysis identified topographic, drainage and operating considerations. This enabled the corridor location and corridor width to change systematically.

The newly identified features and proposed corridor were mapped onto the mylars and then were digitized into the GIS file. Verification of the digital images was accomplished through the use of editplots produced by the GIS. Each of the researchers verified that the entry to the system was correct according to their mylar map input. This process produced GIS maps for use in this report.

Concerns such as wildlife ranges, lands historically used by native Americans, threatened or endangered species habitats, wetlands, etc. will be evaluated during Title I and Title II design phases.

Cost estimates for rail design, construction and operation of construction included life cycle costs.

1.3.2 Study Approach to Heavy Haul

An in-depth analysis was performed to verify the feasibility of heavy haul truck transport, define the transporter configuration, identify an intermodal transfer facility design option, estimate costs of heavy haul transport operations over existing roads and new roads, and estimate the costs of upgrade and maintenance of roads. The state restrictions and permitting requirements were also researched in greater detail.

2. RAIL CORRIDOR LAND USE

Field investigations were performed to acquire data concerning the feasibility of each of the potential routes for a rail line to Yucca Mountain. The investigation was cursory, with the primary focus on defining any previously unknown obstacles to route development.

All access was by four-wheel-drive vehicle. Comparison of visible features was made with USGS 1:24,000 scale (7.5') and 1:100,000 scale topographic maps, as well as BLM 1:100,000 scale Surface Management Status maps.

2.1 VALLEY MODIFIED ROUTE FIELD INVESTIGATION

The Valley Modified Route was investigated from a proposed connection with Union Pacific in the Dike/Apex area to the entry onto Nevada Test Site lands near Mercury, based on a revised version of the Study 1 corridor (CRWMS M&O 1995b). Included were alternate routing possibilities in the Indian Springs area.

2.1.1 Valley/Dike - Corn Creek Springs

Lands west of Dike, including the proposed 7,500 acre BLM exchange parcel, are vacant with the following exceptions:

- A fence surrounds the former Nellis Air Force Small Arms Range.
- A large power substation is in S30 T19S R62E, as shown on the USGS S 7.5 minute map.
- High voltage power lines parallel the Union Pacific main line, as shown on the USGS map.
- A new high voltage power line runs due north from the substation to the northern boundary of the 7,500 acre parcel, then due west.
- A flood control channel has been constructed recently through S7, 8 T19S R62E and S11, 12 T19S R61E[1], to divert floodwater into the large retention basin on Las Vegas Wash in S14, 15 T19S R61E.
- Roads are generally as shown on the USGS map, with an additional north-south gravel road through the 7,500 acre parcel along the border of Sections 13 and 14, ending at the intersection with the paved east-west road in Section 12.

Further west, beyond the north end of Jones Blvd., a dam and retention basin have also been constructed on Las Vegas Wash in S1 T19S R60E. The proposed corridor travels through vacant lands on the alluvial slopes to the north.

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[1]This data is included for information. However, establishing these locations requires use of the USGS 1:24,000 scale maps.

2.1.2 Corn Creek Springs - Indian Springs

The one quarter section of private land southwest of Corn Creek Springs (immediately south of S33 T17S R59E) is occupied by at least 20 houses and mobile homes. Lands between this area and U.S. Route 95 are vacant.

A series of firing range facilities (each of which includes a number of small buildings) are present within the Nellis Air Force Range, from a point in the NW quarter of S14 T17S R58E and extending to northwest about 2.5 miles. These facilities are about a quarter to a half mile from U.S. Route 95, apparently very close to the boundary of the U.S. Department of Defense lands.

South of U.S. Route 95, and west of the correctional facility, the land designated for a power facility has small substations at each end connected by a power line. This does not appear to be a major impediment to a rail line through this area that crosses U.S. Route 95 to the south of Indian Springs and the Indian Hills (called the Indian Hills Alternate).

Six U.S. Department of Defense buildings are clustered within a few hundred feet on the north side of U.S. Route 95, west of the correctional facility.

2.1.3 Indian Springs Vicinity

The area between U.S. Route 95 and the Indian Springs Airfield contains numerous active facilities and structures, both civilian and military.

The area north of the airfield contains four large buildings and several smaller structures. Other than the Indian Hills Alternate (which bypasses Indian Springs altogether), this area may provide the most practical route, if permitted by the U.S. Air Force.

2.1.4 Indian Springs - Nevada Test Site Boundary

The private land at Cactus Springs is occupied by an abandoned gas station and one mobile home north of the highway; one house immediately south of the highway appears to be occupied.

Camp Desert Rock appears to be largely abandoned, although the airstrip is visible from U.S. Route 95 and two buildings are still standing.

2.2 JEAN ROUTE FIELD INVESTIGATION

The Jean Route was investigated from a proposed connection with Union Pacific in the Jean/Borax area to the entry onto Nevada Test Site lands near Amargosa Valley based on a revised and expanded version of Study 1 corridors. Included were key alternate routing possibilities via Wilson Pass versus State Line Pass and via North Pahrump versus Stewart Valley.

2.2.1 Wilson Pass Alternate

2.2.1.1 Jean Vicinity

The Union Pacific main line is about a half mile east of two large casinos near the Interstate 15 exit. Access to the Union Pacific is provided by the road to the state correctional facility, which crosses the Union Pacific main line at grade. The siding is on the west side of the main line and a storage track is present along the southern end of the siding.

On the north side of Jean, Letica Corporation has a large active warehouse served by Union Pacific; connection of the Yucca Mountain rail line to the Union Pacific siding should therefore be north of this warehouse. Connection much further north may complicate design of the grade separations over Interstate 15 and the Old Highway, due to rapidly increasing elevation of the highways relative to the Union Pacific.

Private lands to the north of Jean are vacant. Land is being cleared for new development immediately east of the Old Highway near the intersection of the Goodsprings Highway. The well and pipeline complex west of Jean (south of the Goodsprings Highway) is not evident; the area is vacant except for a power line and one mobile home near the highway.

Jean Airport is active. The only other significant development on the south side of Jean is a small truck storage yard next to the Old Highway approximately opposite the south end of the airstrip.

2.2.1.2 Goodsprings Valley

Goodsprings is a community of at least 100 dwellings; these are a mixture of mobile homes and permanent structures. About 10 relatively new mobile homes occupy the area northeast of Goodsprings in the northwest quarter of S25 T24S R58E. The most northeasterly of these is a quarter to a half mile from the possible track location.

A gas pipeline parallels the possible track location along the east side of Goodsprings Valley. Two buildings and pipeline-related facilities are located in the northwest quarter of S6 T25S R59E.

Rainbow Quarries, in S34 T23S R58E, is an active operation.

2.2.1.3 Wilson Pass Vicinity

Mines north of the Wilson Pass Road do not appear active. Topography in the vicinity of Wilson Pass, including areas both to the east and west for several miles, appears much better than had been visualized from evaluation of USGS maps. Careful consideration should therefore be given during the design process to the trade-offs involved in raising the elevation of the line (through additional distance on the Goodsprings side), which would require some extensive earthwork on both sides of Wilson Pass, but would greatly shorten the tunnel.

It should be noted that the Table Mountain Pass option (listed in Study 1) southwest of Goodsprings, with elevations of 4,400 feet, has more severe topography than Wilson Pass, and is not recommended for further consideration as a feasible corridor.

2.2.1.4 Eastern Pahrump Valley

If the Wilson Pass Alternate is to connect with the North Pahrump Alternate, a potential location for a grade separation over Highway 160 may be in the vicinity of Lovell Wash, as the highway dips down about 20 feet to cross the wash.

2.2.2 State Line Pass Alternate

2.2.2.1 Borax - State Line Pass

Access to Borax is via dirt road only; the siding is on the west side of the Union Pacific main line. Almost any location in Sections 9 or 16 of T26S R59E would appear to be suitable for a grade separation over Interstate 15.

Very extensive earthwork will be required through rocky terrain for about 3 miles around the southern tip of the Spring Mountains. The possible track location would be largely hidden from casinos in the State Line area and almost 2 miles northwest of them. The final 2 miles of the ascent to State Line Pass would be largely on alluvium. A large alluvial fan from a canyon on the north side forms the summit; due to the apparent high runoff, any cut through the summit will require flood protection measures.

About one mile of the road immediately east of the summit has been rerouted from the location shown on the USGS 15 minute map; it is now much higher on the slope to the north, particularly at the summit. Signs near the summit imply that the Wilderness boundary is along the new road; contact with California agencies verified that the signs are incorrectly located. They should be along the old road.

2.2.2.2 State Line Pass - Sandy Valley

The west side of State Line Pass will require more difficult construction than the east side. To avoid entry into the Wilderness Area, it will be necessary to remain on the north side of the canyon leading from the summit. Slopes are very steep; deep excavations will be required and will be almost entirely through hard rock. Some tunneling may be necessary.

The Milford Mine does not appear to be active. At the location designated as "Government Well" on the USGS map, there are two buildings, one large concrete tank and six smaller tanks, all within a fenced area. These facilities do not appear to be currently active.

2.2.2.3 Sandy Valley Vicinity

Southeast of Sandy Valley, the areas noted by Science Applications International Corporation as "Community Pit" areas in Section 10, 15, 22, and 23 of T25S R57E have no evidence of any pit. These lands are largely sagebrush, with a few dwellings mostly on the east side of Cherokee Street. The locations of these dwellings generally match that shown on the USGS 7.5 minute map; most are mobile homes, a few are more permanent structures. The possible track location would parallel a street, and would be less than one mile from some of these dwellings.

The proposed corridor passes immediately east of Shenandoah Mill, which appears to be currently active. A parcel immediately east of Wilson Pass Road, indicated by land records as a Public Recreation Area, is enclosed by a new chain link fence with a locked gate and signs reading "Danger - Contaminated Site." A possible rail line location would be about 1.5 miles north of a new school.

2.2.3 North Pahrump Alternate

2.2.3.1 Pahrump Vicinity

Development in the extreme eastern portion of Pahrump, specifically along Highway 160 in S2, 3, 11 T21S R54E, appears to closely match that indicated by the USGS 7.5 minute map of 1984. Private lands in the south half of Section 2 and the northeast quarter of Section 11 are undeveloped, with the exception of the wooden pole transmission line shown on the USGS maps. These lands would be crossed by an alternate corridor eliminating the need for a tunnel through a branch of the Spring Mountains that approaches the valley floor to the northwest.

Beyond the limits of private lands east of central Pahrump, lands are undeveloped with the exception of the roads shown on the USGS map. The closest proximity of the possible track location to developed areas in central Pahrump would be about 1.5 miles (in the vicinity of the winery on North Homestead Road).

2.2.3.2 Northern Pahrump Valley

Within the northeastern portion of T19S R53E, an attempt has been made to subdivide the private lands. This subdivision is illustrated by a large sign for Green Valley Ranchettes, located in the northeast quarter of Section 11, which indicates the availability of 2.5 acre parcels. The map on the sign shows the east half of Section 11 divided into parcels; no parcels are indicated in Sections 1, 2, or 12. The map also shows 40 foot utility easements along the north and east sides of Section 11. The land was surveyed in 1970 and is owned by American International Development Corporation.

These lands in the northeastern portion of T19S R53E remain largely sagebrush and cactus, with the exception of the developments listed below. Except for a possible conflict with the development noted below in Section 1, the area designated for the alternate corridor through these lands is void of significant development.

Section 1: A recreational vehicle occupies the southwest quarter of the southeast quarter, with fences, mobile storage trailer, and water tank. Of all development in the Pahrump area, this dwelling would be the closest to an alignment within the proposed alternate corridor, being about a quarter mile from the possible track location.

Section 2: Mobile home in the southeast quarter.

Section 13: Gravel pit in the northwest quarter.

Section 15: Major development in northern Pahrump fills this section with a mixture of permanent homes and double-wide trailers. The proposed rail corridor is about 2.5 miles from these homes.

Private lands in T18S R53E are largely sagebrush, cactus and rock. In particular, the area designated for the alternate corridor through these lands is void of significant development. The few dwellings present are nearly a mile from a possible track location within the alternate corridor. The following list summarizes all development within T18S R53E:

Section 4: Small building in the southwest quarter.

Section 9: Very small structure built out of plywood in the southwest quarter.

Section 14: Small building in the south half.

Section 17: Small dwelling in the southeast quarter.

Section 20: One small dwelling in the center of the section, next to the power line.

Section 21: Twelve mobile homes are clustered in the northeast quarter, several of which are occupied.

Section 29: House in the southeast quarter.

Section 33: House as shown on the USGS map. South of this point (toward Pahrump) the density of housing increases rapidly.

2.2.3.3 Johnnie Vicinity

Two dwellings are present within the private lands in the vicinity of Johnnie and the pass immediately to the north. West of the highway, in the northeast quarter of S1 T18S R52E, a frame house and several smaller structures are present as indicated by the USGS map. This group of structures does not interfere with the possible rail corridor.

However, in the southwest quarter of S31 T17S R53E (at the pass, about a quarter mile east of the highway), there is a mobile home and adjacent concrete foundations under construction for a permanent structure. As the optional corridor requires use of this pass between the Pahrump Valley and the Amargosa Desert, this homesite would be less than a quarter mile from the possible track location.

2.2.4 Stewart Valley Alternate

2.2.4.1 Southern Pahrump (Homestead Road) Vicinity

The BLM has proposed a contiguous quarter-mile wide strip of land through Section 25 (T21S R53E) which may be suitable for utility purposes. However, suitability for a rail line is questionable due to the very close proximity of dwellings. A rail line centered in the vacant strip would be less than 800 feet (0.15 mile) from some of these homes.

A feasible alternate of the rail line may be through the north half of Section 25. Although private, this land is vacant. A rail line centered through this area would be a minimum of about 0.3 mile from existing housing.

2.2.4.2 Southwestern Pahrump (Highway 372) Vicinity

Dwellings in Sections 25, 26, 35, and 36 (T20S R52E) largely match the location shown on the USGS 7.5 Minute Map. These are mostly mobile homes. A new home under construction in the SE quarter of Section 26 would be the closest to the possible track location. Depending upon the exact track location selected, the distance from this home would be a quarter to a half mile.

Beyond the northern limit of Sections 25 and 26, there are numerous mobile homes, the most southerly of which would be about one mile from a possible track location.

2.2.4.3 Stewart Valley

Six new homes have been constructed in "Stewart Valley Estates," immediately west of Ash Meadows Road in the southwest quarter of S16 T24N R8E. A large sign indicates that about 75 percent of the 49 lots in the development have been sold. Although this development is in California, the close proximity of a possible track location (within half a mile) is a concern.

The knob in the southwest quarter of S9 T24N R8E, which is an obstacle to rail line construction, is hard rock. A short tunnel may be required here.

2.2.4.4 Amargosa Desert

The significant feature in the Amargosa Desert not evident on the USGS 7.5 Minute Maps is the town of Crystal, located about 2.5 miles west of Highway 160, in Sections 7 and 8 of T17S R52E. The town is composed largely of mobile homes (perhaps 50 or more) and occupies most of the lands in these sections that are designated on BLM maps as private.

A possible track location would be about one mile east of the eastern limit of the town; the gravel road shown on USGS maps that parallels a possible track location is abandoned.

2.3 CARLIN ROUTE FIELD INVESTIGATION

Accessible portions of three alternates of the Carlin Route were covered (totaling approximately 500 miles) from respective Southern Pacific/Union Pacific connections to the point where the Caliente Route alignment would be assumed (in the vicinity of Tonopah). These routes are generally defined as follows:

- Beowawe Option: Connection with Southern Pacific and Union Pacific at Beowawe, proceeding through Crescent Valley, Grass Valley and Big Smoky Valley. An alternate route via Monitor and Ralston Valleys (instead of Big Smoky Valley) was also investigated.

- Palisade Option: Connection with Southern Pacific and Union Pacific at Palisade, proceeding through Pine Valley, Denay Valley, Monitor Valley and Ralston Valley.

- Battle Mountain Option: Connection with Southern Pacific near Battle Mountain, proceeding along the Reese River, through Smith Creek Valley, Ione Valley and the southern end of Big Smoky Valley.

2.3.1 Connections with Southern Pacific and Union Pacific in Northern Nevada

For all three northern corridor (Carlin) routes, track connections with Southern Pacific and Union Pacific are complicated somewhat due to the unique operating nature of these main lines in northern Nevada.

Although Southern Pacific and Union Pacific are single-track, they are operated jointly under a "paired-track" arrangement for approximately 180 miles between Alazon (near Wells) and Weso (near Winnemucca), with the Southern Pacific used for all westbound movements of both railroads and the Union Pacific used for all eastbound movements. This arrangement essentially provides a double-track line for both railroads, although in many areas the two tracks are separated by a significant distance (up to 4 miles). The Union Pacific line passes over the Southern Pacific at a point 2.1 miles west of Palisade; operations are therefore left-handed to the west of this point and right-handed to the east.

As a consequence of the paired-track arrangement, train operations are not controlled directly by train dispatchers, but are instead under automatic block signal control. Most passing sidings originally constructed have been removed. Outside of Alazon, Weso and the crew-change points of Elko and Carlin, there are very few connections between the two lines. Due to heavy traffic (about 30 trains per day), train movements for any significant distance "against the current of traffic" are very disruptive of the operation and are therefore very rare.

In order to avoid movements against the current of traffic, it is essential that significant branch line operations connect to both main lines in the paired-track territory. A key example is the Valmy Power Plant west of Battle Mountain, which is between the two main lines and connects to both.

For a rail line serving Yucca Mountain, the simplest practical arrangement would involve a turnout facing west in the more southerly of the two main lines, with an adjacent crossover to facilitate movements to the other. This arrangement would efficiently handle movements from (and returning to) points east only.

Occasional movements for points west could be handled by reversing train direction (moving the locomotives to the opposite end of the train) at a nearby siding or at Carlin. Avoiding this maneuver would require additional track connections with an east facing turnout and crossover, resulting in a wye. This would provide maximum operational flexibility and eliminate the need for backing moves.

The wye arrangement requires far more space than the simpler west facing arrangement, and can therefore be best implemented at Beowawe. Connections at either Palisade and Battle Mountain will likely require switching and reversing the direction of trains received from (and returned to) the west.

2.3.2 Beowawe Option

Based on this field investigation, the Beowawe Route offers the following positive attributes:

- Connections with Southern Pacific and Union Pacific main lines for traffic in both directions can be facilitated in a much more straightforward manner than is possible with the other two options.

- It appears to be the shortest of the three options, approximately 6 miles shorter than the Palisade Option and approximately 16 miles shorter than the Battle Mountain Option (these differential distances may change significantly during conceptual design work).

The Beowawe Option is characterized by excellent Southern Pacific/Union Pacific connection possibilities, several potential land-use conflict areas, and minimal topographic concerns.

The route traverses the length of Crescent, Grass and Big Smoky Valleys; intervening hills may be traversed with grades in the 1.5 percent to 2 percent range. No river crossings and relatively few major highway crossings are required. Proximity to major mining operations in the Tenabo, Gold Acres, Cortez, and Round Mountain areas may be significant to possible shared-use interests.

2.3.2.1 Southern Pacific/Union Pacific Connections

Through the vicinity of Beowawe, the Southern Pacific and Union Pacific main lines are parallel and 150 feet apart, with the Southern Pacific (westbound) track on the south side. The alignment of the main lines is largely straight, with a long 1 degree curve approximately 1.5 miles east of the townsite.

The primary rail-served facility is the bulk fuel storage facility of Union Pacific Fuels, located about a half mile east of the townsite and on the north side of the Union Pacific main line. Judging by the number of tank cars on the adjacent spur and in nearby sidings, this facility produces significant rail traffic.

The town is very small, probably less than 50 people, but does have a large school building. The location of existing structures very closely matches that shown by the USGS 7.5 Minute Topographic Map of 1986. From the standpoint of becoming a rail connection, Beowawe has a key advantage of being somewhat out of the public view (approximately 6 miles from Interstate 80), while also being served by a paved heavy-duty highway.

The primary site under consideration for rail connections is approximately 1 to 2 miles east of Beowawe townsite. This area is in Section 9 and is currently all sagebrush; the lone structure shown on the USGS topographic map is gone. Range fences are the only evidence of possible private land ownership in the immediate area.

East and west facing turnouts and crossovers could ideally be located at opposite ends of the long 1 degree curve noted earlier. Ample space is present for a full complement of connecting tracks, including a wye and crossovers as outlined in Section 2.4.1, as well as any additional terminal facilities (storage tracks, servicing facilities, shop, etc.) which may be designated for this site. Drainage in the vicinity appears fair to good. No river crossings are required, since the Humboldt River is located north of the Union Pacific main line.

A potential disadvantage of this site is the proximity of the school to rail operations approximately a quarter mile from the Southern Pacific main line and 1 mile from the closest connection trackage to be built). This disadvantage might be resolved by using west facing connections only (at the east end of the existing curve). Alternatively, the most northerly 10 miles of the rail line could be located through the hills east of Crescent Valley (with maximum grades of 1.5 percent), using Southern Pacific/Union Pacific connections further east in Section 12, about 4 miles east Beowawe townsite. However, two mobile homes in the area would be within a quarter mile of rail operations. Connection any further east than this point appears impractical due to the increasing topography to the south.

2.3.2.2 Land-Use Conflicts and Topographic Constraints

Crescent Valley, Northern Portion – North of the town of Crescent Valley, most areas indicated as private lands by BLM maps are undeveloped and are covered with sagebrush. Notable exceptions are as follows:

- Small areas immediately west of the highway, about 2 to 3 miles north of town, are mobile home sites.
- One home built on the east side of the highway about 3 miles north of town.

- A 160-acre private parcel in Section 9 of T31N R48E (which encloses Cold Springs) is fenced grazing land.

Significant townsite development has taken place in the town of Crescent Valley beyond that shown by the USGS 7.5 Minute Map of 1985, now largely filling Section 5.

Much of the eastern portion of the valley is normally dry lake bed (playa, labeled as Alkali Flat on USGS maps) which may accumulate significant water during periods of runoff. These areas should be avoided by rail construction due to the soft subgrade and resulting maintenance problems. Two home sites (one permanent, one mobile) exist on the east side of State Route 306 at the base of Hot Springs Point. Limited road grading for potential further development has been done in the playa area immediately to the west.

Crescent Valley, Southern Portion – South of the town of Crescent Valley, a few sections of land have been cleared of sagebrush and are apparently used for grazing, although the vegetation is very sparse and no livestock were observed. Most other areas are sagebrush.

Grazing lands in Sections 29 and 32 of T29N R48E may be in conflict with an ideal route. Ranch buildings are present in Section 29 and in the northwest quarter of Section 33.

Other private lands in the area, namely parts of Sections 8, 16 and 18 of T28N R48E and parts of Sections 13, 24 and 27 of T28N R47E can easily be avoided by a route between these lands and the highway.

The most critical issue in Crescent Valley is the growth of the Cortez and Gold Acres mining operations. Tailings piles are growing in Sections 7, 8 and 17 of T27N R47E, immediately west of the haul road running directly between Cortez and Gold Acres. These tailings piles are not evident on the USGS 7.5' Cortez Canyon quadrangle (1986). Although a rail route can avoid the current area of the tailings piles, the full extent of properties owned by the mining companies, as well as future plans, must be defined.

The Cortez Canyon quadrangle shows mining prospects west and south of this area. Again, these can be avoided by a route further south. Additional prospects claimed since the 1986 map date may, however, conflict with a rail route.

Big Smoky Valley, Northern Portion – Large areas of the northern end of Big Smoky Valley, particularly in the vicinity of Rye Patch Canyon, are designated as Federal Agency Protective Withdrawals on BLM Surface Management Maps. The reason for this designation is not apparent.

Otherwise, north of the Round Mountain-Hadley-Carvers area, there are numerous ranches and privately owned grazing lands along the west side of the valley. Most of these areas are between Highway 376 and the approximate centerline of the valley. To the west of the highway, the Toiyabe Range is an important recreational resource. Many striking views of rugged portions of the range are possible from the highway.

Based on the above reasons, the most favorable rail route is along the east side of the valley, avoiding private lands and recreational aspects of the west side of the valley, as well as the playa and marsh areas of the valley bottom.

Big Smoky Valley, Southern Portion – Potential land-use conflicts exist in the vicinity of Round Mountain, Hadley and Carvers, which are within 6 to 8 miles of each other. The valley narrows significantly in this area, limiting the opportunity to avoid private lands.

The most critical point is between the Round Mountain mining properties and the recently constructed townsite of Hadley. The tailings pile for the Round Mountain mine is apparently growing toward Highway 376. The balance of Big Smoky Valley south to the Tonopah area is largely sagebrush; the few private lands in this area can easily be avoided. A large mining operation approximately 18 miles north of Tonopah is not currently active.

Ralston Valley – In Ralston Valley, there is a development in the 12-mile stretch north of Highway 6. Several private land holdings on the east side of Highway 376 (notably Section 32 of T5N R44E) are the site of mobile homes, and one is being developed into a sportsman's park. On the west side of Highway 376, about 8 miles north of Highway 6, is a relatively new State prison facility. Although these areas can be avoided by a route along the east side of the valley, much more flexibility in routing is available by using the south end of Big Smoky Valley.

2.3.3 Palisade Option

The Palisade option is characterized by a very confined area available for rail connections, and significant potential land-use conflict areas. The route traverses the length of Pine Creek and Monitor Valleys; intervening hills may be traversed with grades in the 1.5 to 2 percent range. Proximity to mining operations in the Tonkin Summit area may be significant to possible shared-use interests.

Field investigation covered the entire route, although a possible alternate through Garden Valley and Kobeh Valley has not been investigated.

2.3.3.1 Southern Pacific/Union Pacific Connections

Space for track connections is limited in the vicinity of Palisade due to the close confines of Palisade Canyon and the bridges and tunnels present on both the Southern Pacific and Union Pacific main lines. Although the now abandoned Eureka & Palisade Railway connected with Southern Pacific at Palisade, the arrangement used would not be acceptable by today's standards: grade crossings were required over both the Southern Pacific and Western Pacific (now Union Pacific) main lines.

The Union Pacific (eastbound) track is the more southerly of the two main lines here. Although the Southern Pacific (westbound) track is on the opposite bank of the Humboldt River throughout much of Palisade Canyon, the two tracks are adjacent and parallel (about 150 feet apart) for about 1,000 feet at the confluence of Pine Valley and Palisade Canyon. This location, approximately 0.6 mile west (geographic south) of Southern Pacific's Palisade siding, is clearly the most practical connection point in the Palisade area. A west facing connection (from the Union Pacific) and crossover (to the Southern Pacific) appears feasible, but the more flexible wye arrangement described in Section 2.4.1 is impractical due to space limitations. A bridge over the Humboldt River will be necessary within a quarter mile south (geographic east) of the connection.

2.3.3.2 Land-Use Conflicts and Topographic Constraints

Pine Valley – The first 15 miles of Pine Valley south of Palisade are private lands. Although most of the large flatlands along the valley bottom are prime grazing lands (fertile grasslands rather than sagebrush), many private holdings remain in sagebrush, particularly in the narrower portions of the valley and the hills on either side. A carefully selected rail route through this area may therefore need to cut through prime grazing lands for less than half of the total distance.

The more southerly portions of Pine Valley, being much wider and flatter, offer greater alternatives in routing while containing much less private land. Private lands are largely sagebrush, except those closest to Pine Creek.

Denay Valley – Due to the flat topography in this valley, conflict with private holdings (largely along Denay Creek) should be unnecessary. However, there are two significant concerns in the vicinity of Tonkin Summit:

- Tonkin Spring Gold Mine, which appears to be a large open-pit operation, is located approximately in Section 33 of T24N R49E and Sections 2 and 3 of T23-1/2N R49E. This location severely limits routing options in this area, as Tonkin Summit is the lowest pass between the Simpson Park Mountains and the Roberts Mountains. Because this operation is relatively new, the extent of landholdings is not shown on the BLM map of the area.

- Roberts Creek Mountain Habitat Management Area apparently includes Tonkin Summit and lands at least 5 miles into the valleys on either side. These lands are also not designated on the BLM map.

In order to avoid these potential conflicts, it may be necessary to consider a route to the east via Garden Valley and Kobeh Valley. This alternative was not investigated during the field study.

Monitor Valley, Northern Portion – North of Highway 50, Monitor Valley is wide and flat and routing can generally avoid known land use constraints. The few private lands observed are largely sagebrush. The Atlas Gold Bar Mine has a large active operation in the vicinity of Section 23 of T22N R49E. Although this operation does not appear to conflict with a rail route, the full extent of mining properties is not known.

Monitor Valley, Central Portion – Between Highway 50 and Dianas Punch Bowl (approximately 30 miles south of the highway), Monitor Valley is largely sagebrush. The broad sloping planes on either side of the valley floor allow easy avoidance of the few private holdings encountered. The 14-mile long strip of land (along the west side of the valley) designated as *Federal Agency Protective Withdrawal* on the BLM map can also be avoided easily.

Monitor Valley, Southern Portion – South of Dianas Punch Bowl, Monitor Valley becomes very broad. The bottom of the valley is so flat that rail routing directly up the center should be avoided due to accumulation of water during runoff periods. At the time of this inspection, Dry Lake was in fact filled with water and appeared somewhat larger than shown on the BLM map.

According to the BLM map, there are a significant number of private land holdings, and crossing of several of these properties may be necessary to secure an acceptable rail alignment. These private lands are largely sagebrush, and are generally discernable only because of range fences. The notable exception is Section 27 of T46E R10N, which appears to be prime grazing land and can easily be avoided by routing to the east.

Belmont Area – Belmont is an historic mining area, with a small, but growing population. Mining activities, most of which were 1 to 2 miles southeast of the townsite, are no longer active. However, land sales and new home construction are evident within 1.5 miles of the townsite along the main roads to the east and the southwest.

Although the townsite and developing properties are in the immediate vicinity of a low pass between Monitor and Ralston Valleys, another pass about 4 miles to the southeast provides a more isolated (and topographically as acceptable) route.

Ralston Valley – Route considerations through Ralston Valley are described in Section 2.3.2.2. Use of the southern portion of Big Smoky Valley (instead of Ralston Valley) for the Palisade Route is feasible, although the route would be lengthened by approximately 25 miles.

2.3.4 Battle Mountain Option

A route connecting with the Southern Pacific main line about 8 miles east of Battle Mountain would use the Reese River Valley to the Austin vicinity, crest the Shoshone Mountains, and proceed through Smith Creek and Ione Valleys.

Only the northernmost 80 miles of this route, that portion following the Reese River, was included in the field investigation.

2.3.4.1 Southern Pacific/Union Pacific Connections

Of the three connection points investigated, proper main line connection in the Battle Mountain vicinity is the least practical, for two main reasons:

- The proximity of Interstate 80 to the Southern Pacific main line. Distance between the two is several hundred feet, part of which is consumed by a frontage road (old Highway 40). Rail operations at this point would be clearly in public view.

- The wide separation of the Southern Pacific and Union Pacific main lines. For the reasons cited in Section 2.3.1, connection only to the Southern Pacific is operationally unacceptable, as all train movements on the Southern Pacific are westbound only. The Union Pacific (eastbound) main line is approximately 4 miles north of the Southern Pacific, on the opposite side of a network of waterways formed by the Humboldt River and Rock Creek. A connection across this area would involve several bridges as well as cutting through extensive grazing lands.

2.3.4.2 Land-Use Conflicts and Topographic Constraints

Extensive private land holdings and property development pose serious routing problems, particularly in the northerly 20 miles of the route, south and east of Battle Mountain. This situation is most acute near the Lander County Airport (immediately south of Interstate 80), and in the area southeast of the proposed Southern Pacific connection, due to the large number of homesites (mostly mobile homes) in these areas. Although a route further east of the airport will reduce the proximity to some of this development, there is so much private land in the corridor that reduction of land-use conflicts to an acceptable level may be impractical.

Further south, where Antelope Valley joins Reese River Valley, large tracts of land west of State Route 305 have been developed into irrigated agricultural lands, although a satisfactory route along the east side of the highway may be feasible.

Approximately 50 miles south of Battle Mountain, the rail construction may encounter significant difficulties for about 3 miles due to the confines of a canyon with the highway and the Reese River. Several crossings of both the highway and the river in this canyon may be necessary.

A narrow strip of private land continues along the Reese River for most of the remainder of the route through the valley. Although some of this property is sagebrush, significant portions are prime grazing land. Further study would be necessary to determine whether a suitable route avoiding these lands is feasible.

2.4 CALIENTE ROUTE FIELD INVESTIGATION

The Caliente Route was investigated from the Mud Lake area to the entry onto the Nevada Test Site lands near the Repository site, based on a preliminary alignment completed by DeLeuw Cather (SAIC 1992). This portion of the Caliente Route also forms part of the Carlin route. Investigation of the balance of the route from Mud Lake to the Union Pacific connection at Caliente has been left for subsequent studies because of the remote nature of much of this portion of the route. This portion would also be used by the Carlin Route.

2.4.1 Goldfield Vicinity

The most significant mining operation in the Goldfield area is the new open-pit mine about one mile northeast of the town center, in section 36. This operation is approximately three miles from the rail route proposed by DeLeuw Cather (SAIC 1992).

All mines near the proposed route in the Goldfield vicinity appear abandoned or inactive; no activity was apparent in mining patent areas in the Tognoni Springs - Espina Hill vicinity (Sections 21, 28, 33, 34 T2S R43E and Sections 2 and 3 T3S R43E). However, in the southwest quarter of Section 20 T2S R43E, about 1.5 miles west of the proposed route, a small drilling operation is underway.

The closest habitation to the route is also in Section 20 T2S R43E: a small, active ranch (the fenced area is perhaps quarter section) with various ranch buildings. These dwellings are within a mile of the proposed route.

The roadbed of the Las Vegas and Tonopah Railroad southeast from Goldfield is well preserved and is now used by vehicular traffic.

2.4.2 Scottys Junction Vicinity

There is some development on the large parcels of private lands in this area, primarily mobile homes adjacent to the east side of U.S. Route 95.

The following paragraphs describe the area in detail, proceeding generally from north to south. Unless otherwise noted, all dwellings appear to be occupied. Other than the structures and facilities listed here, the private lands in this area are vacant.

Within T7S R44E,

Section 21: In the center of the section is a water well and tank.

Section 28: Buildings shown on the USGS map at the intersection of U.S. Routes 95 and 72 are gone. There is an abandoned house trailer east of the intersection.

Section 33: The airstrip is apparently abandoned; the road leading to it is no longer in use. Immediately west of U.S. Route 95, near the east edge of the section, is the Scottys Junction gas station, restaurant and recreational vehicle park.

Section 34: In the middle of the west half there is a house and five house trailers a quarter mile east of U.S. Route 95, shown as one building on the USGS map. Two structures shown on the USGS map at the northern edge of the section are abandoned. In the southeast quarter, adjacent to the highway, there is a double-wide house trailer on the west side and house trailers on the east side, close to the southern section boundary.

Within T8S R44E,

Section 2: About 0.7 mile east of the highway, near the northern edge of the section, are at least two structures in a cluster of trees. According to the USGS map, these structures are immediately outside the Nellis Air Force Range.

Sections 11 and 12: A series of structures are located within a quarter-mile wide strip along the east side of the highway, scattered over a distance of about a half mile. These include about 10 mobile homes, an abandoned gas station, and one small frame house (with a smaller adjacent building). This frame house, indicated on the USGS map at the bottom center of section 12, is the most permanent and best maintained of the structures in the immediate area. It is about a half mile east of the highway and within about a half mile of the Nellis Air Force Range boundary.

The preferred route through the Scottys Junction area parallels Highway 95 one to two miles to the west; this corridor is completely clear of structures and most private lands. An alternate route east of Highway 95 would enter the Nellis Air Force Range to avoid all structures and private lands. A third possible routing (not indicated on the corridor maps) would be via the abandoned Las Vegas and Tonopah alignment further west, which would lengthen the line at least two miles.

2.4.3 Southern Portion of Sarcobatus Flat

In the event that routing is kept east of the highway through the Scottys Junction area, it may be feasible to avoid the two grade separations over U.S. Route 95 proposed by DeLeuw Cather; routing higher on the wash's alluvial fan is possible, although extensive earthwork may be required.

2.4.4 Oasis Valley

The proposed route crosses a large parcel of private land in the upper portion of the valley, which covers part of sections 22 and 27 of T10S R47E. This appears to be grazing land, and ranch buildings are present as shown on the USGS map.

2.4.5 Beatty Wash

This wash appears to handle significant flash floods. Due to the depth of the canyon and the rugged nature of the adjacent branch of Yucca Mountain, negotiating this area will be one of the more difficult portions of the Caliente (or Carlin) Route. In the Beatty Wash area, several bridges over the highway and the Amargosa River may be required.

2.4.6 Crater Flat

There are no significant obstacles to rail line construction in Crater Flat. The Panama Mine, near the foot of Bare Mountain on the west side of Crater Flat, is a currently active open-pit operation, but is not considered a constraint.

2.5 DOCUMENT REVIEW OF RAIL CORRIDOR ROUTES

In addition to the field investigation, BLM and county documents were reviewed. Information pertaining to the USGS 7.5 and 15 Minute Maps is contained in Appendix C and in Volume II. A list of potential land use conflicts is provided below:

- Privately owned land
- State owned land
- U.S. Department of Defense land
- Patented mining and milling claims
- Indian reservations
- Cultural resource areas
- Archeological sites
- National forests
- National parks, monuments, and recreation areas
- Registered and potential national historic places
- Special recreation management areas
- Federal wildlife refuges and management areas
- Established Areas of Critical Environmental Concern
- Established Desert Wildlife Management Areas
- Wilderness Areas and Wilderness Study Areas.

General observations for each route are given in the following subsections.

2.5.1 Valley Modified Route

The Valley Modified route connection near Apex may be impacted by Clark County's impending sale of the Apex Heavy Industrial Use Park, first advertised on July 31, 1995. This route also assumes that the Nellis Small Arms Range will be returned to the BLM, although that action is almost a certainty. The route also encroaches on the Desert National Wildlife Range, the Quail Springs Wilderness Study Area, Nellis Wilderness Study Areas A, B, and C, and the Nellis Air Force Range. Near Indian Springs, one route option traverses the hills south of Indian Springs (Indian Hills alternate) and enters a proposed BLM utility corridor and follows it to Mercury. The other route option traverses the Nellis Auxiliary Field at Indian Springs and parallels U.S. Route 95. From Mercury, the route options coincide and are within the boundary of the Nevada Test Site to Yucca Mountain. See Valley Modified Corridor Map - Volume II and Appendix C.

2.5.2 Jean Route

The Stateline Pass alternate of the Jean route starts with a large number of utility rights-of-way that follow the alignment of the Union Pacific Railroad and Interstate 15. About 10 miles into this alternate, the route is adjacent to the Stateline Wilderness Area on the California side of the border. Nearing Pahrump a significant number of utility rights-of-way are again encountered. The Wilson Pass and the Stateline alternates have similar utility rights-of-way elements near Jean; however, much of this alternate is within a BLM proposed utility corridor. The North Pahrump alternate involves some private land near Pahrump, but again enters a proposed BLM utility corridor near its end. The Stewart Valley alternate revealed a data gap concerning the narrow strip of land near the Nevada-California border. Neither BLM offices in Nevada nor California have data about this area and there is a discrepancy between the USGS quadrangle maps and the BLM land status maps. The remainder of the Jean route has a few utility rights-of-way near U.S. Route 95 and then enters the Nevada Test Site. See Jean Route Corridor Map - Volume II and Appendix C.

2.5.3 Carlin Route

There are three general characteristics of interest in the Carlin route. First, at the start, a large number of private land holdings are present because the builders of the Transcontinental Railroad were awarded every other section 20 miles on each side of their alignment. This resulted in the checkerboard pattern shown on the maps. Appendix B compiles the number of individual parcels within the corridor in Eureka County. Second, a large new mine is being developed in the Cortez quadrangle that lies between the Gold Acres and Cortez mines. See Section 3.2.1.3 for Carlin route option that is near the new Pipeline Mine. Third, several historic and operational mining districts are located near the route. These districts have numerous numbers of utility rights-of-way associated with them. See Carlin Route Corridor Map - Volume II and Appendix C.

2.5.4 Caliente Route

The Caliente route encounters a large number of pipeline rights-of-way and oil and gas leases in the Reveille Valley area. The historic mining areas around Goldfield have numerous mining patents making routing more difficult. An optional corridor has been proposed that encroaches on the Nellis Air Force Range. Another optional corridor has been proposed near Scottys Junction to minimize private land impacts and eliminate the need for grade separations. The route encounters a number of utility rights-of-way as it nears U.S. Route 95 in the vicinity of Springdale. See Caliente Corridor Map - Volume II and Appendix C.

Note that ownership of the abandoned 200-foot-wide right-of-way of the Union Pacific branch line to Pioche that begins the Caliente Route remains unclear despite recent discussions with BLM representatives and Caliente city officials. Land research in this area, using 1990 BLM Master Title Plats, indicates that the right-of-way CC0356 of the former Union Pacific branch remains active. If ownership of the land is a concern, another origin point for the Caliente route may be justified.

In 1992, DeLeuw, Cather (SAIC 1992) evaluated an alternate route that originated from Crestline and traveled north of Panaca and State Route 319. The Crestline Route has the following characteristics:

- Over 15 miles longer
- Steep grades
- Sharp curvature
- Extensive earthwork because of topography
- Cost five times more ($88 million)
- Additional operating and maintenance cost.

This route alternative was eliminated from further study for the reasons listed above; however, a Crestline alignment south of Panaca and State Route 319 may be an option for future consideration if stakeholder acceptance becomes an issue.

3. ENGINEERING ANALYSIS

3.1 DESIGN CRITERIA

To perform this pre-conceptual design route selection evaluation, design criteria were developed to allow a consistent evaluation of route alternatives. The design criteria are identified in the following paragraphs. These criteria do not constitute a design requirements document and some of them may be revised after the requirements analysis is completed. Prior to the start of conceptual design, these requirements will be evaluated and applicable requirements will be placed in the *Repository Design Requirements Document* (YMP 1994).

3.1.1 General

Design shall comply with Department of Energy Order 6430.1A, General Design Criteria, and the recommendations of the American Railway Engineering Association, as prescribed in the current edition of the *Manual for Railway Engineering* (AREA 1994). Where applicable, Federal Railroad Administration Office of Safety track safety standards shall be considered, based on Class 4 track that assumes a maximum allowable operating speed of 60 miles per hour for freight and 80 miles per hour for passenger.

Much of the non-mountainous terrain in Nevada is alluvial fan; a large percentage of infrastructure in the Southwest is built across alluvial fans. As part of a Department of Energy-sponsored program, the Desert Research Institute is developing design criteria for rail structures that cross alluvials. The Institute will study Union Pacific Railroad maintenance records to establish the types of structures that have withstood flooding for many years. Combined with theoretical analysis, this information will assist the Institute in developing the design criteria. The impact of flash flooding on the rail line will be minimized by using the proper design criteria and by designing for 100-year flood conditions.

3.1.2 Assumed Traffic

The rail line shall be designed to transport spent nuclear fuel; high-level waste; empty transportation casks and disposal canisters; and material and equipment for potential repository construction, maintenance, and operation.

Traffic estimates for spent nuclear fuel and high-level waste transportation casks shall be based on the rail functions listed above at the delivery rates identified in Table 3-1. This table is derived from the Transportation Cask Arrival Scenario in the *Controlled Design Assumptions* document, Key Assumption 001 (CRWMS M&O 1995c). The standard consist for the majority of train movements is assumed, based on engineering judgment to be two 3,000- to 4,000-horsepower diesel-electric locomotives with a maximum of three spent nuclear fuel transportation casks or five high-level waste transportation cask cars, two or more buffer cars (gondolas) and an escort car. See Section 4 for train consist assumptions that differ from Key Assumption 001.

Table 3-1. Potential Transportation Cask Nevada Arrival Scenario*

Year		125T	75T	HLW	Rail Year Total	Rail Weekly Total **	LWT	LWT Casks/ Week
1	2010	36	16	0	52	1	10	0.2
2	2011	41	71	0	112	2	25	0.5
3	2012	89	103	0	192	4	65	1
4	2013	179	121	0	300	6	52	1
5	2014	283	125	0	408	8	72	1
6	2015	267	157	159	583	11	55	1
7	2016	290	115	161	566	11	69	1
8	2017	295	123	160	578	11	54	1
9	2018	310	94	160	564	11	43	1
10	2019	297	92	159	548	11	48	1
11	2020	304	94	160	558	11	29	0.5
12	2021	295	103	160	558	11	40	1
13	2022	316	81	160	557	11	55	1
14	2023	300	99	161	560	11	29	0.5
15	2024	320	81	160	561	11	36	1
16	2025	296	99	160	555	11	33	0.5
17	2026	312	77	159	548	11	57	1
18	2027	321	91	160	572	11	10	0.2
19	2028	306	87	160	553	11	60	1
20	2029	303	107	160	570	11	37	1
21	2030	314	97	37	448	9	41	1
22	2031	324	82	87	493	9	23	0.5
23	2032	297	118	83	498	10	57	1
24	2033	188	77	0	265	5	29	0.5
	Totals	6,283	2,270	2,606	11,159		1,029	

* Based on a maximum of 3,000 metric tons of uranium per year
** Rounded to nearest cask

HLW - high-level waste
LWT - legal weight truck
T - ton

Possible future usage for other freight or passenger transport is assumed to be consistent with the design parameters required for the above traffic; specific consideration of other traffic is not required at this time.

3.1.3 Grades

A maximum grade of 1.5 percent is desired in order to provide a level of operating safety consistent with adjacent rail lines. In areas where 1.5 percent grades are not feasible, a maximum grade of 2.2 percent may be used. Under no circumstances may grades exceed 2.5 percent, based on an evaluation performed by DeLeuw Cather (SAIC 1992).

In tunnels over 1,000 feet in length, grades may not exceed 75 percent of the maximum grade on a given route. The minimum grade in tunnels shall be 0.3 percent to promote drainage.

A more stringent 1.5 percent limit is based on safety considerations (rather than locomotive tonnage ratings) in moving high axle-load cars on downgrades. It is generally recognized by the industry that operating difficulties increase significantly as grades increase above about 1.5 percent, as documented in *Track - Train Dynamics to Improve Freight Train Performance* (AAR/FRA 1973).

Also, most of the rail lines to be used by waste trains traveling to Nevada have maximum grades in the 1 to 1.5 percent range. As each train will operate over such grades before reaching Nevada, continued safe operation to Yucca Mountain over similar grades is a reasonable assumption (as long as the train is kept intact). Union Pacific's 2.2 percent Cima Hill (southwest of Jean) is the notable exception to the 1 to 1.5 percent range indicated above.

Loss of braking control with subsequent "run-away" is a recurring incident on rail lines with higher grades; four such accidents have occurred in recent years between Las Vegas and Los Angeles alone (on grades in the 2.2 percent to 3.0 percent range), including one on Cima Hill.

3.1.4 Horizontal Alignment and Curvature

The horizontal alignment shall be designed in accordance with American Railway Engineering Association recommended practice. Maximum allowable curvature is 8°00' on main tracks. Where feasible, main track curvature should be 2°00' or less in order to accommodate a desired design speed of 60 miles per hour over the majority of a given route.

The curvature limit of 8°00' on main tracks is consistent with the Caliente Route conceptual plans prepared by DeLeuw Cather (SAIC 1992), although 6°00' is a generally accepted limit for new rail lines. The desired curvature of 2°00' is based on a 60 miles per hour design speed with 4.5-inch superelevation (a common limit for freight lines) and minimum unbalance.

3.1.5 Right-of-Way and Land Use Conflicts

The right-of-way will be established with a minimum width of 200 feet (100 feet on each side of the centerline). Increased widths will be established as required by cut or fill slopes.

Definition of route corridors will include right-of-way required by potential alignment modifications that may be considered during subsequent design stages. Corridors were investigated to identify any areas that may have potential land use conflict. Types of land use conflicts are identified in Section 2.

The investigation will also identify areas subject to proposed land use changes, including formal land use proposals in any of the listed categories, as well as federal, state, county, and local planning group proposals for future land use. Potential conflicts with proposed land uses shall be considered less restrictive than established land uses.

If avoidance of a conflict area requires an alignment not meeting standard engineering practices, optional routing will be evaluated that will attempt to minimize land use impacts.

3.1.6 Track and Roadbed

For cost estimating, all track is assumed to be 115-pound continuous-welded rail (a common main track construction standard for heavy axle-load cars) with timber ties and crushed stone ballast. Roadbed width and side slopes for excavations, embankments, ditches, etc. are assumed to follow American Railway Engineering Association recommended practices. Parallel access (maintenance) roads were not considered at this time.

Some railroads (notably Union Pacific) would likely specify heavier rail (133-pound). Lighter weight rail is inappropriate due to resulting higher maintenance costs as well as increased rail stresses (and consequent potential failure).

3.1.7 Bridges

For cost estimating, all bridges shall be assumed as steel superstructures on concrete abutments and piers. Grade separation structures are assumed at all paved public road crossings. The need for separation structures at other public roads will be evaluated during subsequent design.

3.2 ROUTE EVALUATION

3.2.1 Route Engineering Analysis

The engineering criteria and land-use constraints affecting each route alternate were applied in this analysis, reducing corridor width and yielding a more detailed reconnaissance-level engineering survey. Key elements of this analysis included the following:

- Acquiring additional available GIS data and topographic mapping within the corridors. Mapping at 1:62,500 scale was used where available; 1:24,000 scale maps were used elsewhere.

- Establishing approximate locations for feasible alignments according to engineering criteria, topography, land use conflicts and other constraints. In areas where engineering requirements conflict with land-use, options were evaluated for resolution of the conflict.

- Producing overlays of potential feasible alignments with an updated land-use map.

- Updating capital costs and annual operating and maintenance costs.

Refined corridor boundaries (refined from the Study 1 boundaries) for each route are shown in Volume II, Figures 2 through 6. The corridors were developed to meet the engineering criteria while minimizing conflicts with adjacent land uses. This task generates a *fatal flaw* analysis for alternative routes. The output will support the National Environmental Policy Act scoping process, and will identify the investigation area for the Environmental Impact Statement baseline data collection.

A general description of the engineering considerations involving each route is provided in the following paragraphs; additional detail may be found in Appendix C.

3.2.1.1 Valley Modified Route

Connection of the Valley Modified route (See Figures 13 through 15 in Volume II) with the Union Pacific main line would be at a point between the Dike and Apex sidings. The Valley Modified route is the shortest of the four rail routes being considered. The distance from the Union Pacific connection to the potential repository is about 98 miles.

Compared to the other three routes, the Valley Modified route has the straightest alignment and flattest profile. The steepest grades are 1.5 percent, the longest of which would be the westbound ascent of the hills south of Indian Springs.

Location of the eastern half of the route is highly dependent upon land-use constraints, particularly where closest to North Las Vegas. The corridor maps indicate a reasonable compromise between topographic and land-use constraints by locating the line high on the alluvial fans of the Las Vegas Range, through portions of the Desert National Wildlife Range. Acceptable distances are thereby maintained from critical areas of concern, notably the 7,500-acre BLM parcel to be transferred to the city of North Las Vegas. At the same time, this corridor provides the opportunity to design an alignment meeting acceptable engineering practices. Further detail concerning the various constraints in this portion of the route are presented in the route section description sheets for the Las Vegas Wash section in Appendix C.

In the vicinity of Indian Springs, two major route options are possible. The Indian Hills alternate bypasses both the community of Indian Springs and the Nellis Air Force Auxiliary Field by routing through the hills to the south. This route requires 11 miles of 1.5 percent grades, two grade separations over U.S. Route 95, and substantial earthwork. The Cactus Springs alternate, on the other hand, will require negotiation with the Air Force to define a right-of-way through either the built-up area between U.S. Route 95 and the airfield (which would involve relocation of some Air Force and civilian structures and facilities) or through desert areas north of the airfield used for target practice. As this portion of the Cactus Springs Alternate cannot be defined until negotiated, the corridor maps do not show a corridor through this area.

The final 34 miles of the route lies within the Nevada Test Site via Mercury Valley, Rock Valley, and the western portion of Jackass Flats. A steep descent into Mercury Valley is avoided by routing between the townsite of Mercury and the site of Camp Desert Rock. About 14 miles of the route basically parallels Jackass Flats Road (on the east side), using a somewhat less direct route than the road in order to keep grades moderate. Fortymile Wash is crossed at its narrowest point near the potential repository.

3.2.1.2 Jean Route

The Jean route (See Figures 16 and 17 in Volume II) connects with Union Pacific at either Jean or Borax. Both connection points encounter mountainous sections involving heavy grades and sharp curves. The route is in close proximity to the communities of Pahrump, Sandy Valley, Goodsprings and Jean.

As delineated by the route section description sheets in Appendix C, the route is comprised of five sections. These include two possible route alternates on the east end over the Spring Mountains (Wilson Pass and State Line Pass alternates), two possible route alternates around Pahrump (Stewart Valley and North Pahrump alternates), and a common section across the Amargosa Desert to the potential repository. Depending upon the combination of sections selected, total route length may be as short as 114 miles or as long as 127 miles.

Of the two route alternates on the east end, the Wilson Pass alternate is shorter by approximately eight miles and offers a lower level of potential land-use conflict. However, the route does pass within a half mile of housing on the north side of Goodsprings, and approximately 2.5 miles of tunneling would be required through the Spring Mountains. The State Line Pass alternate traverses the Spring Mountains at the lowest pass in the area by entering California for about six miles. Along with a possible conflict with archeological sites near Borax, this alternate passes within one mile of several homes in Sandy Valley. Maximum grade is 2.2 percent for either alternate, although the grades are much shorter in the case of the State Line Pass alternate.

In the vicinity of Pahrump, the North Pahrump alternate climbs alluvial slopes along the east side of the community to maintain a distance from residential areas of generally 1.5 miles or more. Proper development of this route would necessitate purchase of right-of-way through privately held (but largely vacant) lands for about five miles. Routing to avoid all private lands would lengthen the line about three miles and add significant grade and curvature. The Stewart Valley alternate, by using the Bureau of Land Management's proposed utility corridor along the state line, minimizes private land acquisition but passes within 0.2 mile of homes in the developing Homestead Road area. It is also about 4.5 miles longer than the North Pahrump alternate. Both alternates use grades in the 2.0 percent to 2.2 percent range to traverse summits in the Last Chance Range.

The Amargosa Desert Section is relatively free from land use constraints and rough topography, traversing vacant lands administered by Bureau of Land Management or U.S. Department of Energy

(Nevada Test Site). The private holdings north of Crystal are easily avoided, although route length is slightly increased in order to do so. The last 14 miles of the route traverses the Nevada Test Site east of Fortymile Wash, crossing the wash at a narrow point near the potential repository.

3.2.1.3 Carlin Route

The Carlin Route (See Figures 1 through 6 in Volume II) begins with a connection with the Southern Pacific and Union Pacific at Beowawe (Study I used Palisade as a starting point, see Section 2) and proceeds south through Crescent Valley, Grass Valley and Big Smoky Valley to join the Caliente route in the vicinity of Mud Lake. The total length of the route to this point is about 212 miles. Total length to the site is about 331 miles. Possible alternate routes for the central portion of the Carlin route are via Monitor Valley and Ralston Valley. These alternates could add from 7 to 32 miles of additional length.

Beginning at the connection to the Southern Pacific and Union Pacific main line tracks just east of Beowawe, the route runs south through Crescent Valley and passes just east of the town of Crescent Valley. This area is generally flat or gently sloping and mostly unimproved land but contains a large portion of private land (as shown in Appendix C).

Near the southern end of Crescent Valley, the route passes between the Cortez and Gold Acres mining operations. From here it climbs up to Dry Canyon Summit with grades of up to two percent. The summit is approximately 46 miles from Beowawe.

Grades of up to two percent characterize the downgrade from Dry Canyon Summit to the entrance into Grass Valley. The route then follows the west side of the valley, crossing a length of alluvial fans until it passes adjacent to and west of the Grass Valley Ranch where a two percent upgrade to the top of Rye Patch Canyon would be encountered. An alternate location would be to the east of the ranch through an area of more rugged topography. A downgrade of less than 1.5 percent brings the route into Big Smoky Valley.

At this point, an alternate route could go east into Monitor Valley via Hickison Summit, south along the west side of Monitor Valley, and through Ralston Valley to west of Mud Lake; from there it shares a common path with the Caliente route.

The route through Big Smoky Valley crosses to the east side of the valley and follows the alluvial fans until just north of the town of Hadley where it crosses State Route 386 to the west side of the valley. As at the Grass Valley Ranch, an alternate route around Hadley would be to the east between the Hadley Airport and State Route 386, rejoining the main route just south of Hadley. This alternate is closer to the Round Mountain mining operation than the western alternate.

From this point just south of Hadley the route continues south, crossing back to the east side of the valley and paralleling State Route 386. The route continues south, passing about five miles to the west of Tonopah. Finally, the route enters a more rugged area of topography in the vicinity of Klondike and traverses southeast, connecting to the Caliente route west of Mud Lake. See Caliente route evaluation from Mud Lake to Yucca Mountain.

3.2.1.4 Caliente Route

The Caliente route (See Figures 6 though 12 in Volume II) is the most mountainous of the routes under consideration, with seven major mountain crossings and three minor summits. Of the total length of 338 miles from Caliente to the potential repository, over 80 miles involve heavy grades up to 2.4 percent. The balance of the route generally follows the bottom of large desert valleys, notably Sand Spring Valley, Reveille Valley, Ralston Valley, and Sarcobatus Flat.

A majority of the heavy grade areas are in the eastern quarter of the route, nearest Caliente. The two most difficult mountain crossings are Timber Mountain Pass (due to the close proximity of the Seaman Range to the White River) and over the western portion of Yucca Mountain near Beatty Wash. Significant extra distance in the form of large loops is necessary to achieve acceptable grades in these and other cases. Some mountainous areas also require sharp curves, most notably in the upper Crater Flat and Beatty Wash areas. Further engineering work may find that many (but not all) of the heavy grades can be reduced to 1.5 percent with some construction cost penalty.

Route section description sheets in Appendix C detail the characteristics of the two key sections, which are joined west of Mud Lake. The Reveille section (from Caliente to Mud Lake) is exclusive to the Caliente route, while the Goldfield Section (from Mud Lake to the potential repository) is common to the Caliente and Carlin routes.

Significant route options are indicated on the corridor maps by split corridors in three key areas:

- Between Coal Valley and Garden Valley, the route may use either Water Gap or a somewhat higher pass through the Golden Gate Range approximately four miles to the north. The key advantage of routing through Water Gap is the avoidance of about 3.5 miles of steep grade.

- In the vicinity of Goldfield, a route through part of the Nellis Air Force Range (over a distance of about 14 miles) would greatly improve the route by using a much lower summit and avoiding mining patent areas. Grades would be less than 1.5 percent, compared to the 2.4 percent maximum required for the higher summit near Espina Hill. Curvature would also be greatly reduced.

- Across Sarcobatus Flat two options exist to avoid private lands and housing in the area. These options parallel U.S. Route 95 to the west and east, respectively. Routing on the west side will require three highway grade separations. A route east of the highway would have at most two grade separations, which further engineering may find feasible to avoid. However, this route would require penetration of the Nellis Air Force Range to bypass the private lands mentioned above.

The route concludes by bypassing to the north of Amargosa Valley and turning north around Busted Butte, following Fortymile Wash on the west side toward the potential repository.

An alternative Caliente route was evaluated in the *Caliente Conceptual Design Report* (SAIC 1992) that closely paralleled U.S. Route 95 and State Route 375. This route required either extensive earthwork or a 2.5- to 3-mile tunnel to cross Hancock Summit near State Route 375, and was estimated to cost about 30 percent more than the more northern alignment. Because of the significantly higher cost with little benefit, the alternative alignment is not included in Study 2 and will not be considered in future studies unless it becomes necessary when more detailed studies are performed on the Caliente base route.

3.2.2 Map Format

The route corridors from the engineering analysis, and the land use data from the land use review, were input into the Nevada State GIS file developed during Study 1. Volume II, Map Portfolio shows all refined route corridors and pertinent land use data. Maps were developed to identify land uses by color with the corridor overlays shown by patterning.

Maps were developed for each route corridor, and are shown in "tile" fashion. These maps were also developed to identify land uses by color with the corridor overlays shown by patterning, and are included in Volume II.

3.3 RAIL COST ESTIMATES

The cost estimate included in Study 1 (CRWMS M&O 1995b, Figure 3-9) has been revised to reflect updated route lengths, preliminary earthwork quantities, grade separation and drainage structure quantities, and tunnel quantities based on the refined corridor evaluation. Estimated land acquisition costs are included in Table 3-2 under cost per mile. These costs include the acquisition of public and private land. Tables 3-2 and 3-3 show study cost updates. Annual expenditures are shown in Appendix D, Rail Costs (in fiscal year 1995 dollars).

The cost evaluation revision in this study differs significantly from the cost evaluation in Study 1. The engineering, construction management, administration, and planning cost factor of 24 percent used in Study 1 was evaluated and reduced to 15 percent in this study, as shown in Table 3-2. Table 3-3 shows the operations and maintenance costs. For more cost detail see Appendix D.

Table 3-2. Revised Study 1 Cost Estimate Sheet

Unit Costs Remain the Same as Study 1:

Quantities Have Been Updated Based on Study 2 Analysis

ROUTE	TOTAL MILEAGE	MILEAGE @ 0-3% GRADE	COST/MILE @ 0-3%	MILEAGE @ 3-6% GRADE	COST/MILE @ 3-6%	MILEAGE @ > 6% GRADE	COST/MILE @ >6%	TUNNEL COST	SUB-TOTAL	NO. OF SEPARATIONS	COST/EA SEPARATION	SUB-TOTAL	# OF DRAIN STRUCTURES	COST/EA STRUCTURE	SUB-TOTAL	TOTAL DIRECT COST	CONTINGENCY @ 35% OF D.C.	ENGINEERING & MNGMNT COST @ 15%	TOTAL COST (1990 $)	COST/MILE	ESCALATED TOTAL COST* (TO 1994 $)
	GRADES LISTED SHOW GRADE OF EXISTING GROUND																				
CALIENTE	338	262	$1,224,000	66	$2,244,000	10	$3,570,000		$504,492,000	7	$500,000	$3,500,000	52	$1,282,917	$66,711,684	$574,703,684	$201,146,289	$116,377,496	$892,227,469	$2,639,726	$986,803,581
CARLIN- Monitor Valley via Ralston Valley	338	295	$1,248,000	36	$2,288,000	7	$3,640,000		$476,008,000	4	$500,000	$2,000,000	32	$1,282,917	$41,053,344	$519,061,344	$181,671,470	$105,109,922	$805,842,737	$2,384,150	$891,262,067
CARLIN- Monitor Valley via Klondike	363	295	$1,248,000	61	$2,288,000	7	$3,640,000		$533,208,000	4	$500,000	$2,000,000	32	$1,282,917	$41,053,344	$576,261,344	$201,691,470	$116,692,922	$894,645,737	$2,464,589	$989,478,185
CARLIN Smoky Valley Option	331	290	$1,248,000	34	$2,288,000	7	$3,640,000		$465,192,000	6	$500,000	$3,000,000	33	$1,282,917	$42,336,261	$510,528,261	$178,684,891	$103,381,973	$792,595,125	$2,394,547	$876,610,208
VALLEY MODIFIED Option via Indian Hills	98	88	$1,320,000	8	$2,420,000	2	$3,850,000		$143,220,000	2	$1,500,000	$3,000,000	9	$1,282,917	$11,546,253	$157,766,253	$55,218,189	$31,947,666	$244,932,108	$2,499,307	$270,894,911
VALLEY MODIFIED Option via Cactus Springs	98	90	$1,320,000	8	$2,420,000	0	$3,850,000		$138,160,000	0	$0	$0	12	$1,282,917	$15,395,004	$153,555,004	$53,744,251	$31,094,888	$238,394,144	$2,432,593	$263,663,923
JEAN- Wilson Pass Option via N. Pahrump	114	100	$1,320,000	10	$2,288,000	4	$3,640,000	$63,000,000	$232,440,000	4	$750,000	$3,000,000	11	$1,282,917	$14,112,087	$249,552,087	$87,343,230	$50,534,298	$387,429,615	$3,398,505	$428,497,154
JEAN- Wilson Pass Option via Stewart Valley	119	105	$1,320,000	10	$2,288,000	4	$3,640,000	$55,440,000	$231,480,000	4	$750,000	$3,000,000	11	$1,282,917	$14,112,087	$248,592,087	$87,007,230	$50,339,898	$385,939,215	$3,243,187	$426,848,772
JEAN- State Line Pass Option via N. Pahrump	122	65	$1,248,000	42	$2,288,000	15	$3,570,000	$9,660,000	$240,426,000	4	$750,000	$3,000,000	11	$1,282,917	$14,112,087	$257,538,087	$90,138,330	$52,151,463	$399,827,880	$3,277,278	$442,209,635
JEAN- State Line Pass Option via Stewart Valley	127	70	$1,248,000	42	$2,288,000	15	$3,570,000	$2,100,000	$239,106,000	4	$750,000	$3,000,000	11	$1,282,917	$14,112,087	$256,218,087	$89,676,330	$51,884,163	$397,778,580	$3,132,115	$439,943,110

* Excluding O&M Costs

The base cost per mile unit costs were established at:
0-3% Grade $1,200,000
3-6% Grade $2,700,000
Greater than 6% Grade $3,500,000
The unit costs include all track and signal costs, including the identified major cost drivers of earth work, rock excavation ballast, and track and ties.
The other major cost drivers - grade separations and drainage structures - are shown as separate cost items in the No. of Grade Separations column through the Sub-Total column.

A land access cost multiplier was applied to the unit costs listed, based on the amount of potential land use conflicts: A multiplier of 1.02 was applied for rural Bureau of Land Management land, a multiplier of 1.04 was applied for sparsely grouped private land within route boundaries, and a multiplier of 1.10 was applied for urban and more tightly grouped private land.

		MULTIPLIER		
GRADE	BASE UNIT COST	1.02	1.04	1.10
0-3%	1,200,000	1,224,000	1,248,000	1,320,000
3-6%	2,700,000	2,244,000	2,288,000	2,420,000
>6%	3,500,000	3,570,000	3,640,000	3,850,000

The total cost in 1990 dollars has been included to show comparison to the total costs identified in the Caliente Conceptual Design Report (SAIC 1992), which was based on 1990 dollars. The escalated cost in the Escalated Total Cost (1994 dollars) column shows the 1990 dollars total cost escalated by a factor of 1.106 to 1994 dollars.

Based on the Caliente Conceptual Design Report estimate, average unit costs were estimated for grade separations at
$1,500,000 for major structures
$500,000 for minor structures.

The Cost/Each Separation shown is a result of the combination of major and minor separation unit costs for each route. The 3 Jean Route options include 1 major separation and 3 minor separations for an average unit cost of $750,000 per separation.

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earthwork or a 2.5- to 3-mile tunnel to cross Hancock Summit near State Route 375, and was estimated to cost about 30 percent more than the more northern alignment. Because of the significantly higher cost with little benefit, the alternative alignment is not included in Study 2 and will not be considered in future studies unless it becomes necessary when more detailed studies are performed on the Caliente base route.

3.2.2 Map Format

The route corridors from the engineering analysis, and the land use data from the land use review, were input into the Nevada State GIS file developed during Study 1. Volume II, Map Portfolio shows all refined route corridors and pertinent land use data. Maps were developed to identify land uses by color with the corridor overlays shown by patterning.

Maps were developed for each route corridor, and are shown in "tile" fashion. These maps were also developed to identify land uses by color with the corridor overlays shown by patterning, and are included in Volume II.

3.3 RAIL COST ESTIMATES

The cost estimate included in Study 1 (CRWMS M&O 1995b, Figure 3-9) has been revised to reflect updated route lengths, preliminary earthwork quantities, grade separation and drainage structure quantities, and tunnel quantities based on the refined corridor evaluation. Estimated land acquisition costs are included in Table 3-2 under cost per mile. These costs include the acquisition of public and private land. Tables 3-2 and 3-3 show study cost updates. Annual expenditures are shown in Appendix D, Rail Costs (in fiscal year 1995 dollars).

The cost evaluation revision in this study differs significantly from the cost evaluation in Study 1. The engineering, construction management, administration, and planning cost factor of 24 percent used in Study 1 was evaluated and reduced to 15 percent in this study, as shown in Table 3-2. Table 3-3 shows the operations and maintenance costs. For more cost detail see Appendix D.

Table 3-3. Cost Summary of Rail Options

Route	Length (miles)	Costs ($ Millions)		Total Costs ($ Millions)
		Capital	Operating and Maintenance	
Caliente Route	338.1	986.8	68.90	1,055.70
Carlin via Monitor and Ralston Valleys	338	891.26	68.9	960.16
Carlin via Monitor and Klondike	363	989.48	70.52	1,060.00
Carlin via Big Smoky Valley	331	876.61	68.43	945.04
Valley Modified via Indian Hills	98	270.89	40.92	311.81
Valley Modified via Cactus Springs	97.5	263.66	40.69	304.35
Jean via Wilson Pass and N. Pahrump	114	428.50	42.78	471.28
Jean via Wilson Pass and Stewart Valley	118.5	426.85	43.00	469.85
Jean via State Line Pass and N. Pahrump	122	442.21	43.24	485.45
Jean via State Line Pass and Stewart Valley	126.5	439.94	43.47	483.41

4. BRANCH LINE OPERATIONS PLAN

4.1 RAIL OPERATING PLAN

All rail routes to the Yucca Mountain site have similar engineering criteria, and are designed to accept any of the logical train configurations that might be developed for long-haul, national Civilian Radioactive Waste Management System (CRWMS) rail haulage. The rail operating plan varies slightly from one route to another, as described in individual subsections below, but operations via any of the alternative routes are assumed at this stage to share certain common characteristics.

The new rail line from the main line junction to the potential repository at Yucca Mountain would be owned by DOE, and could be leased for maintenance and operation to a qualified, experienced private railroad contractor. The contract operator, who could be selected by competitive bid, could operate either as a common carrier (if there were other customers using the line in addition to DOE), or as a private carrier (if DOE were the only user). In either case, the contract operator would be required to meet Federal Railroad Administration standards for maintenance, operations, and safety—the same standards that would apply to all other carriers involved in the rail haulage of the radioactive waste.

The contract operator would employ and supervise the train and engine crews handling the cask cars from the main line junction to the potential repository. The contract operator would also be responsible for maintaining the track and structures, for train dispatching and control on the branch, and for ensuring that all rolling stock used in the consists of the trains from the branch line junction to the potential repository complies with Federal Railroad Administration mechanical safety standards and Association of American Railroads interchange standards during the time the rolling stock is on the Yucca Mountain branch.

The operating plan further assumes that all cars in the train consists are owned and maintained (either directly or under contract) by DOE. Locomotives for the trains could be supplied by the Class 1 (long-haul) carrier; alternatively, DOE could supply locomotives as well as cars. Finally, the contract operator could supply locomotives for the junction-point to Yucca Mountain haul. The line-haul carrier would set out the transportation cask cars at the junction point, and the branch contract operator would couple into the cars with its locomotives. For operating reasons discussed below, either of the first two alternatives is preferable to the third, though any of the three motive power scenarios is practical.

The operating plan, based on railroad expertise, assumes that each train from the branch line junction to the potential repository will consist of two 3,000-4,000 horsepower locomotive units and any necessary buffer freight cars. The plan deviates from the Key Assumption 001 transportation cask car numbers and assumes a range between one and ten cask cars, and an escort car, which would essentially be a railroad passenger car modified to incorporate living quarters and communication equipment for the escorts accompanying each shipment. (The current assumption used for planning is a maximum of three spent nuclear fuel cars and a maximum of five high-level waste cars (CRWMS M&O 1995c, Key Assumption 001). However, the number of cask cars is dependent on the delivery schedule and the use of a dedicated train or general freight service. Dedicated train service will result in fewer trains with more cask cars than general freight service. Maximum gross trailing train weights would probably not exceed 2,500 tons, and train lengths would not likely exceed 800 feet. The trains would therefore be small, compact consists by industry standards, with locomotive power ample to maintain normal freight train track speeds of 50 miles per hour, and excellent braking and train handling characteristics, even on heavy grades and around sharp curves.

Projections of tonnages destined to the potential repository over the project life suggest that train frequencies could vary from about one train each way every ten days at the low end (±1,000 net metric tons of uranium per year) to two trains each way per week under peak conditions (±3,000 net metric tons of uranium per year).

The physical criteria for the operations are designed to ensure a thoroughly safe, yet expeditious train operation. The other elements of the plan are designed to optimize equipment use and minimize operating costs. The operating plan at the potential repository end of the national system assumes that the entire rail operation, from loading at the utility or other shipping site, to unloading at the potential repository, to return of empty casks and cars for the next cycle of loading, is run on a planned schedule. Planning may be simplified if the individual cars are gathered into dedicated trains: the transcontinental trip times are predictable, and can be guaranteed by contract performance terms. If general freight service is used, predictability will be reduced, but costs may be lower.

One consequence of using a dedicated train service is that the Yucca Mountain end of the line should be able to unload one set of cars in the time interval between train arrivals. Therefore, the locomotives, buffer cars, and escort car arriving at the potential repository with one set of loaded cask cars would leave the loads, immediately pick up the empty casks and cars off the previous train, and return them to be reloaded. This ability to cycle the locomotives and support cars quickly at Yucca Mountain makes it possible to operate the main line locomotives through to the branch at the junction point, as described previously. Operation becomes very costly (in lost asset utilization) if the locomotives and support cars must await the release of the empty cask cars at Yucca Mountain, since any given set of equipment might then be detained three to five days. The ability to run the entire train through from the line-haul connection to the Yucca Mountain branch has other advantages as well. First, it saves time at the junction. Because the locomotives do not have to be changed, the trailing train consist spends less time at the junction location, with less impact on the immediate vicinity. Second, the mechanics of the carrier-to-carrier interchange are simplified. Different, and somewhat simpler, rules apply to such requirements as brake tests and mechanical inspections when an entire train is interchanged intact, without the brake pipe having been disturbed, or the engine consist changed.

At this time a decision has not been made for selection of an operating plan using dedicated train, general freight service, or a combination of the two.

These operating criteria apply generally, regardless of the specific routing chosen. The differences among routes are the varying distance of each alignment, the time required to travel from junction point to the potential repository, and the work schedule of the train and engine crews. These conditions will be discussed, as they apply to each route, in the subsections that follow.

To achieve reasonable run times without excessive track maintenance, run times indicated in the following subsections assume a maximum speed of 50 miles per hour for all routes. Although a requirement does not exist for train speeds at this preconceptual design state, engineering evaluation suggested a class 4 track, and from this 60 mile-per-hour limit for freight, determined that 50 miles per hour was a safe maximum speed to use for time estimates.

4.2 VALLEY MODIFIED ROUTE

The Valley Modified route would physically connect with the Union Pacific main line at a point between the Dike and Apex sidings; a location near Milepost 349 is most likely. Throughout the following discussion the connection point is referred to as Dike, although trains to the potential repository would actually leave the main line about two miles east of Dike.

Physical characteristics of the Valley Modified route that significantly impact operations are summarized as follows:

- Of the routes under consideration, the Valley Modified route is the shortest. Total distance from Dike to the potential repository is about 98 miles.

- Compared to the other three routes, the Valley Modified route has the straightest alignment and flattest profile. Few curves require restriction below 50 miles per hour. On the steepest grades of 1.5 percent, speed would be limited to about 25 miles per hour upgrade and restricted to 40 miles per hour downgrade, given the expected power to weight ratios and braking characteristics of train consists. Due to the high proportion of straight track, maintenance costs per mile will be somewhat lower than for other routes.

- Dike is in close proximity to Union Pacific's yards at Valley and Arden, at distances of 6 and 26 miles, respectively, permitting flexibility for interchange operations between the Union Pacific and the branch line.

Trains arriving at Dike would stop only to secure movement authority and change crews if a dedicated train is used or cask cars would be dropped off at an interchange yard if general freight service is used. Close proximity to North Las Vegas makes Dike suitable as a home terminal for Yucca Mountain crews; Union Pacific crews would terminate at Union Pacific's Arden yard, traveling to and from Dike by motor vehicle.

Based on the maximum expected train consist, the route's physical characteristics and the assumed maximum speed of 50 miles per hour, normal run times between Dike and the potential repository should be under 3 hours in each direction. A crew could operate a train from Dike to the potential repository and return within the "hours of service" 12-hour limit, as required by 49 CFR Part 228, Subpart B, allowing 2 hours or more at the potential repository for switching and make-up of the outbound train.

In the event that a return movement is not available when the crew has completed switching inbound cars at the potential repository, it may be practical to return the crew by motor vehicle to the home terminal at Dike, leaving the motive power idle at the potential repository until needed. The crew would be recalled when required and transported back to the potential repository to pick up the train. Depending upon the length of delay at the potential repository, this option may be less costly than requiring the crew to remain at the potential repository until a return movement is available.

4.3 JEAN ROUTE

Physical characteristics of the Jean route that significantly impact operations are summarized below. The variation in indicated distances reflects possible alternate routings via Wilson Pass and State Line Pass or North Pahrump and Stewart Valley. All references to Jean should be interpreted as either Jean or Borax depending upon selection between alternates Wilson Pass and State Line Pass.

Key physical characteristics are:

- The route is relatively short, 114 to 127 miles from the Union Pacific connection at either Jean or Borax to the potential repository.

- Mountainous territory over 30 to 40 miles of the route involves grades up to 2.2 percent and some relatively sharp curvature. Speed in these areas would be limited to 15 to 20 miles per hour upgrade and restricted to 25 miles per hour downgrade, given the expected power to weight ratios and braking characteristics of the train consist. Track maintenance costs will also be somewhat higher in these areas than on adjacent tangent trackage.

- Mostly tangent track with flat curves would comprise the balance of the route, permitting 50 mile-per-hour operation.

- Close proximity (21 to 26 miles) of Jean to Union Pacific's terminal at Arden (11 miles south of Las Vegas) may have a significant influence on interchange operations between the two railroads.

Jean's proximity to Goodsprings (7 miles) and Las Vegas (30 miles) make it acceptable as a home terminal for Yucca Mountain crews. Union Pacific crews would terminate at Union Pacific's terminal at Arden, traveling to and from Jean by motor vehicle.

Trains would stop at Jean only to secure movement authority and to change crews if dedicated train service is used, or cask cars would be dropped off at an interchange yard if general freight service is used. Alternatively, a trackage rights agreement could be established with Union Pacific between Jean and Arden, enabling a crew run-through at Jean. This arrangement would further enhance operating efficiency by eliminating the need to call a Union Pacific crew for the short run from Arden to Jean. The home terminal for Yucca Mountain crews would then be Arden.

Based on the maximum expected train consist, the route's physical characteristics, and the assumed maximum speed of 50 miles per hour, normal run times between Jean and the potential repository should be under 4 hours in each direction (4.5 hours if the crew changes at Arden). A crew could operate a train from Arden or Jean to the potential repository and return within the 12-hour legal limit, allowing 2 hours or more at the potential repository for switching and make-up of the outbound train. As described for the Valley Modified route, transporting the crew to the home terminal may be appropriate when a return movement is not immediately available at the potential repository.

4.4 CARLIN ROUTE

Physical characteristics of the Carlin route that significantly impact operations are summarized below. The variation in indicated distances reflects possible alternate routings via Monitor Valley and Big Smoky Valley.

- The route is relatively long, 331 to 363 miles from Beowawe to the potential repository.

- Mountainous territory over 50 to 65 miles of the route involves grades up to 2.4 percent. Some of these heavy grade areas also include relatively sharp curvature. Speed in these areas would be limited to 15 to 20 miles per hour upgrade and restricted to 25 miles per hour downgrade. Track maintenance costs will be somewhat higher in these areas than on adjacent tangent trackage.

- Mostly tangent track with flat curves would comprise the balance of the route, permitting 50 mile per hour operation.

- Connections would be made with both the Southern Pacific and Union Pacific at Beowawe. Interchange operations must comply with the unique operating nature of the Southern Pacific/Union Pacific paired track territory, which requires routing of westbound movements over the Southern Pacific track and eastbound movements over the Union Pacific track.

- Beowawe is fairly close to the Southern Pacific and Union Pacific yards at Carlin and Elko (25 miles and 50 miles, respectively). This proximity will provide flexibility for interchange operations, particularly in the case of movements to or from points in California.

Beowawe's proximity to Crescent Valley (10 miles) and Carlin (25 miles) makes it acceptable as a home terminal for Yucca Mountain crews. Southern Pacific and Union Pacific crews would terminate at their respective yards in Carlin and Elko, traveling to and from Beowawe by motor vehicle.

Trains would stop at Beowawe only to secure movement authority and to change crews if dedicated train service is used, or cask cars will be dropped off at an interchange yard if general freight service is used. Alternatively, a trackage rights agreement could be established with Southern Pacific and/or Union Pacific between Carlin and Beowawe. Crew change could take place at Carlin, eliminating the need for an Southern Pacific crew to be called for the short run from Carlin to Beowawe. The home terminal for Yucca Mountain crews would then be Carlin.

Based on the maximum expected train consist, the route's physical characteristics, and the assumed maximum speed of 50 miles per hour, normal run times between Beowawe and the potential repository should be under 9 hours in each direction (10 hours if the crew changes at Carlin). A crew could operate a train from Beowawe (or Carlin) to the potential repository (or return) within the 12-hour legal limit, allowing an hour or more at the potential repository for switching.

Crews would have a programmed layover at the potential repository before returning to the home terminal. Layover time must be at least 10 hours (12 hours if the prior trip required a full 12-hour work period): 8 hours minimum rest time plus 2 hours to call the crew and prepare for departure. Transporting crews between the potential repository and the home terminal is impractical due to the distance involved. The length of the Carlin route therefore introduces disadvantages in the form of layover costs and the necessity of carefully scheduling train movements to avoid extended layovers.

4.5 CALIENTE ROUTE

Physical characteristics of the Caliente route that significantly impact operations are summarized as follows:

- The route is relatively long, 338 miles from the Union Pacific connection at Caliente to the potential repository.
- Mountainous territory over approximately 80 miles of the route involves grades up to 2.4 percent. Some of these heavy grade areas also include relatively sharp curvature. Speed in these areas would be limited to 15 to 20 miles per hour upgrade and restricted to 25 miles per hour downgrade. Track maintenance costs will also be somewhat higher in these areas than on adjacent tangent trackage.
- Mostly tangent track with flat curves would comprise the balance of the route, permitting 50 miles per hour operation.
- The distance from Caliente to the nearest Union Pacific terminals at Milford and Las Vegas is over 115 miles, limiting interchange and crew run-through possibilities.

Caliente could serve as a residence and home terminal for train crews. Trains would stop at Caliente only to change crews and secure movement authority if dedicated train service is used, or cask cars will be dropped off at an interchange yard if general freight service is used. Due to the total distance from the potential repository to Milford (over 450 miles), a crew run-through from Milford to the potential repository is not practical.

Based on the maximum expected train consist, the route's physical characteristics, and the assumed maximum speed of 50 miles per hour, normal run times between Caliente and the potential repository should be under 10 hours in each direction. A crew could operate a train from Caliente to the potential repository (or return) within the 12-hour legal limit, allowing an hour or more at the potential repository for switching.

As with the Carlin route, crews would have a programmed layover at the potential repository before returning to their home terminal. Transporting crews between the potential repository and Caliente is impractical due to the distance involved. The length of the Caliente route therefore introduces disadvantages in the form of layover costs and the necessity of carefully scheduling train movements to avoid extended layovers.

5. RAIL AVAILABILITY FOR SECONDARY USES

This section evaluates possible secondary uses for a rail line to Yucca Mountain, specifically, using the line to transport materials for repository construction, using it to transport passengers to Yucca Mountain or the Nevada Test Site, and sharing the line with commercial interests and local organizations.

The conclusion of this evaluation is that construction of the rail line five to six years early to support repository construction is not economically beneficial because the annual maintenance cost of the railroad exceeds the costs savings of rail transport over truck transport.

5.1 RAIL AVAILABILITY FOR POTENTIAL REPOSITORY CONSTRUCTION

A railroad may provide more efficient transport of repository construction materials than trucks. The following discussion identifies the preliminary repository construction material quantities (major bulk materials), and estimates the cost differential of using rail to transport them.

Early construction of the rail line affects only those construction activities scheduled to be performed prior to 2010. After 2010, the rail line is scheduled to be operating for waste transport, and would be available in any case. Therefore, the construction performed after 2010 will not benefit from early rail construction. A conservative estimate places 50 percent of the subsurface materials at the site by 2010. Fifty percent of the construction quantities will be considered for early rail transport to the potential repository area.

5.1.1 Quantities

5.1.1.1 Subsurface Potential Repository Construction Quantities

The major bulk materials required for subsurface potential repository construction include concrete, steel, and conductor. Table 5-1 shows preliminary quantity estimates for subsurface construction.

Table 5-1. Subsurface Potential Repository Construction Quantities

Material	Total Quantity	50% of Total Quantity
Cement	239,000 cubic yards (484,000 tons)	119,500 cubic yards (242,000 tons)
Steel	60,000 tons	30,000 tons
Conductor	2,400 tons	1,200 tons

Even though the concrete will be batched on-site, the cement, steel, and conductor material must be transported to the site. This evaluation will assume that the entire quantity would require rail/truck transport. Based on a truck transport capacity of 22 tons per truck (for legal weight trucks), the number of trucks required to transport the 50 percent quantity estimates are shown in Table 5-2.

Table 5-2. Subsurface Potential Repository Construction Truck Loads

Material	Truck Loads
Cement	11,000
Steel	1,364
Conductor	55
Total	12,419

5.1.1.2 Surface Potential Repository Construction Quantities

The major bulk materials required for surface potential repository construction include concrete, steel, permanent equipment, electrical, piping/mechanical, asphalt, and architectural material for building construction. Preliminary quantity estimates are shown in Table 5-3.

Table 5-3. Surface Potential Repository Construction Quantities (Major Bulk Materials)

Material	Total Quantity
Cement	100,000 cubic yards (202,500 tons)
Steel/Metal Products	30,000 tons
Permanent Equipment	6,000 tons
Electrical	1,000 tons
Mechanical	1,000 tons

The surface potential repository construction will be complete prior to 2010, so early rail construction supports 100 percent transport of those construction materials.

Based on a truck transport capacity of 22 tons per truck (for legal weight trucks), the number of trucks required to transport the quantity estimates are shown in Table 5-4.

Table 5-4. Surface Potential Repository Construction Truck Loads (Major Bulk Materials)

Material	Truck Loads
Cement	9,205
Steel/Metal Products	1,364
Permanent equipment	273
Electrical	45
Mechanical	45
Total	10,932

5.1.1.3 Heavy Equipment And Fuel Construction Quantities

Heavy equipment will not be transportable by legal weight truck; overweight or heavy haul transport will be required. For this evaluation, 20 pieces of large heavy equipment and 20 pieces of small heavy equipment will be assumed for potential repository construction (surface and subsurface).

Assume one fuel truck shipment per day for six years: 1,560 fuel shipments over the construction period.

5.1.1.4 Miscellaneous Shipments

For this evaluation, assume that miscellaneous equipment, material, supplies, tools, etc. will be transported from Las Vegas, and will be approximately 100 tons per week (10 truck shipments).

5.1.2 Transport Costs

5.1.2.1 Trucking Costs

The truck transport costs shown in Table 5-5 have been estimated for the construction materials listed in this section. The costs to transport equipment were estimated in dollars per mile for 22-ton legal weight loads and for overweight loads. Total one way distance alternatives of 500 miles and 1,000 miles were assumed (to identify the sensitivity of transport distance).

5.1.2.2 Rail Costs

Rail transport costs include both the transport costs from the supplier to the branch line interchange point, and the operating and maintenance costs for the branch line. Because the sole reason for constructing the rail line early is to provide support for potential repository construction, the full cost of operating and maintaining the branch line is directly chargeable to the construction work. If the branch line is not completed until 2010, the operating and maintenance costs would not be expended for the 2004-2010 time period.

Table 5-5. Truck Transport Costs

Commodity	Cost ($/Mile)	500-Mile Total Cost[1]	1,000-Mile Total Cost[2]
Subsurface Materials			
Cement	$1.25	$6,875,000	$13,750,000
Steel	1.50	1,023,000	2,046,000
Conductor	1.50	41,250	82,500
Surface Materials			
Cement	$1.25	$5,750,000	$11,500,000
Steel/Metal Products	1.50	1,020,000	2,040,000
Permanent Equipment	3.50	477,750	955,500
Electrical	1.50	33,750	67,500
Mechanical	3.50	78,750	157,500
Construction Equipment and Fuel			
Construction Equipment, Large	$10.00	$100,000	$200,000
Construction Equipment, Small	3.50	35,000	70,000
Fuel	$250/trip[3]	390,000	390,000
Miscellaneous Shipments			
Material, Tools, Equipment, Supplies at 2 Shipments/Day	$ 250/trip[3]	$780,000	$780,000
Total		$16,604,500	$32,039,000

1 Based on quantities discussed, 22-ton load limits, and 500-mile one-way transport.
2 Based on quantities discussed, 22-ton load limits, and 1,000-mile one-way transport.
3 Fuel and miscellaneous shipments assumed to originate in Las Vegas. Shipments would not be 44,000-pound loads; local delivery rates would apply.

The cost of rail transport from the supplier to the branch line interchange point excluding operating and maintenance costs is estimated in Table 5-6.

The remainder of the cost for rail transport will be operation and maintenance costs for the branch line over the construction period (2004-2010). These costs were estimated by DeLeuw Cather for the Caliente route (SAIC 1992), and were ratioed to the other route alternatives. The highest operating and maintenance costs belong to the longest alternative rail route, currently the Caliente route, and these costs were used for this evaluation. DeLeuw Cather estimated the annual operating and maintenance cost would be $3,300,000 per year in 1990 dollars (SAIC 1992). If those costs are escalated to 1994 dollars (1.126 ratio based on a two-year period at three percent annual inflation), the annual costs would be $3,720,000 per year. Spread over six years' operating time (2004-2010), the total cost for transporting construction materials would be $20,150,000 (escalated at 5.417).

Table 5-6. Rail Transport Costs

Commodity	Cost ($/Ton/Mile)	500-Mile Total Cost[1]	1,000-Mile Total Cost[2]
Subsurface Materials			
Cement	$0.034	$4,114,000	$8,228,000
Steel	0.031	465,000	930,000
Conductor	0.031	18,600	37,200
Surface Materials			
Cement	$0.031	$3,138,750	$6,277,500
Steel/Metal Products	0.031	465,000	930,000
Permanent Equipment	0.110	330,000	660,000
Electrical	0.031	15,500	31,000
Mechanical	0.031	15,500	31,000
Construction Equipment and Fuel			
Construction Equip. Large	$0.110	$110,000	$220,000
Construction Equip. Small	0.110	22,000	44,000
Fuel	Local Shipment	N/A	N/A
Miscellaneous Shipments			
Material, Tools, Equipment, Supplies at 1 Shipment/Day	Local Shipment	N/A	N/A
Total		$8,694,350	$17,388,700

1 Based on quantities discussed and 500-mile one-way transport.
2 Based on quantities discussed and 1,000-mile one-way transport.

With operating and maintenance costs added to the cost of transporting material to the Caliente route interchange point, the total estimated transportation costs are $30,594,350 for 500-mile rail transport and $39,288,700 for 1,000-mile rail transport.

The findings indicate the differences in transport costs between rail and truck are minor, given the estimating uncertainties. Truck transport costs are lower for both haul distances.

5.2 RAIL AVAILABILITY FOR PASSENGER USE

The only reasonable option for passenger use of a constructed rail line to the site would be construction of a line from the Las Vegas area to allow people working at the Nevada Test Site and the potential repository to commute to work on the train, and eliminate or greatly reduce the current bus system. The number of bus passengers in March 1994 was approximately 1,860 per day (357,000 per year) as reported in a white paper concerning potential high speed rail service to the Nevada Test Site that was developed by Raytheon Services Nevada (1994). The white paper reported that there were 62 active buses serving 11 stations in 1994, and that the total cost for the commuter bus service at that time was approximately $32,000 per day. Repository workers during the construction and operations periods are not expected to exceed 1,000 people per day, based on current Total System Life Cycle Costs (CRWMS M&O 1995d).

The utility of the Valley Modified route is limited by its geographical location: it connects with the Union Pacific main line in the Dike or Apex siding area, well to the northeast of Las Vegas, and follows a westerly alignment, passing south of the Nevada Test Site on the way to Yucca Mountain. Therefore, the Valley Modified route does not serve Las Vegas directly (where the passengers would originate), nor does it reach Area 6 within the Nevada Test Site (the major destination for the Nevada Test Site-bound passengers, with the exception of the Mercury passengers, where the route is very close.

A rail passenger service using the Valley Modified route would require one of two modifications. The line could "backtrack" along the Union Pacific from downtown Las Vegas to the branch junction at Dike or Apex prior to proceeding west toward the Nevada Test Site. This circuitous route would make the rail trip longer than the current bus service. Or, a 10-15 mile passenger-only connecting line between Las Vegas and a point on the Yucca Mountain branch about 15 miles west of Apex or Dike could be constructed. This extension, roughly parallel to U.S. Route 95, would cost $40-50 million and would have to be routed through high land-use conflict areas in the northwestern part of the city. The cost for future operation and maintenance of this extension would be allocable exclusively to the Nevada Test Site/Yucca Mountain passenger service.

Even if the Las Vegas access problem could be solved economically, the passenger rail service would face problems achieving direct access to the desirable destination sites within the Nevada Test Site. Here there would also be two options. Another dedicated rail spur north of the alignment of the Yucca Mountain branch could be constructed to serve Area 6 - Control Point. This extension could cost an additional $100 million, and its operation and maintenance cost would also be totally allocated to the Nevada Test Site passenger service. Passengers could be transported by bus from a rail transfer point on the Yucca Mountain branch south of Nevada Test Site to transfer points within the site.

Clearly, use of bus transfers to the rail heads is cheaper than construction of new passenger-only rail lines. However, introducing one or more bus-train transfers into the trip will severely degrade the trip time and transportation service quality compared with the current all-bus service. For example, the rail service would be able to serve no more than one or two originating stations in the Las Vegas area, whereas the bus service can now gather passengers in individual neighborhoods. Experience with transit systems generally suggests that multiple transfers (e.g., bus to rail, then train, then rail back to bus) provoke resistance from passengers, who perceive the service to be inconvenient, even if trip times are not lengthened by the multiple transfers. In this case, times would be longer once bus-rail transfers are included, so service levels with rail would probably be lower.

Finally, the large capital costs involved in the passenger rail line extensions are not economic considering the limited ridership. At best, this system could attract some percentage of the 1,800 riders a day currently using the bus service. But the minimum number of passengers necessary to support the required investment in track and rolling stock is likely to be 5,000 to 8,000 passengers per day, based on experience with start-up commuter rail operations in southern California (e.g., Southern California Railroad Authority and North San Diego County). That kind of market potential does not appear to exist here, especially since the existing bus service is of high quality and operates in a relatively uncongested highway environment. A bus system is much more flexible than a rail system for commuters when accessing a large site such as the Nevada Test Site. The conclusion is that, even with rail service from Las Vegas to the Nevada Test Site, the DOE will probably have to provide bus service on either end of the rail line to provide a system that is only as convenient as the current bus system. Therefore, efficient passenger rail service to the Nevada Test Site and Yucca Mountain is not practical, considering the convenience of the existing bus system and the added cost for rail service.

5.3 SHARED USE OF THE RAIL LINE FOR NON-DOE USE

The rail line will be routed and designed based solely on the requirements for transporting spent nuclear fuel and high-level waste. However, once the rail line construction is complete, the DOE could allow commercial interests and local organizations access to the rail line. The DOE has gone on record in a letter from John W. Bartlett to Keith Whipple, Chairman, County Commission, Lincoln County, stating, "Historically, U.S. Department of Energy has supported shared-use of its rail spurs at other facilities. I would anticipate that this position would continue. If the Yucca Mountain Site is found suitable for a repository and a rail spur is constructed along a route that offers shared-use opportunities, I would strongly support the use of that rail spur for commercial purposes, provided that the required environmental review under National Environmental Policy Act results in a favorable decision for shared-use" (DOE 1991).

From an engineering and operating point of view, there would be no restrictions inhibiting use of any alignment by ordinary freight or even passenger trains. Substantial excess capacity will exist under all conditions, and would be available for other users if commercial justification for such service existed.

From an institutional point of view, the DOE contract operator would be fully capable of negotiating and managing the commercial and transportation services required by other users. This is normal industry practice where short line rail operators conduct rail operations under contract. Because the rail line route will be established based on potential repository support criteria, additional spurs or intermodal transfer facilities would have to be constructed by private or local users to obtain access to the branch line, but this is also normal industry practice.

6. HEAVY HAUL ANALYSIS

An in-depth analysis has been performed to verify the feasibility of heavy haul truck transport, define the transporter configuration, estimate costs of heavy haul transport operations over both existing roads and new roads, and estimate the costs of upgrade and maintenance of roads. The state restrictions and permitting requirements have also been researched in greater detail than was done in Study 1 (CRWMS M&O 1995b). A criterion included in Study 1 for heavy haul truck transport stated that only existing state routes would be considered for use. In Study 2, the feasibility of constructing new heavy haul roads to the site, or using a combination of existing state routes and newly constructed haul roads have been examined.

6.1 HEAVY HAUL ROUTE ANALYSIS

Study 1 identified three heavy haul routes over existing roads that were determined to be reasonable alternatives, although each route had significant limitations. These roads were selected based on minimizing transport length from an existing main line rail interchange point, using roads considered by the Nevada Department of Transportation for transport of controlled quantities of radioactive materials within the State of Nevada, and using roads identified by the Nevada Department of Transportation for the highest allowable axle load limits (as documented in Study 1). The routes are shown in Figure 6 of Volume II.

Positive and negative attributes for each route are discussed in the following paragraphs. Attributes identified are the same as those identified in Study 1. General attributes of all heavy haul routes versus rail transport:

Positive Heavy Haul Attributes - The initial lower cost of establishing a heavy haul route over establishing a rail route is significant in that no construction of new roads is required. Only transporter equipment and intermodal transfer facilities are needed to start operations.

Negative Heavy Haul Attributes - Heavy haul would not be effective for transporting repository construction material, and would not provide any shared use capabilities to commercial and government interests in the state. Heavy haul transport requires an intermodal transfer at the main line rail, increasing the requirements for safety and security systems. Because heavy haul trucks will operate on public roads, safety and security are more of a concern than with a limited access rail line. Public perception of heavy haul trucks transporting radioactive shipments over public roads and through cities and towns would be significantly more negative than rail, which would be separated from areas frequented by the public.

6.1.1 Caliente Route

Positive Attributes - The route does not include travel in the Las Vegas area (as do other two routes). The route travels through more remote areas of the state, resulting in less delay than would be expected on higher volume roads. There are no bridges on this route. The heavy haul route from Caliente has been supported by Lincoln County and the City of Caliente.

Negative Attributes - The route includes a significant distance of roadway that is within the Nevada Department of Transportation's frost restricted road category. All of the applicable portions of State Route 375 and U.S. Route 6 and the northern portion of U.S. Route 95 restrict travel or heavy haul trucks from February to April. This restriction may require a two-step process: an agreement with Nevada Department of Transportation to mitigate impacts, followed by a request for a permit from the Nevada Department of Transportation for use of the roads during the frost restriction period. The route requires two areas of road gradient exceeding 5 percent to be negotiated; one in the Caliente area, and one in the Hancock Summit area. Negotiation of those gradients does not cause significant problems for the transporter equipment, but does require slower speeds, increasing the possibility of delaying other road traffic. The transporter must travel through the city of Tonopah to access U.S. Route 95 and through Goldfield on Route 95.

The route option from the Elgin area has been eliminated from further study due to significant restrictions including tight curves, steep grades, low bridges, road upgrades and frost restrictions.

6.1.2 Arden Route

Positive Attributes - The Arden route is shorter than the Caliente route. It provides a fairly direct route to the potential repository without having to travel directly through high traffic areas of Las Vegas.

Negative Attributes - The average travel speed will be low due to steep gradients. State Route 160 is also currently restricted for wide loads (no loads over 8 feet 6 inches allowed) and Nevada Department of Transportation mandated legal weight axle load limits. Although the road is currently being upgraded, verification is required to see if this restriction is still in effect. Because the road is two-lane, the possibility of traffic delays due to the transporter operation is a concern. In addition, the transporter must travel directly through Pahrump. The intermodal transfer facility at Arden is in close proximity to current and planned areas of development for Las Vegas. The Union Pacific currently has an intermodal transfer yard at Arden; however, Arden would not be a practical location for intermodal transfer of spent nuclear fuel and high-level waste.

6.1.3 Apex Route

Positive Attributes - The Apex route is the shortest route of the three alternatives. The Interstate 15 and U.S. Route 95 sections of the route are multi-lane, which minimizes potential delays to normal traffic. The route has no steep gradients or tight corners to negotiate, allowing the transporter to operate at higher average speeds. There are no frost or wide load restrictions on either Interstate 15 or U.S. Route 95. Interstate 15 and U.S. Route 95 were designed to handle higher traffic levels, which will lower the potential for significant road damage from heavy haul trucks (because of much higher traffic levels, the ratio of heavy haul truck loads to current traffic loads is lower than it is for the other two routes).

Negative Attributes - The route requires the transporter to travel through the area of Las Vegas with one of the highest traffic congestion problems in the city, where Interstate 15 intersects U.S. Route 95. It is feasible to build a bypass around the north side of North Las Vegas, within the corridor shown for the Valley Modified rail route and intersecting with U.S. Route 95 at Corn Creek Springs road, but the initial cost of operation and the schedule constraints imposed on the project due to new construction make a rail line construction more reasonable than a new haul road construction. Heavy haul trucks operating in Las Vegas will have to travel over structures that will require structural analysis for the increased loading. The land around the Apex siding is currently being proposed for sale to a private developer by Clark County. Private development of that area may restrict access to a reasonable intermodal transfer site, and would require that the intermodal transfer facility be moved south on the Union Pacific main line, closer to Las Vegas. The potential Apex intermodal transfer facility site is not as close to dense population areas as the potential Arden site, but is closer than the potential Caliente site.

6.1.4 Development of New Roads

In addition to the existing road routes identified in Study 1 for heavy haul truck transport, it has also been determined that it is feasible to construct new roads for heavy haul truck travel. The criteria for selecting a heavy haul route from an existing rail main line to the site is the same as the criteria used to develop the rail line alternatives. The design criteria for constructing a heavy haul route will be different than for rail in that heavy haul trucks can negotiate steeper grades and tighter corners; however, the heavy haul road route would still be within the rail corridors established, due to land use conflict limitations. Therefore, the heavy haul route for a new road would be the same as a rail corridor route identified in this study.

An added alternative for the heavy haul routes within the identified corridors would use portions of the existing road system usable for part of the route length. For example, if the Valley Modified route were selected for heavy haul road construction, a portion of U.S. Route 95 may be usable from the Corn Creek Springs area to Mercury. Additional lane construction may be required; this would be decided based on input from the Nevada Department of Transportation.

6.2 NEVADA DEPARTMENT OF TRANSPORTATION INPUT

Limited Nevada Department of Transportation input has been obtained to date. No formal position has yet been established by the Nevada Department of Transportation concerning heavy haul shipments of spent nuclear fuel and high-level waste and the approach that would be taken for highway maintenance.

It has not yet been established with the Nevada Department of Transportation if annual permits would be issued for the heavy haul truck transporters, or if each shipment would require a separate permit. Currently, the code is written to require a separate permit for heavy haul transport, unless the Nevada Department of Transportation determines a multiple shipment permit is warranted.

In addition to the heavy haul permits, separate permits for shipment of radioactive materials are required, and negotiations with Nevada Department of Transportation on issuance of both permits will be necessary.

Early Study 2 requests for information on the current Nevada Department of Transportation protocols for permit issuance, specific road limitations, bonding requirements, road conditions and traffic levels, and annual maintenance and repair costs have not been resolved.

6.3 HEAVY HAUL TRUCKING COMPANY INPUT

The following information was obtained from various heavy haul trucking companies via telephone conversations, meetings, and literature search.

An industry standard heavy haul truck trailer can be configured for up to 19 axles to reduce the weight per axle, but the truck weight itself, without a load, will be over the 80,000-pound overweight category. This will place the rig itself in the heavy haul category.

As one trailer option, a 13-axle trailer, called a "California 13 or West Coast 13," would be sufficient to haul the 125-ton multi-purpose canisters over Nevada roads in non-frost restricted seasons. The California 13 trailer uses tandem axle sets with 8 tires per axle, as opposed to a 13-axle tri-axle configuration with four tires per axle. In some states (Nevada included) the California 13 configuration is allowed to carry more weight, while in other states the tri-axle configuration is allowed to carry more weight. A 13-axle trailer comparison with a standard overlength semi-tractor trailer configuration is shown in Figure 6-1.

If the Nevada Department of Transportation requests the axle weight of the trailer be reduced from the 13-axle configuration, a 17-axle configuration would be the next configuration to consider. This trailer uses tandem axles at 8 tires per axle, with a 10-foot axle length. The 13-axle rig weighs approximately 110,000 pounds and the 17-axle rig weighs approximately 250,000 pounds. The increase in the number of axles significantly increases the rig weight.

The jeeps, dollies and support sections for the trailer configurations described above can be combined to configure the trailer for almost any type of load. This portion of the trailer that would be custom built for the Yucca Mountain Site Characterization Project transport is the double goose-neck structure. The double goose-neck would be designed and built with a 25-foot platform rather than the more standard 40-foot platform. Trailer manufacturers indicated that one year should be allowed for design and manufacture of the trailer. Heavy haul trucking companies indicated that a custom trailer would most likely have to be built because a spent fuel shipping cask would be a more concentrated load.

The tractors used are usually custom built to meet the specifications required for the trailer and load. The tractors are grouped with a specific trailer and load limit. For a 125-ton load, a push tractor would be appropriate for the total length of the haul.

The 75-ton multi-purpose canisters may require only a 9-axle trailer, which can transport up to 160,000 pound loads. If the haul sequencing included both 125-ton and 75-ton multi-purpose canisters interspersed in the delivery schedule, it may be cost effective to have two trailer configurations, one for each load type. This would eliminate the need to adjust or change out the cradles on the platform, and would reduce capital and operating costs.

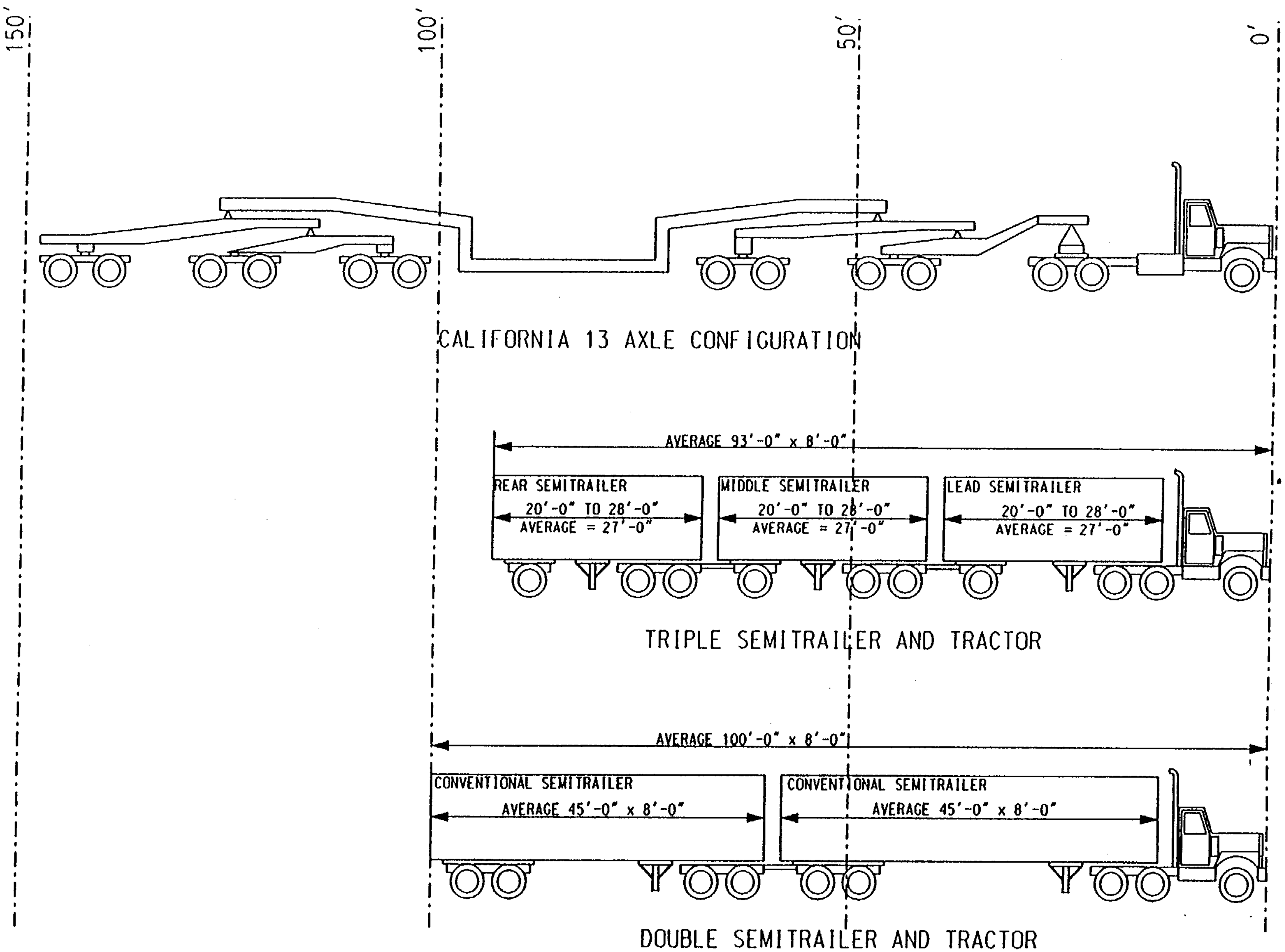

Figure 6-1. 13-Axle Tractor-Trailer Comparison to Standard Semi-Tractor Trailer

With the high-level waste transportation cask at approximately 115 tons, consideration of weight and size differences must be given to trailer flexibility with the multi-purpose canister sizes and weights. A cost benefit analysis may be required to help make this determination.

The most expedient way to set up the Request for Proposal for contracting the heavy haul operations and maintenance may be to identify the configuration and weight of the load, the cradle support points, the number, sequence, and frequency of the loads to be transported, and the route to be used, and let the transporting contractors specify the type of trailer and tractor to use. The transporting contractors will identify road upgrade requirements, contact the Nevada Department of Transportation and agree on a transporter configuration, and conceptually design the trailer. The contractor would complete the preliminary trailer design, and contract with a trailer manufacturer to complete the design and manufacture the trailers. The contractor may also contract with a tractor manufacturer for a custom tractor, if necessary. The trailer manufacturer would design the trailer to conform to Federal trailer requirements, obtain trailer certifications, and get agency approval for the design. When that approval was obtained the trailers would be manufactured. Certification of trailers and post-manufacture load testing may be performed in accordance with ANSI N14.30 (1992).

A trailer can be rebuilt about every 5 to 7 years to be usable for up to 30 years. However, if ANSI N14.30 is used as a trailer requirement, it only allows a trailer carrying radioactive materials to be certified for a maximum of 10 years or 1,000,000 miles, whichever comes first.

The maximum highway speed for the 13/17-axle trailer is about 40 to 45 miles per hour. Average trip speeds would probably be about 30 to 35 miles per hour. Three trailers may be sufficient for single cask daily transports, if unloading of the canisters at the site was done on a second shift the same day as the transporter arrived.

A transporter crew would consist of a driver, a push tractor driver, two escorts (two vehicles), and a trailer operator. The trailer would be equipped with a cab for the operator. The jeeps would be locked into place for the majority of the trip, and released only in tight areas.

The Department of Transportation district establishes routing of heavy haul shipments dependent on point of origin and destination.

Trucking companies state that the 13-axle and 17-axle trailers identified are fully steerable on the front and back jeeps. The steering mechanisms can be locked to follow the tractor, or released to allow the trailer to make up to 90 degree turns. The steerable trailer can negotiate 90 degree corners, if there are no obstructions at corners.

6.4 INPUT ON ROAD MAINTENANCE, UPGRADE, AND CONSTRUCTION COSTS

Input on road repair, upgrade, and construction costs were obtained from Las Vegas Paving, a local paving company, which performs significant amounts of work for the Nevada Department of Transportation. The primary unit costs pertaining to the heavy haul transport evaluation are

- 2-inch asphalt overlay — $0.52/square foot
- Road Rehabilitation — pulverize asphalt, mix pulverized material with base, place new asphalt surface layer - $140,000 per mile for 24-foot wide road
- Surface Gravel/Dirt Road — 9-inch gravel base with 4-inch asphalt surface layer - $160,000 per mile for 24-foot wide road.

Reliable unit costs for new road construction cannot be identified due to great variability in earthwork costs.

Road maintenance costs were obtained from Reynolds Electrical and Engineering Company, Inc., which maintains approximately 120 miles of paved road on the Nevada Test Site. According to the company, the annual road maintenance budget is $3,000,000, and supports 4 road crews (resulting in a unit cost of $25,000 per mile). A similar maintenance unit cost has been assumed for this study.

Based on the following, new heavy haul road costs within the identified rail corridors would be the same as the rail costs, due to similar pre-design activities earthwork requirements, and basically similar road/railbed cross-sections, with two exceptions:

- The cost of the rail and ties, which is approximately 28 to 36 percent of the total direct construction costs, would be deleted from the road costs.
- Road surfacing costs, at $160,000/mile, would be added to the road costs.

Assuming the base rail unit cost of $1,200,000 for flat terrain, 28 to 36 percent of that cost is $336,000 to $432,000/mile. Adding $160,000/mile for road surfacing indicates that new road construction in flat terrain is about $176,000 to $272,000 less expensive than rail construction in flat terrain, or about 17 to 22 percent less expensive. Therefore, it would be safer (no additional fuel transfer) and more efficient to ship to the destination by rail.

6.5 OPERATIONS PLANS/HEAVY HAUL TRUCK ROUTES

6.5.1 Apex Route Interstate 15 - U.S. Route 95 - Jackass Flats Road

The Apex route is 104 miles to the potential repository. The transporter would be loaded with the waste transportation cask at an intermodal facility at the Apex siding area, and travel to the on-ramp to Interstate 15. The transporter would stay on Interstate 15 for approximately 18 miles to the U.S. Route 95 off-ramp, and travel on U.S. Route 95 for approximately 58 miles to the Mercury exit. The transporter would then travel on the Jackass Flats Road on the Nevada Test Site for approximately 28 miles to the potential repository site. The distance of 104 miles would require a travel time of approximately 3 hours at an average speed of 35 miles per hour. Because the Interstate 15 and U.S. Route 95 portions of the route traveled are separated multi-lane roads, the impact to normal traffic would be minimal.

6.5.2 Caliente Route U.S. Route 93 - State Route 375 - U.S. Route 6 - U.S. Route 95 - Lathrop Wells Road

The Caliente route is 321 miles to the potential repository. The transporter would be loaded with the waste transportation cask at an intermodal transfer facility in the Caliente area, and travel directly from the facility to U.S. Route 93. The transporter would travel on U.S. Route 93 for approximately 42 miles to State Route 375. The transporter would travel on State Route 375 for approximately 96 miles to the intersection with U.S. Route 6. U.S. Route 6 would be used to travel to the intersection with U.S. Route 95 in Tonopah; a distance of 48 miles. The transporter would then travel on U.S. Route 95 for approximately 120 miles to the Lathrop Wells road, which would be used for access to the potential repository site; a distance of approximately 15 miles. The total distance of 321 miles would require a travel time of approximately 10 hours at an average speed of 35 miles per hour. Travel speeds would be reduced in the following areas: the upgradient from Caliente, the upgradient and downgradient at Hancock Summit, and the travel through the Tonopah, Goldfield, and Beatty areas. Because all roads along this route are two-lane roads, the transporter operation may cause delays for other traffic.

6.5.3 Arden Route State Route 160 - U.S. Route 95 - Lathrop Wells Road

The Arden route is 111 miles to the potential repository site. The transporter would be loaded with the waste transportation cask at an intermodal transfer facility in the Arden area adjacent to the Union Pacific main line. The transporter would then travel on State Route 160 for approximately 77 miles over the Spring Mountains, through the city of Pahrump to the intersection with U.S. Route 95. The transporter would then travel on U.S. Route 95 for approximately 19 miles to the Lathrop Wells road, which would be used for access to the potential repository site; a distance of approximately 15 miles. The distance of 111 miles would require a travel time of approximately 4 to 5 hours at an average speed of 25 to 30 miles per hour. Travel speeds would be reduced in the following areas: the upgradient and downgradient over the Spring Mountains, travel trough the Pahrump area, and the downgradient to Amargosa Valley. Because of the numerous areas of this route requiring speed reduction, the average rate of travel is lower than for the other routes. The total length of the route to be traveled is two-lane road; transporter operation may delay other traffic along this route.

6.6 ANALYSIS OF ADDITIONAL ROAD WEAR DUE TO HEAVY HAUL

A detailed analysis of road wear/damage, based on the current plan for heavy haul, must be performed to provide final estimates for reduction of road life. The Nevada Department of Transportation is the only source for data on existing road conditions required to perform this analysis; therefore, the department must be consulted during the process of selecting routes and the vehicle configuration.

6.7 HEAVY HAUL COSTS

The heavy haul estimated costs are shown in Table 6-1. Cost backup (in FY 1995 dollars) is included in Appendix E.

In Study 1, key factors in the estimate ($171 to $173 million) were contract hauling at $15,000 per trip multiplied by the number of trips. This rate was based on the longest route considered. The Study 1 estimate also included $2.6 million for an intermodal transfer facility and no costs for highway maintenance dollars (CRWMS M&O 1995b).

In Study 2, the estimate includes the cost of capital equipment and operations and maintenance. Based on preliminary analysis, estimated pavement wear would increase by 10 percent. Because pavement wear would be a major cost driver of the heavy haul truck option, if pavement wear is higher than 10 percent, costs for heavy haul would be more expensive than shown in Table 6-1.

Table 6-1 shows route mileage, capital, operating and maintenance costs, and the total costs in FY 1994 dollars.

Table 6-1. Heavy Haul Cost Summary

Route		Costs ($ Million)		Total Cost (in FY 1994 $ Million)[1]
Heavy Haul Routes	**Length (miles)**	**Capital**	**O&M**	
Caliente	321	$38.31	$140.29	$178.60
Arden	111	$27.33	$113.16	$140.49
Apex	104	$26.97	$112.25	$139.22

[1]To convert 1994 dollars to 1995 dollars, multiply by 1.038.

7. FUTURE PLANNING AND POPULATION ESTIMATES

In the course of this preliminary analysis of the potential effects of the potential rail corridors on the population, various stakeholders including county officials, consultants, industry executives and state and federal agencies were contacted to determine their current plans for development along four potential rail corridors, and to review population rates, estimates, and forecasts along the corridors.

7.1 POPULATION

Among the counties evaluated (Clark, Elko, Esmeralda, Eureka, Lander, Lincoln, and Nye), no potential significant population issues relative to the potential rail corridors were identified in any of the counties studied, with the possible exceptions of the city of North Las Vegas in Clark County and the town of Pahrump in Nye County.

In Table 7-1 U.S. Census population figures with population projections from the State of Nevada, Office of the State Demographer have been used to illustrate the recent historical population scenario within the affected counties, using the mid-range forecasts for those counties (DOC 1981; DOC 1992; Nevada 1995). In Table 7-2 a percentage was calculated to determine the rate of projected growth for each county potentially affected by the potential rail corridor system.

7.2 JEAN ROUTE

Affected counties: western Clark, southern Nye

Nye County realized a population growth of 96.5 percent, increasing from 9,048 in 1980 to 17,781 in 1990 (DOC 1981; DOC 1992). It is projected that between 1990 and 2015, Nye County will increase to a population of 61,731 (Nevada 1995). A large percentage of the projected population will reside in Pahrump, Nevada, which could approach a population of 50,000. This large increase in population could become an issue relative to the Jean route.

The following conditions were additionally identified as being affected. If the Jean route were placed east of Pahrump, the rail corridor would

- Cut across the alluvial fan at the foot of the Spring Mountains, which provides water recharge for the entire Pahrump Valley

- Be near State Route 160 which is anticipated to be designated a scenic highway

- Interrupt the coveted "scenic rural vista" east toward the mountains, which is a quality-of-life issue with Pahrump residents.

Table 7-1. Population Estimates and Forecasts for Selected Counties in Nevada, 1980-2015

County	Census Estimates		Population Projections for Counties in Nevada[1]				
	1980[2]	1990[3]	1995	2000	2005	2010	2015
Clark	463,087	741,459	1,000,286	1,230,964	1,487,139	1,793,245	2,197,074
Elko	17,269	33,350	43,514	51,286	58,152	65,090	73,456
Esmeralda	777	1,344	1,432	1,360	1,291	1,261	1,278
Eureka	1,198	1,547	1,594	1,872	2,102	2,385	2,803
Lander	4,076	6,266	6,396	7,119	7,367	7,839	8,485
Lincoln	3,732	3,775	4,452	4,205	3,886	4,176	4,164
Nye	9,048	17,781	21,725	30,596	40,210	48,483	61,731

1 State of Nevada, Bureau of Business and Economic Research, University of Nevada, Reno, Nevada, Population Projections and Forecasts 1995-2015 and Review of Methods, February 1995 (Nevada 1995)
2 U. S. Department of Commerce, Bureau of the Census, 1980 Census of Population and Housing (DOC 1981)
3 U. S. Department of Commerce, Bureau of the Census, 1990 Census of Population and Housing (DOC 1992)

Table 7-2. Percent Increase of the Population Estimates and Forecasts for Selected Counties in Nevada, 1980-2015

County	Increase of the Population Estimates and Forecasts (in Percentages)						
	1980-1990	5 Year Avg.	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015
Clark	60.1	30.1	34.9	23.1	20.8	20.6	22.5
Elko	94.2	47.1	29.8	17.9	13.4	11.9	12.9
Esmeralda	73.0	36.5	6.5	-5.0	-5.1	-2.3	1.3
Eureka	29.1	14.6	3.0	17.4	12.3	13.5	17.5
Lander	53.7	26.9	2.1	11.3	3.5	6.4	8.2
Lincoln	1.2	0.6	17.9	-5.5	-7.6	7.5	-0.3
Nye	96.5	48.3	22.2	40.8	31.4	20.6	27.3

7.3 VALLEY MODIFIED ROUTE

Affected counties: northern Clark, southeastern Nye

Clark County realized a population growth of 60.1 percent, increasing from 463,087 in 1980 to 741,459 in 1990 (DOC 1981; DOC 1992). The 1990 census reported 47,707 residents in the City of North Las Vegas (DOC 1993). It is projected that between 1990 and 2015, Clark County will increase to a population of 2,197,074 (Nevada 1995) (see Tables 7-1, 7-2). Given the current development patterns and projected economic development in North Las Vegas, this large increase in population could become an issue relative to the Valley Modified route (North Las Vegas 1995).

The following conditions were additionally identified as being affected. If the Valley Modified route were placed in the northern section of Clark County, the rail corridor would

- Be a public perception issue because it will transect City of North Las Vegas property or pass within two miles of North Las Vegas (a city falling within the boundaries of the most heavily populated census designated Metropolitan Statistical Area in the State of Nevada).

- Be located within two miles of the proposed 7,500-acre land transfer from U.S. Bureau of Land Management to the City of North Las Vegas.

- Cut across the alluvial fan to the north of the city. The City of North Las Vegas recently constructed a large detention basin to control water flow and alleviate potential flooding off the alluvial fan to the north.

- Thwart the City of North Las Vegas' attempts to overcome the negative socioeconomic connotations the city has historically evoked through the master-planning of a "new" City of North Las Vegas.

7.4 CARLIN ROUTE

Affected counties: Lander, Eureka, Elko, northern Nye, Esmeralda

The population of Elko County increased by 94.2 percent from 17,269 in 1980 to 33,530 in 1990 (DOC 1981; DOC 1992). It is projected that between 1990 and 2015, Elko County will increase to a population of 73,456 (Nevada 1995). The majority of Elko County's population occurs within 50 miles of the possible tie-in with existing rail lines at Carlin (see Tables 7-1, 7-2).

The population of Eureka County increased 29.1 percent, from 1,198 in 1980 to 1,547 in 1990 (DOC 1981; DOC 1992). It is projected that between 1990 and 2015, Eureka County will increase to a population of 2,803 (Nevada 1995). Population is not a factor to the potential rail corridor for Eureka County.

Lander County is a sparsely populated county, increasing 53.7 percent from 4,076 in 1980 to 6,266 in 1990 (DOC 1981; DOC 1992). It is projected that between 1990 and 2015, Lander County will increase to a population of 8,485 (Nevada 1995). Population is not a factor to the potential rail corridor for Lander County.

Esmeralda County is the least populated county in study area. It increased 73 percent from 777 in 1980 to 1,344 in 1990 (DOC 1981; DOC 1992). It is projected that between 1990 and 2015, Esmeralda County will increase to a population of 1,278 (Nevada 1995). Population is not a factor to the potential rail corridor for Esmeralda County.

The following conditions were additionally identified as being affected. If the origination point were placed at Beowawe, the rail corridor would

- Potentially impact the Humboldt River, a precious water resource for the state. Toward protection of that resource, several counties (Elko, Eureka, Lander, Washoe) have formulated a Humboldt River Consortium, whose primary agenda item is protection of that resource from environmental degradation, and which takes issue specifically with the rail line as a potential threat in the event of a spill or accident.

- Allow shared use, primarily among the mining community. Firm benefits to other private industry have been identified.

- Allow shared use to develop economic bases not now available.

7.5 CALIENTE ROUTE

Affected counties: Nye, Lincoln

Lincoln County realized a population growth of 1.2 percent, increasing from 3,732 in 1980 to 3,775 to in 1990 (DOC 1981; DOC 1992). It is projected that between 1990 and 2015, Lincoln County will increase to a population of 4,164 (Nevada 1995). Population in Lincoln County is not an issue with regards to the Caliente route. No population/planning areas were found to be an issue with regards to the Caliente route.

8. EVALUATION CRITERIA DEVELOPMENT AND ROUTE/MODE SELECTION PROCESS

8.1 RAIL ROUTE PRELIMINARY EVALUATION CRITERIA

A preliminary list of evaluation criteria categories was developed in this study, to be used for comparative evaluation of the rail route alternatives. The preliminary list consists of:

- Stakeholder acceptance: Economics, quality of life
- Cost: Construction, operation, and maintenance
- Regulatory: Construction permits, approvals, and concurrences; operation permits, approvals, and concurrences; published environmental impacts; evaluation of the impacts of the Endangered Species Act, flood plain, and wetlands
- Construction/operation: Complexity of construction, operational safety, security areas, operation and maintenance efficiency.

The preliminary list will be used as a tool during the National Environmental Protection Act scoping process to fully identify significant criteria based on stakeholder input. At the completion of scoping, the evaluation criteria may be revised to incorporate applicable input, and the criteria will be used to comparatively evaluate the four rail corridors and select the preferred corridor.

8.2 CORRIDOR SELECTION PROCESS

A single corridor/route may be selected during the development of the draft Environmental Impact Statement based on the listed criteria and on public input during scoping. The process listed below will ensure a consistent approach over time.

A. Select initial evaluation criteria.

B. Gain public (stakeholder) input through the scoping process. During scoping, state that DOE is proposing to identify a specific rail corridor to be analyzed in the Environmental Impact Statement and is soliciting public input to identify criteria to select the corridor. (The benefit of using this process is that the analysis can be more specific in determining potential consequences associated with rail route construction and operation, it allows earlier public input, and it allows the selection to be made in the implementation plan.)

C. Modify the criteria and develop preliminary weighting based on input.

D. Finalize weighting and rate each corridor.

E. Compare the ratings and select a corridor/route(s).

F. Analyze the preferred and alternate options corridor/route(s) under each implementation alternative.

8.3 HEAVY HAUL ROUTE SELECTION PROCESS

A heavy haul truck route would not be selected in the same manner as the rail route. Heavy haul would be evaluated as a modification of legal weight truck because existing legal weight truck routes would be used, and a selection, concurrence, and approval process involving the Nuclear Regulatory Commission, U.S. Department of Transportation, and State of Nevada is required. The construction or modification of legal weight roads to handle heavy haul would be addressed as a mitigation. As identified in Section 6.4, construction of a separate heavy haul road is not considered cost effective.

9. NATIONAL TRANSPORTATION SYSTEM CONSIDERATIONS

This section describes an analysis performed to evaluate the national-level effects of routing spent nuclear fuel and high-level nuclear waste from the purchasers' and producers' sites to the origins of the four Nevada rail branch lines: Caliente, Carlin, Jean, and Valley Modified. Figure 9-1, a map of the State of Nevada, shows the locations of the railroad lines and the origins of the four Nevada rail branch lines. Appendix F contains a detailed description of the analysis.

9.1 PURPOSE OF THE ANALYSIS

This analysis was intended to determine if there are significant national transportation considerations involved in the selection of the rail branch line to be used to access the potential repository at Yucca Mountain. National effects are based on a set of measures of effectiveness that were evaluated during the analysis. The national transportation system considerations are only some of the many considerations to be evaluated in the selection of the rail branch line. The present analysis is not intended to substitute for an environmental impact analysis which may be found in existing or future Environmental Impact Statements; it is intended to highlight rail branch line selection issues.

9.2 METHODOLOGY

Sets of representative rail routes between the 77 purchaser and producer sites and each of the four Nevada rail branch lines were generated. This analysis also considered the effect of routing through Las Vegas or routing that avoids Las Vegas to reach the rail branch lines. This portion of the analysis was undertaken to determine if routing that avoids Las Vegas, the largest population center in Nevada, has negative effects on the national transportation system.

Eight sets of representative rail routes were generated. A number of measures of effectiveness were used to compare the sets of representative rail routes. These representative rail routes were produced by the DOE's INTERLINE rail routing code, a computer program that selects routes from a railroad network in accordance with reasonable rail industry routing practice. Many of the values for the measures of effectiveness used in the analysis were generated using aggregate INTERLINE results; the others were produced using the CRWMS M&O's Transportation Geographic Information System.

A common scenario was used in each case. The scenario is based on use of the multi-purpose canister, which emphasizes rail instead of truck transportation. All but four purchaser sites in this scenario are designated to be rail sites. The rest are either direct rail or use barge and heavy haul from the purchaser site to an intermodal transfer to rail, where necessary. The scenario also establishes the number of shipments to be made from each site to the potential repository at Yucca Mountain.

Two primary measures of effectiveness were used in this analysis:

- Total Distance – the total of the lengths of the rail routes between each of sites and the start of the rail branch line under consideration.

- Potentially Affected Population – the total of the population along each of the rail routes within a 1-mile (1.6 kilometer) corridor of the rail line.

It is preferable to decrease both total distance and potentially affected population measures. The other measures considered during the analysis are described in Appendix F. They include main line percent, average population density, urban distance, ton-miles, cask-miles, and number of states and cities encountered.

9.3 ANALYTICAL RESULTS

The comparison of rail branch lines based on national transportation considerations, for the most part, showed little significant differentiation among the four alternative rail branch lines for routes that either include or avoid Las Vegas. Tables 9-1 and 9-2 present the values of the primary measures of effectiveness for each of the eight sets of routes. The results for all of the measures of effectiveness are presented in Appendix F. Figures 9-2 through 9-9 present the routes between the 77 purchaser and producer sites and each of the four rail branch line origins.

Table 9-1. Routes That Include Las Vegas

Measure of Effectiveness	Caliente Rail Branch Line	Carlin Rail Branch Line	Jean Rail Branch Line	Valley Modified Rail Branch Line
Total Distance (miles)	264,781	262,874	282,660	277,849
Potentially Affected Population (persons)	51,738,362	51,403,262	54,864,725	51,991,964

Table 9-2. Routes That Avoid Las Vegas

Measure of Effectiveness	Caliente Rail Branch Line	Carlin Rail Branch Line	Jean Rail Branch Line	Valley Modified Rail Branch Line
Total Distance (miles)	270,764	262,874	305,617	285,262
Potentially Affected Population (persons)	52,345,878	51,403,262	48,606,389	52,495,778

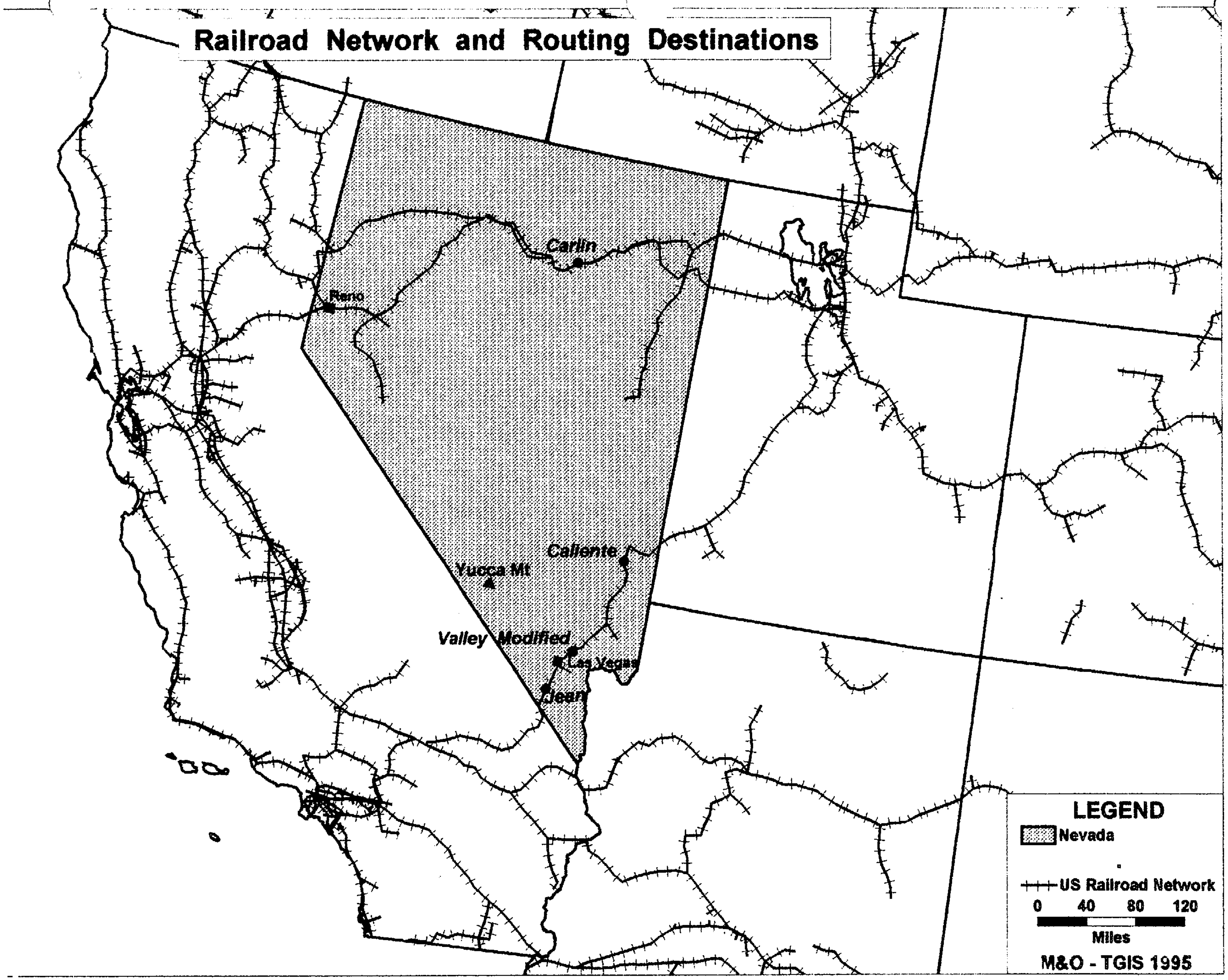

Figure 9-1. Railroad Network and Routing Destinations

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Based on the primary measures of effectiveness, there is less than 7.5 percent difference between the total distance for the routes to any of the four alternatives when routing through Las Vegas is considered. Similarly, there is less than 6.7 percent difference between the potentially affected population associated with the routes to any of the four alternatives. The order of preference within this set of alternatives was the Carlin and Caliente rail branch lines, as most preferable, followed by the Valley Modified and the Jean Rail branch lines.

When routes that avoid Las Vegas were analyzed, the effect of the geography was most notable. As can be seen in Figure 9-1, three of the rail branch lines connect to the same main line section of track: Caliente, Valley Modified, and Jean (listed east to west) are on the same section of Union Pacific main line track; Las Vegas is situated between the Valley Modified Branch and the Jean Branch. Therefore, avoiding Las Vegas from the east, where 90 percent of the routes originate, means that extensive rerouting must take place to reach the Jean branch. A smaller effect is noted with respect to the Caliente and Valley Modified branches; 10 percent of the routes that originate to the west must be rerouted to reach these branch lines when avoiding Las Vegas. It was also noted that the measures of effectiveness for the Carlin branch line routes were not affected by avoiding Las Vegas.

The results for the routes that avoid Las Vegas were different than those that permit routing that includes Las Vegas. While the total distances for the Carlin, Caliente, and Valley Modified branch lines had less than 8.5 percent difference between them, the Jean Branch Line was more than 16 percent different, because of the additional distance needed to route around Las Vegas. However, the potentially affected population was more than 5 percent lower for the Jean branch line than the other three branch lines, because the routes to that line, though longer, traverse regions of lower population density. The potentially affected population for the routes to the other three branch lines differ from each other by less than 2.2 percent.

Comparing the total distance for the sets of routes to the same branch line that include or avoid Las Vegas shows that the routes that avoid Las Vegas are less than 2.25 percent longer than the routes that include Las Vegas, except for Jean, which is more than 8 percent longer. Comparing the potentially affected populations for these sets of routes shows that avoiding Las Vegas results in up to 8 percent higher potentially affected, except for routes to the Jean branch line, which had an almost 13 percent drop in potentially affected population.

9.4 CONCLUSIONS

There appears to be no clear advantage associated with the selection of any of the four rail branch lines analyzed with respect to the national transportation system considerations, as determined by the measures of effectiveness used in this analysis. In order to take the next step in this analysis, a weighting scheme would have to be defined to derive a single effectiveness score based on the measures of effectiveness defined in this analysis.

If total distance is considered to be the dominant measure, then the representative rail routes to the Carlin Rail Branch Line, in aggregate, are the shortest, regardless of whether Las Vegas is included or avoided. However, the differences in the total distance measure between the alternative branch lines are so small that no significant advantage can be asserted. From the total distance perspective, the avoidance of Las Vegas would, in general, be a slight disadvantage because of the increase in total distance that results in routes to the branch lines that avoid Las Vegas. The routes to the Jean branch line increase by more than 8 percent in total length when Las Vegas is avoided.

When considering potentially affected population, the Carlin Branch Line also provides the lowest values, though by only small percent differences, in comparison to the alternative branch lines. Avoiding Las Vegas results in an almost 13 percent drop in potentially affected population for the Jean Branch Line, even though the routes are 8 percent longer.

This analysis, then, has shown that there are no significant national transportation considerations that would support the selection of one of the rail branch lines in place of another.

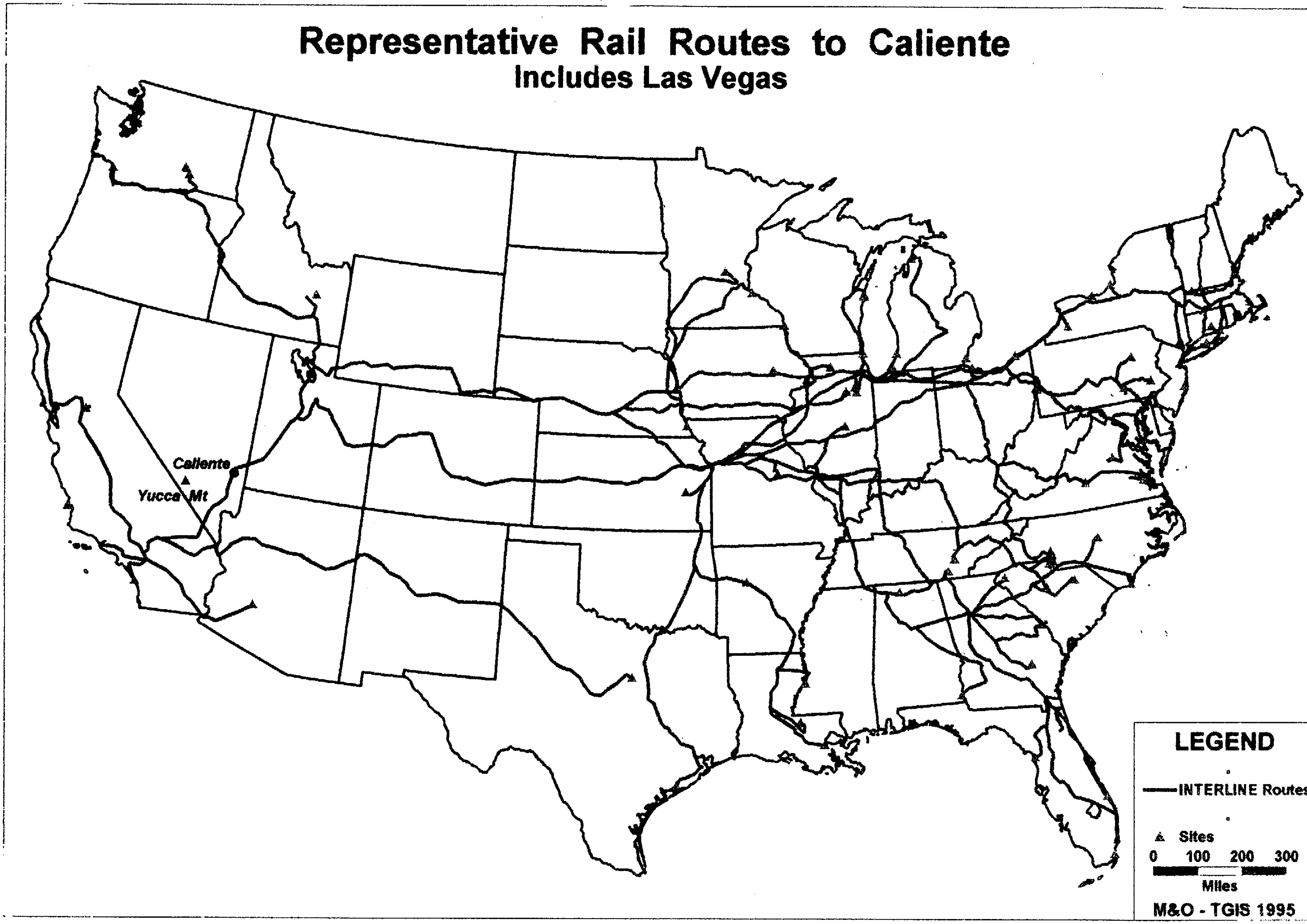

Figure 9-2. Representative Rail Routes to Caliente (Includes Las Vegas)

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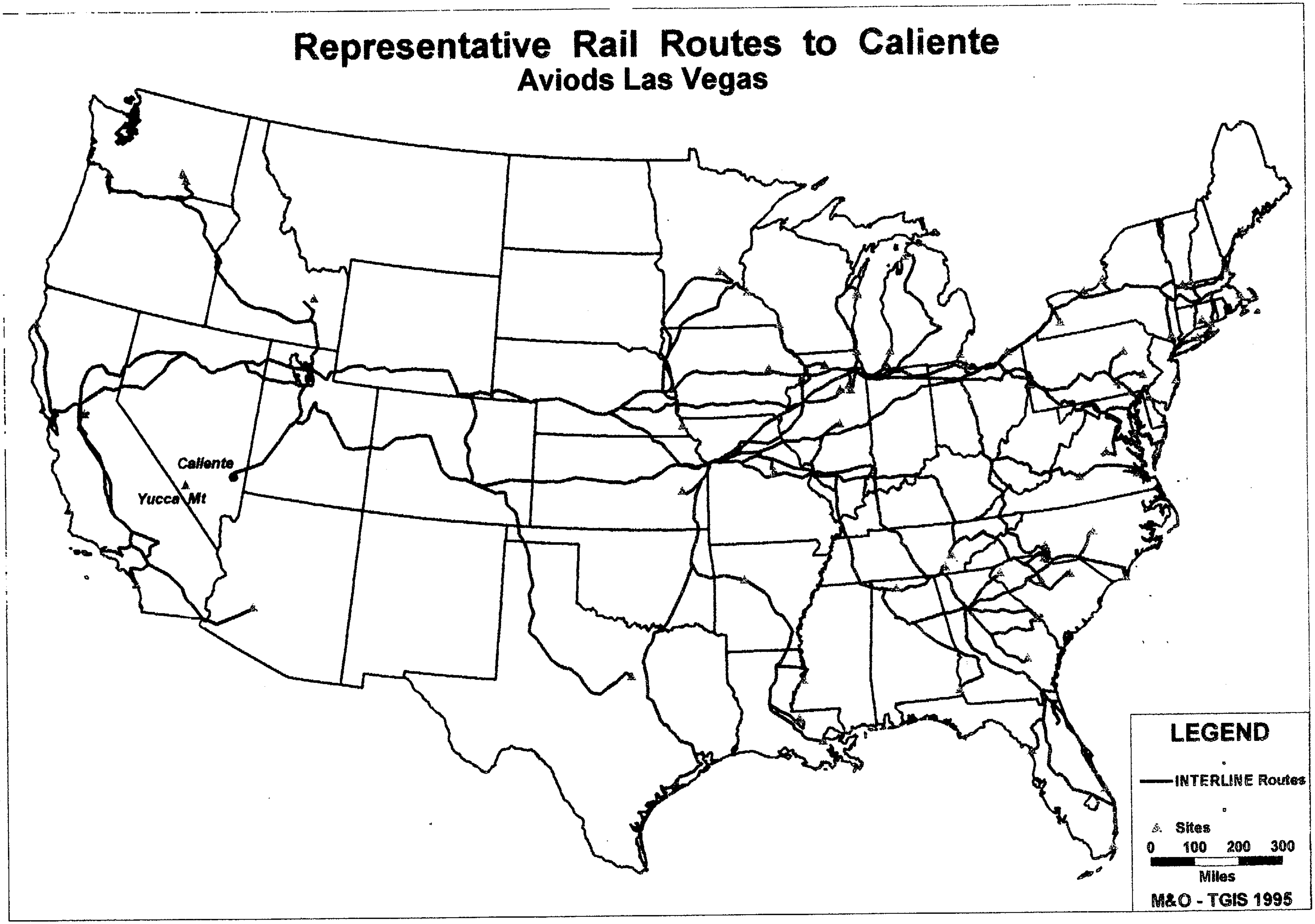

Figure 9-3. Representative Rail Routes to Caliente (Avoids Las Vegas)

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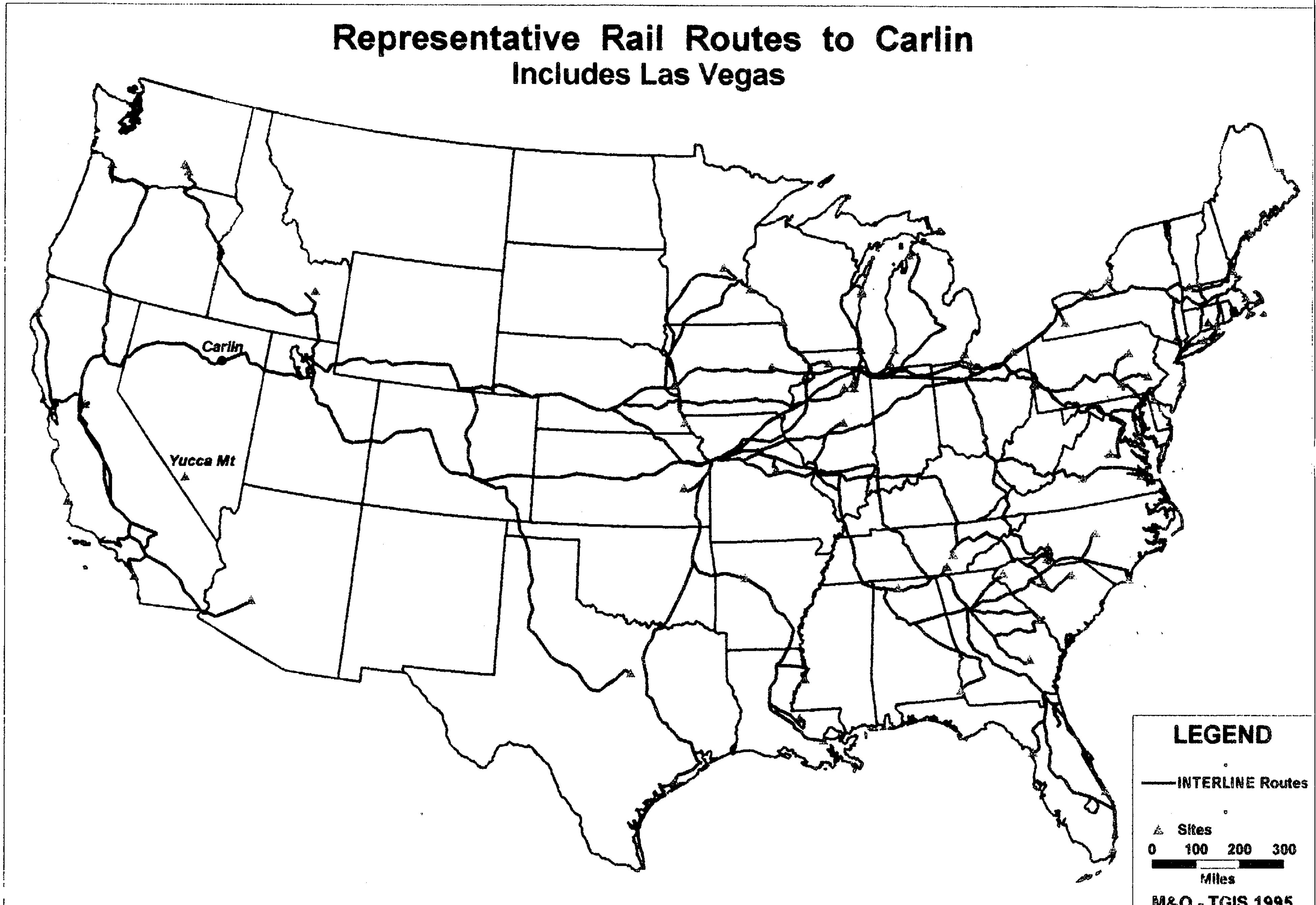

Figure 9-4. Representative Rail Routes to Carlin (Includes Las Vegas)

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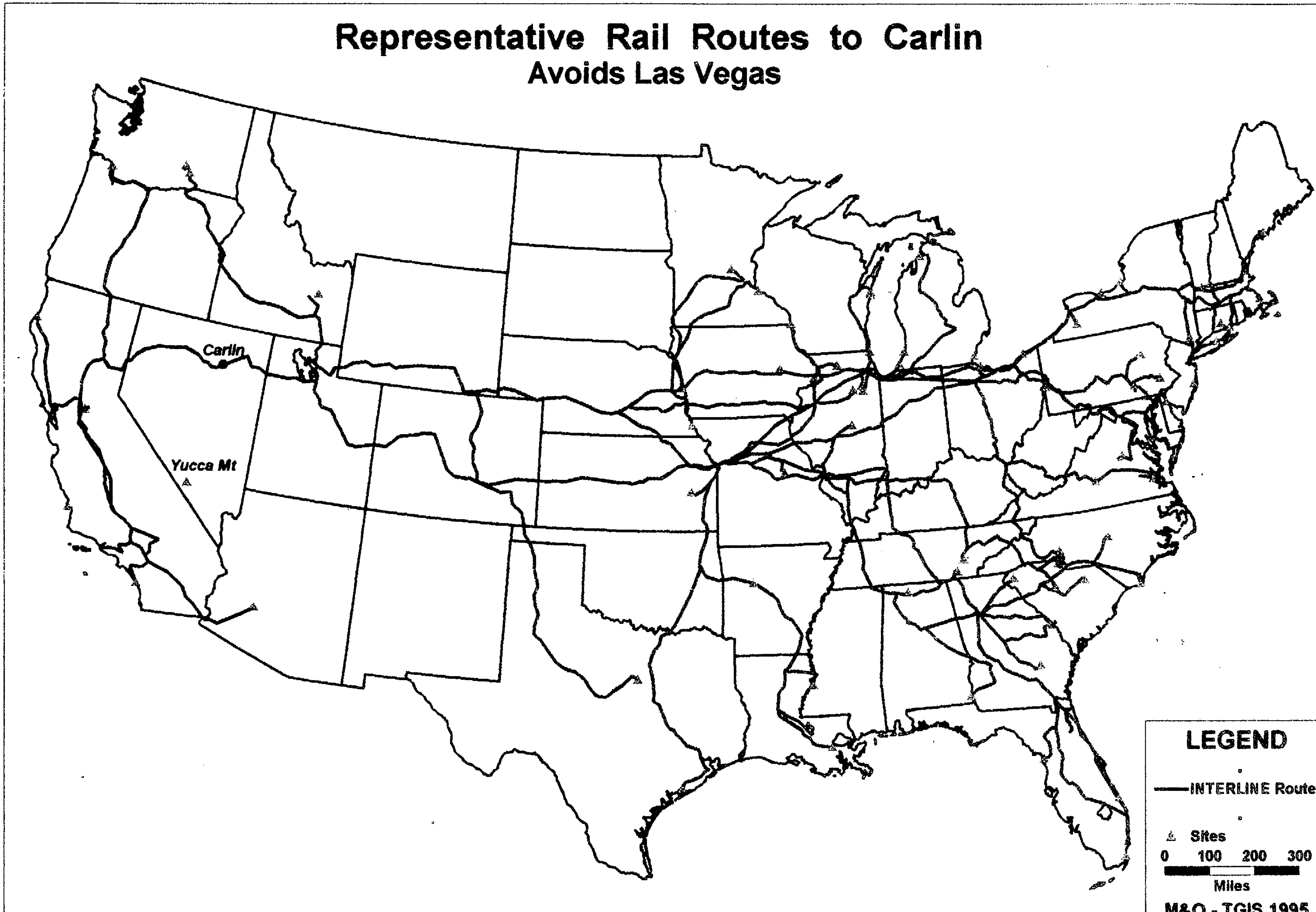

Figure 9-5. Representative Rail Routes to Carlin (Avoids Las Vegas)

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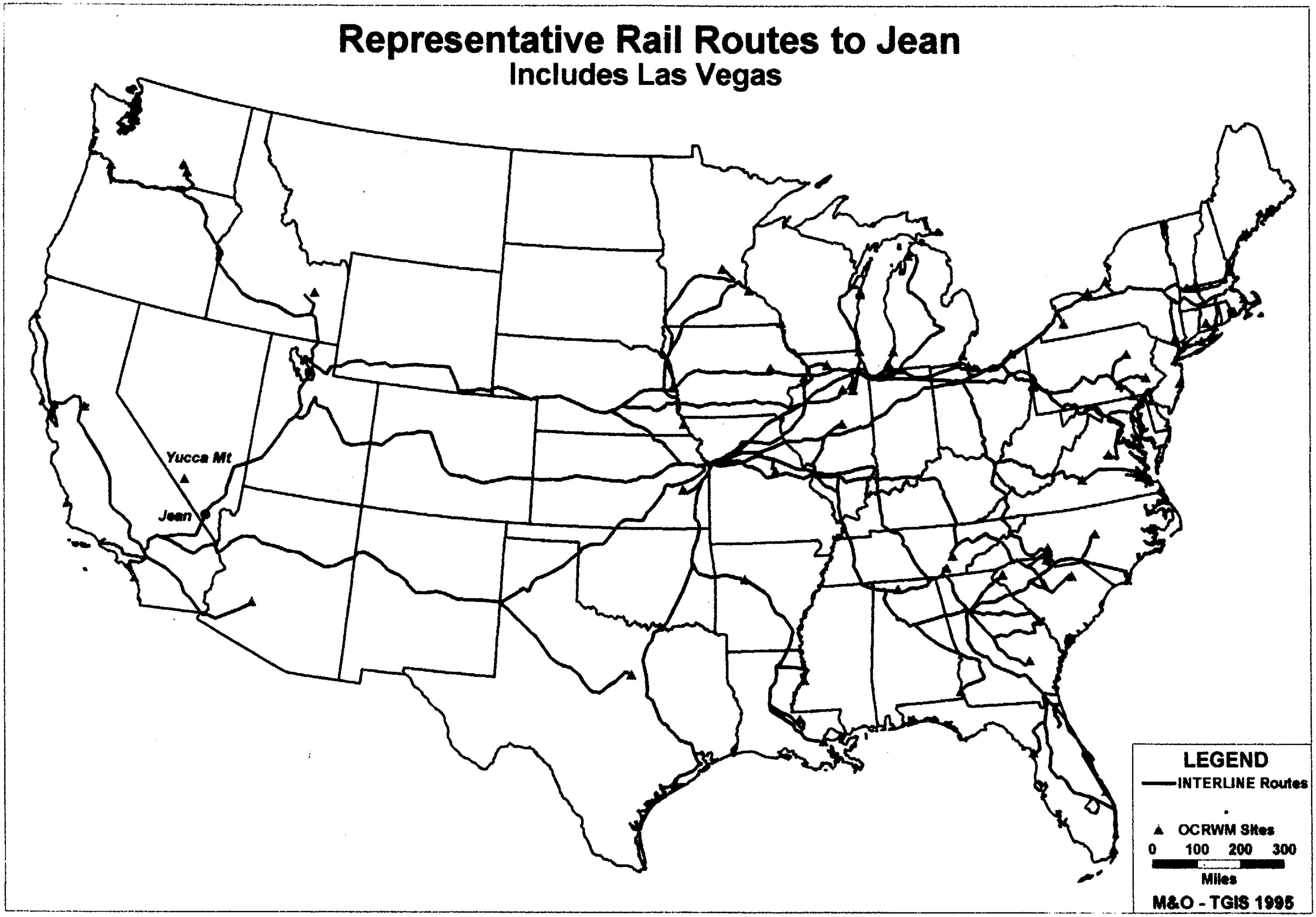

Figure 9-6. Representative Rail Routes to Jean (Includes Las Vegas)

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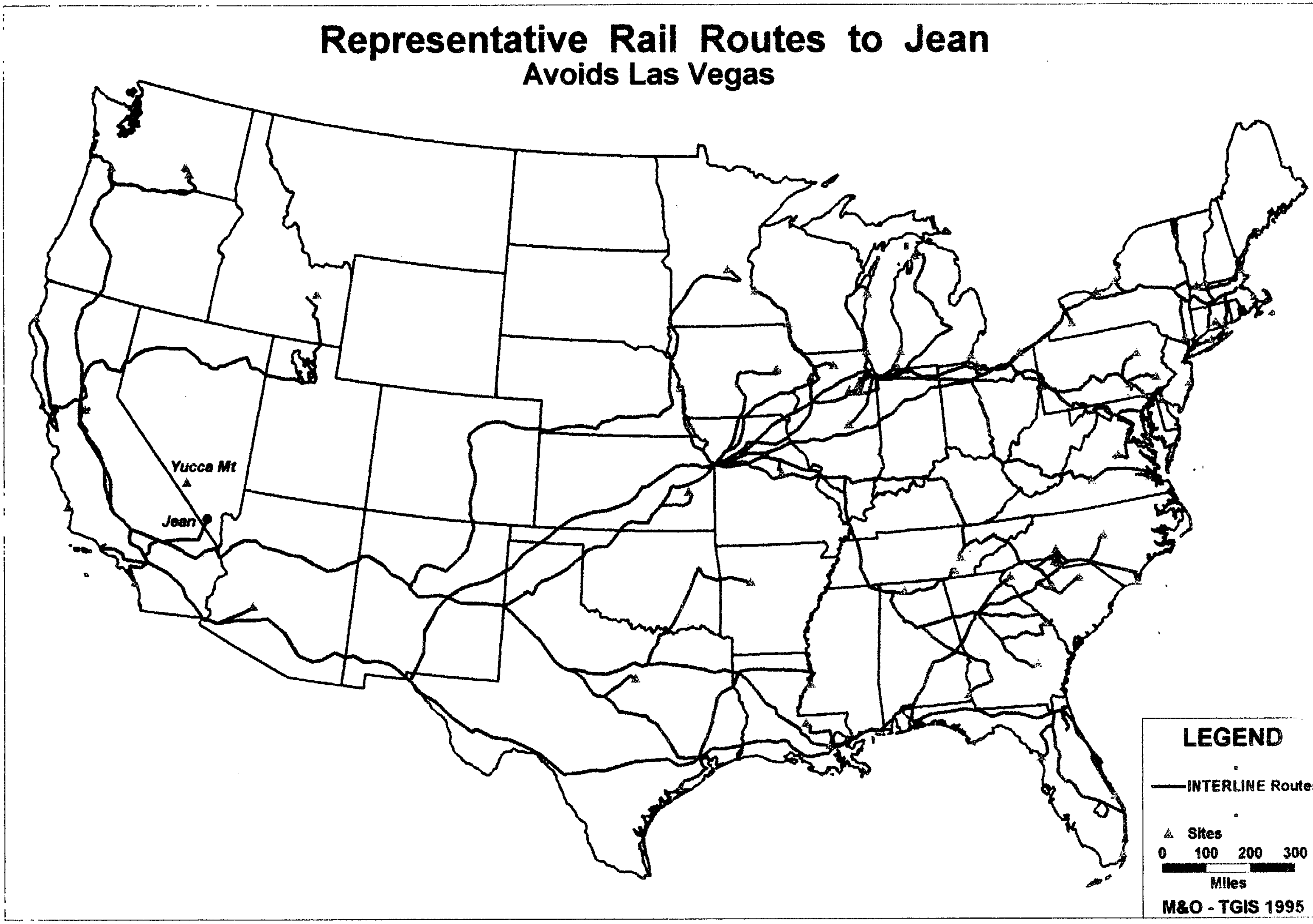

Figure 9-7. Representative Rail Routes to Jean (Avoids Las Vegas)

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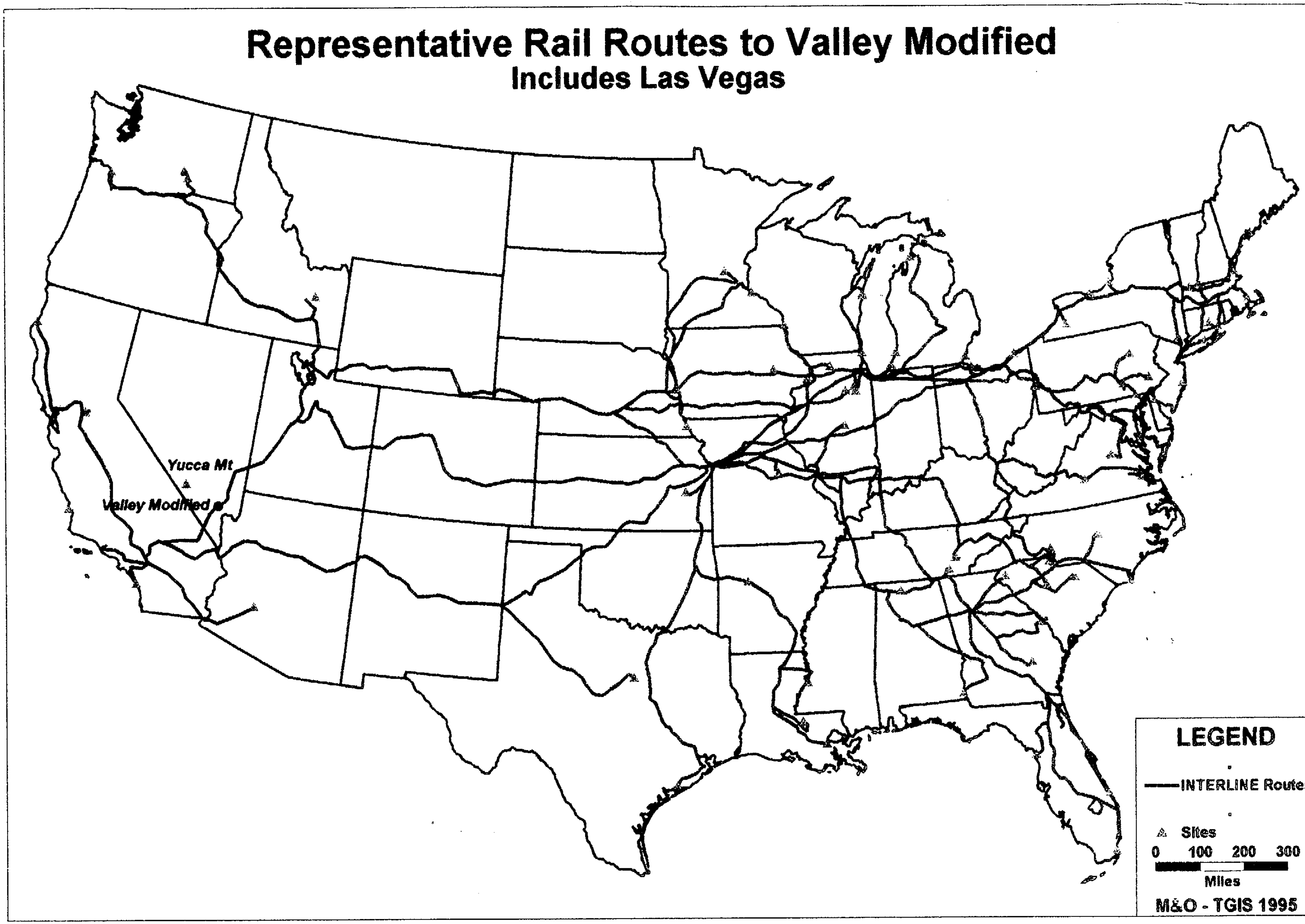

Figure 9-8. Representative Rail Routes to Valley Modified (Includes Las Vegas)

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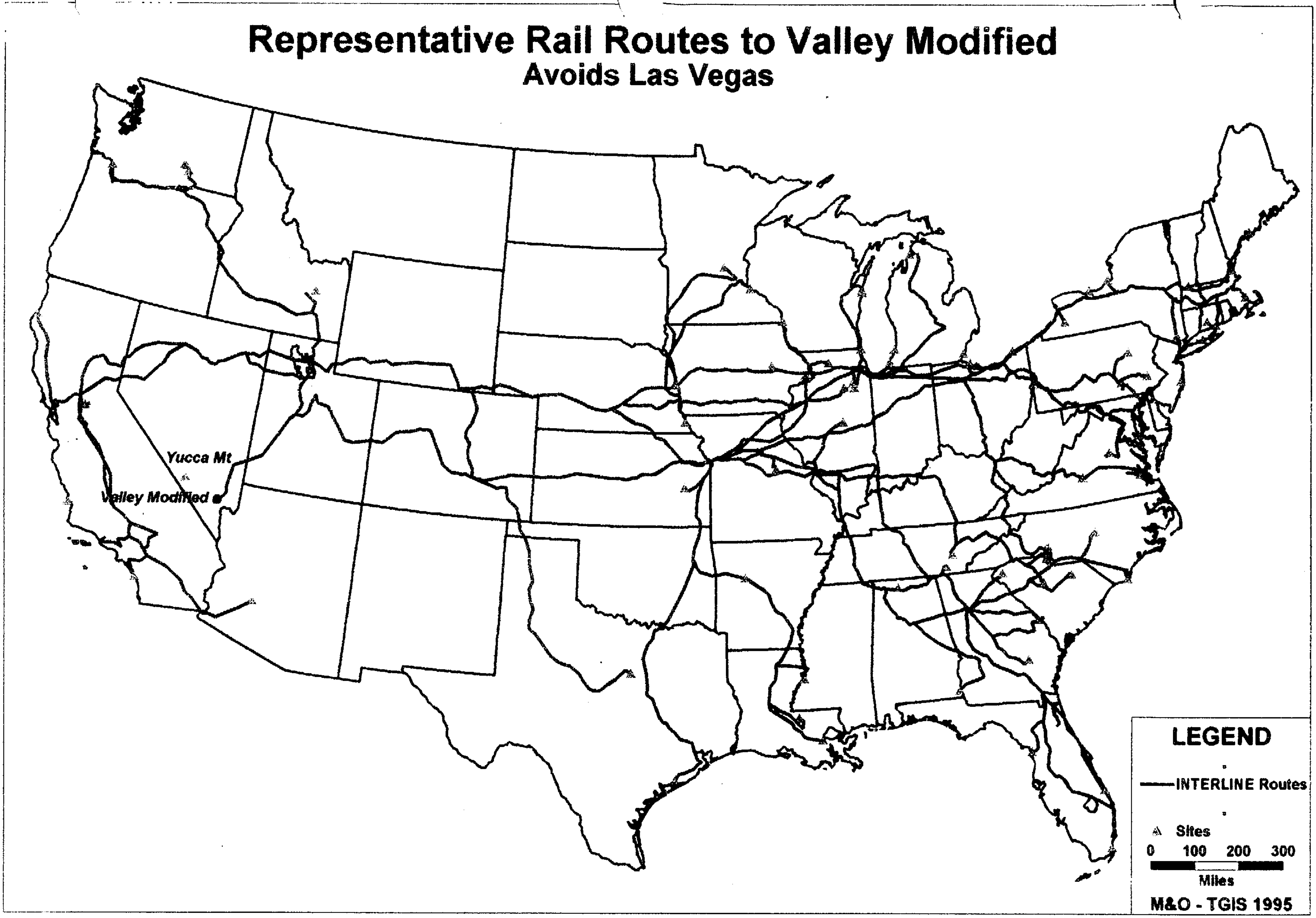

Figure 9-9. Representative Rail Routes to Valley Modified (Avoids Las Vegas)

10. STUDY 1 INFORMATION UPDATES

This section discusses new developments in the Mina, Cherry Creek, and Dike rail routes. All were given the designation *Eliminated from Detailed Evaluation – Monitor* in *Preliminary Transportation Strategy Study 1* (CRWMS M&O 1995b). This study recommends no change in status for the Mina and Cherry Creek routes, and eliminates the Dike route from further study.

10.1 MINA ROUTE STATUS UPDATE

According to the Southern Pacific Transportation Company abandonment petition on March 12, 1991, the abandonment of the rail line from Wabuska to Thorne was approved under Code of Federal Regulations Title 49, Section 10505 from the prior approval requirements of Sections 10903-10904. The abandoned line serves one shipper, the U.S. Army, which has a munitions complex at Hawthorne near Thorne. Under the terms of the agreement, once the line was abandoned by Southern Pacific, the Army purchased the line, obtained the right-of-way across the Walker River Paiute Reservation, and contracted for continued rail service over the line. The proposed transaction has no effect on the rail operations, nor has it resulted in track removal or liquidation of the Thorne branch.

The U.S. Army has obtained a limited lease (50 years) with the Walker River Paiute Indians for the right-of-way across the reservation. According to the Memorandum of Agreement (U.S. Army 1990), the Hawthorne Army Ammunition Plants Government Transportation Officer will provide 24 hours advance notice prior shipment arrival, to the Tribe's designated representative. The notice will include the number of rail cars expected and the hazard class of the material being transported. Shipments that involve unusual transportation requirements (i.e., extremely heavy shipments or hazards that will necessitate either special security or safety) will be coordinated with designated Tribe officials prior to movement across the reservation.

In a December 6, 1991 letter to U.S. Secretary of Energy Admiral James D. Watkins, Anita Collins, chairman of Walker River Paiute Tribe stated, "Please be advised that the Walker River Paiute Tribe will not allow nuclear waste to be transported across any portion of the Walker River Indian Reservation." This position has not been revised. In reply on January 17, 1992, John W. Bartlett, director of Civilian Radioactive Waste Management, explained the ongoing research with several alternative routes within the State of Nevada and expressed that no key decision will be made by the DOE without consulting the Walker River Paiute Tribe.

The U.S. Navy has proposed expanding the Fallon Air Station bombing range. The proposed expansion area is close to the northern perimeter of the Reservation, further restricting possible alternate routes around the Reservation.

Based on the information collected, the Mina route should continue to be monitored for further change in status, but should not be evaluated in greater detail.

10.2 CHERRY CREEK ROUTE STATUS UPDATE

The branch line from Shafter to Ely that passes through Cherry Creek was owned and operated by Northern Nevada Railway Company. Prior to its purchase by the Department of Water and Power of the City of Los Angeles, the line was authorized to be abandoned (60 Federal Register 46).

On December 2, 1994, the Northern Nevada Railroad Company filed a notice under 49 CFR 115 for a modified certificate of public convenience and necessity to operate the rail line. The notice indicates that the line connects with the Southern Pacific Transportation Company at Cobre and with Union Pacific Railroad Company at Shafter. The Department of Water and Power of the City of Los Angeles has entered into an operating agreement with Northern Nevada Railroad Company.

The president of Northern Nevada Railroad Company stated that the company is extending its track to serve a plant near Ruth (personal communication, May 18, 1995). The expected mine life is 15 to 20 years. Currently, the company's only active connection is with Union Pacific at Shafter. The crossing of Union Pacific's main line has been removed; consequently, the line north of Shafter to the Southern Pacific connection at Cobre is out of service. Negotiations are underway with Union Pacific for replacement of the crossing. Two track-related projects are underway:

- Track rehabilitation of the Ely-Shafter line. This work is about 10 percent complete, and involves the replacement of approximately 18,000 ties and placement of ballast. Renewal of the line's 60-pound rail (with 90-pound rail) is planned on an as-needed basis. Train speeds are 10 miles per hour loaded and 15 miles per hour empty.

- Construction of a 3.25 mile track extension to serve a new copper concentrator near Ruth. The Interstate Commerce Commission has approved this extension and bid packages were recently sent out for the grading work. Northern Nevada will build the track with its own work force.

At this time, with the current track rehabilitation activities, it is questionable if the track would suffice for a branch line departure to Yucca Mountain without re-building the entire track. Also, the mileage is quite high (approximately 462 miles) compared to other northern corridors. Northern Nevada's current lease forbids the handling of any kind of hazardous waste but a resolution may be possible. In summary, the Cherry Creek route has numerous negative attributes, but at this time, the route is recommended to remain *Eliminated from Detailed Evaluation – Monitor.*

10.3 DIKE ROUTE STATUS UPDATE

The Dike route assumes a large portion of the Valley Modified route, with the exception of the Las Vegas Valley turnout from the Union Pacific main line. Therefore, to avoid route duplication, this route has been eliminated from further study.

11. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

For the four rail corridors considered, no land use conflicts were identified as fatal flaws because land use conflict areas were minimized by revising the corridor boundaries.

Engineering analysis of the preliminary corridors identified in *Preliminary Transportation Strategy Study 1* (CRWMS M&O 1995b) refined the corridor boundaries based on input from the land use research, and based on the engineering criteria developed for the study. The refined corridors are, for the most part, 1 to 5 miles wide, and identify representative and reasonable land areas for rail routing. These refined corridors are shown in Volume II, and are described in the tables in Appendix C.

The most significant change from the Study 1 corridor evaluation occurs on the Carlin route, where the Study 1 route initiation point was identified in the Palisade area. Based on land use research input, and evaluation of the routing constraints developed in the engineering criteria, an initiation point in the Beowawe area was more reasonable and representative for the Carlin routing. The Monitor Valley and Smoky Valley options identified in Study 1 have been retained. An additional route option has been identified for the Carlin route in the Tonopah area; the Study 1 corridor shows the route on the east side of Tonopah. This study adds an option to route the Carlin line to the west of Tonopah, tieing back into the original corridor north of the Goldfield area. This option was added because of information obtained on potential land use conflicts in the Ralston Valley.

The Caliente and Panaca area in the Caliente option presents some concerns. The old railroad track has been taken out between Caliente and Panaca and it is questionable who owns the right-of-way after the abandonment of the rail line. The alternate Caliente route through the Hancock Summit area was omitted, as the base route provided the most reasonable and representative alternative.

The Jean route options were refined to omit the Table Mountain Pass option, and retain both the Wilson Pass option and the State Line Pass option. Both route options around Pahrump (one east of Pahrump and one west of Pahrump) were retained and refined in this study.

The Valley Modified corridor was refined to minimize the corridor width in the area north of Las Vegas, and locate the route as close to the Wildlife Refuge boundary as possible. Only minor corridor adjustments were made for the remainder of the Valley Modified corridor.

Rail availability for secondary uses indicates that the difference in potential repository construction support costs between rail transport and truck transport is minor, within the uncertainty of the current estimating capability; although the rail line would be useful for freight transport to the potential repository site following the start of waste shipments.

Passenger use may not be economically feasible even if the Valley Modified route is selected. A feasibility study would be required to verify that passenger use makes sense economically, after the route selection has been made. If a route other than Valley Modified is selected, passenger use will not be a feasible secondary use. Bus service could not be completely eliminated even with commuter rail service, as Pahrump and surrounding area commuters to the Nevada Test Site would not have convenient access to the rail line, and an in-city bus service to the rail transfer station may also be required.

Stakeholder input obtained during the development of Study 2 has identified some interest in economic development potential for the counties associated with the Carlin route. However, the input has not been obtained from a representative cross-section of the public in those areas, and no conclusions can be made at this time. No other significant shared use benefits have been identified at this time.

Among the counties evaluated (Clark, Elko, Esmeralda, Eureka, Lander, Lincoln, and Nye), no significant population issues to the potential rail corridors were identified in any of the counties studied, with the possible exception of the City of North Las Vegas in Clark County and the Town of Pahrump in Nye County. Areas identified by stakeholders for future planning projects were avoided to the extent possible.

The three heavy haul routes, Apex Route Interstate 15/U.S. Route 93 to U.S. Route 95, Arden Route State Route 160 - U.S. Route 95 and Caliente Route U.S. Route 93 from Caliente to State Route 375 to U.S. Route 6 to U.S. Route 95 are all feasible options but have certain limitations. These limitations (i.e, traffic congestion, frost restriction and wide load restrictions) are all discussed in detail with respect to each route and their possible workaround.

The Nevada Department of Transportation has not committed to agreeing with any of the workarounds identified, and negotiations with the Nevada Department of Transportation by DOE must be held before any of the routes identified can be considered reasonable unrestricted routes for access to the site using heavy haul trucks.

The route option for heavy haul trucks from the Elgin area has been eliminated from further study due to significant restrictions on that route, including tight curves, steep grades, low bridges, and frost restrictions. The route from Caliente using U.S. Route 93 is much more reasonable, and provides paved road surfaces.

Additional evaluation on heavy haul trailers has produced no surprises from what was identified in Study 1. The trailer components are, for the most part, standard jeep and dollie units. The custom portion of the trailers will be the double goose-neck structure on which the transportation casks will be anchored. The trailer design and fabrication will be developed by the transporter and the trailer manufacturer. The transporter will negotiate with the Nevada Department of Transportation for an approved trailer configuration prior to beginning the design.

Trailer design and fabrication may require a 2-year time period, and may be the critical path item in establishing heavy haul transport services. The trailers must be certified and load tested in accordance with ANSI N14.30 (1992) prior to use for transporting radioactive materials. The certification process is not considered a significant schedule impact activity, and will be performed by the trailer manufacturer. The trailers have a maximum service life of 10 years from the date of certification or 1,000,000 miles maximum. The trailer costs for design and fabrication are in the range of $300,000 to $400,000 per trailer, depending on the final configuration.

Limited input has been received from the Nevada Department of Transportation concerning permitting of frequent heavy haul trucks from an existing rail line to the site. The state permitting question is the most significant data gap remaining for evaluation of the feasibility of heavy haul truck transport.

Study 1 identified that the preliminary estimated cost for operation of the heavy haul trucks was in the $173 million range. During evaluation of the workarounds for using heavy haul as a long-term transportation solution, the costs of road upgrades, road maintenance, and road rehabilitation must be taken into account. The heavy haul transport cost summaries shown in Appendix E assume that DOE will provide 10 percent of the total road maintenance and upgrade rehabilitation costs for the life of the project.

The increase in road wear on the identified state routes was preliminarily analyzed to determine the impact of the heavy haul trucks. At a maximum, the heavy haul trucks, operating consistently over a single route, would cause 10 percent more road wear than current traffic levels. The analysis was based on the increase in equivalent single axle loads as calculated in accordance with American Association of State Highway and Transportation Officials design guidance. The wear analysis is considered conservative in that the equivalent single-axle loads were evaluated based on tandem axle configurations with four tires per axle, when in actual operation, the tandem axles would incorporate eight tires per axle, spreading the load more effectively across the road lane.

There appears to be no clear advantage or disadvantage associated with the choice of any of the four rail routes in Nevada with respect to impacts to the national transportation system. The final evaluation concludes some changes in the status of the rail routes as shown in Table 11-1. The Cherry Creek route continues to remain in the monitor status. Because the Dike route assumes a large portion of the Valley Modified route, with the exception of the Las Vegas Valley turnout from the Union Pacific main line, it has been placed in the category of *Eliminated from Further Study*.

Based on the information collected, the Mina route should be monitored for further change in status, but should not be evaluated in greater detail due to land conflict with Walker River Paiute Tribe.

Table 11-1. Rail Route Status Update

Route Status	Feasible Options	Eliminated from Detailed Evaluation – Monitor	Eliminated from Further Study
Caliente	●		
Carlin	●		
Jean	●		
Valley Modified	●		
Mina		●	
Cherry Creek		●	
Dike		○ →	→ ●

The conceptual design plan for the rail lines has been developed to use a two-phase approach to support the Environmental Impact Statement development plan. The first phase will include sufficient engineering analysis to provide the Environmental Impact Statement development team and DOE with information needed to evaluate the four rail routes, and select a preferred route following completion of the National Environmental Policy Act scoping process. The second phase will include full conceptual design of the selected preferred route. Appendix G identifies the level of effort to develop both phases of the conceptual design.

Table 11-2 provides the summary of the routes. It includes parameters such as length, capital cost, and operation and maintenance costs for each route. The values range from $304 million to $1 billion for Caliente and Valley Modified respectively.

Table 11-2. Cost Summary of Rail Options

Rail Route	Length (miles)	Costs ($ Million)		Total Costs ($ Million)
		Capital	Operations and Maintenance	
Caliente Route	338.1	986.8	68.90	1,055.70
Carlin via Monitor and Ralston Valleys	338	891.26	68.9	960.16
Carlin via Monitor and Klondike	363	989.48	70.52	1,060.00
Carlin via Big Smoky Valley	331	876.61	68.43	945.04
Valley Modified via Indian Hills	98	270.89	40.92	311.81
Valley Modified via Cactus Springs	97.5	263.66	40.69	304.35
Jean via Wilson Pass and N. Pahrump	114	428.50	42.78	471.28
Jean via Wilson Pass and Stewart Valley	118.5	426.85	43.00	469.85
Jean via State Line Pass and N. Pahrump	122	442.21	43.24	485.45
Jean via State Line Pass and Stewart Valley	126.5	439.94	43.47	483.41

Table 11-3 provides the difference of costs from Study 1 to Study 2. In general, the cost is reduced from the first study, due to the reduction in the length of route (i.e., more detail is now available, the engineering and management costs are reduced from 24 percent to 15 percent).

Table 11-3. Comparison of Study 1 and Study 2 Rail Costs

Route	Study 2 Capital Costs ($ Million)	Study 1 Capital Costs ($ Million)	Study 2 vs. Study 1 Delta ($ Million)
Caliente Route	986.8	1,094.80	-108.0
Carlin via Monitor and Ralston Valleys	891.26	1,105.10	-213.84
Carlin via Monitor and Klondike	989.48	N/A	N/A
Carlin via Big Smoky Valley	876.61	1,175.70	-299.09
Valley Modified via Indian Hills	270.89	N/A	N/A
Valley Modified via Cactus Springs	263.66	355.40	-91.74
Jean via Wilson Pass and N. Pahrump	428.50	457.10	-28.60
Jean via Wilson Pass and Stewart Valley	426.85	N/A	N/A
Jean via State Line Pass and N. Pahrump	442.21	438.30	3.91
Jean via State Line Pass and Stewart Valley	439.94	N/A	N/A

Table 11-4 includes all the three routes and their respective capital, operation and maintenance, and total costs. Study 2 total costs include the 10 percent of road maintenance costs and the parameters shown in Appendix D, Heavy Haul Costs. Study 1 costs of $173 million were approximate dollar values calculated with very little detail.

Table 11-4. Cost Summary of Heavy Haul Options

Heavy Haul Route	Length (miles)	Study 2 Costs ($ Million)		Total Study 2 Costs ($ Million) FY 1994	Study 1 Costs ($ Million) FY 1994
		Capital	Operations and Maintenance		
Caliente	321	38.31	140.29	178.60	173.00
Arden	111	27.33	113.16	140.49	
Apex	104	26.97	112.25	139.22	

12. REFERENCES

12.1 DOCUMENTS CITED

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CRWMS M&O 1995b, March 28. Interoffice Correspondence to B. Thomson, "System Logistics and Waste Stream Data for MGDS CDA Update" VS.SA.JK.03/95.038. Las Vegas, Nevada.

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12.2 STANDARDS AND REGULATIONS

60 Federal Register 46. March 9, 1995. "Northern Nevada Railroad Corporation—Modified Rail Certificate—Between Cobre and McGill Junction, Nevada." Finance Dockets 32624, 32623 and 32476.

Code of Federal Regulations Title 49. 1995. *Transportation.* Washington, D.C.: U.S. Government Printing Office.

DOE Order 6430.1A, 1987. *General Design Criteria.* Washington, D.C.: U.S. Government Printing Office.

National Environmental Policy Act of 1969. 42 USC § 4321.

12.3 DATA SOURCES USED TO CREATE THE GIS MAP PRODUCTS

GIS map products were created by the U.S. Department of Energy's Remote Sensing Laboratory, operated by EG&G Energy Measurements, Inc., in September 1995.

This data was developed for use by the Yucca Mountain Site Characterization Project for site characterization studies.

Limitations of data: This data is not to be used in quality-affecting work. This data is preliminary information only. Yucca Mountain Administrative Procedure *YAP-SIII.3Q, Section 5.2.2, states that, "The data provided herein have not received complete technical and quality checks, and, therefore, are considered to be preliminary. These data are for information only and cannot be used for licensing activities until recorded in the Automated Technical Data Tracking system and all technical and quality checks are complete."*

Conceptual Controlled Area Boundary – The Conceptual Controlled Area Boundary was digitized from Sandia National Laboratory Product Number CAL0166.

Hydrographic Features – Springs, wells, and waterbodies were obtained from the U.S. Geological Survey, 1:100,000-scale Digital Line Graph, hydrographic layer.

Land Use – The Nevada land ownership data was obtained from the Bureau of Land Management State of Nevada digital land status map initially processed by the University of Nevada Reno.

The data was obtained in preliminary format, and is not yet available in final format. No effort was made to correct potential errors. As noted on the published Bureau of Land Management Land Status maps: "Land ownership status is subject to change. Recent changes in public land ownership may not be reflected on this map. For more detailed land ownership information, maps covering the state at 1:100,000 can be purchased from the Bureau of Land Management. The official land records of the Bureau of Land Management, Nevada State Office, or other responsible federal agencies should be checked for current status on and specific tract of land."

The land use information used to create Volume II Figures 1 through 17 are stored in the Central Records Facility of the Yucca Mountain Site Characterization Project (files I-373829 through I-373845, respectively).

Major Cities – 1990 Census of Population and Housing, Summary Tape file 1A on CD ROM, U.S. Bureau of the Census, U.S. Department of Commerce, 1991.

Mines and Mining Districts – Tingley, J.V. 1992. Mining Districts of Nevada Map, NBMG Report 47, Nevada Bureau of Mines and Geology.

Minor Infrastructure Features – Minor infrastructure features were digitized from 1:24,000-scale and 1:62,500-scale basemaps. They were defined by Science Applications International Corporation by reviewing state, county and city level records.

Nevada Test Site – Holmes and Narver, Drawing Number 090-094-C7.2, NTS Coordinate Map - Site Plan and Insert, revised 6/8/87.

Potential Repository Outline – Raytheon Services Nevada, drawing number YMP-025-2-MING-M102, Revision 1. Exploratory Studies Facility, General Arrangement, TS Level Exploratory Drifts Plan.

Special Land Use Withdrawals – Leases, withdrawals, rights-of-ways, and other special land used features were digitized from 1:24,000-scale and 1:62,500-scale basemaps. They were defined by Science Applications International Corporation by reviewing state, county and city level records.

State and County Boundaries – Political boundary features were obtained from the U.S. Geological Survey, 1:100,000-scale Digital Line Graph, boundaries layer.

Transmission Lines and Pipelines – Infrastructure features were obtained from the U.S. Geological Survey, 1:100,000-scale Digital Line Graph, transportation layer.

Transportation Features – Road and railroad features were obtained from the U.S. Geological Survey, 1:100,000-scale Digital Line Graph, transportation layer.

Transportation Corridor, Study 1 – Corridor boundaries were digitized from a 1:500,000-scale basemap defined by Morrison Knudson Corporation, January 1995.

Transportation Corridor, Study 2 – Primary and alternate corridor boundaries were digitized from 1:24,000-scale and 1:62,500-scale basemaps defined by Morrison Knudson Corporation, July 1995.

Archeological Data – Archeological data is contained in Project No. 9666 MA at the Desert Research Institute, P.O. Box 19040, Las Vegas, Nevada, 89132.

APPENDIX A

ACRONYM DEFINITIONS AND GLOSSARY

ACRONYMS

AAR/FRA	American Associatio f Railroads, Federal Railroad Administration
ANSI	American National S dards Institute, Inc.
BLM	U.S. Bureau of Land ınagement
CDA	Controlled Design A mptions
CFR	Code of Federal Reg tions
CRWMS	Civilian Radioactive aste Management System
DOE	U.S. Department of ırgy
EIS	Environmental Impa Statement
GIS	Geographic Informa ı System
HLW	High-Level Waste
LWT	Legal Weight Truck
M&O	Management and O ıting Contractor
MTP	Master Title Plat
MTU	Metric Tons of Urar n
NEPA	National Environme l Policy Act
NRC	Nuclear Regulatory mmission
NWPA	Nuclear Waste Poli Act
SAIC	Science Applicatior nternational Corporation
T	Ton
USC	United States Code
USGS	United States Geol al Survey
YMP	Yucca Mountain Si haracterization Project

DEFINITIONS AND GLOSSARY

Affected unit of local government — The unit of local government with jurisdiction over the site of a repository or monitored retrievable storage facility. This term may, at the discretion of the Secretary of Energy, include units of local government that are contiguous with the primary unit.

Association of American Railroads — An organization advocating the interests of railroads in the public policy arena. The association works to enhance the productivity of the railroad industry through research and development, and other support programs. The organization facilitates a seamless intermodal interchange by electronically exchanging information among railroads, their customers, and their suppliers. Although the association's most visible activity is representation of its members before Congress, regulatory agencies, and the courts, most employees and budget are focused on operations, maintenance, safety, theoretical and applied research, economics, finance, accounting, communications, electronic data exchange, and public affairs.

Civilian Radioactive Waste Management System (CRWMS) — The composite of sites, facilities, systems, equipment, materials, information, activities, and personnel required to perform those activities necessary to manage spent nuclear fuel and high-level radioactive waste disposal.

Commercial high-level radioactive waste — The high-level radioactive waste, as defined by Nuclear Waste Policy Act Section 2(12), resulting from reprocessing spent nuclear fuel in a commercial facility.

Consist — Makeup of a train by types of car and motive power.

Curve (of a Railroad Line) — In the United States, it is customary to express track curvature in degrees noted by the deflection from the tangent measured at stations 100 fee apart. In other words, the number of degrees of central angle subtended by a chord of 100 fee represents the "degree curve." One degree of curvature is equal to a radius of 5,750 feet.

Dedicated train — Train which handles only one commodity for only one customer, usually from one origin to destination. As a separately operating train with its own crew, the dedicated train will avoid some rail yards and sidings that are engaged in railcar switching.

Disposal — The isolation of radioactive wastes from the accessible environment. As defined by 10 CFR 60.2, disposal is the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with no foreseeable intent or recovery, whether or not such emplacement permits the recovery of such waste.

Disposal package or waste package — The primary container that holds, and is in contact with, solidified high-level radioactive waste, spent nuclear fuel, or other radioactive materials, and any overpacks that are emplaced at a repository.

Dollie Unit — In truck and trailer i ienclature this is a part of the trailer unit that is connected to the main assembly. It includes wh , axles, tires, etc., but has no included tractor motor power by itself. This unit can have an exten steering assembly when very large.

Grade (degree of) — As used in (iection with railway line, the rise or fall in a track expressed as a ratio of 100 feet of horizontal ck.

Hazardous material (HAZMAT) Any solid, liquid, or gaseous material that is toxic, flammable, radioactive, corrosive, chemically ictive, or unstable upon prolonged storage in quantities that could pose a threat to life, prope , or the environment. (This definition is applicable to U.S. Department of Energy orders and listinct from the term "hazard material substance" defined in Section 101(14) of Comprehensi Environmental Response, Compensation and Liability Act of 1980 and in 40 CFR 300.6.) Alsc fined by 40 CFR 171.8 as a substance or material designated by the Secretary of Transportation e capable of posing an unreasonable risk to health, safety, and property when transported in com rce and which has been so designated.

Heavy-haul truck — (The follow definition is based on Nevada Department of Transportation regulations.) The transport of hea loads by truck over Nevada State roads is governed by NRS 484.500 through 484.580, *Permit l es and Regulations for Operation of Over Legal Size Vehicles and Loads on Nevada Highways.* mits are required under these regulations when

- Traveling on an intersta highway system and the weight of a vehicle or vehicle combination and load exce those limits imposed by state or Federal law. Those limits are 20,000 pounds for single , 34,000 pounds for tandem axles, 42,000 pounds for tridem axles, or a gross weight of ,000 pounds including all enforcement tolerances.

- Traveling on primary, sec lary, urban, or state routes and axle loadings or gross weights exceed the limits establisl by the formula in Nevada Revised Statute 484.745. Where substandard roadway secti or structures exist, the maximum allowable axle loadings or gross weights must not ex l the values established by the state highway engineer for such roadway sections or struct s, unless authorized by permit.

- The maximum width of th hicle or vehicle combination and load exceeds 102 inches or as otherwise designated b atute.

- The maximum length of v cle or vehicle combination exceeds 70 feet.

- The vehicle or vehicle cor nation and load exceeds 75 feet including overhang.

- When overhang exceeds 1 eet regardless of length.

- When height exceeds 14 f except that baled hay loads are legal to 15 feet.

- Loads must be nonreducil

High-level radioactive waste — The highly radioactive waste material that results from the reprocessing of spent nuclear fuel in a commercial or defense facility, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic waste and fission products in concentrations requiring permanent isolation.

Highway route controlled quantity — A quantity within a single package which exceeds (1) 3,000 times the A_I1 value of the radionuclides as specified in 49 CFR 173.433 for special form radioactive material; (2) 3,000 times the A_I2 value of the radionuclides as specified in 49 CFR 173.433 for special form radioactive material; or (3) 30,000 curies, whichever is least.

Highway routing (of highway route controlled quantity) — Refers to those routes which must be selected by the carrier or that person operating a motor vehicle containing a highway route controlled quantity of radioactive materials to reduce time in transit and minimize radiological risk. The route is limited to a preferred route or a state-designated alternative route whenever possible and must be in writing with a copy supplied to the driver and shipper, the latter being notified in writing of any deviations.

Intermodal transfer — The physical transfer of a piece of cargo from one mode of transportation (e.g., highway, rail, or barge) to another to effect continuous movement of the shipment to destination without releasing the contents.

Legal-weight truck — A truck cask system consisting of a tractor, semitrailer, and loaded cask, with a maximum gross weight of 36,288 kg (80,000 pounds) and maximum single axle weight of 20,000 pounds and tandem axle weight limit of 34,000 pounds. Special permits are not required for legal-weight truck shipments.

Legal-weight truck cask — A cask of a size that, when combined with the rest of the transport system, will not exceed the legal-weight truck limits.

Local government — Any county, city, village, town, district, or political subdivision of any state, Indian tribe or authorized tribal organization, or Alaska Native village or organization, including any rural community or unincorporated town or village or any other public entity.

Main Track — A track extending through yards and between stations, upon which trains are operated by timetable or train order, or both, or the use of which is governed by block signals.

Multi-purpose canister — Sealed, metallic containers maintaining multiple spent nuclear fuel assemblies in a dry, inert environment and overpacked separately and uniquely for the various system elements of storage, transportation, and disposal.

Mylar — A thin strong polyester film that is used as a transparency in superimposing one chart or figure on top of another.

National Environmental Policy / **(NEPA) of 1969** — A law established on January 1, 1970 that established a national policy to ı ntain conditions under which man and nature can exist in productive harmony and fulfill th cial, economic, and other requirements of present and future generations of Americans. It esta ıhed the Council on Environmental Quality for coordinating environmental matters at the feder evel and to serve as advisor to the President on such matters. The law made all federal actior nd proposals which could have significant impact on the environment subject to review by eral, state, and local environmental authorities.

Nuclear reactor — An apparatus, er than an atomic weapon, designed or used to sustain nuclear fission in a self-supporting chain ı tion.

Nuclear Regulatory Commissi (NRC) — The Federal agency responsible for regulating commercial nuclear power plants a other commercial nuclear operations pursuant to the Atomic Energy Act of 1954, as amended, a covered by provisions under Section 170(a) of that Act. This Federal agency has a broad statuto uthority over transportation of radioactive material similar to that of the Department of Transpor on. Under a memorandum of understanding between the two agencies, however, NRC limits its a vities to performing safety evaluations of packages and issuing certificates of compliance for Ty B packages and packages for fissile material. The NRC prescribes rules for monitoring of ckages on receipt, for limiting the exposure of individuals to ionizing radiation, and for in-tran security of certain materials. NRC imposes Department of Transportation shipping requirem s by reference and inspects against them, and enforces those requirements.

Nuclear Waste Policy Act (NW) — An Act passed in 1982, and reauthorized in 1987, that directs the Department of Energy t sign, site, and construct a geologic repository for the disposal of defense high-level radioactive w e and spent fuel from civilian (commercial) nuclear reactors. The NWPA also established the Of of Civilian Radioactive Waste Management to carry out these responsibilities.

Overpacks — This is the term for itional packaging as a protective outer layer prior to shipping.

Overweight truck — A truck cask stem consisting of a tractor, semitrailer, and loaded cask with a gross vehicle weight in excess 36,288 kg (80,000 pounds), but not more than 58,514 kg (129,000 pounds). Varies by sta Each state will issue a permit based on individual weight computation formulas.

Preferred route — A preferred r e consists of (1) an interstate system highway for which an alternative route is not designate a state routing agency, and/or (2) a state-designated route selected by a state routing agency i ccordance with the Department of Transportation "Guidelines for Selecting Preferred Highway utes for Highway Route Controlled Quantity Shipments of Radioactive Routing Materials," c ı equivalent routing analysis.

Prime mover — The vehicle prov ng motive power to the transporter.

Producer — Any generator of hi evel radioactive waste resulting from atomic energy defense activities or any producer of vitrified commercial high-level radioactive waste.

Radioactive waste — Solid, liquid, or gaseous material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and of negligible economic value considering costs of recovery.

Railroad — Classifications based on traffic density/utilization measures which are indicative of the level of maintenance and investment applied to various rail line classes. All common carrier railway lines are subject to the Federal Railway Administration regulations intended to promote safety on the rail network.

Main line - Class A: A traffic density measure of 20 million gross tons or more per year per route or route segment.

Main line - Class B: A traffic density measure or at least 5 to less than 20 million gross tons per year per route or route segment.

Branch line - Class A: A traffic density measure, 5 million gross tons or more per year per route or route segment.

Branch line - Class B: A traffic density measure of at least 1 to less than 5 million gross tons per year per route or route segment. (Railroad Revitalization and Regulatory Reform Act of 1976, PL 94-210)

Main track: A track, other than an auxiliary track, extending through yards or between stations, upon which trains are operated by timetable or train order, or both, or the use of which is governed by a signal system. (49 CFR 218.5)

Class of track: The maximum allowable operating speeds for freight and passenger trains as established by the Federal Railroad Administration. Six classes exist (49 CFR 213.9).

	Freight Trains	**Passenger Trains**
Class 1 track	10 mph	15 mph
Class 2 track	25 mph	30 mph
Class 3 track	40 mph	60 mph
Class 4 track	60 mph	80 mph
Class 5 track	80 mph	90 mph
Class 6 track	110 mph	110 mph

Repository — Any system licensed by the Nuclear Regulatory Commission that is intended to be used for, or may be used for, the permanent deep geologic disposal of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of y materials placed in such a system. Such term includes both surface and subsurface areas at wl a high-level radioactive waste and spent nuclear fuel handling activities are conducted.

Reservation — Any Indian reser on or dependent Indian community referred to in clause (a) or (b) of Section 1151 of Title 18, Ui d States Code; or any land selected by an Alaska Native village or regional corporation under the visions of the Alaska Native Claims Settlement Act (43 U.S.C. 1601 et seq.).

Right-of-way — Public lands au rized to be used or occupied pursuant to a right-of-way grant.

Right-of-way grant — An instr ent issued pursuant to Title V of the Federal Land Policy and Management Act authorizing the e of a right-of-way over, upon, under, or through public lands for construction, operation, main ance, and termination of a project.

Roadbed — The foundation on ich the rails and ties of a railroad are placed.

Setout Track — A short sectior track used for temporary car storage.

Siding — A track auxiliary to t main track for meeting or passing change.

Spent nuclear fuel — Fuel that l been withdrawn from a nuclear reactor following irradiation, the constituent elements of whi have not separated by reprocessing [NWPA Section 2(23)] [10 CFR 961.11]. Specifically, in s document, spent nuclear fuel refers to (1) intact, nondefective fuel assemblies; (2) failed fuel semblies in canisters; (3) fuel assemblies in canisters; (4) consolidated fuel rods in canisters) nonfuel components inserted in pressurized-water reactor fuel assemblies including, but not limit to, control rod assemblies, burnable poison assemblies, thimble plug assemblies, neutron source semblies, and instrumentation assemblies; (6) fuel channels attached to boiling-water reactor f assembles; and (7) nonfuel components and structural parts of assemblies in canisters.

State-designated route — A p rred route selected in accordance with U.S. Department of Transportation Guidelines for *Sel ng Preferred Highway Routes for Highway Route Controlled Quantities of Radioactive Materi* or an equivalent routing analysis which adequately considers overall risk to the public.

Superelevation — The vertical stance the outer rail is raised above the inner rail on curves to resist the centrifugal force of mo g trains.

Topographic Map — A topogr ic map shows terrain features such as elevation, mountains, rivers, and lakes.

Traditional lifeway area — Tl 980 amendments to the National Historic Preservation Act directed the Secretary of the Int r to preserve and conserve " . . . intangible elements of our cultural heritage . . . and encoura he continuation of the diverse traditional prehistoric, historic, ethnic, and folk cultural traditions that underlie and are a living expression of our American heritage. . . ." (National Historic Preservation Act Section 502; 16 U.S.C. 470a note). The principal method of accomplishing this direction is to invite cultural groups to provide information to this agency concerning sensitivity of cultural values on Federal lands. Those areas that are considered to exhibit values necessary for continuation of cultural rules of practice are called traditional lifeway areas or traditional cultural properties. The designations are based on the identification of certain areas by Native American groups and individuals as important for the operation of their respective religions and lifeways. These areas generally include the possession of archaeological features and materials and specific plants and animals. Evaluation of traditional lifeway areas or traditional cultural properties also addresses provisions of the American Indian Religious Freedom Act.

Once an area is designated by the district manager as sensitive, the information is used to identify and evaluate effects on cultural resources as the result of a Federal action (National Historic Preservation Act Section, 106). The areas are determined eligible for nomination to the National Register of Historic Places under 36 CFR 60.4(a). Regional Native American tribes and individuals have provided information on sensitive lands to this office. While Native Americans generally consider all their traditional lands as sensitive, they have participated in a process of evaluation that first selects the most sensitive acreage for designation as a traditional lifeway area.

Transportation cask — A container that meets all applicable regulatory requirements for shipping spent nuclear fuel and/or high-level radioactive waste.

Truck cask — A cask designed to be transported by highway. Current truck casks include the General Atomics GA-4 and GA-9 legal-weight truck casks. Each design includes a transportation cask assembly, a specially fabricated trailer, ancillary equipment (including lifting devices), special tools and fixtures, spare parts, and consumables.

Withdrawal — The withholding of an area of Federal land from settlement, sale, location, or entry under some or all of the general land laws for the purpose of limiting activities under those laws to maintain other public values in the area or reserving the area for a particular public purpose or program; or transferring jurisdiction over an area of Federal land from one department, bureau, or agency to another.

Wye — A term used to describe a track arrangement shaped like the letter "Y" but with a connecting segment between the two upper legs. This track layout is often used in small yards and at some rip tracks to enable equipment to be turned without a turntable.

APPENDIX B

PARCEL OWNERSHIP

CARLIN ROUTE

Parcel Ownership: Beowawe, I phy and Crescent Valley Quadrangles: Eureka County

			PARCELS		
Town	Range	S on	Number of Land Parcels	Acres	Ownership
T30N	R48E	1	14	40	Private
			1	80	BLM
		11	1	160	Private
			1	80	Private
			2	40	Private
			1	30	Private
			4	20	Private
			21	10	Private
		13	1	320	Private
			2	160	Private
		15	1	160	Private
			1	50	Private
			1	40	Private
			2	30	Private
			2	20	Private
			29	10	Private
		23	1	320	Private
			1	160	Private
			1	50	Private
			2	30	Private
			2	20	Private
			1	10	Private
			1	120	Private
			4	40	Private
			1	30	Private
			7	20	Private
			19	10	Private

CARLIN ROUTE (Continued)

Parcel Ownership: Beowawe, Dunphy and Crescent Valley Quadrangles: Eureka County

			PARCELS		
Town	Range	Section	Number of Land Parcels	Acres	Ownership
T30N (continued)	R48E (continued)	33	17	20	Private
			1	40	Private
			1	3.48	Municipal
			5	10	Private
			1	52.22	Private
			1	27.26	Private
			2	13.63	Private
			1	26.51	Private
			1	7.26	Private
			1	5	Private
			1	11	Private
			1	13.26	Private
			1	91.53	Private
		35	1	569.36	Private
			2	40	Private
T29N	R48E	3	1	639.72	Private
		9	1	160	Private
			1	60	Private
			1	40	Private
			1	20	Private
			1	200	Subdivision (Less than 5 acres)
			1	160	Subdivision (Less than 5 acres)
		15	1	640	Subdivision (Less than 5 acres)

ARLIN ROUTE (Continued)

Parcel Ownership: Beowawe,] ıphy and Crescent Valley Quadrangles: Eureka County

			PARCELS		
Town	Range	tion	Number of Land Parcels	Acres	Ownership
T29N (continued)	R48E (continued)	17	1	640	Municipal
		21	1	160	Private
			3	80	Private
			6	40	Private
		29	1	640	Subdivision (Less than 5 AC)
T31N	R49E	8	1	480	Private
			1	160	BLM
		9	1	640	Private
		17	1	320	Private
			1	160	Private
			2	40	Private
			4	20	Private
		19	1	320	Private
			5	40	Private
			1	40	BLM
			4	20	Private
		21	2	320	Private
		29	2	320	Private
		31	2	160	Private
			8	40	Private
T30	R49	5	1	60	Private
			1	160	Private
			6	40	Private
			1	30	Private
			5	20	Private
			5	10	Private

CARLIN ROUTE (Continued)

Parcel Ownership: Beowawe, Dunphy and Crescent Valley Quadrangles: Eureka County

Town	Range	Section	PARCELS Number of Land Parcels	Acres	Ownership
T31N	R48E	25	2	160	Private
			1	80	Private
			5	40	Private
			1	30	Private
			1	10	Private
		36	1	160	Private
			1	480	BLM

APPENDIX C

ROUTE SECTION DESCRIPTION

RC 'E SECTION DESCRIPTION KEY

The land use constraints an igineering features identified on the following pages provide a detailed description of the fc ail corridors. These Route Section Sheets correspond to Volume II, figures 1-17 corridor ma The information contained on the Route Section Sheets in each column is identified from le right as follows:

- **USGS Quadrangle** refers to the 7.5' or 15' map that corresponds to a specific corridor section. Within this column, references have been identified to aid in the identification of specific master title plats corresponding to the corridor section. The "Q" number is used by the Yucca Mountain Site Characterization Project Environmental Department as a file designator. The plate number indicates which map in Volume II corresponds to the information on the page, and the alpha-numeric characters indicate where on the map to look for these features listed on the Route Section Sheets.

- **Cumulative Miles** indicate the approximate number of corridor miles. When an alternate corridor has been identified, match points have been identified to aid in the mileage accumulation.

- **Section, Township, and Ranges** - The master title plats indicated in the USGS Quadrangle column are divided into section, township, and range. The location of the corridor corresponds to these three divisions.

- The **Location Description** column orients the reader with physical features near the corridor.

- **Land-Use Constraints** represent known features near and within the corridor.

- **Archaeological and Historical Sites** have been identified near and within the corridor.

- **Road Crossings and Proximity to Population** identifies features required such as grade separations, signaled grade crossings and approximate location to houses and populated areas.

- **Topographic Considerations** describes the rail route, listing notable topographic features affecting the route location.

- **Bridges and Hydrologic Considerations** indicates bridges and culverts required to support the corridor.

- **Operating Considerations** primarily relates to grades and curves that have been identified in the specific section of the corridor.

Route Section Description
Jean Route, *State Line Pass Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Roach Lake 15' References: Q-39 MTP-156 MTP-157 MTP-158 MTP-159 *Plate 17*: D1, D2	0.0	S3 T26S R59E	Borax Siding	Pipeline Right-of-Way N7100, (underground) 50 ft. Pipeline Right-of-Way NEV056213, (underground) 50 ft.					Connection with Union Pacific (to passing siding).
		S7,8,9,16, 17,18 T26S R59E		Material Site NEV05336, S17 Material Site NEV04638, S17	Route passes through a very large unevaluated archaeological site covering most of the area. If found to be a significant site, routing may still be possible if artifacts are diffused.				
	2.0	S16 T26S R59E	Interstate 15 (four lanes)	Highway Right-of-Way NEV046714, 400ft. Powerline Right-of-Way N2078, 20 ft. Telephone Right-of-Way N43923, (underground) 10 ft.		Grade Separation			
	5.0	S30 T26S R59E	Foot of Spring Mtns.						
							Extensive earthwork for 3 miles around southern tip of Spring Mtns. Cus and fills range up to 80'.		2.2 % upgrade. Some sharp curves.
	6.5	S6 T27S R59E	Vicinity of State Line (casinos)			Potential track location within 2.0 miles of casinos.			
	8.0	S35 T26S R58E	Enter California						
	10.5	S28 T18N R14E	State Line Pass	Route parallels perimeter of Stateline Wilderness Area for approx. 4.0 mile. California Desert Conservation Act of 1994.			Deep cut through alluvial fan at summit.	Cut through alluvial fan will require considerable flood protection measures.	Top of grade.
							Extensive earthwork for 3 miles along face of Spring and Clark Mtns. Cuts and fills range up to 100' in hardrock; some tunneling may be necessary.	High run-off rates due to hard ground surface. Some canyon outflows will require major culvert installations.	2.2 % downgrade. Some sharp curves.
	14.0	S17 T26S R58E	Exit California						

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Clark Mtn. 15' References: Q-40 MTP-160 ***Plate 16***: D5		S36 T25S R57E		Corral Community Pit N48722			Route crosses a series of alluvial fans at base of Spring Mtns.	Some major culvert installations per above.	
Shenandoah Peak 15' References: Q-41 MTP-161 MTP-162 MTP-163 MTP-164 MTP-165 MTP-166 ***Plate 16:*** B4, B5, C4, C5	21.5	S10,14,15, 22,23,24,25,26,27 T25S R57E	Enter vicinity of Sandy Valley	Community Pit N48722		Route is adjacent to southeast limit of populated area.			
						Potential track location parallels Cherokee St. and is less than 1.0 mile from homes.	Route crosses series of alluvial fans.		
	24.0	S3 T25S R57E	Sandy Valley Rd.	Community Pit N48722	Potential track location passes within 0.5 mile of Shenandoah Mill, an unevaluated historical site.	Grade Separation			
	25.5	S33 T24S R57E	Wilson Pass Rd.			Signaled Grade Crossing			
	27.0	S29 T24S R57E	Exit vicinity of Sandy Valley			Route is adjacent to northern limit of populated area. Within 1.0 mile of school.			
	33.0	S34 T23S R56E	Road from Sandy Valley to Hwy. 160			Signaled Grade Crossing			
	39.5	S6 T23S R56E			Crossing of Old Spanish Trail, a significant historic site.				

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Pahrump 15' References: Q-74 MTP-167 MTP-168 MTP-169 MTP-170 MTP-171 MTP-172 ***Plate 16:*** A2, A3		S18,19;20, 28,27,34,3 5 T22S R55E		Powerline Right-of-Way NEV066209, 20 ft. Powerline Right-of-Way NEV53100, 80 ft.					
		S14,15,16, 17,18 T21S R55E		Powerline Right-of-Way N17151, 20 ft.					
		S3,4,5 T21S R55E		Pipeline Right-of-Way					
		S6,8,17,21 ,26,27,35,3 6 T20S R54E		Powerline Right-of-Way NEV065524, 200 ft.					
		S27,34 T20S R54E		Water System N46682					
	45.5	10 T22S R55E	Old Spanish Trail Hwy. Match point for either North Pahrump Alternate or Stewart Valley Alternate.			Grade Separation	If Stewart Valley Alternate adjoins, location is in S21 T22S R55E.		

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

Route Section Description
Jean Route, *Wilson Pass Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Goodsprings 15' References: Q-75 MTP-173 MTP-174 MTP-175 MTP-176 MTP-177 MTP-178 *Plate 17:* B1, C1, C2	0.0	S12 T25S R59E	Jean	Pipeline Right-of-Way N7100 (underground), 50 ft. Pipeline Right-of-Way NEV056213 (underground), 50 ft.		Connection trackage within 0.5 mile of casinos and industrial buildings, unless connection site moved to the north.			Connection with Union Pacific (to passing siding). Other potential connection sites within 3 miles to the north of Jean. 2.2 % upgrade begins within 0.5 mile of connection.
	0.7	S12 T25S R59E	Hwy. 604	Highway Right-of-Way CC0200954, 400 ft.		Grade Separation	As the slope of the valley floor is over 1.5 %, long fills will be required in advance of and between grade separations over Hwy. 604 and Interstate 15.		2.2 % upgrade, continuous for approx. 15 miles.
	1.0	S12 T25S R59E	Interstate 15 (four lanes)	Highway Right-of-Way NEVo46714, 400 ft.		Grade Separation			
		S32 T24S R59E		Powerline Right-of-Way NEV015022, 100 ft.	One small unevaluated archaeological site within corridor.				
	7.5	S24 T24S R58E	Goodsprings	Powerline Right-of-Way N37856, 20 ft. Enter potential BLM utility corridor		Potential track location is within 1.0 mile of recently constructed homes on north side of Goodsprings.			
		S2 T24S R58E	Goodsprings Valley	Fence			Route loops around north end of valley, adding sufficient distance to maintain proper grade.		
	15.3	S17 T24S R58E	Wilson Pass Rd.			Signaled Grade Crossing			
	15.5	S17 T24S R58E	East Portal, Wilson Pass Tunnel			Above crossing of Wilson Pass Rd. may possibly be avoided by locating tunnel portal north of road.			Top of 2.2 % grade.
Goodsprings 15' Shenandoah Peak 15'			Wilson Pass Tunnel				Approx. 2.0 mile long tunnel through crest of Spring Mtns. at about 4600' elevation. Design may establish length as much as 0.4 mile shorter or longer.		Tunnel ventilation system may be required due to combined effects of tunnel length and 2.2 % approach grade.

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Shenandoah Peak 15' ***Plate 16:*** B4, B5, C4, C5	17.5	S7 T24S R58E	West Portal, Wilson Pass Tunnel						
		S12 T24S R57E			Two small unevaluated archaeological sites within corridor.				
		S6 T24S R58E	Wilson Pass Rd.			Signaled Grade Crossing. May be avoided depending upon site of tunnel portal (1500' road relocation would be necessary).			
Shenandoah Peak 15' ***Plate 16:*** B4, B5, C4, C5							Extensive earthwork for approx. 3 miles between tunnels; cuts and fills range up to 60'. Earthwork may be reduced by lengthening both tunnels.		
	20.5	S35 T23S R57E	Potosi Tunnel	Powerline Right-of-Way NEV066148, 20 ft.			Approx 0.5 mile long tunnel through branch of Spring Mtns. Design may lengthen as much as 0.4 mile.		Tunnel ventilation system probably not required. 2.2 % downgrade begins at west portal.
							Route crosses series of alluvial fans.	Many culverts required.	2.2 % downgrade, approx. 6 miles long.
	26.5	S6 T23S R57E	Road from Sandy Valley to Hwy. 160			Signaled Grade Crossing			Approx. foot of 2.2 % grade.
	28.5	S35 T22S R56E			Crossing of Old Spanish Trail, a significant historic site.				
	28.6	S35 T22S R56E	Lovell Wash					Bridge up to 300' long.	

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Mountain Springs 15' References: Q-76 MTP-179 MTP-180 ***Plate 16:*** A4, A5									
Pahrump 15' ***Plate 16:*** A2, A3	37.5	S10 T22S R55E	Old Spanish Trail Hwy. Match point for either North Pahrump Alternate or Stewart Valley Alternate.			Grade Separation			

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

Route Section Description

Jean Route, *North Pahrump Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Pahrump 15' *Plate 16:* A2, A3	0.0	S10 T22S R55E	Old Spanish Trail Hwy. Match point for either Wilson Pass Alternate or State Line Pass Alternate.			Grade Separation	Route crosses series of alluvial fans at base of Spring Mtns.	Numerous culverts required.	
	7.0	S13 T21S R54E	Hwy. 160			Grade Separation			
	8.0	S11 T21S R54E	Enter vicinity of built-up portion of Pahrump			Route is adjacent to eastern limit of populated area.			2.0 % downgrade.
	9.5	S2 T21S R54E	Carpenter Canyon Road			Signaled Grade Crossing			
	11.5	S27 T20S R54E					Route along southern tip of branch of Spring Mtns., using grades to avoid tunnel.		
	12.0	S27 T20S R54E	Clark / Nye County Line						2.0 % upgrade.
	13.0	S21 T20S R54E	County road			Signaled Grade Crossing			
	14.5	S17 T20S R54E	Wheeler Wash					Bridge up to 100' long.	
	15.5	S8 T20S R54E	Wheeler Pass Rd.			Signaled Grade Crossing. Route is adjacent to central portion of Pahrump; nearest housing is approx. 1.5 miles from potential track location.			

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Mt. Stirling 15' References: Q-77 MTP-181 MTP-182 MTP-183 ***Plate 14:*** C1, D1		S31 T19S R54E		Powerline Right-of-Way NEV065524, ft.					
	22.0	S12 T19S R53E	Exit vicinity of built-up portion of Pahrump			Route is adjacent to northern limit of populated area, although private lands continue northward.	Route crosses series of alluvial fans at base of Spring Mtns. Optional routing to avoid private lands would be approx. 1.5 miles further east and to an elevation 600' higher on the slope of the Spring Mtns. The additional elevation gain would require approx. 3 miles additional construction involving heavy earthwork.	Numerous culverts required. Several of the larger washes will require major culvert installations.	
	23.0	S1 T19S R53E		Enter private lands.					
	25.5	S26 T18S R53E		Exit private lands.					
Mt. Schader 7.5' References: Q-78 MTP-184 MTP-185 MTP-186 ***Plate 13:*** C5	27.5	S15 T18S R53E		Enter private lands.					
	30.0	S8 T18S R53E		Northern limit of private lands in Pahrump area.					
	32.5	S36 T17S R52E	Johnnie Pass		One unevaluated site within corridor.				2.2 % downgrade, approx. 6.5 miles long.
		S25 T17S R52E			One unevaluated site within corridor.		Route through hills at base of Mt. Schader. Approx. 1800' tunneling required in addition to very heavy earthwork.		
	36.0	S14 T17S R52E	Foot of Mt. Schader						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Specter Range 15' References: Q-84 MTP-194 MTP-195 MTP-196 MTP-197 MTP-198 ***Plate 13:*** A4, A5, B4, B5	42.0	S22 T16S R52E	Hwy. 160	Highway Right-of-Way NEV065993 Telephone Right-of-Way N47397 (underground), 20 ft. Within potential BLM utility corridor		Grade Separation			
	42.5	S21 T16S R52E	Wash					Bridge up to 200' long.	
	45.0	S19 T8S R52E	County Road			Signaled Grade Crossing			
	47.5	S22 T16S R51E	Match point for Amargosa Desert Section.						

*Cumulative mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

Route Section Description
Jean Route, *Stewart Valley Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Pahrump 15' *Plate 16:* A2, A3	0.0	S10 T22S R55E	Old Spanish Trail Hwy. Match point for either Wilson Pass Alternate or State Line Pass Alternate.			Grade Separation	If State Line Pass Alternate adjoins, location is in S21 T22S R55E.		
	3.0	S7 T22S R55E		Enter BLM potential 2640' Utility/Trans. Corridor					
	6.5	S3 T22S R54E	Clark / Nye County Line	Powerline Right-of-Way NEV066289, 20 ft. Telephone Right-of-Way NEV065104, 20 ft.					
	10.0	S25 T21S R53E	Homestead Road			Grade Separation. At least 5 homes are within 0.2 mile of potential track location, numerous other homes are within 1.0 mile.			
Nopah Peak 7.5' References: Q-79 *Plate 16:* A1									
Sixmile Spring 7.5' References: Q-80, MTP-187 *Plate 13:* E5	19.5	S22 T24N R8E	Hwy. 372			Grade Separation			
						Potential track location is within 0.5 mile of California state line, and within 0.6 mile of at least 10 homes (some new) and homes under construction in both Nevada and California.	Extensive earthwork required through hills at southern tip of Last Chance Range.		2.0 %,grades.
Stewart Valley 7.5' References: Q-81, MTP-188, MTP-189, MTP-190, MTP-191 *Plate 13:* E4	23.5	S5 T24N R8E		Exit BLM potential 2640' Utility/Trans. Corridor					

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Jean Route, *Stewart Valley Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Stewart Valley 7.5' High Peak 7.5' *Plate 13:* D4, E4			Stewart Valley			Potential track location within 0.1 mile of Ash Meadows Road for about 6 miles, and within 0.4 mile of 5 homes.	Route along base of High Peak, parallel to Ash Meadow Road.		
High Peak 7.5' References: Q-82 MTP-192 *Plate 13:* D4	30.0	S13 T19S R51E	Amargosa Rd.			Grade Separation	Route through western hills of Last Chance Range.		2.0 % upgrade, approx. 7 miles long.
	34.5	S32 T18S R52E	Wash					Bridge up to 200' long.	
	35.5	S29 T18S R52E	Wash					Major culvert installation.	
	37.0	S19 T18S R52E	Summit						Top of grade.
Amargosa Flat 7.5' References: Q-83 MTP-193 *Plate 13:* C4							Some heavy earthwork required.		2.0 % downgrade, approx. 6 miles long. Some sharp curves.
	39.0	S8 T18S R52E	Foot of Mt. Montgomery						
							Route crosses alluvial fans.	Many culverts required.	
	45.5	S9 T17S R52E	County road (to Crystal)	Powerline Right-of-Way NEV059100, 80 ft. Telephone Right-of-Way NEV064817, 10 ft. Powerline Right-of-Way NEV065524, 200 ft.		Grade Separation			
	49.5	S30 T18S R52E	County road			Signaled Grade Crossing			
Specter Range 15' *Plate 13:* A4, A5, B4, B5	52.0	S22 T16S R51E	Match point for Amargosa Desert Section.						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Specter Range 15' *Plate 13:* A4, A5, B4, B5	0.0	S22 T16S R51E	Match point for either North Pahrump Alternate or Stewart Valley Alternate.						
Lathrop Wells 15' *Plate 13:* A2, A3, B2, B3	7.0	S3 T16S R50E	Rock Valley Wash					Bridge up to 200' long.	
							Route around south side of Skeleton Hills.		
	11.5	S20 T15S R50E	Hwy. 95	Highway Right-of-Way CCO18078, 400 ft. Powerline Right-of-Way NEVO59100, 80 ft. Telephone Right-of-Way NEV065524, 100 ft. Powerline Right-of-way NEV058116, 100 ft.		Grade Separation			1.5 % upgrade.
	15.0	S4 T15S R50E	Enter Nevada Test Site	Nevada Test Site			Potential route parallels power line.		
					One significant archaeological site within corridor.				
Topopah Spring 15' *Plate 12:* E3, E4	21.0		Topopah Wash					Bridge up to 200' long	
	21.3		NTS Road			Grade Separation	Potential route is straight across Jackass Flats, west of powerline. Lack of significant topography permits flexibility in routing to accommodate NTS requirements in this area.		
	21.5		NTS Road			Signaled Grade Crossing			
	24.0		NTS Road			Signaled Grade Crossing			
	25.0		NTS Road			Signaled Grade Crossing			
	27.0		Fortymile Wash		Numerous significant archaeological sites, primarily on terraces along wash.			Bridge up to 600' long. Potential location at narrow point near BM 3403.	
							Route through gap in hills 1.0 mile east of North Portal.		2.0 % upgrade. Some sharp curves.
	29.0		Repository Site (North Portal)						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Dry Lake 15' References: Q-85 MTP-199 MTP-200 *Plate 15:* D4	0.0	S8 T19S R63E	Approx. midway between Dike and Apex near U.P. Milepost 349.	Clark County Development of Apex Heavy Industrial uses Park - Public Law 101-67 would affect corridor from Dike to Apex. Connection at Dike would shorten line by approx. 2 miles, but would move potential track location approx. 0.5 mile closer to 7500 acre potential land exchange area. Enter BLM utility corridor N52787 Powerline Right-of-Way NEV061985, 100 ft. Powerline Right-of-Way NEV067348, 100 ft. Powerline Right-of-Way N39815			Connection at Apex would require 2 miles additional track construction with heavy earthwork and grade separation over Hwy. 604.		Connection with U.P., directly to main line. One mile long 1.5 % upgrade begins within 0.5 mile of connection.
	1.0	S1 T19S R62E	Enter Nellis Small Arms Range						
Gass Peak 15' References: Q-86 MTP-201 MTP-202 MTP-203 MTP-204 MTP-205 *Plate 15:* D2. D3		S11 T19S R62E		Nellis Wilderness Study Area A, B, C Nellis Small Arms Range, to be transferred to BLM.	One small significant archaeological site within corridor.				
		S3 T19S R62E			One small significant archaeological site within corridor.				
	4.0	S3 T19S R62E					Area of very large alluvial fan (4.5 miles across).	Primary route is above North Las Vegas flood control facilities. Many large culverts required.	Approx. 3 miles of 1.5 % upgrade.
		S4 T19S R62E			One small significant archaeological site within corridor.				

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Gass Peak 15' References: Q-86 MTP-201 MTP-202 MTP-203 MTP-204 MTP-205 ***Plate 15:*** D2, D3	6.0	S5 T19S R62E		Closest point to 7500 potential land exchange area. Potential track location is approx. 1.5 miles from northeast corner; elsewhere is 2.0 miles or more from northern property line.					
	6.5	S5 T19S R62E	Exit Nellis Small Arms Range						
	7.5	S1 T19S R61E	Enter Desert National Wildlife Range						
Gass Peak 15' ***Plate 15:*** D2, D3	8.5	S36 T18S R61E		Desert National Wildlife Range					
							Route crosses a series of alluvial fans at base of Las Vegas Range.	Some major culvert installations required.	
	14.5	S31 T18S R61E	Exit Desert National Wildlife Range				Route passes approx. 1.5 miles north of retention basin on Las Vegas Wash.		
	16.5	S26 T18S R60E	Re-enter Desert National Wildlife Range	Desert National Wildlife Range			Route crosses a series of alluvial fans at base of Las Vegas Range.	Some major culvert installations required.	
	18.0	S21 T18S R60E	Exit Desert National Wildlife Range						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Corn Creek Springs 15'	21.0	S24 T18S R59E		Quail Springs Wilderness Study Area Telephone Right-of-Way NEV055905, 20 ft.		Closest point to Las Vegas Paiute Indian Reservation. Potential track location is approx. 1.0 mile from northeast corner of Reservation.	Route crosses alluvial fans.	Many culverts required.	
References:	22.0	S13 T18S R59E	Las Vegas Wash		Two small unevaluated archaeological sites, one on each side of Las Vegas Wash, near potential bridge site.			Bridge from north to south side of wash.	
Q-87 MTP-206 MTP-207 MTP-208 MTP-209 ***Plate 15:*** C1, D1	26.0	S9 T18S R59E				Closest point to private lands and homes in NW 1/4 S4 T18S R59E. Potential track location is approx. 0.5 mile from southwest corner of private land.			Approx. 4.5 miles of 1.5 % upgrade.
Corn Creek Springs 15' ***Plate 15:*** C1, D1	27.5	S32 T17S R59E	Corn Creek Springs Rd.	Telephone Right-of-Way N50113 (underground), 100 ft.		Signaled Grade Crossing			
	31.0	S14 T17S R58E	First entry onto Nellis Air Force Range			Potential track location is parallel to and 0.3 to 0.8 miles north of Hwy. 95.			
				Series of firing range facilities (including many small buildings) along approx. centerline of corridor for about 2.5 miles. Relocation of some of these facilities (further north) may be necessary to keep rail line an acceptable distance from Hwy. 95.					

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Black Hills SW 7.5' References: Q-88 ***Plate 14:*** B5				Potential track location is close to irregular boundary of Nellis Air Force Range, crossing boundary multiple times in this area. Road Right-of-Way N1197, 100 ft., in S21.					
Indian Springs SE 7.5' References: Q-89 MTP-210 MTP-211 ***Plate 14: B4***	38.5	T16S R57E	Match point for either Indian Hills Alternate or Cactus Springs Alternate.						

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Route Section Description
Valley Route, *Indian Hills Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Indian Springs SE 7.5' ***Plate 14***: B4	0.0	T16S R57E	Match point for Las Vegas Wash Section.						
	0.5	T16S R57E	Hwy. 95 (four lanes)	Highway Right-of-Way CC018191, 400 ft. Telephone Right-of-Way CC021488, 40 ft. Powerline Right-of-Way NEV043546, 100 ft.		Grade Separation			
		S28,29 T16S R57E		Withdrawal, Power Project N50954	One small significant archaeological site in northern portion of corridor, south of Hwy. 95.		Route crosses series of alluvial fans along base of Spring Mtns.	Many culverts required.	Approx. 8.0 miles of 1.5 % upgrade.
Indian Springs 7.5' References: Q-90 MTP-212 MTP-213 ***Plate 14:*** B3	5.5	S22 T16S R56E	Eastern foot of hills	Within potential BLM utility corridor		Potential track location is approx. 1.5 miles south of (and is not visible from) populated area at Indian Springs.			
							Extensive earthwork needed for good alignment through eastern portion of hills. Some cuts up to 80' deep, but all are relatively short.		
	8.0	S20 T16S R56E	Summit						Top of grade.
							Route crosses alluvial fans.	Many culverts required.	Approx. 3.0 miles of 1.5 % downgrade.
	11.5	S24 T16S R55E	Willow Creek					Bridge up to 200' long.	

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Mercury 15' References: Q-91 MTP-214 MTP-215 MTP-216 MTP-217 MTP-218 ***Plate 14:*** A1, B1, B2		T16S R55E		Route corridor closely follows 2640' wide utility corridor. Telephone Right-of-Way CC021488, 40 ft.					
	25.0	S36 T15S R53E	Hwy. 95 (four lanes)	Highway Right-of-Way CC018191, 400 ft.		Grade Separation			
	26.0	T15S R53E	Enter Nevada Test Site. Match point for Mercury Section.						

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Route Section Description

Valley Route, *Cactus Springs Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Indian Springs SE 7.5' *Plate 14:* B4	0.0	T16S R57E	Match point for Las Vegas Wash Section.						
	1.0	T16S R57E	Road into Air Force Range			Grade Separation			
	3.5	S13 T16S R56E	Exit Nellis Air Force Range			Potential track location is parallel to and 0.3 to 0.8 miles north of Hwy. 95.			
	5.5-6.5	S10 T16S R56E	Re-enter Nellis Air Force Range						
Indian Springs 7.5' *Plate 14:* B3			Indian Springs	Indian Springs Air Force Auxiliary Field and adjacent military and civilian support facilities.		Routing north of the airfield may require a grade separation over the road into Nellis Air Force Range. Routing south of the airfield may require two signaled grade crossings in addition to the grade separation; housing on the opposite side of Hwy. 95 would be within 0.2 mile of track location.	Rail line could pass either in the open area north of the airfield (approx. 0.3 mile from end of runway) or in the narrow area between the airfield and Hwy. 95. The latter would require relocation of some Air Force and civilian facilities.		
	9.5-10.5	S1 T16S R55½E	Exit Nellis Air Force Range						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Mercury 15' ***Plate 14:*** A1, B1, B2	12.5	S12 T16S R55E	Indian Springs Wash					Due to width of wash (approx. 1000'), crossing may involve several dispersed spans.	
			Indian Springs Valley				Routing in the lower hills on the north side of Indian Springs Valley would require some heavy earthwork over a 3 mile distance, while routing closer to the valley bottom would require heavy earthwork only in section 12.	Routing in the valley bottom north of the wash may require channel relocation in section 12.	Up to 3 miles of 1.5 % upgrade required for routing in the lower hills.
	19.0	S2 T16S R54E	Enter Nellis Air Force Range						
	20.5	S3 T16S R54E	Clark / Nye County Line						
	23.5	S31 T15S R54E	Summit between Indian Springs Valley and Mercury Valley			Potential track location is approx. 0.2 mile from Hwy. 95 due to summit.			
	25.5	T15S R53E	Enter Nevada Test Site. Match point for Mercury Section.						

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Route Section Description
Valley Route, *Mercury Section*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Mercury 15' *Plate 14:* A1, B1, B2	0.0	T15S R53E	Enter Nevada Test Site. Match point for either Indian Hills Alternate or Cactus Springs Alternate.	Nevada Test Site			Routing along upper slopes of Mercury Valley, between the site of Camp Desert Rock and Mercury, limits elevation changes and thereby permits moderate grades.		Short 1.5 % grades, mostly downgrades.
	1.0		Road to Tower Hill			Signaled Grade Crossing			
Specter Range 15' *Plate 13:* A4, A5, B4, B5	2.0		Mercury Highway			Grade Separation. Closest point to town of Mercury, approx. 1.0 mile from potential track location.			
	3.0		Jackass Flats Road			Grade Separation			
							Potential route would generally parallel power line. Some short stretches of heavy earthwork.		Short 1.5 % upgrades.
	10.5		Summit between Mercury Valley and Rock Valley		One small significant archaeological site near summit.	Close proximity to Jackass Flats Road is likely in vicinity of summit.	Extensive earthwork in vicinity of summit.		
	11.5		Cane Spring Road		Very significant archaeological site, approx. 0.5 mile in diameter, in upper portion of Rock Valley.	Signaled Grade Crossing	Potential route is along base of Skull Mtn., north of Jackass Flats Road.		Short 1.5 % downgrades.
					One small unevaluated archaeological site within route corridor.				
	16.5		Jackass Flats Road		One small significant archaeological site in vicinity of potential track location.	Grade Separation			
					One significant archaeological site within corridor.		Some heavy earthwork along southwest side of Little Skull Mountain.		

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Topopah Spring 15' *Plate 12:* E3, E4	25.5		Topopah Wash					Bridge up to 200' long.	
	25.8		NTS Road	Nevada Test Site		Grade Separation	Potential route is straight across Jackass Flats, west of powerline. Lack of significant topography permits flexibility in routing to accommodate NTS requirements in this area.		1.5 % upgrade.
	26.0		NTS Road			Signaled Grade Crossing			
	28.5		NTS Road			Signaled Grade Crossing			
	29.5		NTS Road			Signaled Grade Crossing			
	31.5		Fortymile Wash		Numerous significant archaeological sites, primarily on terraces along wash.			Bridge up to 600' long. Potential location at narrow point near BM 3403.	
							Route through gap in hills 1.0 mile east of North Portal.		2.0 % upgrade. Some sharp curves.
	33.5		Repository Site (North Portal)						

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Route Section Description
Carlin Route, *Crescent Valley Section*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Beowawe 15'** Reference: Q-42 MTP-43 MTP-44 ***Plate 1:*** B5	0.0	S9 T31N R49E	Vicinity Beowawe			Connection is about 1.5 miles east of Beowawe and within 1.0 miles of a school.			Connection with Southern Pacific (directly to main line). Connection with Union Pacific is via crossover(s) between S.P. and U.P.
Dunphy 15'** Reference: Q-43 MTP-45 MTP-46 ***Plate 1:*** B4	6.0	S1,2 T30N R48E			One significant archaeological site within corridor.				
Crescent Valley 15'** Reference: Q-44 MTP-47 MTP-48 MTP-49 MTP-50 ** Every other section is private land in a checkerboard fashion. See Table 4.1 ***Plate 1:*** C4, D3, D4	12.8	S3 T29N R48E		Recreation and Public Purposes Lease N38444		Grade Separation			
	13.5	S4 T29N R48E		Material Pit N39953 Road Right-of-Way N55119		Corridor is about 1.0 mile east of the town of Crescent Valley.			
	17.6	S29,30 T29N R48E	Eureka/Lander county line.	Airport Lease N56882					
	17.7	S29 T29N R48E		Road Right-of-Way N55118 Telephone Right-of-Way N2616 (underground), 10 ft.		Signaled Grade Crossing			
	20.0	S6 T28N R48E		Road Right-of-Way N52826, 60 ft.		Grade Separation			
	21.2	S12 T28N R47E		Telephone Right-of-Way N55672 (underground), 10 ft.		Signaled Grade Crossing			
	21.8	S12 T28N R47E		Powerline		Signaled Grade Crossing			

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Cortez 15' Reference: Q-45 MTP-51 MTP-52 MTP-53 MTP-54 MTP-55 ***Plate 2:*** A4	27.0	T27N R47E	Corridor passes between Cortez and Gold Acres mining operations.						
	28.5	S8 T27N R47E		Telephone Right-of-Way N7808, 30 ft. Road Right-of-Way N43670, 50 ft.		Signaled Grade Crossing			
	28.8	S8 T27N R47E		Telephone Right-of-Way N30650, 10 ft.		Signaled Grade Crossing			
	31.0	S13 T27N R47E			One small unevaluated archaeological site within corridor.				
Carico Lake 15' Reference: Q-46 MTP-56 ***Plate 2:*** A3	33.5	S26 T27N R46E	Vicinity Rocky Pass	Telephone Right-of-Way N30650, 10 ft.					
				Mining Patent					
	35.8	S3 T26N R46E				Signaled Grade Crossing			2% Upgrade
	46.0	S20 T25N R46E	Dry Canyon Summit						Top of Grade
									2% Downgrade
	49.0	S33 T25N R46E	Dry Canyon Spring						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Hall Creek 15' Reference: Q-47 ***Plate 2:*** B3, C3	56.0	S3 T23N R46E		Fence	Several Unevaluated archaeological sites at various springs within corridor.		Route crosses a series of alluvial fans.		
Walti Hot Springs 15' Reference: Q-48 ***Plate 2:*** B4, C4	64.0	T22N R46E		Withdrawal, N378, Desert Land Entry. Beginning of split corridor.	One large unevaluated archaeological site at quarry within corridor.				
Ackerman Canyon 15' Reference: Q-49 ***Plate 2:*** D4	66.0	T22N R46E		Mining Patent, State Selection					
	69.0	S11 T21N R46E			Very significant Burial ground near ranch within corridor.				
Mount Callaghan 15' Reference: Q-50 MTP-57 MTP-58 MTP-59 MTP-60 MTP-61 MTP-62 ***Plate 2:*** D2, D3, E3, E4	70.0	S3 T21N R46E		Corridor is split for approximately 15 miles due to private lands.	Large unevaluated archaeological site, 2.0 miles long, along creek extending into corridor.				
	72.0	S9,10,16 T21N R46E	Grass Valley Ranch			Corridor passes within 1.0 mile of ranch.			
	75.5	S29 T21N R46E				Signaled Grade Crossing			
	79.0	S7 T20N R46E		End of split corridor					2% Upgrade
	81.0	S18 T20N R45E	Rye Patch Canyon Summit						Top of Grade

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
	83.0	S25 T20N R45E		Powerline Right-of-Way N5253, 125 ft.	One significant archaeological site within corridor 0.5 mile east of high point in section 25.				
Spencer Hot Springs 15' *Plate 3:* A2, A3, B2	88.0	S24 T19N R45E	*Match point for either Big Smoky Valley Alternate or Monitor Valley Alternate.*	Powerline Right-of-Way N25341, 140 ft. Telephone Row N51021, 15 ft. Comm Site N51021					

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Route Section Description

Carlin Route, *Big Smoky Valley Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Spencer Hot Springs 15' References: Q-51 MTP-63 MTP-64 MTP-65 MTP-66 MTP-67 *Plate 3:* A2, A3, B2	0.00	S24 T19N R45E	Match point for Crescent Valley Section.	Road Row NEV042796, 200 ft.					
	0.5	S24 T19N R45E	Pony Express Trail		Pony Express Trail is a historical crossing.				
	4.0	S1,2 T18N R45E		Road Row N7219, 66 ft. Well N39525	One significant archaeological site within corridor.				
	7.4	S27 T18N R45E				Signaled Grade Crossing			
	10.4	S10 T17N R45E				Signaled Grade Crossing			
Wildcat Peak 15' Reference: Q-52 *Plate 3:* C2, D2	24.3	S17 T15N R45E	Lander/Nye county line	Fence			Route crosses a long series of alluvial fans.		
Millett Ranch 15' References: Q-53 MTP-68 *Plate 3:* D1				Road Right-of-Way N6971, 70 ft.					

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Carvers, NE 7.5' Reference: Q-54 ***Plate 3:*** E1	45.0	S18 T12N R44E		Withdrawal N37187, Desert Land Entry Withdrawal N37189, Desert Land Entry		Signaled Grade Crossing			
Carvers SE 7.5' References: Q-55 MTP-69 MTP-70 MTP-71 MTP-72 ***Plate 4:*** A5	53.0	S24 T11N R43E		Withdrawal N37188, Desert Land Entry Powerline Right-of-Way N25341, 140 ft. Withdrawal R-0345 Road Right-of-Way N39967, 80 ft. Flume Right-of-Way N39891, 10 ft.					
Carvers 7.5' References: Q-56 MTP-73 MTP-74 ***Plate 4:*** A4	56.5	S3 T10N R43E				Grade Separation, Highway 376			

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Pablo Canyon Ranch 7.5' Reference: Q-57 *Plate 4:* B4	59.0	S20 T10N R43E		Corridor is split for approximately 10 miles due to the town of Hadley, the Hadley Airport and private lands. West Leg: Powerline Right-of-Way NEV064717, 30 ft. Pipeline Right-of-Way CC09123, 100 ft. Powerline Right-of-Way N55147, 250 ft. Powerline Right-of-Way N11777, 25 ft. Pipeline Right-of-Way N46556, 50 ft. Road Right-of-Way N46508, 100 ft. Withdrawal N39765, Desert Land Entry		Grade Separation			
	61.0	S28 T10N R43E		Withdrawal N53593, Desert Land Entry East Leg: Right-of-Way N54310, 12 ft. Powerline Right-of-Way N55147, 250 ft Pipeline Right-of-Way N45089 (underground), 50 ft. Powerline Right-of-Way N11777, 25 ft. Telephone Right-of-Way N46314 (underground), 100 ft. Road Right-of-Way N46508, 100 ft.		Corridor is within 1.0 mile of city of Hadley.			

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Round Mountain 7.5' References: Q-58 MTP-75 ***Plate 4:*** B5	61.5	S29 T10N R43E		Powerline Right-of-Way N25341, 40 ft. Recreation and Public Purposes Lease, N34726 Road Right-of-Way N53177, 60 ft. Highway Right-of-Way CC020778 Telephone Right-of Way N33405, 20 ft. Road Right-of Way N54310, 12 ft. Flume Right-of-Way N54310, 15 ft. Pipeline Right-of-Way N45089 (underground), 50 ft. Powerline Right-of-Way N55247, 250 ft.	Jett Canyon Pipeline is a significant historical site across corridor.	Signaled Grade Crossing			
	63.0	S5 T9N R43E							
Seyler Peak 7.5' References: Q-59 MTP-76 MTP-77 MTP-78 ***Plate 4:*** C4	72.5	S24 T8N R42E				Signaled Grade Crossing			
San Antonio Ranch 15' References: Q-60 MTP-79 MTP-80 MTP-81 ***Plate 4:*** D3, E3	85.0	S11 T6N R41E	Match point for Klondike Alternate.						

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Route Section Description
Carlin Route, *Klondike Alternate*

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
San Antonio Ranch 15' *Plate 4:* D3, E3	0.00	S11 T6n R41E	Match point for either Big Smoky Valley Alternate or Baxter Springs Alternate.						
Baxter Spring 15' References: Q-61 MTP-82 MTP-88 *Plate 4:* D4, D5, E4, E5	2.0	S23 T6N R41E			One significant archaeological site within corridor				
	16.5	S35 T4N R41E				Grade Separation			
	16.7	S35T4N R41E	Nye/Esmeralda county line				Route crosses a long series of alluvial fans.		
Lone Mountain 15' References: Q-62 MTP-89 MTP-90 MTP-91 MTP-92 MTP-93 *Plate 6:* A2, B2	18.3	S11 T3N R41E		Highway Right-of-Way CC018394, 400 ft. Telephone Right-of-Way CC021488, 40 ft. Powerline Right-of-Way NEV043264, 60 ft. Powerline Right-of-Way N33242, 75 ft.	One unevaluated archaeological site within corridor.				
	20.6	S24 T3N R41E				Grade Separation			
	23.2	S1 T2N R41E			Old railroad grade is a significant historical site crossing corridor.				

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Klondike 7.5' References: Q-63 MTP-94 MTP-95 *Plate 6:* C2	31.1	S10 T1N R42E		Powerline Right-of-Way NEV043264, 50 ft. Highway Right-of-Way N10914		Grade Separation			
	33.5	S24 T1N R42E	Vicinity Klondike						
Mud Lake 15' References: Q-64 MTP-96 MTP-97 MTP-123 MTP-124 MTP-125 MTP-126 MTP-127 *Plate 6:* C3, C4, D3, D4	35.0	S25 T1N R42E		Telephone Right-of-Way CC021489, 40 ft. Powerline Right-of-Way CC020795, 400 ft.	Significant archaeological site within corridor in mining area.		Route passes through rugged area with high cuts and fills.		
	38.5	S4 T1S R42E	Esmeralda/Nye county line						
	39.5	S9 T1S R42E	Match point for Goldfield Section.						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Spencer Hot Springs 15' ***Plate 3:*** A2, A3, B2	0.0	S26 T19N R45E	*Match point for Crescent Valley Section.*						
	6.0	S35 T19N R45E, S1,12,13 24 T18N R45E	Adjacent to Overland Express Route		One significant site in Rye Patch Canyon.				
	8.0	T18N R46E	South end of Cape Horn (Simpson Park Mountains)	Material Site NEV044851	Overland Stage Station near Cape Horn is eligible for National Register of Historic Places.				
	13.5	T18N R46E	Cross Highway 50	Highway Right-of Way NEV042796, 200 ft.		Route parallels Highway 50 from Cape Horn to grade separation at east edge of Spencer Hot Springs Quad.	Extensive earthwork and rock excavation required for 5.5 miles.	130 linear foot bridge.	
Hickison Summit 15' References: Q-65 MTP-98 MTP-99 MTP-100 MTP-101 MTP-102 MTP-103 ***Plate 3:*** A4, B4	18.0	T18N R46E	Summit of Toquima Range	Road Right-of-Way NEV042778, 400 ft.	Significant petroglyph site north of the highway near Hickison Summit must be avoided.		Extensive earthwork and rock excavation required for 8.5 miles over Toquima Range.		
	22.0	T17 N R47E	East foot of Toquima Range						
Dianas Punch Bowl 15' References: Q-66 MTP-104 MTP-105 MTP-106 ***Plate 3:*** C4, D4	39.5	S35 T15N R47E	Potts Ranch Vicinity		Monitor Ranch is eligible for National Register of Historic Places.	Signaled crossing of Highway 82.		Two major drainage structures	
	43.7	S21 T14N R47E	Dianas Punch Bowl Vicinity		Significant site at Dianas Punch Bowl hot springs.				

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Box Spring 7.5' References: Q-67 MTP-107 MTP-108 MTP-109 MTP-110 *Plate 3:* E4	49.5	T13N R47E	West of Dry Lake		Two large "no-record" sites and several small "no-record" sites.	Two signaled crossings of Highway 82.		Two major drainage structures.	
Mosquito Creek 7.5' References: Q-68 *Plate 5:* A3	60.0	S1 T11N R47E	Mosquito Creek secondary road crossing		Two unevaluated sites in Mosquito Creek area.				
Pine Creek Ranch 7.5' References: Q-69 *Plate 5:* A2	65.0	S26,35 T11N R46E	Pine Creek Ranch secondary road crossings						
Corcoran Canyon 7.5' References: Q-70 MTP-111 MTP-112 *Plate 5:* B2	70.0	T10N R46E	Stone House Ranch secondary road crossing	Application N27690, Desert Land Entry Road Right-of-Way N6926, 60 ft.					
Belmont East 7.5' References: Q-71 MTP-113 MTP-114 MTP-115 MTP-116 *Plate 5:* C2	74.0	S18 T9N R46E	East of Black Butte			Signaled crossing		Three major drainage structures.	
	80.0	S24 T8N R45E	*Match point for either Baxter Spring Alternate or Ralston Valley Alternate.*				Extensive earthwork required for 2.5 miles in the Horse Heaven Summit area.		

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Belmont East 7.5' ***Plate 5:*** C2	0.0	S24 T8N R45E	*Match point for Monitor Valley Alternate.*	Application N36381, Desert Land Entry Application N34295, Desert Land Entry Application N34294, Desert Land Entry Application N36210, Desert Land Entry Application N36211, Desert Land Entry					
	2.5	S14 T8N R45E	Monarch site vicinity		Town site of Monarch is an unevaluated site. Section 17 is an unevaluated site.				
Big Ten Peak West 7.5' References: Q-72 MTP-117 MTP-118 ***Plate 5:*** D1	13.0	T7N R45E	North of Big Ten Well	Application N30010, Desert Land Entry Application N30009, Desert Land Entry		Cross Highway 82-Signaled Grade Crossing		130 lineal foot bridge and five major drainage structures.	
	14.0	T7N R45E	West of Big Ten Well Vicinity						
Baxter Spring 15' ***Plate 4:*** D4, D5, E4, E5	25.0	S16 T6N R43E	Highway 8A			Cross Highway 8A-Signaled Grade Crossing	Route crosses a series of alluvial fans at south end of Toquima Range	Cut through alluvial fan will require culverts and erosion protection measures 130 lineal foot bridge and one major drainage structure.	
San Antonio Ranch 15' ***Plate 4:*** D3, E3	37.0	S27 T5N R41E	*Match point for Klondike Alternate.*	Powerline Right-of-Way N25341, 140 ft. Powerline Right-of-Way NEV043264, 100ft. Powerline Right-of-Way N33242, 75 ft.			Route crosses a series of alluvial fans at north end of San Antonio Mountains	Cut through alluvial fan will require culverts and erosion protection measures	

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Belmont East 7.5' *Plate 5:* C2	0.0	S24 T8N R45E	*Match point for Monitor Valley Alternate.*						
	2.5	S14 T8N R45E	Monarch site vicinity		Town site of Monarch is an unevaluated site. Section 17 is an unevaluated site.	One signaled road crossing			
Big Ten Peak West 7.5' *Plate 5:* D1	8.5	T7N R45E	Hunts Canyon					200 lineal foot bridge and one major drainage structure.	
	13.0	T7N R45E	East of Big Ten Well						
Baxter Spring 15' *Plate 4:* D4, D5, E4, E5	26.0	S28, T4N R44E	West of Thunder Mountain	Telephone Right-of-Way N4213, 20 ft. Pipeline Right-of-Way R-0240, 10 ft. Highway Right-of-Way CC020465, 400 ft.					
Tonopah 15' References: Q-73 MTP-119 MTP-120 MTP-121 MTP-122 *Plate 6:* A4, B4	38.0	S34, T3N R44E	Cross US 6	Powerline Right-of-Way NEV061459, 30 ft. Powerline Right-of-Way N32741 (underground), 10 ft. Powerline Right-of-Way NEV048554, 25 ft.		Grade separation at US 6		130 lineal foot bridge drainage structure.	
Mud Lake 15' *Plate 6:* C3, C4, D3, D4	55.0	S9, T1S R42E	*Match point for Goldfield Section.*		Significant sites north of Mud Lake, see discussion in Caliente description.				

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Caliente 7.5' References: Q-1 *Plate 10:* E4	0.0		Caliente		Abandoned U.P. roadbed is an unevaluated site.	Route is within 0.1 mile of Nevada Girls Training Center.	Use roadbed of abandoned U.P. Pioche Branch along bottom of canyon formed by Meadow Valley Wash.		Connection with Union Pacific (to passing siding).
	0.5		Road to Nevada Girls Training Center			Signaled Grade Crossing. Route is within 0.1 mile of housing areas and within 0.2 mile of hospital.		Bridge up to 150' long. (Clover Creek)	
	0.8		1st crossing, Meadow Valley Wash			Route is parallel to and approx. 100' from Hwy. 93.		Bridge up to 170' long.	
Chief Mountain 7.5' References: Q-2 *Plate 10:* D4	1.3	S5 T4S R67E	2nd crossing, Meadow Valley Wash					Bridge up to 200' long.	
Indian Cove 7.5' References: Q-3 MTP-1 MTP-2 *Plate 10:* D5	3.2	S28 T3S R67E	3rd crossing, Meadow Valley Wash	Fence				Bridge up to 150' long.	Bridge on sharp curve.
	3.3	S28 T3S R67E	4th crossing, Meadow Valley Wash					Bridge up to 150' long.	
	3.6	S28 T3S R67E	5th crossing, Meadow Valley Wash					Bridge up to 150' long.	
	7.0	S11 T3S R67E	Small wash	Fence		Route is roughly parallel to Hwy. 93, distance varies from 100' to 1500'.	Use roadbed of abandoned U.P. Pioche Branch across Meadow Valley.	Bridge up to 75' long.	
	8.2	S2 T3S R67E	Branch of Meadow Valley Wash		Significant site near west corridor boundary.			Bridge up to 150' long.	
					Abandoned U.P. roadbed is an unevaluated site.				
	10.5	S25 T2S R67E	Branch of Meadow Valley Wash					Bridge up to 600' long.	

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Panaca 7.5' References: Q-4 MTP-1 *Plate 10:* C5	10.9	S25 T2S R67E	Hwy. 93	Telephone Right-of-Way N43923 (underground), 10 ft.		Grade Separation			
							Route ascends Chief Range generally along south side of Bennett Springs Wash, using a loop in upper hills to gain elevation.		2.2 % upgrade. Some sharp curves.
Bennett Pass 7.5' References: Q-5 MTP-3 *Plate 10:* C4		S7 T2S R67E			Unevaluated site near Bennett Springs.				
		S36 T1S R66E			Unevaluated site near west corridor boundary.				
	22.2		Bennett Pass	Telephone Right-of-Way N43923 (underground), 10 ft. Powerline Right-of-Way CC020073, 100 ft.			Route passes between Chief and Highland Ranges.		
									2.0 % downgrade.
Bennett Pass 7.5'	27.4	S13 T2S R65E	Black Canyon					Bridge up to 200' long.	
The Bluffs 7.5' References: Q-7 MTP-3 MTP-5 MTP-12 *Plate 10:* C3									
Deadman Spring SE 7.5' References: Q-6 MTP-4 MTP-5 *Plate 10:* C2	35.1	S24 T1S R64E	Coyote Wash	Fence			Route is nearly straight across Dry Lake Valley.	Bridge up to 500' long.	
	35.6	S23 T1S R64E	Branch of Coyote Wash					Bridge up to 500' long.	
	37.3	S22 T1S R64E	Small wash					Bridge up to 300' long.	

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Deadman Spring NE 7.5' References: Q-8 MTP-6 *Plate 10:* B2				Fence Fence Pipeline Right-of-Way 4070					2.3 % upgrade.
	47.1		Summit	Pipeline Right-of-Way 4070	Significant site near Black Rock Spring.		Pass through North Pahroc Range.		
Deadman Spring 7.5' References: Q-9 MTP-7 MTP-8 MTP-9 MTP-10 *Plate 10:* B1					Two large significant sites on the west side of the White River, approx. 3 to 6 miles south of potential bridge site.		Extensive earthwork; cuts and fills range up to 60'.		1.6 % downgrade. Shifting the potential site of the White River bridge further south would increase grade to as much as 2.0 %.
Silver King Mtn. SW 7.5' References: Q-10 MTP-11 *Plate 10:* A1	54.0	S19 T2N R63E	Hwy. 318	Highway Right-of-Way N43923, 400 ft.		Grade Separation			
	54.4	S19 T2N R63E	White River	Road Right-of-Way N14148, 60 ft Material Site.				Bridge up to 400' long. Location up to 1.5 miles further south may offer better bridge site and improved route profile to west.	
Timber Mtn. Pass East 7.5' References: Q-11 MTP-13 MTP-14 *Plate 9:* D5	58.7	S34 T3N R62E	Lincoln / Nye County Line						
		S32 T3N R62E		Fence					2.3 % upgrade. Grade could be reduced to 2.0 % by shifting potential site of the White River bridge further south.
		T3N R61E		Road Right-of-Way N53636, 40 ft.					

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Timber Mtn. Pass West 7.5'	66.2		Timber Mtn. Pass	Road Right-of-Way N53636, 40 ft.			Pass through Seaman Range.		
References: Q-12 MTP-15 ***Plate 9:*** D4				Fence					2.4 % downgrade. Grade could be reduced to 2.0 % by adding distance through larger loops.
Water Gap East 7.5'	77.0		Small wash	Fence			Coal Valley	Bridge up to 300' long.	
References: Q-13 MTP-16 MTP-17				Road Right-of-way N53636, 40 ft.					2.2 % upgrade.
MTP-18 ***Plate 9:*** D3	81.9		Summit	Road Right-of-Way N57490, 60 ft. Fence			Pass through Golden Gate Range. Alternate route approx. 4 miles to the south through Water Gap would reduce grades.		
Water Gap West 7.5'							Route nearly straight across Garden Valley.		2.2 % downgrade.
References:	84.0		Small wash					Bridge up to 500' long.	
Q-14	87.6		Cherry Creek					Bridge up to 200' long.	
MTP-19	88.9		Sand Creek					Bridge up to 200' long.	
Plate 9: D2	89.3		Nye / Lincoln County Line	Pipeline Right-of-Way 4137					
Wadsworth Ranch 7.5'	90.4		Pine Creek	Pipeline Right-of-Way/Reservoir 4137				Bridge up to 400' long.	
References: Q-15 MTP-20 ***Plate 9:*** D1	93.4		Cottonwood Creek	Pipeline Right-of-Way 4026			Route nearly straight across Garden Valley.	Bridge up to 300' long.	
Worthington Peak 7.5'	94.8	S32 T2N R57E	Barton Creek	Pipeline Right-of-Way 4026				Bridge up to 300' long.	
References: Q-16 MTP-16 MTP-17 ***Plate 9:*** E1		S1, 12 T1N R56E		Oil/Gas Lease					1.5 % upgrade.

* Cumulative Mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
McCutchen Spring 7.5' References: Q-17 MTP-16 MTP-21 MTP-22 *Plate 8:* B5	100.5	S11 T1N R56E	Summit	Oil/Gas Lease N52646 Oil/Gas Lease N52649 Oil/Gas Lease N52648 Oil/Gas Lease N52650 Oil/Gas Lease N52651			Route passes between Quinn Canyon Range and Worthington Mountains.		
									2.2 % downgrade.
	105.2	S19 T1N R56E	Davis Creek				Route nearly straight along northwest side of Sand Spring Valley.	Bridge up to 300' long.	
Quinn Canyon Springs 7.5' References: Q-18 MTP-22 *Plate 8:* B4	109.0	S28 T1N R55E	Quinn Canyon Creek					Bridge up to 500' long.	
Honest John Well 7.5' References: Q-19 MTP-23 *Plate 8:* C4									
Black Top 7.5'	116.7		Lincoln / Nye County Line						
Q-20	119.0		Summit		Unevaluated site near southern corridor boundary.		Pass through Quinn Canyon Range.		
MTP-24 *Plate 8:* C3				Fence			Railroad Valley		1.4 % downgrade.
	124.3	S10 T2S R53E	Hwy. 375	Material Site	Two unevaluated sites near potential grade separation.	Grade Separation			

* ...tive Mileage figures are approximate and refer to this route section only; mileage betw... ...oining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Reveille Peak 15' References: Q-21 MTP-25 MTP-26 MTP-27 MTP-28 MTP-29 MTP-30 MTP-31 *Plate 8:* B1, C1, C2				Potential track location is within 2.5 miles of Nellis Air Force Range boundary. Pipeline Right-of-Way 0641 Pipeline Right-of-Way 04976 Pipeline Right-of-Way 4717		Potential track location is parallel to and within 0.1 mile of secondary roads for a total of approx. 32 miles.			
	135.2	T2S R50E	Small wash					Bridge up to 400' long.	
		T1S R52E			Unevaluated site near BM 5926.				
Kawich Peak 15' References: Q-22 MTP-32 MTP-33 MTP-34 MTP-35 MTP-36 *Plate 7:* C4, C5, D4				Pipeline Right-of-Way 4976 Pipeline Right-of-Way 4717 Pipeline Right-of-Way 0659			Route is largely straight through Reveille Valley.		

* Cumulative Mileage figures are approximate and refer to this route section only; mileage between adjoining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Warm Springs 15' References: Q-23 MTP-37 MTP-38 MTP-39 MTP-40 MTP-41 MTP-42 *Plate 7:* A4, A5, B4, B5		S22 T2N R50E			Reveille Mill is an unevaluated site.				
	163.2	T3N R50E	Cow Canyon					Bridge up to 500' long.	
				Pipeline Right-of-Way 0668 Pipeline Right-of-Way 0139					2.3 % upgrade.
	169.2	T4N R49E	Summit			Potential track location is parallel to and within 0.1 mile of Hwy. 6 for approx. 1.0 mile.	Route passes between Kawich and Hot Creek Ranges.		
					Clifford mine is an unevaluated site.				2.0 % downgrade.
Stone Cabin Ranch SE 7.5' References: Q-24 *Plate 7:* B3	178.0	S26 T3N R48E	Branch of Bellehelen Canyon Creek	Pipeline Right-of-Way R3523				Bridge up to 400' long.	
Stone Cabin Ranch SW 7.5' References: Q-25 *Plate 7:* B2	182.9	S8 T2N R48E	Haws Canyon Creek			Potential track location is parallel to and within 0.1 mile of secondary road for approx. 9.0 miles.	Route nearly straight across Stone Cabin Valley.	Bridge up to 600' long.	
Stinking Spring 15' References: Q-26 MTP-123 MTP-124 MTP-125 MTP-126 *Plate 7:* C2, C3				Flightline Right-of-Way NEV052668, 400 ft.					
		S30 T1N R47E		Communications Site/Access Road Right-of-Way N26253 Pipeline Right-of-Way N26253 Powerline Right-of-Way N4436, 40 ft.	Unevaluated site within corridor.		Cactus Flat		

* [illegible]tive Mileage figures are approximate and refer to this route section only; mileage b[illegible]oining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Cactus Peak 15' References: Q-27 *Plate 6:* C5		S19 T1N R46E			Reeds Ranch is a significant site.				
	199.1		Large unnamed wash from northern Cactus Flat					Bridge up to 1000' long.	
	199.8		Small wash					Bridge up to 400' long.	
				Potential track location is within 0.5 mile of Nellis Air Force Range boundary. Flightline Right-of-Way NEV052668, 400 ft. Powerline Right-of-Way N33242, 75 ft.					
Mud Lake 15' *Plate 6:* C3, C4, D3, D4	208.6		Large unnamed wash from northeastern Ralston Valley				Route traverses Ralston Valley using flat curves and long tangents, passing north and west of Mud Lake.	Bridge up to 700' long.	
		T1N R44E T1N R43E			Several very significant sites within 2.0 miles of north end of Mud Lake.				
	219.6	S9 T1S R43E	Match point for Goldfield Section.						

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
	0.0	S9 T1S R43E	Match point for either Reveille Section (Caliente Route) or Klondike / Ralston Valley Sections (Beowawe Route).	Mining Patent (Irregular Shape), east edge of main route.			Alternate corridor 4 to 7 miles to the east would avoid high summit near Espina Hill, reducing grades to less than 1.5 %, but would penetrate Nellis Air Force Range up to 3.5 miles over a distance of approx. 14 miles.		2.3 % upgrade.
Mud Lake 15'		S28 T2S R43E			Significant site at Tagnani Springs.				
Plate 6: C4, C5, D3, D4	9.9	S34 T2S R43E	Summit near Espina Hill			Potential track location is within 4.0 miles of Goldfield.			
		S2 T3S R43E		Five Mining Patents (Irregular Shape)	Significant site at Willow Springs.				2.4 % downgrade. Some sharp curves.
		S5,8 T3S R44E			Six unevaluated sites within alternate corridor.				
	21.3	S22 T4S R43E	Small unnamed wash from Chispa Hills				Stonewall Flat	Bridge up to 200' long.	
Gold Field 15' References: Q-28 MTP-127 MTP-128 MTP-129 MTP-130 MTP-131 *Plate 11:* A2, A3									
Stonewall Pass 7.5' References: Q-29 MTP-132 *Plate 11:* B2					Old railroad grades are unevaluated sites. Significant site along lakebed near highway.		Lida Valley		
Scottys Junction NE	33.0	T6S R43E	Large unnamed wash from Lida Valley		Old railroad grades are unevaluated sites.			Bridge up to 1200' long.	
References: *Plate 11:* B3	34.7	T6S R43E	Summit						

* ...tive Mileage figures are approximate and refer to this route section only; mileage be... ining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Scottys Junction 7.5' Reference: Q-31 MTP-133 MTP-134 MTP-135 ***Plate 11:*** C4		T7S R43E		Material Sites Telephone Right-of-Way CC021488, 40 ft. Powerline Right-of-Way NEV066116, 20 ft. Powerline Right-of-Way N1614, 20 ft.					2.0 % downgrade.
	40.9	S17 T7S R44E	Large unnamed wash from upper Sarcobatus Flat	Powerline Right-of-Way NEV0665524, 200 ft.		If routed west of Hwy. 95, potential track location is within 1.5 miles of both Hwy. 95 and occupied housing. If routed through Nellis Air Force Range, track location is within 1.0 mile of housing and 2.0 miles of Hwy. 95.	Route is nearly straight across Sarcobatus Flat. Two route corridors are possible, one on either side of Hwy. 95. These corridors avoid private lands and housing throughout the 4 milestretch south of Scottys Junction. The corridor west of the Hwy. 95 requires an *(continued on next page)*	Bridge up to 1300' long.	
		S32 T7S R44E			Small unevaluated site.				
Bonnie Claire 7.5' References: Q-32 ***Plate 11:*** D3		S34 T8S R44E			Small unevaluated site.				
Tolicha Peak 15' References: Q-32 MTP-136 MTP-137 ***Plate 11:*** C4									

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Springdale 15' References: Q-33 MTP-138 MTP-139 MTP-140 MTP-141 MTP-142 ***Plate 11:*** D4, D5, E5	49.1	T8S R44E	Hwy. 95	Telephone Right-of-Way CC02148, 40 ft. Powerline Right-of-Way NEV 066116, 20 ft. Material Site Powerline Right-of-Way NEV065524, 200 ft.		Grade Separation	*(cont. from previous page)* additional grade separation (at mileage 43.1), over Hwy. 72. The corridor east of Hwy. 95 penetrates the Nellis Air Force Range a maximum of 3.0 miles over a distance of approx. 17 miles, and would potentially avoid the two grade separations over Hwy. 95 as well as over Hwy. 72.		
	50.6	T8S R45E	Tolicha Wash	Fence Numerous Material Sites				Bridge up to 500' long.	
	55.4	T9S R45E	Hwy. 95	Road Right-of-Way N47795, 60 ft. Telephone Right-of-Way N24739, 20 ft. Road Right-of-Way N47795, 30 ft. Powerline Right-of-Way NEV065524, 200 ft.	Small unevaluated site near potential grade separation.	Grade Separation			
Thirsty Canyon 15' References: Q-34 MTP-143 MTP-144 MTP-145 ***Plate 12:*** C1	70.2	S22 T10S R47E	Thirsty Canyon Wash	Powerline Right-of-Way NEV065524, 200 ft.				Bridge up to 1200' long.	
				Powerline Right-of-Way N57777, 20 ft. Road Right-of-Way N52809, 30 ft.		Potential track location is within 2.0 miles of housing along upper Amargosa River.			

* C[illegible]ative Mileage figures are approximate and refer to this route section only; mileage betwe[illegible]ining route sections is not contiguous.

USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Bare Mtn. 15' References: Q-35 MTP-146 MTP-147 MTP-148 MTP-149 MTP-150 MTP-151 MTP-152 *Plate 12:* D1, D2, E2	78.9	T11S R48E	Beatty Wash		Small unevaluated site along bottom of wash near west edge of corridor.			Bridge up to 300' long.	
							Route is very circuitous in ascent to summit, involving large loop to increase distance and reduce grade.		2.0 % upgrade. Many sharp curves.
	81.9	T11S R48E	Summit			Potential track location is within 7.0 miles of Beatty.			
							Route is very circuitous in northern portion of Crater Flat. Descent from summit involves several large loops to increase distance and reduce grade. Alternate corridor area, which clips corner of Nellis Air Force Range for approx 4 miles, would facilitate an alignment approx. 8.5 miles shorter.		1.8 % downgrade. Many sharp curves.
Big Dune 15' References: Q-36 MTP-153 MTP-154 *Plate 13:* A1	105.3	T14S R49E	Southern tip of Yucca Mtn.			Potential route is approx. 4.5 miles from Hwy. 95.	Route around southern tip of Yucca Mtn.		Undulating profile with grades up to 2.2 %. Some sharp curves.
Lathrop Wells 15' References: Q-37 MTP-219 MTP-220 MTP-221 MTP-222 *Plate 13:* A2, A3, B2, B3	109.2	T14S R49E	Enter Nevada Test Site.	Nevada Test Site.					

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USGS Quadrangle	Cuml. Miles *	Sec Twp Rng	Location Description	Land-Use Constraints	Archaeological & Historical Sites	Road Crossings & Proximity to Population	Topographic Considerations	Bridges & Hydrologic Considerations	Operating Considerations
Topopah Spring 15' References: Q-38 MTP-155 MTP-223 ***Plate 12:*** E3, E4					Numerous significant sites, primarily on terraces along Fortymile Wash.		Route along west side of Fortymile Wash, close to base of hills to avoid archaeological sites.		2.2 % maximum upgrade. Some sharp curves.
	117.4		Road to Repository Site from Hwy. 95.			Signaled Grade Crossing	Route through gap in hills 1.0 mile east of North Portal.		
	118.5		Repository Site (North Portal)						

* C[illegible]tive Mileage figures are approximate and refer to this route section only; mileage betwe[illegible]ining route sections is not contiguous.

APPENDIX D

RAIL COSTS

RAIL BRANCHLINE ALTERNATIVES - PRELIMINARY COST ESTIMATES

9/20/95

(All costs are in Millions of $)

PAGE 1

		JEAN ROUTE via Wilson Pass/N. Pahrump RTE LENGTH 114				JEAN ROUTE via Wilson Pass/Stewart Valley RTE LENGTH 118.5				JEAN ROUTE via State Line Pass/N. Pahrump RTE LENGTH 122				JEAN ROUTE via State Line Pass/Stewart Valley RTE LENGTH 126.5				VALLEY MOD. ROUTE via Indian Hills Alternate RTE LENGTH 98			
YEAR	ESCALATION FACTOR	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)
2004	1.372																				
2005	1.413	7.86		7.86	11.11	7.83		7.83	11.07	8.11		8.11	11.46	8.07		8.07	11.41	4.97		4.97	7.02
2006	1.456	7.86		7.86	11.44	7.83		7.83	11.40	8.11		8.11	11.81	8.07		8.07	11.75	4.97		4.97	7.23
2007	1.499	7.86		7.86	11.78	7.83		7.83	11.74	8.11		8.11	12.16	8.07		8.07	12.10	4.97		4.97	7.45
2008	1.544	210.60		210.60	325.20	209.79		209.79	323.95	217.34		217.34	335.61	216.22		216.22	333.88	133.14		133.14	205.59
2009	1.590	210.60		210.60	334.95	209.79		209.79	333.67	217.34		217.34	345.67	216.22		216.22	343.89	133.14		133.14	211.76
2010	1.638		1.85	1.85	3.03		1.86	1.86	3.05		1.87	1.87	3.06		1.88	1.88	3.08		1.77	1.77	2.90
2011	1.687		1.85	1.85	3.12		1.86	1.86	3.14		1.87	1.87	3.16		1.88	1.88	3.17		1.77	1.77	2.99
2012	1.738		1.85	1.85	3.22		1.86	1.86	3.23		1.87	1.87	3.25		1.88	1.88	3.27		1.77	1.77	3.08
2013	1.790		1.85	1.85	3.31		1.86	1.86	3.33		1.87	1.87	3.35		1.88	1.88	3.37		1.77	1.77	3.17
2014	1.844		1.85	1.85	3.41		1.86	1.86	3.43		1.87	1.87	3.45		1.88	1.88	3.47		1.77	1.77	3.26
2015	1.899		1.85	1.85	3.51		1.86	1.86	3.53		1.87	1.87	3.55		1.88	1.88	3.57		1.77	1.77	3.36
2016	1.956		1.85	1.85	3.62		1.86	1.86	3.64		1.87	1.87	3.66		1.88	1.88	3.68		1.77	1.77	3.46
2017	2.015		1.85	1.85	3.73		1.86	1.86	3.75		1.87	1.87	3.77		1.88	1.88	3.79		1.77	1.77	3.57
2018	2.075		1.85	1.85	3.84		1.86	1.86	3.86		1.87	1.87	3.88		1.88	1.88	3.90		1.77	1.77	3.67
2019	2.137		1.85	1.85	3.95		1.86	1.86	3.98		1.87	1.87	4.00		1.88	1.88	4.02		1.77	1.77	3.78
2020	2.202		1.85	1.85	4.07		1.86	1.86	4.09		1.87	1.87	4.12		1.88	1.88	4.14		1.77	1.77	3.90
2021	2.268		1.85	1.85	4.20		1.86	1.86	4.22		1.87	1.87	4.24		1.88	1.88	4.26		1.77	1.77	4.01
2022	2.336		1.85	1.85	4.32		1.86	1.86	4.34		1.87	1.87	4.37		1.88	1.88	4.39		1.77	1.77	4.13
2023	2.406		1.85	1.85	4.45		1.86	1.86	4.47		1.87	1.87	4.50		1.88	1.88	4.52		1.77	1.77	4.26
2024	2.478		1.85	1.85	4.58		1.86	1.86	4.61		1.87	1.87	4.63		1.88	1.88	4.66		1.77	1.77	4.39
2025	2.552		1.85	1.85	4.72		1.86	1.86	4.75		1.87	1.87	4.77		1.88	1.88	4.80		1.77	1.77	4.52
2026	2.629		1.85	1.85	4.86		1.86	1.86	4.89		1.87	1.87	4.92		1.88	1.88	4.94		1.77	1.77	4.65
2027	2.708		1.85	1.85	5.01		1.86	1.86	5.04		1.87	1.87	5.06		1.88	1.88	5.09		1.77	1.77	4.79
2028	2.789		1.85	1.85	5.16		1.86	1.86	5.19		1.87	1.87	5.22		1.88	1.88	5.24		1.77	1.77	4.94
2029	2.873		1.85	1.85	5.31		1.86	1.86	5.34		1.87	1.87	5.37		1.88	1.88	5.40		1.77	1.77	5.08
2030	2.959		1.85	1.85	5.47		1.86	1.86	5.50		1.87	1.87	5.53		1.88	1.88	5.56		1.77	1.77	5.24
2031	3.048		1.85	1.85	5.64		1.86	1.86	5.67		1.87	1.87	5.70		1.88	1.88	5.73		1.77	1.77	5.39
2032	3.139		1.85	1.85	5.81		1.86	1.86	5.84		1.87	1.87	5.87		1.88	1.88	5.90		1.77	1.77	5.56
2033	3.233		1.85	1.85	5.98		1.86	1.86	6.01		1.87	1.87	6.05		1.88	1.88	6.08		1.77	1.77	5.72
TOTAL		444.78	44.40	489.18	798.82	443.07	44.64	487.71	796.72	459.02	44.88	503.90	822.18	456.65	45.12	501.77	819.05	281.19	42.48	323.67	538.87

CAPITAL COSTS ARE BASED ON THE REVISED ESTIMATES USING THE STUDY 1 FORMAT AND UNIT COSTS
A FACTOR OF 1/1.038 IS USED TO CONVERT $1995 to $ 1994

RAIL BRANCHLINE ALTERNATIVES - PRELIMINARY COST ESTIMATES

9/20/95

(All costs are in Millions of $)

PAGE 2

		CALIENTE ROUTE via Base Route Option RTE LENGTH 338.1				CARLIN ROUTE via Big Smoky Valley RTE LENGTH 331				CARLIN ROUTE via Monitor & Ralston Valleys RTE LENGTH 338				CARLIN ROUTE via Monitor Valley & Klondike RTE LENGTH 363				VALLEY MOD. ROUTE via Cactus Springs Alternate RTE LENGTH 97.5			
YEAR	ESCALATION FACTOR	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)
2004	1.372																				
2005	1.413	18.10		18.103	25.58	16.08		16.082	22.73	16.35		16.35	23.11	18.15		18.1522	25.65	4.84		4.83698	6.84
2006	1.456	18.10		18.103	26.35	16.08		16.082	23.41	16.35		16.35	23.80	18.15		18.1522	26.42	4.84		4.83698	7.04
2007	1.499	18.10		18.103	27.14	16.08		16.082	24.11	16.35		16.35	24.51	18.15		18.1522	27.21	4.84		4.83698	7.25
2008	1.544	485.00		485	748.91	430.84		430.84	665.28	438.04		438.04	676.40	486.31		486.31	750.94	129.59		129.59	200.11
2009	1.590	485.00		485	771.38	430.84		430.84	685.24	438.04		438.04	696.69	486.31		486.31	773.47	129.59		129.59	206.11
2010	1.638		2.98	2.98	4.88		2.96	2.96	4.85		2.98	2.98	4.88		3.05	3.05	5.00		1.76	1.76	2.88
2011	1.687		2.98	2.98	5.03		2.96	2.96	4.99		2.98	2.98	5.03		3.05	3.05	5.15		1.76	1.76	2.97
2012	1.738		2.98	2.98	5.18		2.96	2.96	5.14		2.98	2.98	5.18		3.05	3.05	5.30		1.76	1.76	3.06
2013	1.790		2.98	2.98	5.33		2.96	2.96	5.30		2.98	2.98	5.33		3.05	3.05	5.46		1.76	1.76	3.15
2014	1.844		2.98	2.98	5.49		2.96	2.96	5.46		2.98	2.98	5.49		3.05	3.05	5.62		1.76	1.76	3.25
2015	1.899		2.98	2.98	5.66		2.96	2.96	5.62		2.98	2.98	5.66		3.05	3.05	5.79		1.76	1.76	3.34
2016	1.956		2.98	2.98	5.83		2.96	2.96	5.79		2.98	2.98	5.83		3.05	3.05	5.97		1.76	1.76	3.44
2017	2.015		2.98	2.98	6.00		2.96	2.96	5.96		2.98	2.98	6.00		3.05	3.05	6.15		1.76	1.76	3.55
2018	2.075		2.98	2.98	6.18		2.96	2.96	6.14		2.98	2.98	6.18		3.05	3.05	6.33		1.76	1.76	3.65
2019	2.137		2.98	2.98	6.37		2.96	2.96	6.33		2.98	2.98	6.37		3.05	3.05	6.52		1.76	1.76	3.76
2020	2.202		2.98	2.98	6.56		2.96	2.96	6.52		2.98	2.98	6.56		3.05	3.05	6.71		1.76	1.76	3.87
2021	2.268		2.98	2.98	6.76		2.96	2.96	6.71		2.98	2.98	6.76		3.05	3.05	6.92		1.76	1.76	3.99
2022	2.336		2.98	2.98	6.96		2.96	2.96	6.91		2.98	2.98	6.96		3.05	3.05	7.12		1.76	1.76	4.11
2023	2.406		2.98	2.98	7.17		2.96	2.96	7.12		2.98	2.98	7.17		3.05	3.05	7.34		1.76	1.76	4.23
2024	2.478		2.98	2.98	7.38		2.96	2.96	7.33		2.98	2.98	7.38		3.05	3.05	7.56		1.76	1.76	4.36
2025	2.552		2.98	2.98	7.61		2.96	2.96	7.55		2.98	2.98	7.61		3.05	3.05	7.78		1.76	1.76	4.49
2026	2.629		2.98	2.98	7.83		2.96	2.96	7.78		2.98	2.98	7.83		3.05	3.05	8.02		1.76	1.76	4.63
2027	2.708		2.98	2.98	8.07		2.96	2.96	8.01		2.98	2.98	8.07		3.05	3.05	8.26		1.76	1.76	4.77
2028	2.789		2.98	2.98	8.31		2.96	2.96	8.26		2.98	2.98	8.31		3.05	3.05	8.51		1.76	1.76	4.91
2029	2.873		2.98	2.98	8.56		2.96	2.96	8.50		2.98	2.98	8.56		3.05	3.05	8.76		1.76	1.76	5.06
2030	2.959		2.98	2.98	8.82		2.96	2.96	8.76		2.98	2.98	8.82		3.05	3.05	9.02		1.76	1.76	5.21
2031	3.048		2.98	2.98	9.08		2.96	2.96	9.02		2.98	2.98	9.08		3.05	3.05	9.29		1.76	1.76	5.36
2032	3.139		2.98	2.98	9.35		2.96	2.96	9.29		2.98	2.98	9.35		3.05	3.05	9.57		1.76	1.76	5.52
2033	3.233		2.98	2.98	9.63		2.96	2.96	9.57		2.98	2.98	9.63		3.05	3.05	9.86		1.76	1.76	5.69
TOTAL		1024.3	71.52	1095.8	1767.43	909.92	71.04	980.96	1587.7	925.13	71.52	996.65	1612.57	1027.1	73.2	1100.28	1775.7	273.69	42.24	315.931	526.603

CAPITAL COSTS ARE BASED ON THE REVISED ESTIMATES USING THE STUDY 1 FORMAT AND UNIT COSTS

A FACTOR OF 1/1.038 IS USED TO CONVERT $1995 to $ 1994

COMPARISON OF ROUTE ALTERNATES - JEAN ROUTE
FY95$

YMP TRANSPORTATION STUDY 2
ANNUAL OPERATING & MAINTENANCE COSTS

Description		Unit Cost, $	Unit	JEAN ROUTE via Wilson Pass/N. Pahrump Quantity	JEAN ROUTE via Wilson Pass/N. Pahrump Extension, $	JEAN ROUTE via Wilson Pass/Stewart Valley Quantity	JEAN ROUTE via Wilson Pass/Stewart Valley Extension, $	JEAN ROUTE via State Line Pass/N. Pahrump Quantity	JEAN ROUTE via State Line Pass/N. Pahrump Extension, $	JEAN ROUTE via State Line Pass/Stewart Valley Quantity	JEAN ROUTE via State Line Pass/Stewart Valley Extension, $
Route Length			Miles	114		119		122		127	
Assumed round-trip time:			Hours	12		12		12		12	
Calc. of Train-Miles:											
	Assumed casks per train:		Ea.	6		6		6		6	
	Trains per yr. (each dir.):		Ea.	84		84		84		84	
	Train-miles per year:		Train-Mi.	19,152		19,908		20,496		21,252	
Calc. of Gross Ton-Miles:											
	Locomotives per train:		Ea.	2		2		2		2	
	Gross Weight per train:		Tons	2,064		2,064		2,064		2,064	
	GTM per year, thous.:		1000 GTM	39,530		41,090		42,304		43,864	
Annual Oper. & Maint. Costs,											
	Staffing				$1,005,000		$1,005,000		$1,005,000		$1,005,000
	Locomotives (pooled power)	$42.00	Loco-hr.	2,016	$85,000	2,016	$85,000	2,016	$85,000	2,016	$85,000
	Locomotive fuel & oil	$6.50	Loco-mi.	38,300	$249,000	39,800	$259,000	41,000	$267,000	42,500	$276,000
	Maintenance of Equip. Mat'ls.	$50.00	% of Labor	122,000	$61,000	122,000	$61,000	122,000	$61,000	122,000	$61,000
	Maintenance of Way Mat'ls.	$35.00	% of Labor	221,000	$77,000	221,000	$77,000	221,000	$77,000	221,000	$77,000
Total					$1,477,000		$1,487,000		$1,495,000		$1,504,000
Contingency		$25.00	% of Total		$369,000		$372,000		$374,000		$376,000
Total Cost					$1,846,000		$1,859,000		$1,869,000		$1,880,000

COMPARISON OF ROUTE ALTERNATES - VALLEY ROUTE
FY95$

YMP TRANSPORTATION STUDY 2
ANNUAL OPERATING & MAINTENANCE COSTS

Description		Unit Cost, $	Unit	VALLEY MOD. ROUTE via Indian Hills Alternate Quantity	VALLEY MOD. ROUTE via Indian Hills Alternate Extension, $	VALLEY MOD. ROUTE via Cactus Springs Alternate Quantity	VALLEY MOD. ROUTE via Cactus Springs Alternate Extension, $
Route Length			Miles	98		98	
Assumed round-trip time:			Hours	8		8	
Calc. of Train-Miles:							
	Assumed casks per train:		Ea.	6		6	
	Trains per yr. (each dir.):		Ea.	84		84	
	Train-miles per year:		Train-Mi.	16,464		16,380	
Calc. of Gross Ton-Miles:							
	Locomotives per train:		Ea.	2		2	
	Gross Weight per train:		Tons	2,064		2,064	
	GTM per year, thous.:		1000 GTM	33,982		33,808	
Annual Oper. & Maint. Costs,							
	Staffing				$1,005,000		$1,005,000
	Locomotives (pooled power)	$42.00	Loco-hr.	1,344	$56,000	1,344	$56,000
	Locomotive fuel & oil	$6.50	Loco-mi.	32,900	$214,000	32,800	$213,000
	Maintenance of Equip. Mat'ls.	$50.00	% of Labor	122,000	$61,000	122,000	$61,000
	Maintenance of Way Mat'ls.	$35.00	% of Labor	221,000	$77,000	221,000	$77,000
Total					$1,413,000		$1,412,000
Contingency		$25.00			$353,000		$353,000
Total Cost					$1,766,000		$1,765,000

COMPARISON OF ROUTE ALTERNATES - CALIENTE & CARLIN ROUTES
FY 95$

YMP TRANSPORTATION STUDY 2
ANNUAL OPERATING & MAINTENANCE COSTS

				CALIENTE ROUTE via Base Route Option		CARLIN ROUTE via Big Smoky Valley		CARLIN ROUTE via Monitor & Ralston Valleys		CARLIN ROUTE via Monitor Valley & Klondike	
Description		Unit Cost, $	Unit	Quantity	Extension, $	Quantity	Extension, $	Quantity		Quantity	Extension, $
Route Length			Miles	338		331		338		363	
Assumed round-trip time:			Hours	36		36		36		36	
Calc. of Train-Miles:											
	Assumed casks per train:		Ea.	6		6		6		6	
	Trains per yr. (each dir.):		Ea.	84		84		84		84	
	Train-miles per year:		Train-Mi.	56,801		55,608		56,784		60,984	
Calc. of Gross Ton-Miles:											
	Locomotives per train:		Ea.	2		2		2		2	
	Gross Weight per train:		Tons	2,064		2,064		2,064		2,064	
	GTM per year, thous.:		1000 GTM	117,237		114,775		117,202		125,871	
Annual Oper. & Maint. Costs,											
	Staffing				$1,223,000		$1,223,000				$1,223,000
	Locomotives (pooled power)	$42.00	Loco-hr.	6,048	$254,000	6,048	$254,000	6,048		6,048	$254,000
	Locomotive fuel & oil	$6.50	Loco-mi.	113,600	$738,000	111,200	$723,000	113,600		122,000	$793,000
	Maintenance of Equip. Mat'ls.	$50.00	% of Labor	122,000	$61,000	122,000	$61,000	122,000		122,000	$61,000
	Maintenance of Way Mat'ls.	$35.00	% of Labor	303,000	$106,000	303,000	$106,000	303,000		303,000	$106,000
Total					$2,382,000		$2,367,000				$2,437,000
Contingency		$25.00			$596,000		$592,000				$609,000
Total Cost					$2,978,000		$2,959,000				$3,046,000

APPENDIX E

HEAVY HAUL COSTS

HEAVY HAUL ROUTE ALTERNATIVES - PRELIMINARY COST ESTIMATES

(All costs are in Millions of $)

		CALIENTE ROUTE via US93; SR375; US6; US95 RTE LENGTH 321				ARDEN ROUTE via SR160 through Pahrump; US95 RTE LENGTH 111				APEX ROUTE via I-15; US95 RTE LENGTH 104			
YEAR	ESCALATION FACTOR	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)	CAPITAL 1995 $	O&M 1995 $	TOTAL 1995 $	TOTAL (YOE $)
2004	1.372												
2005	1.413												
2006	1.456												
2007	1.499	0.416	0.000	0.416	0.624	0.416		0.416	0.624	0.416		0.416	0.624
2008	1.544	2.243	0.000	2.243	3.464	2.243		2.243	3.464	2.242		2.242	3.462
2009	1.590	9.825	0.949	10.774	17.136	9.825	0.959	10.784	17.152	9.825	0.959	10.784	17.152
2010	1.638	1.615	5.363	6.978	11.431	1.615	4.619	6.234	10.212	1.615	4.594	6.209	10.172
2011	1.687		5.451	5.451	9.198		4.650	4.650	7.846		4.623	4.623	7.801
2012	1.738	0.117	5.569	5.686	9.882	0.117	4.691	4.808	8.356	0.117	4.662	4.779	8.306
2013	1.790		5.731	5.731	10.259		4.747	4.747	8.498		4.714	4.714	8.439
2014	1.844	1.423	5.889	7.312	13.482	0.492	4.801	5.293	9.759	0.461	4.765	5.226	9.636
2015	1.899	1.423	6.206	7.629	14.488	0.492	4.911	5.403	10.261	0.461	4.868	5.329	10.120
2016	1.956		6.181	6.181	12.091		4.902	4.902	9.589		4.860	4.860	9.507
2017	2.015	1.969	6.203	8.172	16.465	1.970	4.909	6.879	13.860	1.970	4.866	6.836	13.773
2018	2.075	1.969	6.175	8.144	16.901	1.970	4.900	6.870	14.257	1.970	4.857	6.827	14.167
2019	2.137	1.423	6.155	7.578	16.198	0.492	4.893	5.385	11.510	0.461	4.851	5.312	11.354
2020	2.202	1.423	6.171	7.594	16.719	0.492	4.899	5.391	11.869	0.461	4.856	5.317	11.706
2021	2.268	0.117	6.165	6.282	14.245	0.117	4.897	5.014	11.370	0.117	4.854	4.971	11.272
2022	2.336	0.010	6.265	6.275	14.656	0.010	4.991	5.001	11.681	0.010	4.948	4.958	11.580
2023	2.406	0.010	6.263	6.273	15.091	0.010	4.990	5.000	12.029	0.010	4.948	4.958	11.928
2024	2.478	2.015	6.177	8.192	20.299	0.697	4.901	5.598	13.871	0.653	4.858	5.511	13.656
2025	2.552	2.015	6.162	8.177	20.870	0.697	4.896	5.593	14.275	0.653	4.853	5.506	14.053
2026	2.629	3.984	6.160	10.144	26.667	2.667	4.894	7.561	19.876	2.623	4.852	7.475	19.650
2027	2.708	1.969	6.193	8.162	22.100	1.970	4.906	6.876	18.618	1.970	4.863	6.833	18.502
2028	2.789		6.160	6.160	17.180		4.895	4.895	13.652		4.853	4.853	13.535
2029	2.873	1.423	6.199	7.622	21.895	0.492	4.908	5.400	15.512	0.461	4.865	5.326	15.299
2030	2.959	1.540	6.177	7.717	22.833	0.609	4.901	5.510	16.303	0.578	4.858	5.436	16.084
2031	3.048		5.945	5.945	18.118		4.821	4.821	14.692		4.783	4.783	14.576
2032	3.139		6.001	6.001	18.837		4.840	4.840	15.192		4.801	4.801	15.070
2033	3.233	2.846	5.712	8.558	27.669	0.984	4.740	5.724	18.506	0.922	4.708	5.630	18.202
TOTAL		39.775	145.622	185.397	428.795	28.377	117.461	145.838	332.833	27.996	116.519	144.515	329.624

A FACTOR OF 1/1.038 IS USED TO CONVERT $1995 TO $1994

Intermodal Facility - Caliente Option

Year	Construction Dollars	A&E Dollars	Equipment Dollars	Management Dollars	Construction Contingency	Other Contingency	Capital Dollars	Operating Dollars	Operating Contingency	Sales Tax Dollars	total O&M	Total Dollars
2007		$130,000				$39,000	$169,000				$0	$169,000
2008		$130,000				$39,000	$169,000				$0	$169,000
2009	$2,363,638		$3,125,000	$407,727	$345,545		$6,241,910	$550,000	$165,000	$233,765	$948,765	$7,190,675
2010								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2011								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2012								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2013								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2014								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2015								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2016								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2017								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2018								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2019								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2020								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2021								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2022								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2023								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2024								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2025								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2026								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2027								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2028								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2029								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2030								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2031								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2032								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2033								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
TOTAL	2,363,638	260,000	3,125,000	407,727	345,545	78,000	6,579,910	27,430,000	8,229,000	967,589	36,626,589	43,206,499

Total design and construction cost for
intermodal transfer - $2,600,000 -
as identified in Transportation Study 1

10 FTE's for IMTF operation
@ $1,000,000 per year
plus $120,000/year for materials

Heavy Haul Transportation - Caliente Option 321 miles

Year	Vehicles Dollars	Vehicles Contingency	Vehicles Total	Bonds & Fees Dollars	Bonds & Fees Contingency	Fuel Diesel	Fuel Gasoline	Parts	Tires	Personnel	Contingency	Total O&M	Total Transportation	Grand Total
2007													$0	$416,260
2008	$1,515,000	$454,500	$1,969,500										$1,969,500	$2,242,500
2009	$1,515,000	$454,500	$1,969,500										$1,969,500	$10,774,775
2010				$87,000	$26,100	$16,062	$9,855	$13,687	$23,182	$2,100,000	$540,697	$2,816,583	$2,816,583	$6,977,861
2011				$87,000	$26,100	$33,011	$21,226	$29,481	$49,930	$2,100,000	$558,412	$2,905,160	$2,905,160	$5,451,839
2012	$90,000	$27,000	$117,000	$87,000	$26,100	$55,609	$36,388	$50,538	$85,595	$2,100,000	$582,033	$3,023,263	$3,140,263	$5,686,941
2013				$87,000	$26,100	$86,399	$57,045	$79,229	$134,187	$2,100,000	$614,215	$3,184,175	$3,184,175	$5,730,854
2014				$87,000	$26,100	$116,625	$77,324	$107,394	$181,888	$2,100,000	$645,808	$3,342,139	$3,342,139	$7,311,815
2015				$87,000	$26,100	$177,358	$118,070	$163,986	$277,736	$2,100,000	$709,288	$3,659,538	$3,659,538	$7,629,214
2016				$87,000	$26,100	$172,556	$114,848	$159,511	$270,158	$2,100,000	$704,268	$3,634,441	$3,634,441	$6,181,120
2017	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$176,793	$117,691	$163,460	$276,845	$2,100,000	$708,697	$3,656,586	$5,626,086	$8,172,765
2018	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$171,426	$114,090	$158,458	$268,374	$2,100,000	$703,087	$3,628,535	$5,598,035	$8,144,714
2019				$87,000	$26,100	$167,471	$111,437	$154,773	$262,133	$2,100,000	$698,954	$3,607,868	$3,607,868	$7,577,544
2020				$87,000	$26,100	$170,578	$113,522	$157,669	$267,037	$2,100,000	$702,202	$3,624,108	$3,624,108	$7,593,784
2021	$90,000	$27,000	$117,000	$87,000	$26,100	$169,448	$112,763	$156,616	$265,254	$2,100,000	$701,020	$3,618,201	$3,735,201	$6,281,880
2022				$87,000	$26,100	$171,143	$113,901	$158,195	$267,929	$2,100,000	$702,792	$3,627,060	$3,627,060	$6,274,619
2023				$87,000	$26,100	$170,861	$113,711	$157,932	$267,483	$2,100,000	$702,497	$3,625,584	$3,625,584	$6,273,142
2024				$87,000	$26,100	$171,708	$114,280	$158,722	$268,820	$2,100,000	$703,383	$3,630,013	$3,630,013	$8,192,250
2025				$87,000	$26,100	$168,883	$112,384	$156,089	$264,362	$2,100,000	$700,430	$3,615,248	$3,615,248	$8,177,485
2026	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$168,318	$112,005	$155,563	$263,471	$2,100,000	$699,839	$3,612,296	$5,581,796	$10,144,034
2027	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$174,816	$116,364	$161,617	$273,724	$2,100,000	$706,630	$3,646,251	$5,615,751	$8,162,430
2028				$87,000	$26,100	$168,601	$112,195	$155,826	$263,916	$2,100,000	$700,135	$3,613,773	$3,613,773	$6,160,451
2029				$87,000	$26,100	$175,945	$117,122	$162,670	$275,507	$2,100,000	$707,811	$3,652,155	$3,652,155	$7,621,832
2030	$90,000	$27,000	$117,000	$87,000	$26,100	$171,708	$114,280	$158,722	$268,820	$2,100,000	$703,383	$3,630,013	$3,747,013	$7,716,689
2031				$87,000	$26,100	$127,359	$84,525	$117,396	$198,829	$2,100,000	$657,027	$3,398,236	$3,398,236	$5,944,915
2032				$87,000	$26,100	$138,093	$91,727	$127,398	$215,770	$2,100,000	$668,247	$3,454,335	$3,454,335	$6,001,014
2033				$87,000	$26,100	$82,727	$54,581	$75,807	$128,392	$2,100,000	$610,377	$3,164,984	$3,164,984	$8,557,675
TOTAL	9,360,000	2,808,000	12,168,000	2,088,000	626,400	3,403,498	2,261,334	3,140,739	5,319,342	50,400,000	16,131,228	83,370,541	95,538,541	185,400,398

Purchase new tractors and trailers every 10 years @ $400,000/trailer & $150,000/tractor
Purchase new support equipment every 5 years

Transporter permits at $29,000 per transporter per year for 3 transporters = $87,000/year

5 FTE's for each transporter @ 3 transporters operating at the same time, with 6 support personnel for all transporters = 21 FTE's total

Intermodal Facility - Arden Option 111 Miles

Year	Construction Dollars	A&E Dollars	Equipment Dollars	Management Dollars	Construction Contingency	Other Contingency	Capital Dollars	Operating Dollars	Operating Contingency	Sales Tax Dollars		Total Dollars
2007		$130,000				$39,000	$169,000				$0	$169,000
2008		$130,000				$39,000	$169,000				$0	$169,000
2009	$2,363,636		$3,125,000	$407,727	$354,545		$6,250,908	$550,000	$165,000	$233,765	$948,765	$7,199,673
2010								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2011								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2012								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2013								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2014								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2015								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2016								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2017								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2018								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2019								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2020								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2021								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2022								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2023								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2024								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2025								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2026								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2027								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2028								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2029								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2030								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2031								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2032								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2033								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
TOTAL	$2,363,636	$260,000	$3,125,000	$407,727	$354,545	$78,000	$6,588,908	$27,430,000	$8,229,000	$967,589	$36,626,589	$43,215,497

Total design and construction cost for
intermodal transfer - $2,600,000 -
as identified in Transportation Study 1

10 FTE's for IMTF operation
@ $1,000,000 per year
plus $120,000/year for materials

Road construction and Maintenance - Arden Option 111 Miles

Year	A&E Dollars	A&E Contingency	Construction Dollars*	Construction Contingency*	Const. Material Dollars	Sales tax Dollars	Tot. Const. Dollars	Maintenance Dollars*	Maintenance Contingency*	Main. Material Dollars	Sales Tax Dollars	Tot Rd Maint Dollars	Total Roads Dollars
2007	$190,200	$57,060					$247,260						$247,260
2008	$80,000	$24,000					$104,000						$104,000
2009			$1,200,000	$360,000	$780,000	$54,600	$1,614,600						$1,614,600
2010			$1,200,000	$360,000	$780,000	$54,600	$1,614,600	$277,500	$83,250	$83,250	$5,828	$366,578	$1,981,178
2011								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2012								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2013								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2014			$365,700	$109,700	$237,700	$16,639	$492,039	$277,500	$83,250	$83,250	$5,828	$366,578	$858,617
2015			$365,700	$109,700	$237,700	$16,639	$492,039	$277,500	$83,250	$83,250	$5,828	$366,578	$858,617
2016								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2017								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2018								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2019			$365,700	$109,700	$237,700	$16,639	$492,039	$277,500	$83,250	$83,250	$5,828	$366,578	$858,617
2020			$365,700	$109,700	$237,700	$16,639	$492,039	$277,500	$83,250	$83,250	$5,828	$366,578	$858,617
2021								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2022	$77,600	$23,280					$100,880	$277,500	$83,250	$83,250	$5,828	$366,578	$467,458
2023	$77,600	$23,280					$100,880	$277,500	$83,250	$83,250	$5,828	$366,578	$467,458
2024			$518,000	$155,400	$336,700	$23,569	$696,969	$277,500	$83,250	$83,250	$5,828	$366,578	$1,063,547
2025			$518,000	$155,400	$336,700	$23,569	$696,969	$277,500	$83,250	$83,250	$5,828	$366,578	$1,063,547
2026			$518,000	$155,400	$336,700	$23,569	$696,969	$277,500	$83,250	$83,250	$5,828	$366,578	$1,063,547
2027								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2028								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2029			$365,700	$109,700	$237,700	$16,639	$492,039	$277,500	$83,250	$83,250	$5,828	$366,578	$858,617
2030			$365,700	$109,700	$237,700	$16,639	$492,039	$277,500	$83,250	$83,250	$5,828	$366,578	$858,617
2031								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2032								$277,500	$83,250	$83,250	$5,828	$366,578	$366,578
2033			$731,400	$219,400	$475,400	$33,278	$984,078	$277,500	$83,250	$83,250	$5,828	$366,578	$1,350,656
TOTAL	$425,400	$127,620	$6,879,600	$2,063,800	$4,471,700	$313,019	$9,809,439	$6,660,000	$1,998,000	$1,998,000	$139,860	$8,797,860	$18,607,299

A&E costs @ 5% of construction costs

2" overlay on all roads every 5 years, split over 2 years' time

Rehab of all roads @ 15 years split over three years' time

Maintenance costs of roads @ $25,000/mile annually

* Initial construction will be 100% DOE cost, subsequent construction, and O&M will be 10% DOE cost

Heavy Haul Transportation - Arden Option 111 Miles

Year	Vehicles Dollars	Vehicles Contingency	Vehicles Total	Bonds & Fees Dollars	Bonds & Fees Contingency	Fuel Diesel	Fuel Gasoline	Parts	Tires	Personnel	Contingency For O&M	Total O&M	Total Transportation	Grand Total
2007													$0	$416,260
2008	$1,515,000	$454,500	$1,969,500										$1,969,500	$2,242,500
2009	$1,515,000	$454,500	$1,969,500										$1,969,500	$10,783,773
2010				$87,000	$26,100	$6,452	$3,408	$4,733	$8,016	$2,100,000	$530,652	$2,766,361	$2,766,361	$6,234,115
2011				$87,000	$26,100	$12,313	$7,340	$10,194	$17,266	$2,100,000	$536,778	$2,796,991	$2,796,991	$4,650,145
2012	$90,000	$27,000	$117,000	$87,000	$26,100	$20,127	$12,583	$17,476	$29,598	$2,100,000	$544,946	$2,837,830	$2,954,830	$4,807,984
2013				$87,000	$26,100	$30,774	$19,726	$27,397	$46,401	$2,100,000	$556,075	$2,893,473	$2,893,473	$4,746,626
2014				$87,000	$26,100	$41,226	$26,738	$37,136	$62,896	$2,100,000	$566,999	$2,948,095	$2,948,095	$5,293,288
2015				$87,000	$26,100	$62,227	$40,828	$56,705	$96,040	$2,100,000	$588,950	$3,057,850	$3,057,850	$5,403,043
2016				$87,000	$26,100	$60,567	$39,714	$55,158	$93,419	$2,100,000	$587,215	$3,049,173	$3,049,173	$4,902,326
2017	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$62,032	$40,697	$56,523	$95,731	$2,100,000	$588,746	$3,056,829	$5,026,329	$6,879,482
2018	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$60,176	$39,452	$54,794	$92,802	$2,100,000	$586,806	$3,047,130	$5,016,630	$6,869,784
2019				$87,000	$26,100	$58,809	$38,534	$53,520	$90,644	$2,100,000	$585,377	$3,039,984	$3,039,984	$5,385,176
2020				$87,000	$26,100	$59,883	$39,255	$54,521	$92,340	$2,100,000	$586,500	$3,045,599	$3,045,599	$5,390,791
2021	$90,000	$27,000	$117,000	$87,000	$26,100	$59,492	$38,993	$54,157	$91,723	$2,100,000	$586,091	$3,043,556	$3,160,556	$5,013,710
2022				$87,000	$26,100	$60,078	$39,386	$54,703	$92,648	$2,100,000	$586,704	$3,046,619	$3,046,619	$5,000,652
2023				$87,000	$26,100	$59,981	$39,321	$54,612	$92,494	$2,100,000	$586,602	$3,046,110	$3,046,110	$5,000,144
2024				$87,000	$26,100	$60,274	$39,517	$54,885	$92,957	$2,100,000	$586,908	$3,047,641	$3,047,641	$5,597,764
2025				$87,000	$26,100	$59,297	$38,862	$53,975	$91,415	$2,100,000	$585,887	$3,042,536	$3,042,536	$5,592,659
2026	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$59,102	$38,731	$53,793	$91,107	$2,100,000	$585,683	$3,041,516	$5,011,016	$7,561,139
2027	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$61,348	$40,238	$55,886	$94,652	$2,100,000	$588,031	$3,053,255	$5,022,755	$6,875,909
2028				$87,000	$26,100	$59,199	$38,796	$53,884	$91,261	$2,100,000	$585,785	$3,042,025	$3,042,025	$4,895,179
2029				$87,000	$26,100	$61,739	$40,500	$56,250	$95,269	$2,100,000	$588,440	$3,055,298	$3,055,298	$5,400,490
2030	$90,000	$27,000	$117,000	$87,000	$26,100	$60,274	$39,517	$54,885	$92,957	$2,100,000	$586,908	$3,047,641	$3,164,641	$5,509,834
2031				$87,000	$26,100	$44,938	$29,228	$40,595	$68,754	$2,100,000	$570,879	$2,967,494	$2,967,494	$4,820,647
2032				$87,000	$26,100	$48,650	$31,719	$44,054	$74,612	$2,100,000	$574,759	$2,986,894	$2,986,894	$4,840,047
2033				$87,000	$26,100	$29,505	$18,874	$26,214	$44,397	$2,100,000	$554,748	$2,886,838	$2,886,838	$5,724,069
TOTAL	$9,360,000	$2,808,000	$12,168,000	$2,088,000	$626,400	$1,198,463	$781,957	$1,086,050	$1,839,399	$50,400,000	$13,826,467	$71,846,736	$84,014,736	$145,837,532

Purchase new tractors and trailers every 10 years @ $400,000/trailer & $150,000/tractor
Purchase new support equipment every 5 years

Transporter permits at $29,000 per transporter per year for 3 transporters = $87,000/year

5 FTE's for each transporter @ 3 transporters operating at the same time, with 6 support personnel for all transporters = 21 FTE's total

Intermodal Facility - Apex Option 104 Miles

Year	Construction Dollars	A&E Dollars	Equipment Dollars	Management Dollars	Construction Contingency	Other Contingency	Capital Dollars	Operating Dollars	Operating Contingency	Sales Tax Dollars		Total Dollars
2007		$130,000				$39,000	$169,000				$0	$169,000
2008		$130,000				$39,000	$169,000				$0	$169,000
2009	$2,363,636		$3,125,000	$407,727	$354,545		$6,250,908	$550,000	$165,000	$233,765	$948,765	$7,199,673
2010								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2011								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2012								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2013								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2014								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2015								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2016								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2017								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2018								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2019								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2020								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2021								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2022								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2023								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2024								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2025								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2026								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2027								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2028								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2029								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2030								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2031								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2032								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
2033								$1,120,000	$336,000	$30,576	$1,486,576	$1,486,576
TOTAL	$2,363,636	$260,000	$3,125,000	$407,727	$354,545	$78,000	$6,588,908	$27,430,000	$8,229,000	$967,589	$36,626,589	$43,215,497

Total design and construction cost for
intermodal transfer - $2,600,000 -
as identified in Transportation Study 1

10 FTE's for IMTF operation
@ $1,000,000 per year
plus $120,000/year for materials

Road construction and Maintenance - Apex Option 104 Miles

Year	A&E Dollars	A&E Contingency	Construction Dollars*	Construction Contingency*	Const. Material Dollars	Sales tax Dollars	Tot. Const. Dollars	Maintenance Dollars*	Maintenance Contingency*	Main. Material Dollars	Sales Tax Dollars	Tot Rd Maint Dollars	Total Roads Dollars
2007	$190,200	$57,060					$247,260						$247,260
2008	$80,000	$24,000					$104,000						$104,000
2009			$1,200,000	$360,000	$780,000	$54,600	$1,614,600						$1,614,600
2010			$1,200,000	$360,000	$780,000	$54,600	$1,614,600	$260,000	$78,000	$78,000	$5,460	$343,460	$1,958,060
2011								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2012								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2013								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2014			$342,600	$102,800	$222,700	$15,589	$460,989	$260,000	$78,000	$78,000	$5,460	$343,460	$804,449
2015			$342,600	$102,800	$222,700	$15,589	$460,989	$260,000	$78,000	$78,000	$5,460	$343,460	$804,449
2016								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2017								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2018								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2019			$342,600	$102,800	$222,700	$15,589	$460,989	$260,000	$78,000	$78,000	$5,460	$343,460	$804,449
2020			$342,600	$102,800	$222,700	$15,589	$460,989	$260,000	$78,000	$78,000	$5,460	$343,460	$804,449
2021								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2022	$77,600	$23,280					$100,880	$260,000	$78,000	$78,000	$5,460	$343,460	$444,340
2023	$77,600	$23,280					$100,880	$260,000	$78,000	$78,000	$5,460	$343,460	$444,340
2024			$485,300	$145,600	$315,500	$22,085	$652,985	$260,000	$78,000	$78,000	$5,460	$343,460	$996,445
2025			$485,300	$145,600	$315,500	$22,085	$652,985	$260,000	$78,000	$78,000	$5,460	$343,460	$996,445
2026			$485,300	$145,600	$315,500	$22,085	$652,985	$260,000	$78,000	$78,000	$5,460	$343,460	$996,445
2027								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2028								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2029			$342,600	$102,800	$222,700	$15,589	$460,989	$260,000	$78,000	$78,000	$5,460	$343,460	$804,449
2030			$342,600	$102,800	$222,700	$15,589	$460,989	$260,000	$78,000	$78,000	$5,460	$343,460	$804,449
2031								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2032								$260,000	$78,000	$78,000	$5,460	$343,460	$343,460
2033			$685,300	$205,600	$445,400	$31,178	$922,078	$260,000	$78,000	$78,000	$5,460	$343,460	$1,265,538
TOTAL	$425,400	$127,620	$6,596,800	$1,979,200	$4,288,100	$300,167	$9,429,187	$6,240,000	$1,872,000	$1,872,000	$131,040	$8,243,040	$17,672,227

A&E costs @ 5% of construction costs

2" overlay on all roads every 5 years, split over 2 years' time

Rehab of all roads @ 15 years split over three years' time

Maintenance costs of roads @ $25,000/mile annually

* Initial construction will be 100% DOE cost, subsequent construction, and O&M will be 10% DOE cost

Heavy Haul Transportation Apex Option 104 Miles

Year	Vehicles Dollars	Vehicles Contingency	Vehicles Total	Bonds & Fees Dollars	Bonds & Fees Contingency	Fuel Diesel	Fuel Gasoline	Parts	Tires	Personnel	Contingency For O&M	Total O&M	Total Transportation	Grand Total
2007													$0	$416,260
2008	$1,515,000	$454,500	$1,969,500										$1,969,500	$2,242,500
2009	$1,515,000	$454,500	$1,969,500										$1,969,500	$10,783,773
2010				$87,000	$26,100	$6,132	$3,193	$4,435	$7,511	$2,100,000	$530,318	$2,764,689	$2,764,689	$6,209,325
2011				$87,000	$26,100	$11,623	$6,877	$9,551	$16,177	$2,100,000	$536,057	$2,793,385	$2,793,385	$4,623,421
2012	$90,000	$27,000	$117,000	$87,000	$26,100	$18,945	$11,789	$16,374	$27,732	$2,100,000	$543,710	$2,831,650	$2,948,650	$4,778,686
2013				$87,000	$26,100	$28,920	$18,482	$25,669	$43,475	$2,100,000	$554,137	$2,883,783	$2,883,783	$4,713,819
2014				$87,000	$26,100	$38,713	$25,052	$34,794	$58,930	$2,100,000	$564,372	$2,934,961	$2,934,961	$5,225,986
2015				$87,000	$26,100	$58,390	$38,253	$53,129	$89,983	$2,100,000	$584,939	$3,037,794	$3,037,794	$5,328,819
2016				$87,000	$26,100	$56,834	$37,209	$51,680	$87,528	$2,100,000	$583,313	$3,029,664	$3,029,664	$4,859,700
2017	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$58,207	$38,130	$52,959	$89,694	$2,100,000	$584,748	$3,036,838	$5,006,338	$6,836,374
2018	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$56,468	$36,964	$51,339	$86,950	$2,100,000	$582,930	$3,027,751	$4,997,251	$6,827,287
2019				$87,000	$26,100	$55,187	$36,104	$50,145	$84,928	$2,100,000	$581,591	$3,021,055	$3,021,055	$5,312,080
2020				$87,000	$26,100	$56,193	$36,780	$51,083	$86,517	$2,100,000	$582,643	$3,026,316	$3,026,316	$5,317,341
2021	$90,000	$27,000	$117,000	$87,000	$26,100	$55,827	$36,534	$50,742	$85,939	$2,100,000	$582,261	$3,024,403	$3,141,403	$4,971,439
2022				$87,000	$26,100	$56,376	$36,902	$51,253	$86,806	$2,100,000	$582,834	$3,027,271	$3,027,271	$4,958,187
2023				$87,000	$26,100	$56,285	$36,841	$51,168	$86,661	$2,100,000	$582,739	$3,026,794	$3,026,794	$4,957,710
2024				$87,000	$26,100	$56,559	$37,025	$51,424	$87,094	$2,100,000	$583,026	$3,028,228	$3,028,228	$5,511,249
2025				$87,000	$26,100	$55,644	$36,411	$50,571	$85,650	$2,100,000	$582,069	$3,023,445	$3,023,445	$5,506,466
2026	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$55,461	$36,288	$50,400	$85,361	$2,100,000	$581,878	$3,022,488	$4,991,988	$7,475,009
2027	$1,515,000	$454,500	$1,969,500	$87,000	$26,100	$57,566	$37,701	$52,362	$88,683	$2,100,000	$584,078	$3,033,490	$5,002,990	$6,833,026
2028				$87,000	$26,100	$55,553	$36,350	$50,486	$85,506	$2,100,000	$581,974	$3,022,969	$3,022,969	$4,853,005
2029				$87,000	$26,100	$57,932	$37,946	$52,703	$89,261	$2,100,000	$584,461	$3,035,403	$3,035,403	$5,326,428
2030	$90,000	$27,000	$117,000	$87,000	$26,100	$56,559	$37,025	$51,424	$87,094	$2,100,000	$583,026	$3,028,228	$3,145,228	$5,436,253
2031				$87,000	$26,100	$42,191	$27,385	$38,035	$64,418	$2,100,000	$568,007	$2,953,136	$2,953,136	$4,783,172
2032				$87,000	$26,100	$45,668	$29,718	$41,276	$69,907	$2,100,000	$571,642	$2,971,311	$2,971,311	$4,801,347
2033				$87,000	$26,100	$27,731	$17,684	$24,561	$41,597	$2,100,000	$552,893	$2,877,566	$2,877,566	$5,629,680
TOTAL	$9,360,000	$2,808,000	$12,168,000	$2,088,000	$626,400	$1,124,964	$732,643	$1,017,563	$1,723,402	$50,400,000	$13,749,643	$71,462,615	$83,630,615	$144,518,339

Purchase new tractors and trailers every
10 years @ $400,000/trailer & $150,000/tractor
Purchase new support equipment every 5 years

Transporter permits at $29,000
per transporter per year for
3 transporters = $87,000/year

5 FTE's for each transporter @ 3 transporters
operating at the same time, with 6 support
personnel for all transporters = 21 FTE's total

APPENDIX F

NATIONAL TRANSPORTATION SYSTEM DETAILS

NATIONAL TRANSPORTATION SYSTEM DETAILS

F.1 INTRODUCTION

This appendix describes in detail an analysis that was performed to evaluate the national-level effects of routing spent nuclear fuel and high-level radioactive waste from the purchasers' and producers' sites to the origins of the four Nevada rail branch lines, Caliente, Carlin, Jean, and Valley Modified.

The representative routes over which these rail shipments would travel include a majority of the states. This analysis is intended to determine if there are significant national transportation considerations that could be involved in selection of the rail branch line used to access the proposed repository at Yucca Mountain. The national effects are based on a set of measures that were evaluated during the analysis. The national transportation system considerations are only some of the many considerations to be evaluated for the selection of the rail route.

F.2 METHODOLOGY

The methodology employed in this analysis includes identification of the origins and destinations of the routes, the route selection technique, and the measures of effectiveness used to evaluate the routes.

A routing code was used to identify representative routes between purchasers' and producers' sites and the origins of the four Nevada rail branch lines under investigation. A routing code consists of a computer program and its database. The program selects a route from user-specified origin to user-specified destination according to user-selected routing criteria. The U.S. Department of Energy (DOE)-accepted rail routing code used in this analysis is INTERLINE. INTERLINE is described in Section F.2.1.

Representative routes between each of 77 purchaser and producer sites (origins) and each of the four rail branch lines under investigation were generated using INTERLINE. The selection of the route origins is described in subsection F.2.3. Figure 9-1 in Section 9 of this study illustrates the locations of the branch line origins, that is, the locations where the existing national railroad network intersects the proposed rail branch lines. The route destinations shown in Figure 9-1 are Caliente, Carlin, Jean, and Valley Modified; the locations are based on locations in the INTERLINE database. The Valley Modified location used in this analysis is an approximation of the Valley Modified branch line origin described elsewhere in this report. This approximation was made to accommodate the capabilities of INTERLINE.

The INTERLINE routing code was run using several routing options, as described in Section F.3. The results of the INTERLINE runs were captured in spreadsheets for further analysis. A set of measures of effectiveness was developed for the analysis. Section F.2.4 provides a discussion of each of the measures, describing their derivation from the data and identifying their utility for the current analysis. The measures of effectiveness were evaluated and the results are described in Section F.6.2.

Maps of the representative routes were also generated. These maps are based on the INTERLINE-defined routes; they were produced by the Civilian Radioactive Waste Management System Management and Operating Contractor (CRWMS M&O) Transportation Geographic Information System. The use of map graphic results will assist the reader in understanding the routing alternatives in a geographic context. The Transportation Geographic Information System is described in Section F.2.2. The maps are included in Section 9 of this document.

F.2.1 INTERLINE Routing Code

The INTERLINE database used in this analysis contains over 15,000 rail and barge route segments and over 13,000 stations, interchange points, ports, and other nodes. The database includes segment length, class, ownership, and population density in proximity to the segment (based on the 1990 Census, DOC 1990).

The routing algorithm employed by INTERLINE attempts to emulate rail industry standard practice. The algorithm seeks to minimize the following impedance equation:

$$\text{Impedance} = \min \quad \{ \sum_i \alpha_i * f_i * d_i + \sum_n t_n \}$$

Where

- α_i is a factor used to account for the originating railroad benefit for the *ith* route segment
  - α_i = 0.8 for the originating railroad (unless overridden)
  - α_i = 1.0 for all other railroads
- f_i is a rail class factor for the *ith* route segment
  - f_i = 1.0 for main line A route segments (more than 20 million gross ton miles per year)
  - f_i = 1.2 for main line B route segments (between 5 and 20 million gross ton miles per year)
  - f_i = 1.9 for branch line A route segments (between 1 and 5 million gross ton miles per year)
  - f_i = 4.0 for branch line B route segments (less than 1 million gross ton miles per year)
- d_i is the length, in miles, of the *ith* route segment
- t_n is the transfer penalty associated with the nth node
  - t_n = 300 miles for standard transfers
  - t_n = 151 miles for transfers involving terminal railroads

The routing algorithm employed by INTERLINE emulates railroad industry standard routing practice. This practice routes on the following priorities:

- The use of the originating railroad's route segments is favored.
- The use of the best, most traveled track is favored.
- The distance traveled is minimized.
- The number of railroad transfers is minimized.

INTERLINE provides options to alter the factors described above, as well as options to eliminate specific nodes (e.g., cities, stations), states, railroad companies, or route segments. INTERLINE also produces the population density in proximity to the route and generates a geographically-identified route listing. Many of these options were exercised in support of the current analysis. One of the primary analytical objectives was to analyze the effect of avoiding rail routes through Las Vegas, Nevada, so routes were generated for the same origin-destination pairs with and without the inclusion of Las Vegas. Population density was used as a measure of effectiveness in the study. An additional analysis was performed examining the effect of eliminating the originating railroad benefit (α_i was set to 1.0). The results of this additional analysis were not significantly different from the base analysis.

F.2.2 Transportation Geographic Information System

The Transportation Geographic Information System is a transportation-oriented geographic information system developed by the CRWMS M&O. The major benefit of the Transportation Geographic Information System for this application is that it can display the results of the INTERLINE runs on maps with a variety of additional contextual data. The following information in the system's database is of greatest use in this analysis:

- National, state, tribal, county, and city boundary files
- Federal Railroad Administration 1994 Railroad Network
- Purchaser and producer site location and information
- Cities and places data
- Waterways data.

These data can be used as backgrounds for maps showing the representative routes produced by INTERLINE. The INTERLINE routes are composed of a series of straight line segments between nodes. At the national level, the routes do have adequate geographic quality to make a reasonable presentation of the routes possible. The straight line segments of INTERLINE routes could be contrasted with the 1:2,000,000 resolution of the Federal Railroad Administration Railroad Network or the 1:100,000 resolution of other rail databases, but for purposes of this analysis, the INTERLINE data quality is adequate.

Figure F-1 is a map of the United States showing the Federal Railroad Administration 1994 Railroad Network and the 77 purchaser and producer sites (route origins).

F.2.3 Routing Origins

The 77 rail route origins consist of the following:

- 73 commercial reactor and storage (purchasers') sites

- 4 high-level waste producer sites: Hanford, Idaho National Engineering Laboratory, Savannah River Plant, and West Valley. (Note that Hanford, Idaho National Engineering Laboratory, and West Valley are sources of both high-level waste and spent nuclear fuel.)

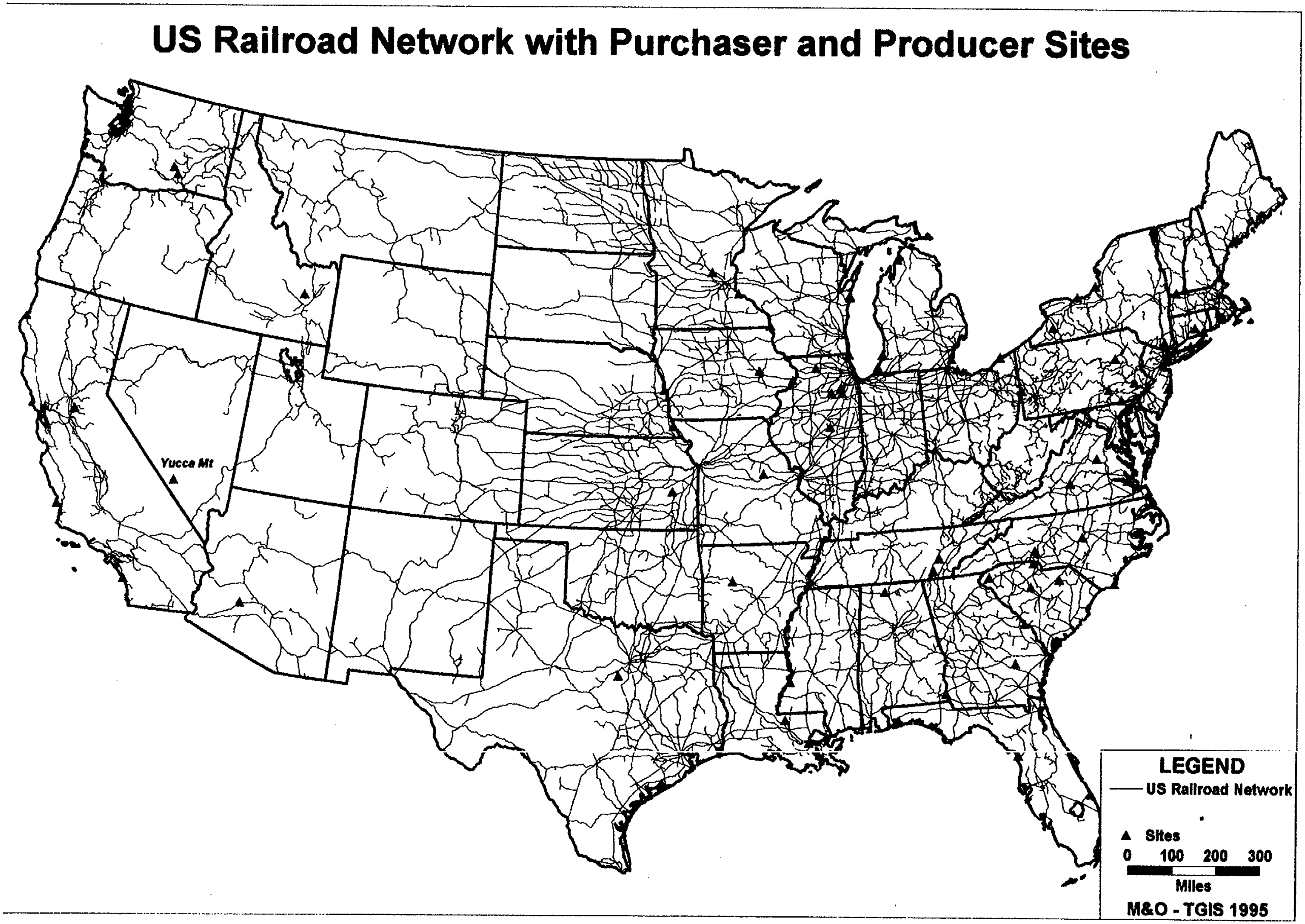

Figure F-1. U.S. Railroad Network with Purchaser and Producer Sites

The route origins are shown in Figure F-1 and are listed in Table F-1. The purchaser sites are based on the baseline multi-purpose canister scenario; specifically, this is the so-called "four truck reactor scenario," in which all purchaser sites except those at Ginna and Indian Point are assumed to be rail sites.

Several of the purchaser and producer sites lack on-site rail capabilities. The use of barge and heavy haul transportation to an appropriate rail head was modeled for such sites. INTERLINE has a barge routing option that was used to identify representative barge-rail intermodal locations. Nearest representative rail heads for heavy haul were developed for other sites.

The barge and heavy haul intermodal transfer sites are intended to be representative locations for analytical purposes. They were used consistently during the present analysis.

F.2.4 Analytical Measures of Effectiveness

The principal measures of effectiveness used in the current analysis are described in the following subsections. These measures are used to characterize the four routing options so that comparisons can be made between alternatives. The summary values of these measures were evaluated by summing the measures over all 77 routes (routes to each destination from each of the 77 origins).

F.2.4.1 Total Distance

Total distance is the computed route length from the origin to the destination (the start of the branch line under investigation) along the route selected. It is generated directly from INTERLINE output and is presented in both kilometers and miles. This distance does not include the length of the rail branch line itself. The effect of the inclusion of the rail branch line length is evaluated in Section F.4.3.

Total distance is the first of this analysis' two primary measures of effectiveness and is the most easily perceived. The goal is to select the routing option and destination that minimizes the distance the CRWMS cargos must be shipped. Total route distance has a direct effect on transportation cost and time in transit.

F.2.4.2 Potentially-Affected Population

The potentially-affected population is the second of the primary measures of effectiveness used in this analysis. The population within 800 meters on either side of the track is nominally considered to be affected by incident-free rail transportation of spent nuclear fuel and high-level waste. Beyond 800 meters, there is essentially no measurable radiological effect of incident-free transportation. The potentially-affected population values represent the number of people within the 1.6-kilometer-wide corridor over the entire length of the route. The values are computed by multiplying the average population density for each route (in persons per square kilometer, as defined in Section F.2.4.4) by the length of the route (in kilometers, as defined in Section F.2.4.1) and then by the corridor width (1.6 kilometers). This is a measure of potential national societal effects of transporting of CRWMS cargos through the nation. The optimal routing option and destination minimize this measure.

Table F-1. Purchaser and Producer Sites — Route Origins

Originating Sites	State	Originating Sites	State	Originating Sites	State
Arkansas NP	AR	Harris NP	NC	Rancho Seco NP	CA
Arnold NP	IA	Hatch NP	GA	River Bend NP	LA
Beaver Valley NP	PA	Hope Creek NP	NJ	Robinson NP	SC
Big Rock Point NP	MI	Humboldt Bay NP	CA	Salem NP	NJ
Braidwood NP	IL	Idaho National Engineering Laboratory	ID	San Onofre NP	CA
Browns Ferry NP	AL	Kewaunee NP	WI	Savannah River Plant	SC
Brunswick NP	NC	La Cross NP	WI	Seabrook NP	NH
Byron NP	IL	La Salle NP	IL	Sequoyah NP	TN
Callaway NP	MO	Limerick NP	PA	South Texas NP	TX
Calvert Cliffs NP	MD	Maine Yankee NP	ME	St. Lucie NP	FL
Catawba NP	SC	McGuire NP	NC	Summer NP	SC
Clinton NP	IL	Millstone NP	CT	Surry NP	VA
Comanche Peak NP	TX	Monticello NP	MN	Susquehanna NP	P[illegible]
Conn Yankee NP	CT	Morris (G.E. Repro Plant)	IL	Three Mile Island NP	PA
Cook NP	MI	Nine Mile Point NP	NY	Trojan NP	OR
Cooper Station NP	NE	North Anna NP	VA	Turkey Point NP	FL
Crystal River NP	FL	Oconee NP	SC	Vermont Yankee NP	VT
Davis-Besse NP	OH	Oyster Creek NP	NJ	Vogtle NP	GA
Diablo Canyon NP	CA	Palisades NP	MI	Waterford NP	LA
Dresden NP	IL	Palo Verde NP	AZ	Watts Bar NP	TN
Farley NP	AL	Peach Bottom NP	PA	West Valley	NY
Fermi NP	MI	Perry NP	OH	Washington NP	WA
Fitzpatrick NP	NY	Pilgrim NP	MA	Wolf Creek NP	KS
Fort Calhoun NP	NE	Point Beach NP	WI	Yankee Rowe NP	MA
Grand Gulf NP	MS	Prairie Island NP	MN	Zion NP	IL
Hanford	WA	Quad Cities NP	IL		

Note: NP = nuclear plant

F.2.4.3 Urban Distance

Urban distance is the distance traveled in regions that have a population density of at least 1,284 people per square kilometer (3,326 people per square mile). The population density threshold for an urban region is based on the population density bounds used in INTERLINE. INTERLINE generates this value when the population density option has been selected. The urban distance is evaluated in both kilometers and miles and the population data are based on the 1990 Census block group population data (DOC 1992).

This measure is less politically sensitive than listing or counting the major cities along the representative routes. The inclusion of a city in the number of cities encountered is based on the route intersecting the city's boundaries; however, there may not be a high population concentration near the actual location of the railroad line just because the location is within the city's boundaries. Using the Transportation Geographic Information System, it is possible to identify the cities affected by the routing options. The affected cities are addressed in Sections F.4.4 and F.6.4.

Like the potentially-affected population measure, the goal is to select the routing option and destination that minimize the amount of urban exposure as represented by the urban distance. This has the effect of minimizing the size of the potentially-affected population as concentrated in urban environments.

F.2.4.4 Average Population Density

Like urban distance, the average population density in proximity to the route is an indication of relative population exposure. The measure is derived from INTERLINE output; it is the distance-weighted average of the population densities produced by INTERLINE. The equation for the average population density is shown below. Each of the values in the equation is output by INTERLINE. The operational definition of the population density zones used by INTERLINE is shown in Table F-2.

$$\text{AVG POP DEN} = \frac{(\text{POP DEN}_R * \text{DIST}_R) + (\text{POP DEN}_S * \text{DIST}_S) + (\text{POP DEN}_U * \text{DIST}_U)}{\text{DISTANCE}_{Total}}$$

Where

- AVG POP DEN is the average population density
- POP DEN_R is the population density in the rural zone
- POP DEN_S is the population density in the suburban zone
- POP DEN_U is the population density in the urban zone
- DIST_R is the distance in the rural zone
- DIST_S is the distance in the suburban zone
- DIST_U is the distance in the urban zone
- DISTANCE_{Total} is the total route distance

Table F-2. Population Density Zones

Zones	Rural (R)	Suburban (S)	Urban (U)
Persons per square kilometer	0 to 53	54 to 1,284	Greater than 1,284
Persons per square mile	0 to 138	139 to 3,326	Greater than 3,326

The average population density is related to the potentially-affected population measure, as described in Section F.2.4.2. It includes the effect of urban population, but balances urban with rural and suburban population. As a measure of effectiveness, the optimal routing option and destination is the one that minimizes the average population density in proximity to the route.

F.2.4.5 Main Line Distance

Main line distance is the portion of the rail route that uses track classed as "Main line A" track; that is, the best quality track in the railroad network. Track usage (in units of millions of gross ton miles per year) can be a surrogate for track quality. Main line A track carries more than 20 million gross ton miles of usage per year. The assumption is that the railroad companies maintain such track at a higher level and provide better safety sensors than is provided for less traveled track because these routes provide the railroad companies with greater revenues. INTERLINE favors (maximizes) the use of such track. The distance on Main line A track is output by INTERLINE. The percent of the total distance that is Main line A track is used as a measure of effectiveness in this analysis; that is, Main line A Distance divided by Total Distance.

The optimal routing option and destination maximizes the percentage of the total distance that is composed of Main line A track. The percent of main line track may be considered to be an indirect measure of route safety — the higher the percentage of main line track used, the better the route. The summary value for this measure is computed by dividing the total of the distances on Main line A track by the total distances.

F.2.4.6 Metric Tons of Uranium Measures

The number of metric tons of uranium shipped from each of the purchaser and producer sites to the proposed first repository, over the life of the program, is used in this measure. Shipments of spent nuclear fuel and high-level waste were aggregated. Table F-3 presents the metric tons of uranium data by purchaser and producer. The spent nuclear fuel data is from the current CRWMS M&O systems analysis multi-purpose canister base case for fiscal year 1995 (CRWMS M&O 1995a). The high-level waste data is taken from Table 2.3 of the *Integrated Database Report–1993: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics* (DOE 1994b).

This measure attempts to emphasize the effect of the routes that will ship more spent nuclear fuel and high-level waste. Distance ignores the amount of material to be shipped; this measure weights the distance by the quantity of material shipped.

The value of metric tons of uranium is multiplied by the route distance to derive a weighted sum, metric tons of uranium-kilometers or metric tons of uranium-miles. The optimal routing option and destination minimizes metric tons of uranium-kilometers.

F.2.4.7 Cask Measures

The number of casks (canisters) shipped from each of the purchaser and producer sites to the proposed first repository over the life of the program is used in this measure. Shipments of both spent nuclear fuel and high-level waste were aggregated. Table F-3 presents the cask data by purchaser and producer site. The spent nuclear fuel data is from the current CRWMS M&O Systems Analysis multi-purpose canister base case for fiscal year 1995 (CRWMS M&O 1995a). The high-level waste data is taken from Table 2.3 of the *Integrated Database Report–1993: U.S. Spent Nuclear Fuel and Radioactive Waste Inventories, Projections, and Characteristics* (DOE 1994b). The measure attempts to emphasize the effect of the routes that will carry more spent nuclear fuel and high-level waste shipments. Route distance ignores the number of railcars to be transported. This measure weights the route distance by the number of loaded railcars using that route.

The number of casks is multiplied by the route distance to derive a weighted sum, cask-kilometers or cask-miles. Note the difference between this measure and the number of metric tons of uranium-kilometers; this measure takes into account the cask capacities and waste forms being transported in the casks. The measure cannot represent the number of shipments, however. Derivation of the number of shipments (trains) on each route depends upon operational considerations and campaign strategies. The optimal routing option and destination minimizes cask-kilometers.

F.2.4.8 Number of Interchanges and Number of States

The number of railroad company interchanges (changes from one railroad company to another) encountered on a route and the number of states encountered on a route were also used as measures of effectiveness. These may be considered to be the third measures because both have an effect on the cost of transportation. A greater the number of interchanges encountered, potentially, means higher rail costs and longer transportation time. Each state the route passes through may require enroute inspections, and would be involved in aspects of the political process of route acceptance.

INTERLINE uses the number of interchanges as a part of the route impedance formula, a value to be minimized, as described in Section F.2.1. Both of these measures are derived from INTERLINE outputs. The optimal routing option and destination minimizes the number of railroad company interchanges and the number of states encountered.

Section F.4.4 addresses the affected cities, the incorporated city units whose boundaries are intersected by the INTERLINE representative routes. Affected cities data is provided for information and is not used as a measure of effectiveness.

Table F-3. Casks and Metric Tons of Uranium by Purchaser and Producer Site

Purchaser/Producer Sites		Spent Nuclear Fuel		High-Level Waste		Total	
Origin	State	Casks	MTU	Casks	MTU	Casks	MTU
Arkansas NP	AR	128	1,150.65			128	1,150.65
Arnold NP	IA	64	456.68			64	456.68
Beaver Valley NP	PA	106	1,015.37			106	1,015.37
Big Rock Point NP	MI	40	62.61			40	62.61
Braidwood NP	IL	119	1,049.36			119	1,049.36
Browns Ferry NP	AL	210	1,537.23			210	1,537.23
Brunswick NP	NC	207	914.57			207	914.57
Byron NP	IL	130	1,146.96			130	1,146.96
Callaway NP	MO	75	640.21			75	640.21
Calvert Cliffs NP	MD	145	1,143.03			145	1,143.03
Catawba NP	SC	128	1,193.37			128	1,193.37
Clinton NP	IL	65	453.03			65	453.03
Comanche Peak NP	TX	105	918.37			105	918.37
Conn Yankee NP	CT	109	508.58			109	508.58
Cook NP	MI	146	1,350.08			146	1,350.08
Cooper Station NP	NE	106	457.99			106	457.99
Crystal River NP	FL	89	490.82			89	490.82
Davis-Besse NP	OH	58	508.87			58	508.87
Diablo Canyon NP	CA	133	1,190.92			133	1,190.92
Dresden NP Dock	IL	355	1,423.68			355	1,423.68
Farley NP	AL	123	1,140.46			123	1,140.46
Fermi NP	MI	77	500.91			77	500.91
Fitzpatrick NP	NY	73	519.21			73	519.21
Fort Calhoun NP	NE	89	380.68			89	380.68
Grand Gulf NP	MS	121	851.64			121	851.64
Hanford (assumes spent nuclear fuel truck casks)	WA	3	2.36	1,207	3,015.50	1,210	3,017.86
Harris NP	NC	69	597.98			69	597.98

Table F-3. Casks and Metric Tons of Uranium by Purchaser and Producer Site (Continued)

Purchaser/Producer Sites		Spent Nuclear Fuel		High-Level Waste		Total	
Origin	State	Casks	MTU	Casks	MTU	Casks	MTU
Hatch NP	GA	184	1,332.20			184	1,332.20
Hope Creek NP	NJ	101	717.06			101	717.06
Humboldt Bay NP	CA	17	28.94			17	28.94
Idaho National Engineering Lab. (assumes spent nuclear fuel truck casks)	ID	6	42.63	225	561.50	231	604.13
Kewaunee NP	WI	59	466.24			59	466.24
La Crosse NP	WI	14	37.98			14	37.98
La Salle NP	IL	176	1,261.51			176	1,261.51
Limerick NP	PA	165	1,128.90			165	1,128.90
Maine Yankee NP	ME	91	716.83			91	716.83
Mcguire NP	NC	151	1,418.58			151	1,418.58
Millstone NP	CT	347	1,733.88			347	1,733.88
Monticello NP	MN	95	393.78			95	393.78
Morris (G.E. Repro Plant)	IL	89	674.08			89	674.08
Nine Mile Point NP	NY	148	1,029.54			148	1,029.54
North Anna NP	VA	131	1,149.13			131	1,149.13
Oconee NP	SC	204	1,897.39			204	1,897.39
Oyster Creek NP	NJ	92	651.48			92	651.48
Palisades NP	MI	69	574.75			69	574.75
Palo Verde NP	AZ	204	1,687.35			204	1,687.35
Peach Bottom NP	PA	225	1,602.10			225	1,602.10
Perry NP	OH	86	605.10			86	605.10
Pilgrim NP	MA	117	505.85			117	505.85
Point Beach NP	WI	107	837.48			107	837.48
Prairie Island NP	MN	106	807.39			106	807.39
Quad Cities NP	IL	314	1,346.52			314	1,346.52
Rancho Seco NP	CA	24	228.36			24	228.36

Table F-3. Casks and Metric Tons of Uranium by Purchaser and Producer Site (Continued)

Purchaser/Producer Sites		Spent Nuclear Fuel		High-Level Waste		Total	
Origin	State	Casks	MTU	Casks	MTU	Casks	MTU
River Bend NP	LA	69	487.97			69	487.97
Robinson NP	SC	70	344.54			70	344.54
Salem NP	NJ	123	1,136.28			123	1,136.28
San Onofre NP	CA	175	1,469.16			175	1,469.16
Savannah River Plant	SC	0	0.00	1,114	2,784.50	1,114	2,784.50
Seabrook NP	NH	47	438.53			47	438.53
Sequoyah NP	TN	103	979.37			103	979.37
South Texas NP	TX	76	808.45			76	808.45
St Lucie NP	FL	147	1,150.55			147	1,150.55
Summer NP	SC	59	524.50			59	524.50
Surry NP	VA	120	1,084.93			120	1,084.93
Susquehanna NP	PA	211	1,470.33			211	1,470.33
Three Mile Island NP	PA	56	523.34			56	523.34
Trojan NP	OR	38	358.86			38	358.86
Turkey Point NP	FL	107	1,010.93			107	1,010.93
Vermont Yankee NP	VT	138	601.61			138	601.61
Vogtle NP	GA	218	1,024.33			218	1,024.33
Waterford NP	LA	75	596.66			75	596.66
Watts Bar NP	NY	32	299.56			32	299.56
West Valley	NY	5	26.79	60	639.00	65	665.79
Washington NP	WA	81	554.68			81	554.68
Wolf Creek NP	KS	63	574.57			63	574.57
Yankee Rowe NP	MA	45	127.24			45	127.24
Zion NP	IL	144	1,375.18			144	1,375.18

F.3 ROUTING ALTERNATIVES

A block of 308 routes (77 origins and four destinations) was generated for each of the following four routing options:

- Favoring originating railroad and permitting routing through Las Vegas (routes including Las Vegas)
- Favoring originating railroad and *not* permitting routing through Las Vegas (routes avoiding Las Vegas)
- *Not* favoring originating railroad and permitting routing through Las Vegas (routes including Las Vegas)
- *Not* favoring originating railroad and *not* permitting routing through Las Vegas (routes avoiding Las Vegas).

Las Vegas is the principal population center in the State of Nevada. Routing schemes that avoid Las Vegas may be more acceptable to the state. This analytical option is intended to determine if there are any adverse effects, from the national perspective, of avoiding Las Vegas.

Within each of these routing options, the four alternative branch line cases (77 origins and one branch line) were analyzed. Each of the measures was derived and aggregated, case by case.

The results of this analysis focus on a comparison of the first two options, both of which favor the originating railroad. They form a consistent analytical baseline. The other two options were found not to be significantly different from the first two; therefore, these results are not included in the analytical evaluation. The data for all of the options are included Section F.6.2.

F.4 ANALYTICAL RESULTS

In the following discussion of the results, comparisons between cases use the percent difference between the values of respective measures of effectiveness. The percent difference is defined to be the difference between the measure's value for an alternative and the optimal value (the value of the optimal case—the lowest or highest value) divided by the optimal value. The reader therefore can make the evaluation of whether a given value is significant.

Qualitatively, the representative routes outside of the State of Nevada when Las Vegas is included are the same for the Jean and the Valley Modified rail branch lines. The routes outside of the State of Nevada, when Las Vegas is avoided, are the same for the Caliente and the Valley Modified rail branch lines. The routes for the Carlin rail branch line are unaffected by the inclusion or avoidance of Las Vegas. The primary differences between these routes occur within the State of Nevada. As can be seen on Figure 9-1, three of the rail branch lines connect to the same section of main line track: Caliente, Valley Modified, and Jean (listed east to west) are on the same section of Union Pacific main line track. Las Vegas is situated between where the Valley Modified branch and the

Jean branch connect to the main line. Hence, avoiding Las Vegas from the east, where 90 percent of the routes originate, means that extensive rerouting must take place to reach the Jean branch. A smaller effect is noted with respect to the Caliente and Valley Modified branch lines; 10 percent of the routes that originate to the west must be rerouted to reach these branch lines when avoiding Las Vegas. It was also noted that the measures of effectiveness for the Carlin branch line routes are not affected by avoiding Las Vegas.

F.4.1 Optimal Selection within an Option

Based on the measures of effectiveness described, it is possible to rank the use of the four rail branch lines analytically within the options described in Section F.3. The two principal options, (1) favoring the originating railroad while permitting routing through Las Vegas, and (2) favoring the originating railroad while avoiding routing through Las Vegas, are considered. (The detailed spreadsheets showing the measures of effectiveness for each source-destination pair for the four options are presented in Section F.6.2.)

Summaries of the two principal options are shown in Tables F-4 and F-5. The tables provide summations over all origins for each case (e.g., all 77 origins to the Caliente branch line, all 77 origins to the Carlin branch line, and so on) for each of the measures of effectiveness, except the main line percent, which is a percent of the total distance, and the population density, which is an average. The tables also identify the cases that produce the optimal value for each measure and the percent difference between cases.

F.4.1.1 Routing That Includes Las Vegas

Table F-4 presents the results for the routing option that includes Las Vegas. The measures of effectiveness indicate that use of the Carlin or the Caliente rail branch lines represent the best choices. They have only slight advantages over the Valley Modified and Jean branch lines. The average difference between the measures of effectiveness for the Carlin and Caliente cases are generally less than one percent. The Valley Modified case produced the next best results, with percent differences of about 3.5 percent, followed by the Jean case, with percent differences of about 7 percent, considering all the measures.

F.4.1.2 Routing That Avoids Las Vegas

Table F-5 presents the results for the routing option that avoids Las Vegas. The measures of effectiveness are less conclusive for the cases in this option. Even considering only the two primary measures of effectiveness, total distance and potentially-affected population, the results are somewhat contradictory.

The case with the lowest total distance is the Carlin case. The Caliente case is about 3 percent higher total distance, the Valley Modified case is about 8.5 percent higher, and the Jean case is about 16.25 percent higher. The metric tons of uranium and cask measures result in similar rankings.

However, the Jean case has the lowest value for the potentially-affected population measure. The Carlin case is 5.75 percent higher than the Jean case, and the Caliente and Valley Modified cases are almost 8 percent higher. The rationale for this situation is that, although the routes to the Jean rail branch line are more than 16 percent longer than the routes to the Carlin rail branch line, they avoid both Las Vegas and any other high population areas. This conclusion is supported by the urban distance measure that shows the urban distance for the Jean case to be at least 12 percent lower than any of the other cases. The average population density for both the Jean and the Valley Modified cases are at least 5 percent lower than the other cases.

The Jean case is slightly better in terms of the percent of main line track. The Jean and Carlin cases are 5 percent higher than the Caliente and the Valley Modified cases. This is an interesting result, in that the routes to the Jean branch line are longer, more of that distance consists of main line track. It is interesting to note the effect that avoiding Las Vegas has on the number of railroad interchanges and the number of states encountered. The routes to the Jean branch line encounter more than 32 percent more railroad interchanges and more than 10 percent more states than do the routes to the other branch lines.

F.4.2 Comparison Between Cases Including and Avoiding Las Vegas

This section describes the comparison of the results from the two principal routing options, including or avoiding Las Vegas. Tables F-4 and F-5 contain the values for the measures of effectiveness resulting from the two options. Table F-6 presents the percent difference between the measures of effectiveness for the rail routes for the cases comparing the option to route with Las Vegas (include Las Vegas) and the option to route without Las Vegas (avoid Las Vegas). These are the results under the default option of favoring the originating railroad.

The following observations can be made when comparing the with and without Las Vegas options:

- The values of the measures of effectiveness for the Carlin rail branch line are not affected by avoiding Las Vegas since none of the routes approach Las Vegas.

- The Carlin rail branch line produces the shortest total distance under either option. Each of the other destinations experienced increases in total distances when Las Vegas is avoided. The routes from eastern origins must divert to avoid Las Vegas when routing to the Jean rail branch line and the routes from western origins must divert to avoid Las Vegas when routing to the Caliente and Valley Modified rail branch lines, resulting in longer distances. About 90 percent of the route origins can be considered to be to the east of the rail branch lines, so the effect on routing to the Jean branch line is far greater (a more than 8 percent increase) than the effect on routing to the Caliente or Valley Modified branch lines (less than 3 percent increases).

Table F-4. Summary of Routes Favoring Originating Railroad That Include Routing Through Las Vegas

Measure	Units	Caliente	Carlin	Jean	Valley Modified	Optimal Value and Case
Total Distance	Km	264,781	262,874	282,660	277,849	262,874
	Mi	164,527	163,342	175,636	172,647	163,342
	% Diff.	0.73%	Minimum	7.53%	5.70%	Carlin
Potentially-Affected Population	Persons	51,738,362	51,403,262	54,864,725	51,991,964	51,403,262
	% Diff.	0.65%	Minimum	6.73%	1.15%	Carlin
Urban Distance	Km	7,272	7,234	7,788	7,292	7,234
	Mi	4,519	4,495	4,839	4,531	4,495
	% Diff.	0.54%	Minimum	7.66%	0.80%	Carlin
Average Population Density	P/sq Km	120.85	115.16	125.41	120.38	115.16
	P/sq Mi	313.00	298.26	324.80	311.78	298.26
	% Diff.	4.94%	Minimum	8.90%	4.53%	Carlin
Main line Track	% of Dist	85.86%	89.54%	86.89%	86.66%	89.54%
	Km	227,329	235,367	245,605	240,794	235,367
	Mi	141,255	146,250	152,611	149,622	146,250
	% Diff.	4.11%	Maximum	2.95%	3.21%	Carlin
MTU - Distance	MTU*Km	235,352,853	236,238,915	251,181,537	246,954,749	235,352,853
	MTU*Mi	146,240,938	146,791,509	156,076,389	153,449,994	146,240,938
	% Diff.	Minimum	0.38%	6.73%	4.93%	Caliente
Cask - Distance	Cask*Km	37,605,132	37,559,061	40,311,710	39,571,627	37,559,061
	Cask*Mi	23,366,658	23,338,032	25,048,442	24,588,577	23,338,032
	% Diff.	0.12%	Minimum	7.33%	5.36%	Carlin
RR Interchanges	RRs	131	132	132	132	Caliente
States	States	738	739	740	740	Caliente

Table F-5. Summary of Routes Favoring Originating Railroad That Avoid Routing Through Las Vegas

Measures	Units	Caliente	Carlin	Jean	Valley Modified	Optimal Value and Case
Total Distance	Km	270,764	262,874	305,617	285,262	262,874
	Mi	168,244	163,342	189,901	177,253	163,342
	% Diff.	3.00%	Minimum	16.26%	8.52%	Carlin
Potentially-Affected Population	Persons	52,345,878	51,403,262	48,606,389	52,495,778	48,606,389
	% Diff.	7.69%	5.75%	Minimum	8.00%	Jean
Urban Distance	Km	7,326	7,234	6,454	7,362	6,454
	Mi	4,575	4,495	4,010	4,575	4,010
	% Diff.	14.07%	12.08%	Minimum	14.07%	Jean
Average Population Density	P/sq Km	113.34	115.16	108.79	107.91	107.91
	P/sq Mi	293.56	298.26	281.76	279.48	279.48
	% Diff.	5.04%	6.72%	0.81%	Minimum	Valley Mod
Main line Track	% of Dist	85.45%	89.54%	90.64%	86.19%	90.64%
	Km	231,369	235,367	277,008	245,867	277,008
	Mi	143,765	146,250	172,124	152,774	172,124
	% Diff.	5.72%	1.22%	Maximum	4.91%	Jean
MTU - Distance	MTU*Km	243,204,5938	236,238,915	271,379,714	256,093,230	236,238,915
	MTU*Mi	151,119,7688	146,791,509	168,626,907	159,128,363	146,791,509
	% Diff.	2.95%	Minimum	14.88%	8.40%	Carlin
Cask - Distance	Cask*Km	38,533,491	37,559,061	44,081,622	40,642,948	37,559,061
	Cask*Mi	23,943,512	23,338,032	27,390,948	25,254,263	23,338,032
	% Diff.	2.59%	Minimum	17.37%	8.21%	Carlin
RR Interchanges	RRs	132	132	175	132	Cal/Car/Val
States	States	744	739	815	744	Carlin

- The Jean rail branch line is preferred for several of the measures of effectiveness in both cases (with and without Las Vegas), although the routes to the Jean rail branch line have increased more than the other three alternatives.

  - The urban distances for the routes to the Jean rail branch line are more than 20 percent lower when Las Vegas is avoided than when Las Vegas is included. The urban distance for the Jean case when Las Vegas is avoided is the optimum in either option. The implication is that these routes are longer but they tend to bypass urban areas.

  - The routes to the Jean rail branch line include a higher percent of Main line A track when Las Vegas is avoided. The main line percent for the Jean branch line when Las Vegas is avoided is the higher (optimal) under either option. This implies that, although the routes are longer, they consist of a higher percent of Main line A track, in aggregate.

  - The effect of lower urban distances for the routes to the Jean rail branch line when Las Vegas is avoided is the more than 12 percent reduction in the potentially- affected population, even though the total distance is longer. The population value for the Jean rail branch line is 5.75 percent less than for any of the other three alternatives, regardless of routing option.

  - The average population density for routes to the Valley Modified rail branch line is less than 1 percent lower than that for the Jean rail branch line when Las Vegas is avoided. These values are more than 5 percent lower than the population density results for the other two alternatives in either routing option.

- The routes to the Jean rail branch line encounter 32 percent more railroad interchanges and 10 percent more states when Las Vegas is avoided than any of the other routes in either routing option. This is for the same reason that the total distance is significantly higher for the Jean branch line when Las Vegas is avoided: it is more difficult to reach the Jean rail branch line and avoid Las Vegas.

Table F-6. Comparison of Percent Differences Between Cases That Include and Avoid Routing Through Las Vegas

Measures	Caliente w/LV	Caliente wo/LV	Carlin w/LV	Carlin wo/LV	Jean w/LV	Jean wo/LV	Valley Mod w/LV	Valley Mod wo/LV
Total Distance	Min	2.26%	Equal	Equal	Min	8.12%	Min	2.67%
Pot. Affected Pop.	Min	1.17%	Equal	Equal	12.88%	Min	Min	0.97%
Urban Distance	Min	1.24%	Equal	Equal	20.67%	Min	Min	0.96%
Avg. Pop. Density	6.63%	Min	Equal	Equal	15.28%	Min	11.56%	Min
Main line Track %	Max	0.48%	Equal	Equal	4.14%	Max	Max	0.54%
MTU - Distance	Min	3.33%	Equal	Equal	Min	8.04%	Min	3.70%
Cask - Distance	Min	2.47%	Equal	Equal	Min	9.35%	Min	2.71%
RR Interchanges	Min	0.76%	Equal	Equal	Min	32.54%	Equal	Equal
States	Min	0.81%	Equal	Equal	Min	10.14%	Min	0.54%

F.4.3 Effect of Branch Line Length

An analysis was conducted using distance measures that include the length of the rail branch line in the Total Distance. The total distance and main line percent measures are shown in Tables F-7 and F-8. The branch line lengths included in these tables are based on Study 1 distances.

Table F-7. Summary of Measures Aggregated with Branch Line Length That Include Routing Through Las Vegas

Measures	Units	Caliente	Carlin	Jean	Valley Modified	Optimal Value and Case
Branch Line Length	Km	587	587	204	166	
	Mi	365	365	127	103	
Total Distance	Km	310,012	308,104	298,397	290,613	290,613
	Mi	192,632	191,447	185,415	180,578	180,578
	% Diff.	6.68%	6.02%	2.68%	Minimum	Valley Mod
Main line Track	% of Dist	73.33%	76.39%	82.31%	82.86%	82.86%
	% Diff.	11.50%	7.83%	0.66%	Maximum	Valley Mod

Table F-8. Summary of Measures Aggregated with Branch Line Length That Avoid Routing Through Las Vegas

Measures	Units	Caliente	Carlin	Jean	Valley Modified	Optimal Value and Case
Branch Line Length	Km	587	587	204	166	
	Mi	365	365	127	103	
Total Distance	Km	315,994	308,104	321,355	298,026	298,026
	Mi	196,349	191,447	199,680	185,184	185,184
	% Diff.	6.03%	3.38%	7.83%	Minimum	Valley Mod
Main line Track	% of Dist	73.22%	76.39%	86.20%	82.50%	86.20%
	% Diff.	15.06%	11.38%	Maximum	4.29%	Jean

When the rail branch line length is added into the total route length, the ordering of the options and cases changes with respect to the ordering of the alternatives discussed in Section F.4.1. The results and percent differences for this measure are shown in Tables F-7 and F-8.

When routing is permitted to include Las Vegas, the Valley Modified rail branch line has the minimum total distance. These changes in route distance also affect the metric tons of uranium-kilometer and cask-kilometer measures in the same way, to favor the Valley Modified rail branch line.

The main line track percentage decreases for all the alternative cases since the total distance increases by the length of the rail branch line while the main line distance remains the same. These values are also presented in Tables F-7 and F-8. The number of interchanges and the number of states is unaffected by including the branch line length.

It is difficult to evaluate the other measures of effectiveness for the rail routes. The INTERLINE-based population density measures are not available for these specific rail branch lines. Pragmatically, the population density in proximity to the rail branch lines may be assumed to be uniformly low, once the branch lines are no longer in proximity to Las Vegas. This condition affects the potentially-affected population measure, the urban distance measure, and the average population density measure in the same way.

The total distance measure (with the inclusion of the rail branch line lengths) for the Valley Modified rail branch line is about 2.6 percent shorter than the Jean branch line case and more than 6 percent shorter than the other two cases. When Las Vegas is avoided, this measure shows the Valley Modified rail branch line is more than 3.3 percent shorter than the Carlin branch line case, 6 percent shorter than the Caliente branch line case, and more than 7.8 percent shorter than the Jean branch line case.

F.4.4 Affected Cities

Using the Transportation Geographic Information System described in Section F.2.2 it is possible to develop a list of cities that are in proximity to the routes and therefore potentially-affected by the shipments of spent nuclear fuel and high-level waste. There are 200 such cities in the geographic database, as shown in Figure F-2. A population threshold of 100,000 (DOC, 1992) was used to define a city. The database includes the cities' boundaries. A five-mile-wide zone was added around the city limits to account for the node-to-node straight line nature of the route representations provided by the INTERLINE routing code.

Affected cities is a more qualitative than quantitative measure, and was therefore not included in the discussion of measures of effectiveness, Section F.2.4.

In aggregate, a total of 109 cities of 100,000 population or greater were encountered. Table F-9 shows the number of cities encountered by option and branch line case. Many of the cities are in proximity to the route origin (the purchaser or producer site); some of the larger cities are in proximity to barge-rail intermodal sites. The cities are identified in Section F.6.4.

Table F-9. Total Cities Encountered by Option and Branch Line Case

	Total Number Of Cities Encountered	
Routing Option	**Including Las Vegas**	**Avoiding Las Vegas**
Caliente	84	84
Carlin	82	82
Jean	86	100
Valley Modified	86	84

There are several difficulties in evaluating this data. First, railroad routes will inherently encounter cities; it is the function of the railroad lines to link cities together. Second, the number of large cities encountered by the representative routes used in this analysis is itself a representative number. Third, the number and populations of cities does not indicate the number of people potentially-affected by the shipment of spent nuclear fuel and high-level waste. The more quantitative urban distance measure of effectiveness described in Section F.2.4.3 provides greater specificity.

Cities are defined as incorporated areas and are not areas of uniformly high population density. The representative rail routes may traverse areas with low population density and still be within the boundaries of a city with population in excess of 100,000. Hence, the number of cities encountered is not necessarily an analytically meaningful measure.

Cities with Population in Excess of 100,000

Figure F-2. Cities with Population in Excess of 100,000

Interpreting the results of the data shown in Table F-9 would indicate that, except for the Jean branch line case in the option of avoiding Las Vegas, the destinations and routing options cannot be differentiated based on the number of large cities the rail routes encounter. The Jean branch line routes avoiding Las Vegas encounters almost 22 percent more cities with population greater than 100,000 than do the routes to the other branch lines in this option.

F.5 CONCLUSIONS

This appendix has provided a detailed description of an analysis of the national-level effects of the selection of one of the four alternative rail branch lines to the proposed repository at Yucca Mountain. Based on the results of this analysis, using the measures of effectiveness that were defined and evaluated, there appears to be significant advantage to the selection of one alternative over another. To take the next step in this analysis, a weighting scheme would have to be defined to derive a single effectiveness score based on the measures of effectiveness defined in this analysis.

If total distance is considered to be the dominant measure, then the representative rail routes to the Carlin rail branch line, in aggregate, are the shortest, regardless of whether Las Vegas is included or avoided. However, the differences in the total distance measure between the alternative branch lines are so small that no significant advantage can be asserted. From the total distance perspective, the avoidance of Las Vegas would, in general, be a slight disadvantage because of the increase in total distance that results in routes to the branch lines that avoid Las Vegas. The routes to the Jean branch line increase by more than 8 percent in total length when Las Vegas is avoided.

When considering potentially-affected population, the Carlin branch line also provides the lowest values, though by only small percent differences, in comparison to the alternative branch lines. Avoiding Las Vegas results in an almost 13 percent drop in potentially-affected population for the Jean branch line, even though the routes are 8 percent longer.

As pointed out in the alternative analysis, Section F.4.3, when the length of the rail spur is added to the total distance measure, the Valley Modified rail branch line case results in the lowest total distance, whether Las Vegas is included or avoided.

When measures other than total distance (e.g., urban distance, population density, and main line percent) and the numbers of railroad interchanges and states encountered are considered, the Jean branch line changes from the least desirable destination in the option for which Las Vegas is included to a favorable alternative in the option for which Las Vegas is avoided. However, the Jean branch line case has significantly worse values for distance-related measures and the numbers of railroad interchanges and states encountered. The greatest changes in the measures of effectiveness occur for the routes to the Jean rail branch line between the case including Las Vegas and the case avoiding Las Vegas.

This analysis, then, has shown that there are no significant national transportation considerations that would support the selection of one of the rail branch lines in place of another.

F.6 FURTHER BACKUP INFORMATION

This section provides additional backup information for the national transportation system considerations analysis. This information includes the following:

- A qualitative description of the representative routes and resulting maps
- The detailed spreadsheets (Table F-14) that provide the measure of effectiveness data for all routes under all options and branch lines
- A description of intermodal transfer points at which the barge and heavy haul shipments from some of the purchaser sites are transferred to rail transport
- The detailed tables (Tables 12 and 13) showing the cities encountered during transit.

F.6.1 Qualitative Description and Maps

This section provides a brief narrative describing the qualitative differences between the routes to each of the four rail branch lines under the option of routing that includes Las Vegas and the option of avoiding routing through Las Vegas. The maps generated by the CRWMS M&O Transportation Geographic Information System, which are based on the representative routes selected by the INTERLINE routing code are shown in Section 9 of this document.

The following narratives can be augmented with tables found in Sections F.6.4, which list the cities with populations of greater than 100,000 encountered by destination and routing option.

F.6.1.1 The Caliente Rail Branch Line

The Caliente case is mildly affected to by the avoidance of routing through Las Vegas. The Caliente rail branch line is to the east of Las Vegas (and the Valley Modified rail branch line) along the Union Pacific rail line. Shipments with origins to the west and south of Las Vegas are affected by avoiding Las Vegas. Those with eastern and northern origins are, for the most part, not affected.

The major cities encountered by the routes to the Caliente rail branch line when Las Vegas is included are Chicago, Atlanta, St. Louis, Kansas City, Houston, Dallas, Salt Lake City, Albuquerque, and Las Vegas. Figure 9-2 shows the routes that include Las Vegas.

Avoiding Las Vegas shifts the routes with western origins (Palo Verde NP, San Onofre NP, Diablo Canyon NP, and Humboldt Bay NP) from entering Nevada from the south to routing north to Central California, east to Salt Lake City, and then south to Caliente. Comanche Peak NP shipments are rerouted from Arizona, New Mexico, and Southern Nevada to a northern route through Texas, Colorado, Utah, and Nevada. The Clinton NP route interchanges at Kansas City (then follows the northern route) instead of routing through Kansas, Texas, New Mexico, Arizona, California, and Southern Nevada. The Clinton NP and Comanche Peak NP rerouting may be due to originating railroad effects.

The other eastern origins are essentially unaffected by avoiding Las Vegas. The northern sites, Hanford, Washington Nuclear, and Idaho National Engineering Laboratory, are also unaffected by avoiding Las Vegas. When Las Vegas is avoided, Albuquerque is no longer encountered, but Denver and Reno are added to the list of cities encountered. Figure 9-3 shows the routes when avoiding Las Vegas.

F.6.1.2 The Carlin Rail Branch Line

The Carlin case is unaffected by whether Las Vegas is included or avoided. The major cities encountered by the routes to the Carlin rail branch line include Chicago, Atlanta, St. Louis, Kansas City, Houston, Dallas, Salt Lake City, and Las Vegas. Figures 9-4 and 9-5 present the Carlin cases.

F.6.1.3 The Jean Rail Branch Line

Of the four destinations, the Jean cases are the most reactive to the inclusion or avoidance of routing through Las Vegas. Since the Jean rail branch line is to the west of Las Vegas along the Union Pacific rail line, if Las Vegas is to be avoided, the eastern and northern shipments must be rerouted significantly to get to Jean.

When Las Vegas is included, the major cities encountered by the routes include Chicago, Atlanta, St. Louis, Kansas City, Salt Lake City, and Las Vegas. Figure 9-6 presents the routes to the Jean branch line that include Las Vegas.

Avoiding Las Vegas shifts the route from Idaho National Engineering Laboratory south to Salt Lake City, west through Nevada, south through California, then northeast to Jean. The other northern origins, Washington Nuclear, Hanford, and Trojan NP, are shifted west and south through Oregon and California, then northeast to Jean. A southwestern shift of all the eastern routes occurs to the west of Kansas City. An eastern shift in routes occurs in the southeast United States, specifically from Crystal River NP, St. Lucie NP, Turkey Point NP, and Oconee NP. There are no cities dropped when routing through Las Vegas is precluded. Several additional cities are encountered when Las Vegas is avoided, however, such as Denver, New Orleans, and El Paso. Figure 9-7 presents the routes to the Jean rail branch line that avoid Las Vegas.

F.6.1.4 The Valley Modified Rail Branch Line

The Valley Modified routing cases are somewhat affected by the avoidance of routing through Las Vegas, just as the Caliente cases are. Note that the Valley Modified rail branch line used in the INTERLINE analysis is a surrogate for the Valley Modified rail route used elsewhere in this report. The Valley Modified rail branch line is to the east of Las Vegas (between Caliente and Las Vegas) along the Union Pacific rail line. Origins to the south and west of Las Vegas are rerouted when Las Vegas is to be avoided.

The cities of Chicago, Atlanta, St. Louis, Kansas City, Houston, Dallas, Salt Lake City, and Las Vegas are encountered when Las Vegas is included in the routes. Figure 9-8 presents these routes.

Avoiding Las Vegas shifts the western and southern origins' (Palo Verde NP, San Onofre NP, Diablo Canyon NP, and Humboldt Bay NP) routes from entering Nevada from the south to routing north to Central California and east to Salt Lake City and then south to the Valley Modified branch line. Comanche Peak NP shipments are rerouted from Arizona, New Mexico, and Southern Nevada to a northern route through Texas, Colorado, Utah, and Nevada. The Clinton NP route interchanges at Kansas City (then follows the northern route) instead of routing through Kansas, Texas, New Mexico, Arizona, California, and Southern Nevada. Albuquerque is no longer encountered when Las Vegas is avoided; however, the additional cities of Denver and Reno are encountered when Las Vegas is avoided. Figure 9-9 presents the routes to the Valley Modified branch line that avoid Las Vegas.

F.6.2 BARGE AND HEAVY HAUL INTERMODAL TRANSPORTATION

This section addresses the destinations of barge and heavy haul transport used in this analysis as substitutes for the purchaser and producer sites. Several of the purchaser and producer sites require the use of barge or heavy haul transport to reach rail lines. The barge-rail intermodal transfer locations for those sites requiring barge were selected using the barge routing option of INTERLINE. INTERLINE selects the shortest barge route to the nearest port that provides heavy lift capabilities for transferring cargo from barge to rail. The barge-rail intermodal sites are listed in Table F-10.

Table F-10. Barge Intermodal Transfer Locations

Baltimore, Maryland	New Haven, Connecticut
Boston, Massachusetts	New York, New York
Buffalo, New York	Port Hueneme, California
Cairo, Illinois	Vicksburg, Mississippi
Chicago, Illinois	West Palm Beach, Florida
Miami, Florida	Wilmington, Delaware

The heavy haul intermodal sites used were the nearest rail node in the INTERLINE data base to the Purchaser or Producer site. The heavy haul Intermodal sites are shown in Table F-11.

Table F-11. Heavy Haul Intermodal Transfer Locations

Blair, Nebraska	Nebraska City, Nebraska
Clemson, South Carolina	Petoskey, Michigan
Fulton, Missouri	Scoville, Idaho
Hoosac Tunnel, Massachusetts	York, Pennsylvania
Kewaunee, Wisconsin	

Note that these are representative intermodal site locations at which the shipments reach an appropriate rail head. Some of them are large cities and will appear in the list of cities in Section F.6.4.

F.6.3 DETAILED DATA SHOWING CITIES ENCOUNTERED

The Tables F-12 and F-13 are provided to present the detailed information discussed in Section F.4.4. They also support the qualitative discussions in Section F.6.1. The data listed here was generated by the Transportation Geographic Information System software. The Transportation Geographic Information System has in its database city boundary and population data. Cities with population greater than 100,000 were selected. There are 200 of them in the database, based on the 1990 census. A zone of five miles was used in the search; that is, if a city boundary is within five miles of the rail routes, the city is included as being encountered by the rail route.

F.6.4 DETAILED MEASURE OF EFFECTIVENESS SPREADSHEETS

This section provides information on the full set of detailed spreadsheets (Table F-14) derived from the INTERLINE routing code runs. There are four options examined, only the first two of which treated in the analysis in this report:

1) Favoring originating railroad and permitting routing through Las Vegas
2) Favoring originating railroad and *not* permitting routing through Las Vegas
3) *Not* favoring originating railroad and permitting routing through Las Vegas
4) *Not* favoring originating railroad and *not* permitting routing through Las Vegas.

The effects of not favoring the originating railroad are not significantly different from the base case, which includes the favoring of the originating railroad.

The spreadsheets present the values of the measures of effectiveness defined in Section F.2.4 for each of the 77 route origins.

Table F-12. Cities Encountered on Routes Including Las Vegas

City	State	Population	Caliente	Carlin	Jean	Valley
New York	NY	7,322,564	X	X	X	X
Los Angeles	CA	3,485,398	X	X	X	X
Chicago	IL	2,783,726	X	X	X	X
Houston	TX	1,630,672	X	X	X	X
Dallas	TX	1,006,831				
San Antonio	TX	935,927				
Baltimore	MD	736,014	X	X	X	X
Jacksonville City	FL	635,230	X	X	X	X
Columbus	OH	632,958	X	X	X	X
Milwaukee	WI	628,088	X	X	X	X
Washington	DC	606,900	X	X	X	X
El Paso	TX	515,342				
Cleveland	OH	505,616	X	X	X	X
New Orleans	LA	496,938				
Nashville-Davidson	TN	488,518	X	X	X	X
Denver	CO	467,610		X		
Fort Worth	TX	447,619	X	X	X	X
Portland	OR	437,398	X	X	X	X
Kansas City	MO	435,141	X	X	X	X
Tucson	AZ	405,390				
St. Louis	MO	396,685	X	X	X	X
Charlotte	NC	396,003	X	X	X	X
Atlanta	GA	394,017	X	X	X	X
Albuquerque	NM	384,736				
Pittsburgh	PA	369,879	X	X	X	X
Sacramento	CA	369,365	X	X	X	X
Minneapolis	MN	368,383	X	X	X	X
Fresno	CA	354,202	X	X	X	X
Omaha	NE	335,795	X	X	X	X
Toledo	OH	332,943	X	X	X	X

Table F-12. Cities Encountered on Routes Including Las Vegas (Continued)

City	State	Population	Caliente	Carlin	Jean	Valley
Buffalo	NY	328,123	X	X	X	X
Santa Ana	CA	293,742	X	X	X	X
Colorado Springs	CO	281,140		X		
St. Paul	MN	272,235	X	X	X	X
Louisville	KY	269,157	X	X	X	X
Anaheim	CA	266,406	X	X	X	X
Birmingham	AL	265,852	X	X	X	X
Arlington	TX	261,763				
Las Vegas	NV	258,295	X		X	X
Rochester	NY	231,636	X	X	X	X
Jersey City	NJ	228,537	X	X	X	X
Riverside	CA	226,505	X	X	X	X
Akron	OH	223,019	X	X	X	X
Baton Rouge	LA	219,531	X	X	X	X
Stockton	CA	210,943	X	X	X	X
Richmond	VA	203,056	X	X	X	X
Shreveport	LA	198,528				
Mobile	AL	196,278				
Des Moines	IA	193,187				
Lincoln	NE	191,972	X	X	X	X
Hialeah	FL	188,004	X	X	X	X
Montgomery	AL	187,106				
Lubbock	TX	186,281	X	X	X	X
Glendale	CA	180,038	X		X	X
Columbus City	GA	178,701	X	X	X	X
Little Rock	AR	175,781	X	X	X	X
Bakersfield	CA	174,820	X	X	X	X
Fort Wayne	IN	173,072	X	X	X	X
Newport News	VA	170,045	X	X	X	X
Worcester	MA	169,759	X	X	X	X

Table F-12. Cities Encountered on Routes Including Las Vegas (Continued)

City	State	Population	Caliente	Carlin	Jean	Valley
Knoxville	TN	165,121	X	X	X	X
Modesto	CA	164,730	X	X	X	X
San Bernardino	CA	164,164	X	X	X	X
Syracuse	NY	163,860	X	X	X	X
Salt Lake City	UT	159,936	X	X	X	X
Huntsville	AL	159,866	X	X	X	X
Amarillo	TX	157,615		X	X	X
Springfield	MA	156,983	X	X	X	X
Chattanooga	TN	152,488	X	X	X	X
Kansas City	KS	149,768	X	X	X	X
Metairie	LA	149,428				
Fort Lauderdale	FL	149,377	X	X	X	X
Oxnard	CA	142,192	X	X	X	X
Hartford	CT	139,739	X	X	X	X
Reno	NV	133,850				
Hampton	VA	133,793	X	X	X	X
Ontario	CA	133,179	X		X	X
Pomona	CA	131,723	X		X	X
Lansing	MI	127,321	X	X	X	X
East Los Angeles	CA	126,379	X		X	X
Evansville	IN	126,272	X	X	X	X
Tallahassee	FL	124,773				
Paradise	NV	124,682	X		X	X
Hollywood	FL	121,697	X	X	X	X
Topeka	KS	119,883	X	X	X	X
Gary	IN	116,646	X	X	X	X
Beaumont	TX	114,323				
Fullerton	CA	114,144	X	X	X	X
Santa Rosa	CA	113,313	X	X	X	X
Eugene	OR	112,669				

Table F-12. Cities Encountered on Routes Including Las Vegas (Continued)

City	State	Population	Caliente	Carlin	Jean	Valley
Independence	MO	112,301			X	X
Overland Park	KS	111,790	X	X	X	X
Alexandria	VA	111,183	X	X	X	X
Orange	CA	110,658	X	X	X	X
Santa Clarita	CA	110,642		X		
Irvine	CA	110,330	X	X	X	X
Cedar Rapids	IA	108,751	X	X	X	X
Erie	PA	108,718	X	X	X	X
Salem	OR	107,786				
Citrus Heights	CA	107,439				
Abilene	TX	106,665				
Macon	GA	106,640	X	X	X	X
South Bend	IN	105,536	X	X	X	X
Springfield	IL	105,227	X	X	X	X
Thousand Oaks	CA	104,352	X	X	X	X
Waco	TX	103,590	X	X	X	X
Lowell	MA	103,439	X	X	X	X
Mesquite	TX	101,484				
Simi Valley	CA	100,217	X	X	X	X
Maximum Count	109	Total Count	84	82	86	86

Table F-13. Cities Encountered on Routes Avoiding Las Vegas

City	State	Population	Caliente	Carlin	Jean	Valley
New York	NY	7,322,564	X	X	X	X
Los Angeles	CA	3,485,398	X	X	X	X
Chicago	IL	2,783,726	X	X	X	X
Houston	TX	1,630,672	X	X	X	X
Dallas	TX	1,006,831			X	
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El Paso	TX	515,342			X	
Cleveland	OH	505,616	X	X	X	X
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Birmingham	AL	265,852	X	X	X	X
Arlington	TX	261,763			X	
Las Vegas	NV	258,295				
Rochester	NY	231,636	X	X	X	X
Jersey City	NJ	228,537	X	X	X	X
Riverside	CA	226,505	X	X	X	X
Akron	OH	223,019	X	X	X	X
Baton Rouge	LA	219,531	X	X	X	X
Stockton	CA	210,943	X	X	X	X
Richmond	VA	203,056	X	X	X	X
Shreveport	LA	198,528			X	
Mobile	AL	196,278			X	
Des Moines	IA	193,187			X	
Lincoln	NE	191,972	X	X	X	X
Hialeah	FL	188,004	X	X	X	X
Montgomery	AL	187,106			X	
Lubbock	TX	186,281	X	X	X	X
Glendale	CA	180,038			X	
Columbus City	GA	178,701	X	X	X	X
Little Rock	AR	175,781	X	X		X
Bakersfield	CA	174,820	X	X	X	X
Fort Wayne	IN	173,072	X	X	X	X
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Amarillo	TX	157,615	X	X	X	X
Springfield	MA	156,983	X	X	X	X
Chattanooga	TN	152,488	X	X	X	X
Kansas City	KS	149,768	X	X	X	X
Metairie	LA	149,428			X	
Fort Lauderdale	FL	149,377	X	X	X	X
Oxnard	CA	142,192	X	X	X	X
Hartford	CT	139,739	X	X	X	X
Reno	NV	133,850	X			X
Hampton	VA	133,793	X	X	X	X
Ontario	CA	133,179			X	
Pomona	CA	131,723			X	
Lansing	MI	127,321	X	X	X	X
East Los Angeles	CA	126,379			X	
Evansville	IN	126,272	X	X		X
Tallahassee	FL	124,773			X	
Paradise	NV	124,682				
Hollywood	FL	121,697	X	X	X	X
Topeka	KS	119,883	X	X	X	X
Gary	IN	116,646	X	X	X	X
Beaumont	TX	114,323			X	
Fullerton	CA	114,144	X	X	X	X
Santa Rosa	CA	113,313	X	X	X	X
Eugene	OR	112,669			X	

Table F-13. Cities Encountered on Routes Avoiding Las Vegas (Continued)

City	State	Population	Caliente	Carlin	Jean	Valley
Independence	MO	112,301			X	
Overland Park	KS	111,790	X	X	X	X
Alexandria	VA	111,183	X	X	X	X
Orange	CA	110,658	X	X	X	X
Santa Clarita	CA	110,642	X	X		X
Irvine	CA	110,330	X	X	X	X
Cedar Rapids	IA	108,751	X	X	X	X
Erie	PA	108,718	X	X	X	X
Salem	OR	107,786			X	
Citrus Heights	CA	107,439	X		X	X
Abilene	TX	106,665			X	
Macon	GA	106,640	X	X	X	X
South Bend	IN	105,536	X	X	X	X
Springfield	IL	105,227	X	X	X	X
Thousand Oaks	CA	104,352	X	X	X	X
Waco	TX	103,590	X	X		X
Lowell	MA	103,439	X	X	X	X
Mesquite	TX	101,484			X	
Simi Valley	CA	100,217	X	X	X	X
Maximum Count	109	Total Count	84	82	100	84

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,933	1,823	236,519	30	19	50.40	130.53	84.03%	2,465	1,532	3,375,088	2,097,175	375,450	233,293	0	9
ARNOLD NP	2,539	1,578	201,751	26	16	49.66	128.63	92.71%	2,354	1,463	1,159,470	720,458	162,490	100,966	2	6
BEAVER VALLEY NP	3,616	2,247	816,949	120	75	141.21	365.75	95.19%	3,442	2,139	3,671,300	2,281,232	383,267	238,150	3	10
BIG ROCK POINT NP	3,624	2,252	643,485	98	61	110.97	287.41	85.83%	3,111	1,933	226,915	140,998	144,970	90,080	4	9
BRAIDWOOD NP	3,175	1,973	276,795	33	21	54.49	141.13	49.47%	1,571	976	3,331,471	2,070,072	377,797	234,751	1	6
BROWNS FERRY NP	3,028	1,881	320,180	43	27	66.09	171.19	80.17%	2,427	1,508	4,654,225	2,891,991	635,811	395,073	1	8
BRUNSWICK NP	4,656	2,893	770,725	83	51	103.45	267.94	82.11%	3,823	2,376	4,258,542	2,646,125	963,861	598,913	3	15
BYRON NP	2,773	1,723	245,697	32	20	55.38	143.44	90.58%	2,512	1,561	3,180,232	1,976,097	360,457	223,977	2	7
CALLAWAY NP	2,617	1,626	178,729	22	14	42.69	110.57	83.47%	2,184	1,357	1,675,200	1,040,917	196,248	121,943	1	7
CALVERT CLIFFS NP	4,136	2,570	1,008,084	146	91	152.34	394.57	96.11%	3,975	2,470	4,727,238	2,937,358	599,678	372,621	2	12
CATAWBA NP	4,194	2,606	610,617	77	48	91.00	235.69	70.36%	2,951	1,834	5,004,761	3,109,803	536,807	333,555	1	13
CLINTON NP	3,041	1,890	353,001	50	31	72.54	187.88	78.75%	2,395	1,488	1,377,823	856,136	197,688	122,837	1	8
COMANCHE PEAK NP	2,754	1,712	148,113	15	9	33.61	87.05	94.68%	2,608	1,621	2,529,561	1,571,790	289,212	179,708	1	5
CONN YANKEE NP	4,453	2,767	1,449,099	209	130	203.39	526.79	94.04%	4,187	2,602	2,264,661	1,407,190	485,367	301,592	2	13
COOK NP	2,998	1,863	635,645	99	62	132.51	343.21	92.48%	2,773	1,723	4,047,618	2,515,064	437,716	271,983	2	9
COOPER STATION NP	2,227	1,384	238,193	36	23	66.84	173.11	88.98%	1,982	1,232	1,020,100	633,858	236,098	146,704	0	5
CRYSTAL RIVER NP	4,621	2,871	665,273	73	45	89.98	233.05	81.69%	3,775	2,346	2,268,043	1,409,291	411,262	255,546	2	14
DAVIS-BESSE NP	3,494	2,171	372,645	52	32	66.67	172.67	78.93%	2,758	1,714	1,777,777	1,104,655	202,627	125,906	1	10
DIABLO CANYON NP	859	534	720,395	136	85	524.40	1,358.21	88.19%	757	471	1,022,510	635,356	114,192	70,956	2	2
DRESDEN NP DOCK	2,876	1,787	305,142	40	25	66.31	171.74	92.22%	2,653	1,648	4,094,832	2,544,401	1,021,062	634,456	2	7
FARLEY NP	4,109	2,553	536,137	66	41	81.56	211.24	68.21%	2,803	1,741	4,685,591	2,911,480	505,347	314,007	1	13
FERMI NP	3,711	2,306	1,043,476	159	99	175.74	455.17	95.66%	3,550	2,206	1,858,877	1,155,048	285,747	177,554	2	11
FITZPATRICK NP	4,005	2,489	1,213,632	180	112	189.38	490.51	94.30%	3,777	2,347	2,079,534	1,292,158	292,379	181,676	2	11
FORT CALHOUN NP	2,111	1,312	154,249	21	13	45.67	118.29	92.38%	1,950	1,212	803,548	499,300	187,863	116,732	1	5
GRAND GULF NP	3,500	2,175	318,717	39	24	56.92	147.42	83.22%	2,912	1,810	2,980,478	1,851,976	423,463	263,127	1	11
HANFORD RPSTRY	1,794	1,115	159,579	23	14	55.60	144.00	72.86%	1,307	812	5,413,867	3,364,009	2,170,670	1,348,787	2	5
HARRIS NP	4,543	2,823	753,338	81	50	103.65	268.45	83.07%	3,773	2,345	2,716,355	1,687,858	313,436	194,759	2	15
HATCH NP	4,187	2,601	584,201	69	43	87.21	225.88	75.97%	3,181	1,976	5,577,339	3,465,585	770,328	478,658	1	13
HOPE CREEK NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	3,020,481	1,876,833	425,444	264,357	2	12
HUMBOLDT BAY NP	1,892	1,176	642,472	114	71	212.20	549.61	71.87%	1,360	845	54,762	34,028	32,169	19,989	2	2
INEL	869	540	96,555	15	10	69.43	179.82	50.10%	435	271	525,116	326,291	200,787	124,763	0	3
KEWAUNEE NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	1,508,490	937,329	190,891	118,614	3	8
LA CROSSE NP	3,022	1,878	257,620	35	22	53.27	137.98	89.56%	2,707	1,682	114,789	71,326	42,313	26,292	1	8
LA SALLE NP	2,943	1,828	195,795	24	15	41.59	107.71	91.25%	2,685	1,668	3,712,038	2,306,545	517,886	321,798	1	9
LIMERICK NP	4,179	2,596	1,299,340	192	119	194.35	503.36	95.65%	3,997	2,483	4,717,127	2,931,076	689,455	428,406	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,710	2,927	1,489,542	207	129	197.67	511.96	84.62%	3,985	2,476	3,376,099	2,097,803	428,588	266,312	4	15
MCGUIRE NP	4,335	2,694	898,347	124	77	129.52	335.46	93.49%	4,053	2,518	6,149,467	3,821,087	654,577	406,734	2	13
MILLSTONE NP	4,571	2,840	1,481,420	211	131	202.58	524.67	93.63%	4,279	2,659	7,924,792	4,924,219	1,585,982	985,480	3	13
MONTICELLO NP	2,763	1,717	283,581	35	22	64.15	166.15	69.35%	1,916	1,191	1,087,924	676,002	262,463	163,087	1	8
MORRIS (G E Repro Plnt, IL)	2,873	1,785	305,117	40	25	66.38	171.91	92.33%	2,653	1,648	1,936,640	1,203,368	255,698	158,883	2	7
NINE MILE POINT NP	4,004	2,488	1,213,478	180	112	189.42	490.60	94.33%	3,777	2,347	4,122,177	2,561,393	592,577	368,209	2	11
NORTH ANNA NP	4,324	2,687	1,210,017	180	112	174.90	453.00	93.24%	4,031	2,505	4,968,655	3,087,368	566,423	351,958	2	14
OCONEE NP	4,068	2,528	644,228	79	49	98.97	256.34	79.71%	3,243	2,015	7,719,106	4,796,412	829,928	515,692	1	14
OYSTER CREEK NP	4,426	2,750	1,417,352	203	126	200.13	518.34	91.27%	4,040	2,510	2,883,683	1,791,831	407,225	253,037	2	11
PALISADES NP	2,860	1,777	442,447	69	43	96.67	250.38	94.37%	2,700	1,677	1,644,049	1,021,561	197,372	122,641	1	7
PALO VERDE NP	1,148	714	139,773	21	13	76.08	197.04	86.62%	995	618	1,937,535	1,203,924	234,247	145,554	1	3
PEACH BOTTOM NP	4,093	2,543	1,211,397	181	112	184.97	479.07	95.16%	3,895	2,420	6,557,749	4,074,781	920,975	572,265	3	10
PERRY NP	3,600	2,237	573,560	82	51	99.57	257.88	78.58%	2,829	1,758	2,178,528	1,353,669	309,624	192,391	1	10
PILGRIM NP	4,508	2,801	1,503,922	220	137	208.50	540.02	94.92%	4,279	2,659	2,280,428	1,416,987	527,449	327,740	2	12
POINT BEACH NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	2,709,614	1,683,670	346,192	215,113	3	8
PRAIRIE ISLAND NP	2,693	1,674	258,967	30	19	60.10	155.65	74.86%	2,016	1,253	2,174,501	1,351,167	285,484	177,391	2	7
QUAD CITIES NP	2,751	1,710	296,731	43	27	67.41	174.58	92.81%	2,553	1,587	3,704,741	2,302,011	863,922	536,814	2	7
RANCHO SECO NP	1,350	839	439,515	79	49	203.44	526.92	97.85%	1,321	821	308,342	191,594	32,406	20,136	1	2
RIVER BEND NP	3,761	2,337	340,294	39	24	56.56	146.48	81.42%	3,062	1,903	1,835,044	1,140,239	259,479	161,232	1	10
ROBINSON NP	4,386	2,725	785,862	90	56	111.98	290.03	80.70%	3,540	2,200	1,511,195	939,009	307,029	190,778	2	14
SALEM NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	4,786,367	2,974,099	518,114	321,940	2	12
SAN ONOFRE NP	761	473	372,627	69	43	305.94	792.40	91.12%	694	431	1,118,358	694,913	133,214	82,775	1	2
SAVANNA RIVER PLANT	4,222	2,623	717,983	88	55	106.29	275.28	76.22%	3,218	2,000	11,756,072	7,304,857	4,703,273	2,922,468	3	14
SEABROOK NP	4,554	2,830	1,443,406	204	127	198.10	513.09	87.52%	3,985	2,476	1,996,985	1,240,864	214,029	132,991	3	14
SEQUOYAH NP	3,673	2,282	443,823	51	32	75.52	195.61	72.05%	2,646	1,644	3,597,087	2,235,118	378,304	235,067	1	13
SOUTH TEXAS NP	3,778	2,348	519,952	66	41	86.02	222.79	78.04%	2,948	1,832	3,054,283	1,897,836	287,124	178,410	0	9
ST LUCIE NP	4,880	3,033	945,707	112	70	121.11	313.68	86.71%	4,232	2,630	5,615,091	3,489,043	717,412	445,778	3	14
SUMMER NP	4,129	2,566	533,917	68	42	80.81	209.30	68.61%	2,833	1,761	2,165,887	1,345,815	243,636	151,388	1	13
SURRY NP	4,438	2,758	972,291	137	85	136.93	354.66	96.37%	4,277	2,658	4,814,684	2,991,694	532,534	330,900	2	12
SUSQUEHANNA NP	4,177	2,595	1,209,566	179	111	180.99	468.77	92.33%	3,857	2,396	6,141,432	3,816,094	881,327	547,629	3	10
THREE MILE ISLAND NP	4,072	2,530	1,211,767	181	113	185.98	481.68	95.38%	3,884	2,413	2,131,197	1,324,260	228,049	141,702	2	10
TROJAN NP	2,027	1,260	209,092	32	20	64.46	166.96	79.32%	1,608	999	727,516	452,056	77,037	47,869	1	4
TURKEY POINT NP	5,083	3,159	1,055,938	139	86	129.83	336.27	78.22%	3,976	2,471	5,138,691	3,193,022	543,895	337,960	2	14
VERMONT YANKEE NP	4,462	2,773	1,371,822	196	122	192.16	497.69	94.46%	4,215	2,619	2,684,337	1,667,964	615,745	382,605	3	13
VOGTLE NP	4,243	2,637	585,290	69	43	86.21	223.29	75.74%	3,214	1,997	4,346,285	2,700,646	924,985	574,757	1	13
WATERFORD NP	3,809	2,367	332,928	39	24	54.63	141.49	84.07%	3,202	1,990	2,272,588	1,412,115	285,664	177,503	0	10
WATTS BAR NP	3,684	2,289	427,631	59	37	72.56	187.92	73.20%	2,696	1,676	1,103,472	685,663	117,877	73,245	1	11
WEST VALLEY	3,762	2,338	1,082,052	166	103	179.74	465.54	94.35%	3,550	2,206	2,505,034	1,556,550	244,562	151,964	3	11
WNP - Washington Nuclear	1,760	1,094	159,473	23	14	56.63	146.66	74.26%	1,307	812	976,318	606,654	142,572	88,590	1	5
WOLF CREEK NP	2,494	1,550	210,769	30	18	52.82	136.81	92.77%	2,314	1,438	1,432,891	890,354	157,112	97,625	0	7
YANKEE ROWE NP	4,267	2,651	1,291,704	187	116	189.22	490.08	93.41%	3,985	2,476	542,876	337,326	191,995	119,300	3	13
ZION NP	2,908	1,807	464,952	69	43	99.92	258.80	93.80%	2,728	1,695	3,999,376	2,485,088	418,789	260,222	1	7
Summary	264,781	164,527	51,738,362	7,272	4,519	120.85	313.00	85.86%	227,329	141,255	235,352,853	146,240,938	37,605,132	23,366,658	131	738

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,887	1,794	233,692	30	19	50.60	131.05	89.35%	2,579	1,603	3,321,386	2,063,806	369,476	229,581	0	9
ARNOLD NP	2,492	1,549	198,924	26	16	49.89	129.20	99.03%	2,468	1,534	1,138,156	707,215	159,503	99,110	2	6
BEAVER VALLEY NP	3,569	2,218	814,037	120	75	142.55	369.21	99.64%	3,556	2,210	3,623,912	2,251,786	378,320	235,076	3	10
BIG ROCK POINT NP	3,578	2,223	640,728	98	61	111.93	289.91	90.15%	3,225	2,004	223,993	139,182	143,103	88,920	4	9
BRAIDWOOD NP	3,239	2,013	318,566	39	24	61.47	159.22	54.84%	1,776	1,104	3,398,685	2,111,837	385,419	239,488	1	6
BROWNS FERRY NP	2,981	1,852	317,337	43	27	66.53	172.32	85.26%	2,542	1,579	4,582,481	2,847,411	626,010	388,983	1	8
BRUNSWICK NP	4,610	2,864	768,081	83	51	104.14	269.72	85.42%	3,938	2,447	4,215,858	2,619,603	954,200	592,910	3	15
BYRON NP	2,726	1,694	242,952	32	20	55.70	144.27	96.32%	2,626	1,632	3,126,702	1,942,836	354,390	220,207	2	7
CALLAWAY NP	2,570	1,597	176,028	22	14	42.81	110.88	89.44%	2,298	1,428	1,645,321	1,022,351	192,748	119,768	1	7
CALVERT CLIFFS NP	4,089	2,541	1,005,347	146	91	153.66	397.99	100.00%	4,089	2,541	4,673,891	2,904,211	592,910	368,416	2	12
CATAWBA NP	4,147	2,577	607,756	77	48	91.59	237.23	73.91%	3,065	1,905	4,949,065	3,075,195	530,833	329,843	1	13
CLINTON NP	2,995	1,861	350,194	50	31	73.09	189.30	83.80%	2,509	1,559	1,356,679	842,998	194,654	120,952	1	8
COMANCHE PEAK NP	2,850	1,771	266,149	31	19	58.37	151.18	65.60%	1,869	1,162	2,617,205	1,626,250	299,233	185,934	1	6
CONN YANKEE NP	4,406	2,738	1,446,145	209	130	205.13	531.28	97.63%	4,302	2,673	2,240,925	1,392,441	480,280	298,431	2	13
COOK NP	2,951	1,834	633,051	99	62	134.06	347.21	97.82%	2,887	1,794	3,984,609	2,475,912	430,902	267,749	2	9
COOPER STATION NP	2,181	1,355	235,478	36	23	67.49	174.80	96.13%	2,096	1,303	998,725	620,576	231,151	143,630	0	5
CRYSTAL RIVER NP	4,574	2,842	662,423	73	45	90.51	234.42	85.02%	3,889	2,417	2,245,136	1,395,058	407,109	252,965	2	14
DAVIS-BESSE NP	3,447	2,142	369,810	52	32	67.05	173.67	83.32%	2,872	1,785	1,754,027	1,089,898	199,921	124,224	1	10
DIABLO CANYON NP	1,608	999	740,144	134	83	287.73	745.21	87.59%	1,408	875	1,914,690	1,189,729	213,830	132,867	2	2
DRESDEN NP DOCK	2,830	1,758	302,295	40	25	66.77	172.94	97.78%	2,767	1,719	4,028,387	2,503,114	1,004,494	624,161	2	7
FARLEY NP	4,062	2,524	533,264	66	41	82.05	212.52	71.81%	2,917	1,812	4,632,364	2,878,407	499,606	310,440	1	13
FERMI NP	3,664	2,277	1,040,835	159	99	177.53	459.80	100.00%	3,664	2,277	1,835,499	1,140,522	282,153	175,321	2	11
FITZPATRICK NP	3,959	2,460	1,210,710	180	112	191.16	495.10	98.30%	3,891	2,418	2,055,302	1,277,101	288,972	179,558	2	11
FORT CALHOUN NP	2,064	1,283	151,444	21	13	45.86	118.77	100.00%	2,064	1,283	785,782	488,260	183,710	114,151	1	5
GRAND GULF NP	3,453	2,146	316,011	39	24	57.20	148.14	87.65%	3,027	1,881	2,940,731	1,827,279	417,816	259,618	1	11
HANFORD RPSTRY	1,747	1,086	156,793	23	14	56.09	145.26	81.35%	1,421	883	5,273,020	3,276,491	2,114,198	1,313,697	2	5
HARRIS NP	4,496	2,794	750,443	81	50	104.32	270.20	86.47%	3,888	2,416	2,688,446	1,670,517	310,216	192,758	2	15
HATCH NP	4,140	2,572	581,562	69	43	87.80	227.40	79.59%	3,295	2,047	5,515,164	3,426,951	761,740	473,322	1	13
HOPE CREEK NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	2,987,015	1,856,038	420,730	261,428	2	12
HUMBOLDT BAY NP	1,321	821	169,747	28	17	80.31	208.02	59.70%	789	490	38,228	23,754	22,456	13,954	2	2
INEL	823	511	93,828	15	10	71.29	184.65	66.84%	550	342	496,920	308,771	190,006	118,064	0	3
KEWAUNEE NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	1,486,730	923,808	188,137	116,903	3	8
LA CROSSE NP	2,976	1,849	254,907	35	22	53.54	138.67	94.81%	2,821	1,753	113,017	70,225	41,660	25,886	1	8
LA SALLE NP	2,896	1,799	192,930	24	15	41.64	107.85	96.67%	2,799	1,739	3,653,162	2,269,961	509,672	316,894	1	9
LIMERICK NP	4,132	2,567	1,296,681	192	119	196.14	508.01	99.49%	4,111	2,554	4,664,440	2,898,338	681,754	423,621	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,663	2,898	1,486,593	207	129	199.25	516.06	87.92%	4,100	2,547	3,342,644	2,077,015	424,341	263,673	4	15
MCGUIRE NP	4,288	2,665	895,665	124	77	130.54	338.10	97.17%	4,167	2,589	6,083,260	3,779,948	647,529	402,355	2	13
MILLSTONE NP	4,524	2,811	1,478,682	211	131	204.29	529.11	97.12%	4,394	2,730	7,843,870	4,873,937	1,569,787	975,417	3	13
MONTICELLO NP	2,716	1,688	280,880	35	22	64.63	167.40	74.75%	2,030	1,262	1,069,546	664,583	258,029	160,332	1	8
MORRIS (G E Repro Plnt, IL)	2,826	1,756	302,427	40	25	66.88	173.21	97.89%	2,767	1,719	1,905,180	1,183,819	251,544	156,302	2	7
NINE MILE POINT NP	3,957	2,459	1,210,513	180	112	191.19	495.18	98.33%	3,891	2,418	4,074,127	2,531,536	585,670	363,917	2	11
NORTH ANNA NP	4,277	2,658	1,207,077	180	112	176.38	456.84	96.93%	4,146	2,576	4,915,024	3,054,043	560,309	348,159	2	14
OCONEE NP	4,022	2,499	641,417	79	49	99.68	258.18	83.47%	3,357	2,086	7,630,553	4,741,388	820,407	509,776	1	14
OYSTER CREEK NP	4,380	2,721	1,414,717	203	126	201.89	522.89	94.86%	4,154	2,581	2,853,277	1,772,938	402,931	250,369	2	11
PALISADES NP	2,814	1,748	439,702	69	43	97.67	252.96	100.00%	2,814	1,748	1,617,224	1,004,893	194,151	120,640	1	7
PALO VERDE NP	2,064	1,283	480,689	88	55	145.56	377.00	92.55%	1,910	1,187	3,482,676	2,164,026	421,054	261,630	1	3
PEACH BOTTOM NP	4,047	2,514	1,208,654	181	112	186.68	483.50	99.09%	4,010	2,491	6,482,977	4,028,320	910,474	565,740	3	10
PERRY NP	3,554	2,208	570,744	82	51	100.38	259.99	82.83%	2,944	1,829	2,150,287	1,336,121	305,610	189,897	1	10
PILGRIM NP	4,461	2,772	1,501,087	220	137	210.29	544.64	98.48%	4,394	2,730	2,256,819	1,402,317	521,988	324,347	2	12
POINT BEACH NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	2,670,528	1,659,383	341,198	212,010	3	8
PRAIRIE ISLAND NP	2,647	1,645	256,152	30	19	60.49	156.67	80.50%	2,130	1,324	2,136,819	1,327,753	280,537	174,317	2	7
QUAD CITIES NP	2,705	1,681	293,879	43	27	67.91	175.89	98.63%	2,668	1,658	3,641,897	2,262,962	849,268	527,708	2	7
RANCHO SECO NP	856	532	100,291	18	11	73.21	189.62	96.62%	827	514	195,516	121,488	20,548	12,768	1	2
RIVER BEND NP	3,714	2,308	337,478	39	24	56.79	147.09	85.52%	3,176	1,974	1,812,270	1,126,088	256,259	159,231	1	10
ROBINSON NP	4,339	2,696	782,947	90	56	112.77	292.06	84.20%	3,654	2,271	1,495,115	929,018	303,762	188,748	2	14
SALEM NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	4,733,335	2,941,147	512,374	318,373	2	12
SAN ONOFRE NP	1,748	1,086	618,686	110	68	221.22	572.97	93.55%	1,635	1,016	2,567,967	1,595,655	305,885	190,068	2	2
SAVANNA RIVER PLANT	4,175	2,594	715,075	88	55	107.04	277.23	79.81%	3,332	2,071	11,626,116	7,224,107	4,651,282	2,890,162	3	14
SEABROOK NP	4,507	2,801	1,440,457	204	127	199.75	517.34	90.96%	4,100	2,547	1,976,519	1,228,147	211,836	131,628	3	14
SEQUOYAH NP	3,626	2,253	441,058	51	32	76.02	196.89	76.13%	2,761	1,715	3,551,379	2,206,716	373,497	232,080	1	13
SOUTH TEXAS NP	3,731	2,319	517,105	66	41	86.62	224.34	82.08%	3,063	1,903	3,016,552	1,874,391	283,577	176,206	0	9
ST LUCIE NP	4,834	3,004	942,830	112	70	121.91	315.74	89.92%	4,346	2,701	5,561,394	3,455,677	710,551	441,515	3	14
SUMMER NP	4,083	2,537	531,234	68	42	81.32	210.63	72.19%	2,948	1,832	2,141,408	1,330,604	240,883	149,677	1	13
SURRY NP	4,391	2,729	969,607	137	85	138.01	357.44	100.00%	4,391	2,729	4,764,049	2,960,232	526,933	327,420	2	12
SUSQUEHANNA NP	4,130	2,566	1,206,794	179	111	182.62	472.98	96.14%	3,971	2,467	6,072,810	3,773,455	871,480	541,510	3	10
THREE MILE ISLAND NP	4,026	2,501	1,209,136	181	113	187.72	486.21	99.32%	3,998	2,484	2,106,772	1,309,083	225,435	140,078	2	10
TROJAN NP	1,595	991	112,204	13	8	43.98	113.90	53.43%	852	529	572,276	355,594	60,599	37,654	1	4
TURKEY POINT NP	5,036	3,130	1,053,172	139	86	130.69	338.50	81.21%	4,090	2,542	5,091,509	3,163,705	538,901	334,857	2	14
VERMONT YANKEE NP	4,415	2,744	1,368,867	196	122	193.77	501.86	98.05%	4,329	2,690	2,656,260	1,650,517	609,305	378,603	3	13
VOGTLE NP	4,196	2,608	582,390	69	43	86.74	224.66	79.31%	3,328	2,068	4,298,478	2,670,940	914,811	568,435	1	13
WATERFORD NP	3,762	2,338	330,127	39	24	54.84	142.04	88.15%	3,316	2,061	2,244,741	1,394,812	282,163	175,328	0	10
WATTS BAR NP	3,637	2,260	424,744	59	37	72.99	189.05	77.28%	2,811	1,747	1,089,491	676,976	116,383	72,317	1	11
WEST VALLEY	3,716	2,309	1,079,143	166	103	181.51	470.12	98.61%	3,664	2,277	2,473,961	1,537,243	241,529	150,079	3	11
WNP - Washington Nuclear	1,713	1,065	156,777	23	14	57.19	148.11	82.95%	1,421	883	950,430	590,568	138,791	86,241	1	5
WOLF CREEK NP	2,447	1,521	207,960	30	18	53.11	137.56	99.21%	2,428	1,509	1,406,075	873,691	154,172	95,798	0	7
YANKEE ROWE NP	4,220	2,622	1,288,735	187	116	190.87	494.36	97.15%	4,100	2,547	536,937	333,636	189,894	117,995	3	13
ZION NP	2,862	1,778	462,249	69	43	100.96	261.49	99.33%	2,842	1,766	3,935,195	2,445,208	412,068	256,046	1	7
Summary	262,874	163,342	51,403,262	7,234	4,495	115.16	298.26	89.54%	235,367	146,250	236,238,915	146,791,509	37,559,061	23,338,032	132	739

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,200	1,989	285,830	38	24	55.82	144.57	85.37%	2,732	1,698	3,682,487	2,288,183	409,645	254,541	0	9
ARNOLD NP	2,806	1,744	251,106	34	21	55.93	144.86	93.40%	2,621	1,629	1,281,473	796,267	179,588	111,590	2	6
BEAVER VALLEY NP	3,883	2,413	865,557	128	80	139.32	360.85	95.52%	3,709	2,305	3,942,559	2,449,783	411,585	255,746	3	10
BIG ROCK POINT NP	3,891	2,418	692,765	107	66	111.27	288.18	86.81%	3,378	2,099	243,641	151,391	155,656	96,720	4	9
BRAIDWOOD NP	3,442	2,139	325,594	42	26	59.12	153.13	53.39%	1,838	1,142	3,611,810	2,244,266	409,588	254,505	1	6
BROWNS FERRY NP	3,295	2,047	368,804	51	32	69.96	181.19	81.78%	2,695	1,674	5,064,900	3,147,171	691,913	429,933	1	8
BRUNSWICK NP	4,923	3,059	819,551	91	56	104.04	269.45	83.08%	4,090	2,542	4,502,871	2,797,944	1,019,161	633,275	3	15
BYRON NP	3,040	1,889	294,996	40	25	60.65	157.09	91.41%	2,779	1,727	3,486,645	2,166,493	395,187	245,557	2	7
CALLAWAY NP	3,133	1,947	221,882	29	18	44.26	114.63	91.01%	2,852	1,772	2,005,934	1,246,425	234,993	146,018	2	8
CALVERT CLIFFS NP	4,403	2,736	1,057,327	154	96	150.09	388.74	96.34%	4,242	2,636	5,032,601	3,127,101	638,415	396,691	2	12
CATAWBA NP	4,461	2,772	659,891	85	53	92.45	239.46	72.13%	3,218	2,000	5,323,673	3,307,902	571,003	354,803	1	13
CLINTON NP	3,309	2,056	402,311	58	36	76.00	196.84	80.47%	2,662	1,654	1,498,851	931,339	215,053	133,627	1	8
COMANCHE PEAK NP	2,487	1,546	99,263	7	4	24.94	64.60	94.11%	2,341	1,455	2,284,216	1,419,341	261,161	162,278	1	5
CONN YANKEE NP	4,720	2,933	1,498,253	217	135	198.39	513.83	94.37%	4,455	2,768	2,400,529	1,491,614	514,487	319,686	2	13
COOK NP	3,265	2,029	685,125	107	67	131.14	339.66	93.10%	3,040	1,889	4,408,295	2,739,177	476,721	296,219	2	9
COOPER STATION NP	2,494	1,550	287,119	44	28	71.94	186.32	90.16%	2,249	1,398	1,142,453	709,885	264,416	164,300	0	5
CRYSTAL RIVER NP	4,888	3,037	714,423	81	50	91.35	236.59	82.69%	4,042	2,512	2,399,167	1,490,768	435,039	270,320	2	14
DAVIS-BESSE NP	3,761	2,337	421,484	60	37	70.05	181.42	80.43%	3,025	1,880	1,913,722	1,189,127	218,122	135,534	1	10
DIABLO CANYON NP	591	368	671,091	128	80	709.18	1,836.77	82.86%	490	305	704,353	437,663	78,661	48,878	2	2
DRESDEN NP DOCK	3,143	1,953	353,814	48	30	70.35	182.20	92.88%	2,920	1,814	4,475,171	2,780,732	1,115,901	693,386	2	7
FARLEY NP	4,376	2,719	584,953	74	46	83.55	216.40	70.15%	3,070	1,907	4,990,267	3,100,797	538,206	334,425	1	13
FERMI NP	3,978	2,472	1,092,202	167	104	171.59	444.43	95.95%	3,817	2,372	1,992,696	1,238,199	306,318	190,336	2	11
FITZPATRICK NP	4,272	2,655	1,262,890	188	117	184.75	478.50	94.66%	4,044	2,513	2,218,242	1,378,347	311,881	193,793	2	11
FORT CALHOUN NP	2,378	1,478	203,110	29	18	53.38	138.26	93.23%	2,217	1,378	905,248	562,493	211,640	131,506	1	5
GRAND GULF NP	3,767	2,341	367,684	47	29	61.01	158.01	84.41%	3,179	1,976	3,207,996	1,993,349	455,788	283,213	1	11
HANFORD RPSTRY	2,061	1,281	208,404	31	19	63.20	163.68	76.38%	1,574	978	6,220,095	3,864,973	2,493,924	1,549,647	2	5
HARRIS NP	4,810	2,989	802,488	89	55	104.28	270.09	84.01%	4,041	2,511	2,876,106	1,787,123	331,870	206,213	2	15
HATCH NP	4,454	2,767	633,074	77	48	88.84	230.10	77.42%	3,448	2,142	5,933,239	3,686,730	819,484	509,202	1	13
HOPE CREEK NP	4,479	2,783	1,297,588	194	121	181.05	468.91	95.65%	4,285	2,662	3,212,045	1,995,865	452,426	281,123	2	12
HUMBOLDT BAY NP	1,625	1,010	593,798	106	66	228.37	591.47	67.24%	1,093	679	47,031	29,224	27,627	17,167	2	2
INEL	1,136	706	145,381	23	15	79.96	207.10	61.83%	703	437	686,510	426,576	262,500	163,109	0	3
KEWAUNEE NP	3,503	2,176	695,145	103	64	124.04	321.27	87.81%	3,076	1,911	1,633,047	1,014,725	206,653	128,408	3	8
LA CROSSE NP	3,290	2,044	306,477	43	27	58.23	150.82	90.41%	2,974	1,848	124,936	77,631	46,053	28,616	1	8
LA SALLE NP	3,474	2,159	189,734	20	12	34.13	88.41	99.68%	3,463	2,152	4,382,617	2,723,222	611,442	379,931	1	10
LIMERICK NP	4,446	2,762	1,348,757	200	125	189.62	491.11	95.91%	4,264	2,649	5,018,715	3,118,473	733,535	455,796	2	10

Table F-14. Detailed Measure ^ Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,977	3,093	1,538,081	215	134	193.15	500.26	85.45%	4,253	2,642	3,567,602	2,216,797	452,899	281,418	4	15
MCGUIRE NP	4,602	2,860	947,711	132	82	128.71	333.35	93.87%	4,320	2,684	6,528,443	4,056,571	694,917	431,800	2	13
MILLSTONE NP	4,838	3,006	1,530,157	219	136	197.69	512.01	93.98%	4,546	2,825	8,388,002	5,212,043	1,678,684	1,043,082	3	13
MONTICELLO NP	3,030	1,883	332,357	43	27	68.56	177.56	72.06%	2,183	1,357	1,193,123	741,370	287,843	178,857	1	8
MORRIS (G E Repro Plnt, IL)	3,140	1,951	353,790	48	30	70.42	182.38	92.98%	2,920	1,814	2,116,722	1,315,265	279,475	173,657	2	7
NINE MILE POINT NP	4,271	2,654	1,262,740	188	117	184.78	478.59	94.69%	4,044	2,513	4,397,221	2,732,296	632,116	392,777	2	11
NORTH ANNA NP	4,591	2,853	1,258,575	188	117	171.34	443.77	93.63%	4,299	2,671	5,275,647	3,278,123	601,420	373,704	2	14
OCONEE NP	4,335	2,694	693,021	87	54	99.91	258.76	80.96%	3,510	2,181	8,225,998	5,111,379	884,427	549,556	1	14
OYSTER CREEK NP	4,694	2,916	1,466,860	211	131	195.33	505.91	91.77%	4,307	2,676	3,057,727	1,899,976	431,803	268,309	2	11
PALISADES NP	3,128	1,943	491,180	77	48	98.15	254.22	94.85%	2,967	1,843	1,797,594	1,116,969	215,805	134,095	1	7
PALO VERDE NP	881	548	91,110	13	8	64.63	167.38	82.56%	727	452	1,486,756	923,824	179,748	111,690	1	3
PEACH BOTTOM NP	4,360	2,709	1,260,082	189	117	180.62	467.80	95.46%	4,162	2,586	6,985,753	4,340,730	981,084	609,615	3	10
PERRY NP	3,867	2,403	622,973	90	56	100.68	260.75	80.06%	3,096	1,924	2,340,181	1,454,116	332,599	206,667	1	10
PILGRIM NP	4,775	2,967	1,552,570	228	142	203.20	526.30	95.21%	4,546	2,825	2,415,567	1,500,958	558,706	347,162	2	12
POINT BEACH NP	3,503	2,176	695,145	103	64	124.04	321.27	87.81%	3,076	1,911	2,933,349	1,822,691	374,777	232,875	3	8
PRAIRIE ISLAND NP	2,960	1,840	308,303	38	24	65.09	168.58	77.13%	2,283	1,419	2,390,197	1,485,194	313,802	194,987	2	7
QUAD CITIES NP	3,018	1,876	345,382	51	32	71.51	185.22	93.44%	2,821	1,753	4,064,466	2,525,533	947,808	588,938	2	7
RANCHO SECO NP	1,083	673	390,137	71	44	225.13	583.09	97.33%	1,054	655	247,335	153,686	25,994	16,152	1	2
RIVER BEND NP	4,028	2,503	389,491	47	29	60.44	156.54	82.65%	3,329	2,069	1,965,407	1,221,243	277,913	172,686	1	10
ROBINSON NP	4,653	2,891	835,214	98	61	112.18	290.55	81.81%	3,807	2,366	1,603,239	996,203	325,729	202,398	2	14
SALEM NP	4,479	2,783	1,297,588	194	121	181.05	468.91	95.65%	4,285	2,662	5,089,926	3,162,722	550,974	342,358	2	12
SAN ONOFRE NP	494	307	323,860	61	38	409.68	1,061.08	86.32%	426	265	725,869	451,032	86,462	53,725	1	2
SAVANNA RIVER PLANT	4,489	2,789	767,356	96	60	106.84	276.70	77.63%	3,485	2,166	12,499,957	7,767,084	5,000,881	3,107,392	3	14
SEABROOK NP	4,821	2,996	1,492,041	212	132	193.43	500.99	88.21%	4,253	2,642	2,114,139	1,313,660	226,586	140,793	3	14
SEQUOYAH NP	3,940	2,448	492,418	59	37	78.11	202.31	73.95%	2,914	1,810	3,858,728	2,397,694	405,821	252,165	1	13
SOUTH TEXAS NP	4,045	2,514	568,728	74	46	87.87	227.59	79.49%	3,215	1,998	3,270,262	2,032,039	307,428	191,026	0	9
ST LUCIE NP	5,148	3,199	994,756	121	75	120.78	312.82	87.40%	4,499	2,796	5,922,463	3,680,034	756,683	470,180	3	14
SUMMER NP	4,397	2,732	583,259	76	47	82.91	214.75	70.52%	3,100	1,927	2,306,008	1,432,882	259,398	161,182	1	13
SURRY NP	4,705	2,924	1,021,746	145	90	135.73	351.54	96.58%	4,544	2,824	5,104,525	3,171,793	564,592	350,820	2	12
SUSQUEHANNA NP	4,444	2,761	1,258,996	187	116	177.06	458.59	92.79%	4,124	2,562	6,534,233	4,060,169	937,696	582,655	3	10
THREE MILE ISLAND NP	4,339	2,696	1,261,162	189	118	181.64	470.45	95.66%	4,151	2,579	2,271,008	1,411,134	243,009	150,998	2	10
TROJAN NP	2,294	1,426	257,731	40	25	70.21	181.83	81.73%	1,875	1,165	823,386	511,627	87,189	54,177	1	4
TURKEY POINT NP	5,350	3,325	1,105,451	147	92	129.13	334.46	79.31%	4,243	2,637	5,408,763	3,360,837	572,480	355,722	2	14
VERMONT YANKEE NP	4,729	2,939	1,421,120	204	127	187.82	486.45	94.78%	4,482	2,785	2,845,059	1,767,831	652,612	405,513	3	13
VOGTLE NP	4,510	2,803	634,113	77	48	87.87	227.59	77.18%	3,481	2,163	4,619,937	2,870,685	983,224	610,945	1	13
WATERFORD NP	4,076	2,533	381,582	47	29	58.51	151.54	85.11%	3,469	2,156	2,431,987	1,511,161	305,700	189,953	0	10
WATTS BAR NP	3,951	2,455	476,403	67	42	75.37	195.20	75.01%	2,964	1,842	1,183,500	735,390	126,425	78,557	1	11
WEST VALLEY	4,030	2,504	1,130,747	174	108	175.38	454.23	94.73%	3,817	2,372	2,682,902	1,667,072	261,927	162,754	3	11
WNP - Washington Nuclear	2,027	1,260	208,326	31	19	64.23	166.34	77.65%	1,574	978	1,124,502	698,730	164,211	102,036	1	5
WOLF CREEK NP	2,761	1,716	260,041	38	24	58.86	152.46	93.47%	2,581	1,604	1,586,388	985,732	173,943	108,083	0	7
YANKEE ROWE NP	4,534	2,817	1,340,954	195	121	184.86	478.79	93.80%	4,253	2,642	576,868	358,448	204,016	126,770	3	13
ZION NP	3,175	1,973	513,596	77	48	101.09	261.82	94.32%	2,995	1,861	4,366,758	2,713,368	457,259	284,126	1	7
Summary	282,660	175,636	54,864,725	7,788	4,839	125.41	324.80	86.89%	245,605	152,611	251,181,537	156,076,389	40,311,710	25,048,442	132	740

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,121	1,940	238,384	30	19	47.73	123.62	85.00%	2,653	1,649	3,591,749	2,231,801	399,551	248,269	0	9
ARNOLD NP	2,727	1,695	203,713	26	16	46.69	120.92	93.21%	2,542	1,580	1,245,460	773,890	174,541	108,454	2	6
BEAVER VALLEY NP	3,804	2,364	818,834	120	75	134.53	348.45	95.43%	3,630	2,256	3,862,488	2,400,030	403,226	250,552	3	10
BIG ROCK POINT NP	3,813	2,369	645,418	98	61	105.80	274.04	86.53%	3,299	2,050	238,704	148,323	152,502	94,760	4	9
BRAIDWOOD NP	3,363	2,090	278,711	33	21	51.80	134.15	52.30%	1,759	1,093	3,529,059	2,192,848	400,204	248,674	1	6
BROWNS FERRY NP	3,216	1,998	322,220	43	27	62.62	162.19	81.33%	2,616	1,625	4,943,677	3,071,847	675,352	419,643	1	8
BRUNSWICK NP	4,845	3,010	772,691	83	51	99.68	258.18	82.81%	4,012	2,493	4,430,750	2,753,130	1,002,838	623,132	3	15
BYRON NP	2,961	1,840	247,557	32	20	52.25	135.34	91.18%	2,700	1,678	3,396,198	2,110,292	384,936	239,187	2	7
CALLAWAY NP	3,212	1,996	268,718	37	23	52.29	135.42	91.23%	2,930	1,821	2,056,420	1,277,795	240,908	149,693	2	8
CALVERT CLIFFS NP	4,324	2,687	1,010,069	146	91	146.00	378.13	96.28%	4,163	2,587	4,942,464	3,071,093	626,980	389,586	2	12
CATAWBA NP	4,382	2,723	612,437	77	48	87.35	226.24	71.63%	3,139	1,951	5,229,466	3,249,427	560,909	348,531	1	13
CLINTON NP	3,230	2,007	354,955	50	31	68.69	177.91	79.99%	2,583	1,605	1,463,125	909,141	209,927	130,442	1	8
COMANCHE PEAK NP	2,566	1,595	146,106	15	9	35.59	92.17	94.29%	2,420	1,504	2,356,637	1,464,341	269,441	167,423	1	5
CONN YANKEE NP	4,641	2,884	1,450,963	209	130	195.39	506.07	94.28%	4,376	2,719	2,360,424	1,466,694	505,891	314,345	2	13
COOK NP	3,186	1,980	637,757	99	62	125.10	324.00	92.93%	2,961	1,840	4,301,830	2,673,023	465,207	289,065	2	9
COOPER STATION NP	2,416	1,501	240,211	36	23	62.15	160.97	89.84%	2,170	1,349	1,106,336	687,443	256,057	159,106	0	5
CRYSTAL RIVER NP	4,809	2,988	667,021	73	45	86.69	224.52	82.41%	3,963	2,463	2,360,462	1,466,717	428,021	265,959	2	14
DAVIS-BESSE NP	3,682	2,288	374,515	52	32	63.57	164.66	80.01%	2,946	1,831	1,873,594	1,164,193	213,549	132,692	1	10
DIABLO CANYON NP	670	417	718,569	136	85	670.01	1,735.34	84.87%	569	354	798,267	496,018	89,149	55,395	2	2
DRESDEN NP DOCK	3,065	1,904	307,114	40	25	62.63	162.22	92.70%	2,841	1,765	4,362,902	2,710,971	1,087,906	675,991	2	7
FARLEY NP	4,297	2,670	538,172	66	41	78.28	202.75	69.61%	2,991	1,858	4,900,333	3,044,914	528,507	328,398	1	13
FERMI NP	3,899	2,423	1,045,440	159	99	167.57	434.00	95.87%	3,738	2,323	1,953,195	1,213,655	300,246	186,563	2	11
FITZPATRICK NP	4,193	2,606	1,215,458	180	112	181.15	469.19	94.56%	3,965	2,464	2,177,298	1,352,905	306,124	190,216	2	11
FORT CALHOUN NP	2,299	1,429	156,203	21	13	42.46	109.98	93.00%	2,138	1,329	875,228	543,839	204,621	127,145	1	5
GRAND GULF NP	3,688	2,292	320,725	39	24	54.35	140.77	84.07%	3,101	1,927	3,140,837	1,951,618	446,246	277,284	1	11
HANFORD RPSTRY	1,982	1,232	161,468	23	14	50.91	131.86	75.44%	1,495	929	5,982,112	3,717,098	2,398,506	1,490,357	2	5
HARRIS NP	4,731	2,940	755,128	81	50	99.76	258.38	83.74%	3,962	2,462	2,828,951	1,757,822	326,428	202,832	2	15
HATCH NP	4,375	2,718	586,233	69	43	83.75	216.91	77.01%	3,369	2,093	5,828,185	3,621,452	804,974	500,186	1	13
HOPE CREEK NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	3,155,499	1,960,729	444,461	276,174	2	12
HUMBOLDT BAY NP	1,704	1,059	640,490	114	71	234.92	608.46	68.76%	1,172	728	49,313	30,642	28,968	18,000	2	2
INEL	1,058	657	98,508	16	10	58.22	150.79	58.99%	624	388	638,870	396,974	244,283	151,790	0	3
KEWAUNEE NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	1,596,280	991,879	202,000	125,517	3	8
LA CROSSE NP	3,211	1,995	259,585	35	22	50.53	130.88	90.18%	2,895	1,799	121,941	75,770	44,949	27,930	1	8
LA SALLE NP	3,553	2,208	236,599	28	17	41.62	107.80	99.68%	3,542	2,201	4,482,097	2,785,036	625,321	388,555	1	10
LIMERICK NP	4,367	2,713	1,301,267	192	119	186.24	482.37	95.84%	4,185	2,600	4,929,692	3,063,157	720,524	447,711	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,898	3,044	1,491,573	207	129	190.33	492.95	85.21%	4,174	2,593	3,511,074	2,181,672	445,723	276,959	4	15
MCGUIRE NP	4,523	2,811	900,396	124	77	124.41	322.23	93.76%	4,241	2,635	6,416,577	3,987,061	683,009	424,401	2	13
MILLSTONE NP	4,759	2,957	1,483,402	211	131	194.82	504.59	93.88%	4,468	2,776	8,251,271	5,127,083	1,651,320	1,026,079	3	13
MONTICELLO NP	2,951	1,834	285,648	35	22	60.50	156.69	71.31%	2,104	1,308	1,162,070	722,074	280,351	174,202	1	8
MORRIS (G E Repro Plnt, IL)	3,061	1,902	307,090	40	25	62.70	162.38	92.80%	2,841	1,765	2,063,565	1,282,235	272,456	169,296	2	7
NINE MILE POINT NP	4,192	2,605	1,215,261	180	112	181.18	469.26	94.59%	3,965	2,464	4,316,033	2,681,849	620,445	385,525	2	11
NORTH ANNA NP	4,512	2,804	1,211,851	180	112	167.86	434.76	93.52%	4,220	2,622	5,185,029	3,221,816	591,090	367,285	2	14
OCONEE NP	4,257	2,645	646,199	79	49	94.88	245.75	80.60%	3,431	2,132	8,076,373	5,018,407	868,340	539,560	1	14
OYSTER CREEK NP	4,615	2,867	1,419,337	203	126	192.23	497.88	91.63%	4,228	2,627	3,006,352	1,868,054	424,548	263,801	2	11
PALISADES NP	3,049	1,894	444,350	69	43	91.09	235.93	94.72%	2,888	1,794	1,752,271	1,088,806	210,364	130,714	1	7
PALO VERDE NP	960	597	137,795	21	13	89.71	232.36	83.99%	806	501	1,619,818	1,006,504	195,835	121,686	1	3
PEACH BOTTOM NP	4,282	2,660	1,213,328	181	112	177.12	458.73	95.38%	4,084	2,537	6,859,415	4,262,227	963,341	598,590	3	10
PERRY NP	3,789	2,354	575,428	82	51	94.93	245.86	79.65%	3,018	1,875	2,292,464	1,424,466	325,817	202,453	1	10
PILGRIM NP	4,696	2,918	1,505,940	220	137	200.41	519.07	95.13%	4,468	2,776	2,375,677	1,476,171	549,479	341,429	2	12
POINT BEACH NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	2,867,306	1,781,655	366,339	227,632	3	8
PRAIRIE ISLAND NP	2,882	1,791	261,028	30	19	56.62	146.64	76.50%	2,204	1,370	2,326,528	1,445,632	305,443	189,793	2	7
QUAD CITIES NP	2,940	1,827	298,782	43	27	63.52	164.53	93.27%	2,742	1,704	3,958,282	2,459,553	923,047	573,552	2	7
RANCHO SECO NP	1,162	722	437,574	79	49	235.37	609.60	97.51%	1,133	704	265,343	164,876	27,887	17,328	1	2
RIVER BEND NP	3,949	2,454	342,083	39	24	54.14	140.23	82.31%	3,250	2,020	1,926,926	1,197,332	272,471	169,305	1	10
ROBINSON NP	4,574	2,842	787,866	90	56	107.65	278.80	81.50%	3,728	2,317	1,576,069	979,320	320,209	198,968	2	14
SALEM NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	5,000,321	3,107,044	541,275	336,331	2	12
SAN ONOFRE NP	573	356	370,669	69	43	404.36	1,047.29	88.20%	505	314	841,724	523,021	100,263	62,300	1	2
SAVANNA RIVER PLANT	4,410	2,740	719,975	88	55	102.03	264.26	77.23%	3,406	2,117	12,280,377	7,630,644	4,913,033	3,052,806	3	14
SEABROOK NP	4,742	2,947	1,445,184	204	127	190.47	493.32	88.01%	4,174	2,593	2,079,558	1,292,172	222,879	138,490	3	14
SEQUOYAH NP	3,861	2,399	445,638	51	32	72.13	186.83	73.42%	2,835	1,761	3,781,497	2,349,705	397,699	247,118	1	13
SOUTH TEXAS NP	3,966	2,465	521,979	66	41	82.25	213.04	79.08%	3,137	1,949	3,206,509	1,992,425	301,434	187,302	0	9
ST LUCIE NP	5,069	3,150	947,449	112	70	116.83	302.58	87.21%	4,420	2,747	5,831,733	3,623,657	745,091	462,977	3	14
SUMMER NP	4,318	2,683	535,845	68	42	77.56	200.89	69.98%	3,022	1,878	2,264,647	1,407,181	254,746	158,291	1	13
SURRY NP	4,626	2,875	974,341	137	85	131.64	340.94	96.52%	4,465	2,775	5,018,969	3,118,631	555,129	344,940	2	12
SUSQUEHANNA NP	4,365	2,712	1,211,597	179	111	173.47	449.30	92.66%	4,045	2,513	6,418,286	3,988,123	921,057	572,316	3	10
THREE MILE ISLAND NP	4,261	2,647	1,213,718	181	113	178.04	461.14	95.58%	4,072	2,530	2,229,739	1,385,490	238,593	148,254	2	10
TROJAN NP	2,216	1,377	211,007	32	20	59.52	154.17	81.08%	1,796	1,116	795,087	494,043	84,193	52,315	1	4
TURKEY POINT NP	5,271	3,276	1,057,990	139	86	125.44	324.89	79.00%	4,164	2,588	5,329,043	3,311,301	564,043	350,479	2	14
VERMONT YANKEE NP	4,650	2,890	1,373,676	196	122	184.63	478.18	94.69%	4,403	2,736	2,797,617	1,738,352	641,730	398,751	3	13
VOGTLE NP	4,431	2,754	587,374	69	43	82.84	214.57	76.78%	3,402	2,114	4,539,160	2,820,493	966,033	600,263	1	13
WATERFORD NP	3,997	2,484	334,934	39	24	52.37	135.64	84.82%	3,390	2,107	2,384,935	1,481,924	299,786	186,278	0	10
WATTS BAR NP	3,872	2,406	429,573	59	37	69.34	179.59	74.50%	2,885	1,793	1,159,877	720,711	123,902	76,989	1	11
WEST VALLEY	3,951	2,455	1,084,059	166	103	171.49	444.17	94.62%	3,738	2,323	2,630,399	1,634,448	256,802	159,569	3	11
WNP - Washington Nuclear	1,948	1,211	161,501	23	14	51.80	134.17	76.75%	1,495	929	1,080,761	671,551	157,824	98,067	1	5
WOLF CREEK NP	2,682	1,667	212,671	30	18	49.56	128.35	93.28%	2,502	1,555	1,541,079	957,578	168,975	104,996	0	7
YANKEE ROWE NP	4,455	2,768	1,293,656	187	116	181.50	470.08	93.69%	4,174	2,593	566,834	352,213	200,468	124,565	3	13
ZION NP	3,097	1,924	467,032	69	43	94.26	244.15	94.18%	2,916	1,812	4,258,314	2,645,984	445,903	277,070	1	7
Summary	277,849	172,647	51,991,964	7,292	4,531	120.38	311.78	86.66%	240,794	149,622	246,954,749	153,449,994	39,571,627	24,588,577	132	740

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,933	1,823	236,519	30	19	50.40	130.53	84.03%	2,465	1,532	3,375,088	2,097,175	375,450	233,293	0	9
ARNOLD NP	2,539	1,578	201,751	26	16	49.66	128.63	92.71%	2,354	1,463	1,159,470	720,458	162,490	100,966	2	6
BEAVER VALLEY NP	3,616	2,247	816,949	120	75	141.21	365.75	95.19%	3,442	2,139	3,671,300	2,281,232	383,267	238,150	3	10
BIG ROCK POINT NP	3,624	2,252	643,485	98	61	110.97	287.41	85.83%	3,111	1,933	226,915	140,998	144,970	90,080	4	9
BRAIDWOOD NP	3,175	1,973	276,795	33	21	54.49	141.13	49.47%	1,571	976	3,331,471	2,070,072	377,797	234,751	1	6
BROWNS FERRY NP	3,028	1,881	320,180	43	27	66.09	171.19	80.17%	2,427	1,508	4,654,225	2,891,991	635,811	395,073	1	8
BRUNSWICK NP	4,656	2,893	770,725	83	51	103.45	267.94	82.11%	3,823	2,376	4,258,542	2,646,125	963,861	598,913	3	15
BYRON NP	2,773	1,723	245,697	32	20	55.38	143.44	90.58%	2,512	1,561	3,180,232	1,976,097	360,457	223,977	2	7
CALLAWAY NP	2,617	1,626	178,729	22	14	42.69	110.57	83.47%	2,184	1,357	1,675,200	1,040,917	196,248	121,943	1	7
CALVERT CLIFFS NP	4,136	2,570	1,008,084	146	91	152.34	394.57	96.11%	3,975	2,470	4,727,238	2,937,358	599,678	372,621	2	12
CATAWBA NP	4,194	2,606	610,617	77	48	91.00	235.69	70.36%	2,951	1,834	5,004,761	3,109,803	536,807	333,555	1	13
CLINTON NP	3,041	1,890	353,001	50	31	72.54	187.88	78.75%	2,395	1,488	1,377,823	856,136	197,688	122,837	1	8
COMANCHE PEAK NP	2,897	1,800	268,895	31	19	58.02	150.28	60.60%	1,755	1,091	2,660,066	1,652,882	304,133	188,979	1	6
CONN YANKEE NP	4,453	2,767	1,449,099	209	130	203.39	526.79	94.04%	4,187	2,602	2,264,661	1,407,190	485,367	301,592	2	13
COOK NP	2,998	1,863	635,645	99	62	132.51	343.21	92.48%	2,773	1,723	4,047,618	2,515,064	437,716	271,983	2	9
COOPER STATION NP	2,227	1,384	238,193	36	23	66.84	173.11	88.98%	1,982	1,232	1,020,100	633,858	236,098	146,704	0	5
CRYSTAL RIVER NP	4,621	2,871	665,273	73	45	89.98	233.05	81.69%	3,775	2,346	2,268,043	1,409,291	411,262	255,546	2	14
DAVIS-BESSE NP	3,494	2,171	372,645	52	32	66.67	172.67	78.93%	2,758	1,714	1,777,777	1,104,655	202,627	125,906	1	10
DIABLO CANYON NP	2,442	1,517	911,219	163	101	233.21	604.02	85.24%	2,082	1,293	2,908,260	1,807,102	324,790	201,814	2	3
DRESDEN NP DOCK	2,876	1,787	305,142	40	25	66.31	171.74	92.22%	2,653	1,648	4,094,832	2,544,401	1,021,062	634,456	2	7
FARLEY NP	4,109	2,553	536,137	66	41	81.56	211.24	68.21%	2,803	1,741	4,685,591	2,911,480	505,347	314,007	1	13
FERMI NP	3,711	2,306	1,043,476	159	99	175.74	455.17	95.66%	3,550	2,206	1,858,877	1,155,048	285,747	177,554	2	11
FITZPATRICK NP	4,005	2,489	1,213,632	180	112	189.38	490.51	94.30%	3,777	2,347	2,079,534	1,292,158	292,379	181,675	2	11
FORT CALHOUN NP	2,111	1,312	154,249	21	13	45.67	118.29	92.38%	1,950	1,212	803,548	499,300	187,863	116,732	1	5
GRAND GULF NP	3,500	2,175	318,717	39	24	56.92	147.42	83.22%	2,912	1,810	2,980,478	1,851,976	423,463	263,127	1	11
HANFORD RPSTRY	1,794	1,115	159,579	23	14	55.60	144.00	72.86%	1,307	812	5,413,867	3,364,009	2,170,670	1,348,787	2	5
HARRIS NP	4,543	2,823	753,338	81	50	103.65	268.45	83.07%	3,773	2,345	2,716,355	1,687,858	313,436	194,759	2	15
HATCH NP	4,187	2,601	584,201	69	43	87.21	225.88	75.97%	3,181	1,976	5,577,339	3,465,585	770,328	478,658	1	13
HOPE CREEK NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	3,020,481	1,876,833	425,444	264,357	2	12
HUMBOLDT BAY NP	2,155	1,339	340,709	57	35	98.80	255.90	67.83%	1,462	908	62,373	38,756	36,639	22,766	2	3
INEL	869	540	96,555	15	10	69.43	179.82	50.10%	435	271	525,116	326,291	200,787	124,763	0	3
KEWAUNEE NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	1,508,490	937,329	190,891	118,614	3	8
LA CROSSE NP	3,022	1,878	257,620	35	22	53.27	137.98	89.56%	2,707	1,682	114,789	71,326	42,313	26,292	1	8
LA SALLE NP	2,943	1,828	195,795	24	15	41.59	107.71	91.25%	2,685	1,668	3,712,038	2,306,545	517,886	321,798	1	9
LIMERICK NP	4,179	2,596	1,299,340	192	119	194.35	503.36	95.65%	3,997	2,483	4,717,127	2,931,076	689,455	428,406	2	10

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Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,710	2,927	1,489,542	207	129	197.67	511.96	84.62%	3,985	2,476	3,376,099	2,097,803	428,588	266,312	4	15
MCGUIRE NP	4,335	2,694	898,347	124	77	129.52	335.46	93.49%	4,053	2,518	6,149,467	3,821,087	654,577	406,734	2	13
MILLSTONE NP	4,571	2,840	1,481,420	211	131	202.58	524.67	93.63%	4,279	2,659	7,924,792	4,924,219	1,585,982	985,480	3	13
MONTICELLO NP	2,763	1,717	283,581	35	22	64.15	166.15	69.35%	1,916	1,191	1,087,924	676,002	262,463	163,087	1	8
MORRIS (G E Repro Plnt, IL)	2,873	1,785	305,117	40	25	66.38	171.91	92.33%	2,653	1,648	1,936,640	1,203,368	255,698	158,883	2	7
NINE MILE POINT NP	4,004	2,488	1,213,478	180	112	189.42	490.60	94.33%	3,777	2,347	4,122,177	2,561,393	592,577	368,209	2	11
NORTH ANNA NP	4,324	2,687	1,210,017	180	112	174.90	453.00	93.24%	4,031	2,505	4,968,655	3,087,368	566,423	351,958	2	14
OCONEE NP	4,068	2,528	644,228	79	49	98.97	256.34	79.71%	3,243	2,015	7,719,106	4,796,412	829,928	515,692	1	14
OYSTER CREEK NP	4,426	2,750	1,417,352	203	126	200.13	518.34	91.27%	4,040	2,510	2,883,683	1,791,831	407,225	253,037	2	11
PALISADES NP	2,860	1,777	442,447	69	43	96.67	250.38	94.37%	2,700	1,677	1,644,049	1,021,561	197,372	122,641	1	7
PALO VERDE NP	2,898	1,801	651,767	117	73	140.55	364.03	89.14%	2,584	1,605	4,890,410	3,038,749	591,249	367,384	1	4
PEACH BOTTOM NP	4,093	2,543	1,211,397	181	112	184.97	479.07	95.16%	3,895	2,420	6,557,749	4,074,781	920,975	572,265	3	10
PERRY NP	3,600	2,237	573,560	82	51	99.57	257.88	78.58%	2,829	1,758	2,178,528	1,353,669	309,624	192,391	1	10
PILGRIM NP	4,508	2,801	1,503,922	220	137	208.50	540.02	94.92%	4,279	2,659	2,280,428	1,416,987	527,449	327,740	2	12
POINT BEACH NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	2,709,614	1,683,670	346,192	215,113	3	8
PRAIRIE ISLAND NP	2,693	1,674	258,967	30	19	60.10	155.65	74.86%	2,016	1,253	2,174,501	1,351,167	285,484	177,391	2	7
QUAD CITIES NP	2,751	1,710	296,731	43	27	67.41	174.58	92.81%	2,553	1,587	3,704,741	2,302,011	863,922	536,814	2	7
RANCHO SECO NP	1,690	1,050	271,290	46	29	100.30	259.78	88.77%	1,501	932	386,034	239,869	40,571	25,210	1	3
RIVER BEND NP	3,761	2,337	340,294	39	24	56.56	146.48	81.42%	3,062	1,903	1,835,044	1,140,239	259,479	161,232	1	10
ROBINSON NP	4,386	2,725	785,862	90	56	111.98	290.03	80.70%	3,540	2,200	1,511,195	939,009	307,029	190,778	2	14
SALEM NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	4,786,367	2,974,099	518,114	321,940	2	12
SAN ONOFRE NP	2,665	1,656	626,531	110	68	146.92	380.53	89.73%	2,391	1,486	3,915,671	2,433,076	466,418	289,818	2	3
SAVANNA RIVER PLANT	4,222	2,623	717,983	88	55	106.29	275.28	76.22%	3,218	2,000	11,756,072	7,304,857	4,703,273	2,922,468	3	14
SEABROOK NP	4,554	2,830	1,443,406	204	127	198.10	513.09	87.52%	3,985	2,476	1,996,985	1,240,864	214,029	132,991	3	14
SEQUOYAH NP	3,673	2,282	443,823	51	32	75.52	195.61	72.05%	2,646	1,644	3,597,087	2,235,118	378,304	235,067	1	13
SOUTH TEXAS NP	3,778	2,348	519,952	66	41	86.02	222.79	78.04%	2,948	1,832	3,054,283	1,897,836	287,124	178,410	0	9
ST LUCIE NP	4,880	3,033	945,707	112	70	121.11	313.68	86.71%	4,232	2,630	5,615,091	3,489,043	717,412	445,778	3	14
SUMMER NP	4,129	2,566	533,917	68	42	80.81	209.30	68.61%	2,833	1,761	2,165,887	1,345,815	243,636	151,388	1	13
SURRY NP	4,438	2,758	972,291	137	85	136.93	354.66	96.37%	4,277	2,658	4,814,684	2,991,694	532,534	330,900	2	12
SUSQUEHANNA NP	4,177	2,595	1,209,566	179	111	180.99	468.77	92.33%	3,857	2,396	6,141,432	3,816,094	881,327	547,629	3	10
THREE MILE ISLAND NP	4,072	2,530	1,211,767	181	113	185.98	481.68	95.38%	3,884	2,413	2,131,197	1,324,260	228,049	141,702	2	10
TROJAN NP	2,027	1,260	209,092	32	20	64.46	166.96	79.32%	1,608	999	727,516	452,056	77,037	47,869	1	4
TURKEY POINT NP	5,083	3,159	1,055,938	139	86	129.83	336.27	78.22%	3,976	2,471	5,138,691	3,193,022	543,895	337,960	2	14
VERMONT YANKEE NP	4,462	2,773	1,371,822	196	122	192.16	497.69	94.46%	4,215	2,619	2,684,337	1,667,964	615,745	382,605	3	13
VOGTLE NP	4,243	2,637	585,290	69	43	86.21	223.29	75.74%	3,214	1,997	4,346,285	2,700,646	924,985	574,757	1	13
WATERFORD NP	3,809	2,367	332,928	39	24	54.63	141.49	84.07%	3,202	1,990	2,272,588	1,412,116	285,664	177,503	0	10
WATTS BAR NP	3,684	2,289	427,631	59	37	72.56	187.92	73.20%	2,696	1,676	1,103,472	685,663	117,877	73,245	1	11
WEST VALLEY	3,762	2,338	1,082,052	166	103	179.74	465.54	94.35%	3,550	2,206	2,505,034	1,556,550	244,562	151,964	3	11
WNP - Washington Nuclear	1,760	1,094	159,473	23	14	56.63	146.66	74.26%	1,307	812	976,318	606,654	142,572	88,590	1	5
WOLF CREEK NP	2,494	1,550	210,769	30	18	52.82	136.81	92.77%	2,314	1,438	1,432,891	890,354	157,112	97,625	0	7
YANKEE ROWE NP	4,267	2,651	1,291,704	187	116	189.22	490.08	93.41%	3,985	2,476	542,876	337,326	191,995	119,300	3	13
ZION NP	2,908	1,807	464,952	69	43	99.92	258.80	93.80%	2,728	1,695	3,999,376	2,485,088	418,789	260,222	1	7
Summary	270,764	168,244	52,345,878	7,362	4,575	113.34	293.56	85.45%	231,369	143,765	243,204,598	151,119,768	38,533,491	23,943,512	132	744

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,887	1,794	233,692	30	19	50.60	131.05	89.35%	2,579	1,603	3,321,386	2,063,806	369,476	229,581	0	9
ARNOLD NP	2,492	1,549	198,924	26	16	49.89	129.20	99.03%	2,468	1,534	1,138,156	707,215	159,503	99,110	2	6
BEAVER VALLEY NP	3,569	2,218	814,037	120	75	142.55	369.21	99.64%	3,556	2,210	3,623,912	2,251,786	378,320	235,076	3	10
BIG ROCK POINT NP	3,578	2,223	640,728	98	61	111.93	289.91	90.15%	3,225	2,004	223,993	139,182	143,103	88,920	4	9
BRAIDWOOD NP	3,239	2,013	318,566	39	24	61.47	159.22	54.84%	1,776	1,104	3,398,685	2,111,837	385,419	239,488	1	6
BROWNS FERRY NP	2,981	1,852	317,337	43	27	66.53	172.32	85.26%	2,542	1,579	4,582,481	2,847,411	626,010	388,983	1	8
BRUNSWICK NP	4,610	2,864	768,081	83	51	104.14	269.72	85.42%	3,938	2,447	4,215,858	2,619,603	954,200	592,910	3	15
BYRON NP	2,726	1,694	242,952	32	20	55.70	144.27	96.32%	2,626	1,632	3,126,702	1,942,836	354,390	220,207	2	7
CALLAWAY NP	2,570	1,597	176,028	22	14	42.81	110.88	89.44%	2,298	1,428	1,645,321	1,022,351	192,748	119,768	1	7
CALVERT CLIFFS NP	4,089	2,541	1,005,347	146	91	153.66	397.99	100.00%	4,089	2,541	4,673,891	2,904,211	592,910	368,416	2	12
CATAWBA NP	4,147	2,577	607,756	77	48	91.59	237.23	73.91%	3,065	1,905	4,949,065	3,075,195	530,833	329,843	1	13
CLINTON NP	2,995	1,861	350,194	50	31	73.09	189.30	83.80%	2,509	1,559	1,356,679	842,998	194,654	120,952	1	8
COMANCHE PEAK NP	2,850	1,771	266,149	31	19	58.37	151.18	65.60%	1,869	1,162	2,617,205	1,626,250	299,233	185,934	1	6
CONN YANKEE NP	4,406	2,738	1,446,145	209	130	205.13	531.28	97.63%	4,302	2,673	2,240,925	1,392,441	480,280	298,431	2	13
COOK NP	2,951	1,834	633,051	99	62	134.06	347.21	97.82%	2,887	1,794	3,984,609	2,475,912	430,902	267,749	2	9
COOPER STATION NP	2,181	1,355	235,478	36	23	67.49	174.80	96.13%	2,096	1,303	998,725	620,576	231,151	143,630	0	5
CRYSTAL RIVER NP	4,574	2,842	662,423	73	45	90.51	234.42	85.02%	3,889	2,417	2,245,136	1,395,058	407,109	252,965	2	14
DAVIS-BESSE NP	3,447	2,142	369,810	52	32	67.05	173.67	83.32%	2,872	1,785	1,754,027	1,089,898	199,921	124,224	1	10
DIABLO CANYON NP	1,608	999	740,144	134	83	287.73	745.21	87.59%	1,408	875	1,914,690	1,189,729	213,830	132,867	2	2
DRESDEN NP DOCK	2,830	1,758	302,295	40	25	66.77	172.94	97.78%	2,767	1,719	4,028,387	2,503,114	1,004,494	624,161	2	7
FARLEY NP	4,062	2,524	533,264	66	41	82.05	212.52	71.81%	2,917	1,812	4,632,364	2,878,407	499,606	310,440	1	13
FERMI NP	3,664	2,277	1,040,835	159	99	177.53	459.80	100.00%	3,664	2,277	1,835,499	1,140,522	282,153	175,321	2	11
FITZPATRICK NP	3,959	2,460	1,210,710	180	112	191.16	495.10	98.30%	3,891	2,418	2,055,302	1,277,101	288,972	179,558	2	11
FORT CALHOUN NP	2,064	1,283	151,444	21	13	45.86	118.77	100.00%	2,064	1,283	785,782	488,260	183,710	114,151	1	5
GRAND GULF NP	3,453	2,146	316,011	39	24	57.20	148.14	87.65%	3,027	1,881	2,940,731	1,827,279	417,816	259,618	1	11
HANFORD RPSTRY	1,747	1,086	156,793	23	14	56.09	145.26	81.35%	1,421	883	5,273,020	3,276,491	2,114,198	1,313,697	2	5
HARRIS NP	4,496	2,794	750,443	81	50	104.32	270.20	86.47%	3,888	2,416	2,688,446	1,670,517	310,216	192,758	2	15
HATCH NP	4,140	2,572	581,562	69	43	87.80	227.40	79.59%	3,295	2,047	5,515,164	3,426,951	761,740	473,322	1	13
HOPE CREEK NP	4,166	2,588	1,245,464	186	115	186.86	483.98	99.19%	4,132	2,567	2,987,015	1,856,038	420,730	261,428	2	12
HUMBOLDT BAY NP	1,321	821	169,747	28	17	80.31	208.02	59.70%	789	490	38,228	23,754	22,456	13,954	2	2
INEL	823	511	93,828	15	10	71.29	184.65	66.84%	550	342	496,920	308,771	190,006	118,064	0	3
KEWAUNEE NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	1,486,730	923,808	188,137	116,903	3	8
LA CROSSE NP	2,976	1,849	254,907	35	22	53.54	138.67	94.81%	2,821	1,753	113,017	70,225	41,660	25,886	1	8
LA SALLE NP	2,896	1,799	192,930	24	15	41.64	107.85	96.67%	2,799	1,739	3,653,162	2,269,961	509,672	316,694	1	9
LIMERICK NP	4,132	2,567	1,296,681	192	119	196.14	508.01	99.49%	4,111	2,554	4,664,440	2,898,338	681,754	423,621	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,663	2,898	1,486,593	207	129	199.25	516.06	87.92%	4,100	2,547	3,342,644	2,077,015	424,341	263,673	4	15
MCGUIRE NP	4,288	2,665	895,665	124	77	130.54	338.10	97.17%	4,167	2,589	6,083,260	3,779,948	647,529	402,355	2	13
MILLSTONE NP	4,524	2,811	1,478,682	211	131	204.29	529.11	97.12%	4,394	2,730	7,843,870	4,873,937	1,569,787	975,417	3	13
MONTICELLO NP	2,716	1,688	280,880	35	22	64.63	167.40	74.75%	2,030	1,262	1,069,546	664,583	258,029	160,332	1	8
MORRIS (G E Repro Plnt, IL)	2,826	1,756	302,427	40	25	66.88	173.21	97.89%	2,767	1,719	1,905,180	1,183,819	251,544	156,302	2	7
NINE MILE POINT NP	3,957	2,459	1,210,513	180	112	191.19	495.18	98.33%	3,891	2,418	4,074,127	2,531,536	585,670	363,917	2	11
NORTH ANNA NP	4,277	2,658	1,207,077	180	112	176.38	456.84	96.93%	4,146	2,576	4,915,024	3,054,043	560,309	348,159	2	14
OCONEE NP	4,022	2,499	641,417	79	49	99.68	258.18	83.47%	3,357	2,086	7,630,553	4,741,388	820,407	509,776	1	14
OYSTER CREEK NP	4,380	2,721	1,414,717	203	126	201.89	522.89	94.86%	4,154	2,581	2,853,277	1,772,938	402,931	250,369	2	11
PALISADES NP	2,814	1,748	439,702	69	43	97.67	252.96	100.00%	2,814	1,748	1,617,224	1,004,893	194,151	120,640	1	7
PALO VERDE NP	2,064	1,283	480,689	88	55	145.56	377.00	92.55%	1,910	1,187	3,482,676	2,164,026	421,054	261,630	1	3
PEACH BOTTOM NP	4,047	2,514	1,208,654	181	112	186.68	483.50	99.09%	4,010	2,491	6,482,977	4,028,320	910,474	565,740	3	10
PERRY NP	3,554	2,208	570,744	82	51	100.38	259.99	82.83%	2,944	1,829	2,150,287	1,336,121	305,610	189,897	1	10
PILGRIM NP	4,461	2,772	1,501,087	220	137	210.29	544.64	98.48%	4,394	2,730	2,256,819	1,402,317	521,988	324,347	2	12
POINT BEACH NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	2,670,528	1,659,383	341,198	212,010	3	8
PRAIRIE ISLAND NP	2,647	1,645	256,152	30	19	60.49	156.67	80.50%	2,130	1,324	2,136,819	1,327,753	280,537	174,317	2	7
QUAD CITIES NP	2,705	1,681	293,879	43	27	67.91	175.89	98.63%	2,668	1,658	3,641,897	2,262,962	849,268	527,708	2	7
RANCHO SECO NP	856	532	100,291	18	11	73.21	189.62	96.62%	827	514	195,516	121,488	20,548	12,768	1	2
RIVER BEND NP	3,714	2,308	337,478	39	24	56.79	147.09	85.52%	3,176	1,974	1,812,270	1,126,088	256,259	159,231	1	10
ROBINSON NP	4,339	2,696	782,947	90	56	112.77	292.06	84.20%	3,654	2,271	1,495,115	929,018	303,762	188,748	2	14
SALEM NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	4,733,335	2,941,147	512,374	318,373	2	12
SAN ONOFRE NP	1,748	1,086	618,686	110	68	221.22	572.97	93.55%	1,635	1,016	2,567,967	1,595,655	305,885	190,068	2	2
SAVANNA RIVER PLANT	4,175	2,594	715,075	88	55	107.04	277.23	79.81%	3,332	2,071	11,626,116	7,224,107	4,651,282	2,890,162	3	14
SEABROOK NP	4,507	2,801	1,440,457	204	127	199.75	517.34	90.96%	4,100	2,547	1,976,519	1,228,147	211,836	131,628	3	14
SEQUOYAH NP	3,626	2,253	441,058	51	32	76.02	196.89	76.13%	2,761	1,715	3,551,379	2,206,716	373,497	232,080	1	13
SOUTH TEXAS NP	3,731	2,319	517,105	66	41	86.62	224.34	82.08%	3,063	1,903	3,016,552	1,874,391	283,577	176,206	0	9
ST LUCIE NP	4,834	3,004	942,830	112	70	121.91	315.74	89.92%	4,346	2,701	5,561,394	3,455,677	710,551	441,515	3	14
SUMMER NP	4,083	2,537	531,234	68	42	81.32	210.63	72.19%	2,948	1,832	2,141,408	1,330,604	240,883	149,677	1	13
SURRY NP	4,391	2,729	969,607	137	85	138.01	357.44	100.00%	4,391	2,729	4,764,049	2,960,232	526,933	327,420	2	12
SUSQUEHANNA NP	4,130	2,566	1,206,794	179	111	182.62	472.98	96.14%	3,971	2,467	6,072,810	3,773,455	871,480	541,510	3	10
THREE MILE ISLAND NP	4,026	2,501	1,209,136	181	113	187.72	486.21	99.32%	3,998	2,484	2,106,772	1,309,083	225,435	140,078	2	10
TROJAN NP	1,595	991	112,204	13	8	43.98	113.90	53.43%	852	529	572,276	355,594	60,599	37,654	1	4
TURKEY POINT NP	5,036	3,130	1,053,172	139	86	130.69	338.50	81.21%	4,090	2,542	5,091,509	3,163,705	538,901	334,857	2	14
VERMONT YANKEE NP	4,415	2,744	1,368,867	196	122	193.77	501.86	98.05%	4,329	2,690	2,656,260	1,650,517	609,305	378,603	3	13
VOGTLE NP	4,196	2,608	582,390	69	43	86.74	224.66	79.31%	3,328	2,068	4,298,478	2,670,940	914,811	568,435	1	13
WATERFORD NP	3,762	2,338	330,127	39	24	54.84	142.04	88.15%	3,316	2,061	2,244,741	1,394,812	282,163	175,328	0	10
WATTS BAR NP	3,637	2,260	424,744	59	37	72.99	189.05	77.28%	2,811	1,747	1,089,491	676,976	116,383	72,317	1	11
WEST VALLEY	3,716	2,309	1,079,143	166	103	181.51	470.12	98.61%	3,664	2,277	2,473,961	1,537,243	241,529	150,079	3	11
WNP - Washington Nuclear	1,713	1,065	156,777	23	14	57.19	148.11	82.95%	1,421	883	950,430	590,568	138,791	86,241	1	5
WOLF CREEK NP	2,447	1,521	207,960	30	18	53.11	137.56	99.21%	2,428	1,509	1,406,075	873,691	154,172	95,798	0	7
YANKEE ROWE NP	4,220	2,622	1,288,735	187	116	190.87	494.36	97.15%	4,100	2,547	536,937	333,636	189,894	117,995	3	13
ZION NP	2,862	1,778	462,249	69	43	100.96	261.49	99.33%	2,842	1,766	3,935,195	2,445,208	412,068	256,046	1	7
Summary	262,874	163,342	51,403,262	7,234	4,495	115.16	298.26	89.54%	235,367	146,250	236,238,915	146,791,509	37,559,061	23,338,032	132	739

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,115	1,936	224,723	16	10	45.08	116.77	89.75%	2,796	1,737	3,584,712	2,227,428	398,769	247,782	1	7
ARNOLD NP	3,436	2,135	223,262	24	15	40.61	105.17	89.70%	3,082	1,915	1,569,282	975,103	219,922	136,653	3	9
BEAVER VALLEY NP	4,302	2,673	521,382	63	39	75.75	196.18	98.77%	4,249	2,640	4,368,238	2,714,287	456,024	283,359	3	13
BIG ROCK POINT NP	4,330	2,691	481,645	62	39	69.52	180.06	91.86%	3,978	2,472	271,109	168,458	173,205	107,624	4	12
BRAIDWOOD NP	3,905	2,426	431,543	59	37	69.08	178.91	90.73%	3,543	2,201	4,097,336	2,545,957	464,648	288,718	1	9
BROWNS FERRY NP	3,801	2,362	423,253	56	35	69.60	180.26	88.44%	3,361	2,089	5,842,707	3,630,476	798,168	495,957	2	9
BRUNSWICK NP	5,126	3,185	1,036,482	124	77	126.37	327.30	90.89%	4,659	2,895	4,688,326	2,913,180	1,061,136	659,357	3	11
BYRON NP	3,553	2,208	264,296	30	19	46.49	120.41	84.84%	3,015	1,873	4,075,290	2,532,258	461,906	287,014	2	10
CALLAWAY NP	3,133	1,947	221,882	29	18	44.26	114.63	91.01%	2,852	1,772	2,005,934	1,246,425	234,993	146,018	2	8
CALVERT CLIFFS NP	4,822	2,996	712,575	89	55	92.36	239.21	99.17%	4,782	2,971	5,511,800	3,424,861	699,204	434,464	2	15
CATAWBA NP	4,722	2,934	614,393	74	46	81.31	210.60	77.09%	3,640	2,262	5,635,662	3,501,826	604,477	375,603	2	14
CLINTON NP	3,783	2,351	338,767	45	28	55.97	144.96	97.51%	3,689	2,292	1,713,857	1,064,938	245,901	152,796	3	10
COMANCHE PEAK NP	2,487	1,546	99,263	7	4	24.94	64.60	94.11%	2,341	1,455	2,284,216	1,419,341	261,161	162,278	1	5
CONN YANKEE NP	5,180	3,219	1,120,937	146	91	135.25	350.30	95.49%	4,946	3,074	2,634,370	1,636,916	564,604	350,827	2	16
COOK NP	3,684	2,289	340,918	42	26	57.83	149.78	97.16%	3,580	2,224	4,974,297	3,090,873	537,929	334,252	2	12
COOPER STATION NP	3,090	1,920	202,184	25	16	40.90	105.93	92.14%	2,847	1,769	1,415,093	879,295	327,518	203,509	1	8
CRYSTAL RIVER NP	4,677	2,906	814,497	100	62	108.84	281.90	85.88%	4,017	2,496	2,295,611	1,426,421	416,261	258,652	2	9
DAVIS-BESSE NP	4,022	2,499	376,543	49	30	58.51	151.54	85.70%	3,447	2,142	2,046,802	1,271,819	233,290	144,959	2	11
DIABLO CANYON NP	591	368	671,091	128	80	709.18	1,836.77	82.86%	490	305	704,353	437,663	78,661	48,878	2	2
DRESDEN NP DOCK	3,571	2,219	229,743	25	16	40.21	104.15	98.65%	3,522	2,189	5,083,484	3,158,719	1,267,586	787,639	2	10
FARLEY NP	4,637	2,881	539,997	64	40	72.78	188.50	75.31%	3,492	2,170	5,288,520	3,286,121	570,373	354,412	2	14
FERMI NP	4,438	2,758	714,606	96	60	100.64	260.65	97.10%	4,309	2,678	2,223,010	1,381,309	341,722	212,335	2	14
FITZPATRICK NP	4,732	2,940	885,362	117	73	116.93	302.86	95.86%	4,536	2,819	2,456,971	1,526,685	345,446	214,649	2	14
FORT CALHOUN NP	3,245	2,017	247,363	30	19	47.64	123.38	89.91%	2,918	1,813	1,235,465	767,679	288,842	179,477	2	9
GRAND GULF NP	3,582	2,226	513,284	73	45	89.55	231.93	81.33%	2,914	1,811	3,050,926	1,895,751	433,472	269,346	2	7
HANFORD RPSTRY	2,570	1,597	841,331	151	94	204.59	529.90	94.43%	2,427	1,508	7,756,298	4,819,522	3,109,860	1,932,370	3	4
HARRIS NP	5,012	3,115	1,019,625	123	76	127.14	329.28	91.96%	4,609	2,864	2,997,364	1,862,469	345,861	214,907	2	11
HATCH NP	4,715	2,930	587,957	66	41	77.93	201.85	82.08%	3,870	2,405	6,281,635	3,903,213	867,603	539,102	2	14
HOPE CREEK NP	4,939	3,069	920,112	123	77	116.43	301.55	96.71%	4,777	2,968	3,541,743	2,200,729	498,865	309,979	2	15
HUMBOLDT BAY NP	1,625	1,010	593,798	106	66	228.37	591.47	67.24%	1,093	679	47,031	29,224	27,627	17,167	2	2
INEL	2,532	1,573	394,003	64	40	97.26	251.91	87.44%	2,214	1,376	1,529,554	950,417	584,853	363,409	1	4
KEWAUNEE NP	3,976	2,471	569,245	78	49	89.47	231.74	93.31%	3,711	2,306	1,853,948	1,151,986	234,607	145,777	5	11
LA CROSSE NP	3,705	2,302	228,334	24	15	38.52	99.77	87.97%	3,259	2,025	140,705	87,430	51,866	32,228	2	10
LA SALLE NP	3,474	2,159	189,734	20	12	34.13	88.41	99.68%	3,463	2,152	4,382,617	2,723,222	611,442	379,931	1	10
LIMERICK NP	4,905	3,048	971,307	130	81	123.75	320.52	96.95%	4,756	2,955	5,537,773	3,441,000	809,401	502,937	2	13

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	5,420	3,368	1,246,793	159	99	143.78	372.38	89.54%	4,853	3,016	3,885,081	2,414,068	493,203	306,461	5	18
MCGUIRE NP	4,881	3,033	1,045,072	129	80	133.82	346.59	92.69%	4,524	2,811	6,924,086	4,302,411	737,031	457,968	2	11
MILLSTONE NP	5,281	3,281	1,239,375	162	101	146.69	379.93	97.47%	5,147	3,198	9,155,925	5,689,207	1,832,368	1,138,576	4	16
MONTICELLO NP	3,800	2,361	418,317	57	35	68.81	178.21	50.43%	1,916	1,191	1,496,300	929,754	360,984	224,305	2	9
MORRIS (G E Repro Plnt, IL)	3,567	2,217	229,721	25	16	40.25	104.24	98.74%	3,522	2,189	2,404,744	1,494,233	317,503	197,286	2	10
NINE MILE POINT NP	4,731	2,940	885,207	117	73	116.95	302.89	95.88%	4,536	2,819	4,870,594	3,026,436	700,165	435,061	2	14
NORTH ANNA NP	5,010	3,113	914,221	122	76	114.04	295.38	96.57%	4,839	3,007	5,757,404	3,577,472	656,340	407,829	2	17
OCONEE NP	4,597	2,856	648,144	76	47	88.12	228.24	85.54%	3,932	2,443	8,722,202	5,419,705	937,777	582,706	2	15
OYSTER CREEK NP	5,153	3,202	1,089,163	140	87	132.10	342.13	93.13%	4,799	2,982	3,357,272	2,086,104	474,104	294,593	2	14
PALISADES NP	3,582	2,226	266,605	31	19	46.52	120.48	100.00%	3,582	2,226	2,058,714	1,279,221	247,153	153,573	2	10
PALO VERDE NP	881	548	91,110	13	8	64.63	167.38	82.56%	727	452	1,486,756	923,824	179,748	111,690	1	3
PEACH BOTTOM NP	4,803	2,985	969,150	132	82	126.11	326.61	99.16%	4,763	2,960	7,695,312	4,781,628	1,080,735	671,535	4	13
PERRY NP	4,129	2,566	577,444	79	49	87.41	226.39	85.22%	3,519	2,187	2,498,427	1,552,445	355,090	220,642	2	11
PILGRIM NP	5,235	3,253	1,175,074	157	98	140.29	363.35	96.24%	5,038	3,131	2,648,152	1,645,479	612,501	380,589	2	15
POINT BEACH NP	3,976	2,471	569,245	78	49	89.47	231.74	93.31%	3,711	2,306	3,330,140	2,069,246	425,473	264,376	5	11
PRAIRIE ISLAND NP	3,868	2,404	285,804	33	21	46.18	119.61	82.22%	3,180	1,976	3,123,043	1,940,562	410,016	254,771	2	10
QUAD CITIES NP	3,419	2,125	260,373	32	20	47.60	123.27	86.10%	2,944	1,829	4,603,838	2,860,682	1,073,586	667,093	2	10
RANCHO SECO NP	1,083	673	390,137	71	44	225.13	583.09	97.33%	1,054	655	247,335	153,686	25,994	16,152	1	2
RIVER BEND NP	3,737	2,322	664,199	91	57	111.09	287.72	87.37%	3,265	2,029	1,823,500	1,133,066	257,847	160,218	2	6
ROBINSON NP	4,856	3,017	1,052,308	132	82	135.44	350.78	90.11%	4,376	2,719	1,673,104	1,039,615	339,924	211,218	2	10
SALEM NP	4,939	3,069	920,112	123	77	116.43	301.55	96.71%	4,777	2,968	5,612,378	3,487,357	607,528	377,499	2	15
SAN ONOFRE NP	494	307	323,860	61	38	409.68	1,061.08	86.32%	426	265	725,869	451,032	86,462	53,725	1	2
SAVANNA RIVER PLANT	4,692	2,915	984,354	130	81	131.12	339.61	86.40%	4,054	2,519	13,064,593	8,117,931	5,226,775	3,247,756	3	10
SEABROOK NP	5,264	3,271	1,200,638	156	97	142.56	369.22	92.20%	4,853	3,016	2,308,361	1,434,344	247,402	153,728	4	17
SEQUOYAH NP	4,202	2,611	447,741	49	30	66.60	172.50	79.40%	3,336	2,073	4,114,852	2,556,841	432,758	268,902	2	14
SOUTH TEXAS NP	3,000	1,864	268,037	31	19	55.84	144.63	90.70%	2,721	1,691	2,425,341	1,507,032	227,999	141,672	1	5
ST LUCIE NP	4,980	3,095	1,086,658	135	84	136.37	353.21	90.06%	4,485	2,787	5,729,893	3,560,377	732,080	454,892	3	9
SUMMER NP	4,658	2,894	537,716	65	40	72.15	186.86	75.63%	3,523	2,189	2,443,175	1,518,113	274,828	170,770	2	14
SURRY NP	5,124	3,184	676,754	80	49	82.54	213.79	99.21%	5,084	3,159	5,559,366	3,454,417	614,900	382,080	2	15
SUSQUEHANNA NP	4,887	3,037	967,466	130	81	123.73	320.46	96.67%	4,724	2,936	7,185,432	4,464,804	1,031,147	640,723	4	13
THREE MILE ISLAND NP	4,799	2,982	883,807	118	74	115.10	298.10	96.75%	4,643	2,885	2,511,636	1,560,652	268,758	166,998	2	13
TROJAN NP	2,202	1,368	778,808	138	86	221.09	572.63	96.56%	2,126	1,321	790,063	490,920	83,660	51,984	2	3
TURKEY POINT NP	5,139	3,193	1,205,147	166	103	146.56	379.59	82.07%	4,218	2,621	5,195,471	3,228,304	549,905	341,694	2	9
VERMONT YANKEE NP	5,172	3,214	1,129,695	148	92	136.52	353.58	98.27%	5,083	3,158	3,111,608	1,933,394	713,732	443,491	4	16
VOGTLE NP	4,772	2,965	589,336	66	41	77.19	199.93	81.80%	3,903	2,426	4,887,819	3,037,138	1,040,236	646,370	2	14
WATERFORD NP	3,288	2,043	358,179	41	25	68.09	176.35	70.96%	2,333	1,450	1,961,664	1,218,917	246,581	153,218	1	6
WATTS BAR NP	4,212	2,617	431,456	56	35	64.02	165.80	80.39%	3,386	2,104	1,261,840	784,068	134,794	83,757	2	12
WEST VALLEY	4,473	2,779	839,904	118	73	117.37	303.99	98.78%	4,418	2,745	2,977,775	1,850,297	290,715	180,642	4	14
WNP - Washington Nuclear	2,536	1,576	841,317	151	94	207.32	536.95	95.69%	2,427	1,508	1,406,855	874,176	205,443	127,656	2	4
WOLF CREEK NP	2,726	1,694	114,938	10	6	26.35	68.25	95.16%	2,594	1,612	1,566,323	973,264	171,743	106,716	1	7
YANKEE ROWE NP	4,977	3,092	1,049,609	139	86	131.82	341.41	97.52%	4,853	3,016	633,222	393,464	223,947	139,154	4	16
ZION NP	3,649	2,268	387,957	52	33	66.45	172.09	99.47%	3,630	2,256	5,018,308	3,118,221	525,485	326,520	3	10
Summary	305,617	189,901	48,606,389	6,454	4,010	108.79	281.76	90.64%	277,008	172,124	271,379,714	168,626,907	44,081,622	27,390,948	175	815

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas VALLEY MODIFIED	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,121	1,940	238,384	30	19	47.73	123.62	85.00%	2,653	1,649	3,591,749	2,231,801	399,551	248,269	0	9
ARNOLD NP	2,727	1,695	203,713	26	16	46.69	120.92	93.21%	2,542	1,580	1,245,460	773,890	174,541	108,454	2	6
BEAVER VALLEY NP	3,804	2,364	818,834	120	75	134.53	348.45	95.43%	3,630	2,256	3,862,488	2,400,030	403,226	250,552	3	10
BIG ROCK POINT NP	3,813	2,369	645,418	98	61	105.80	274.04	86.53%	3,299	2,050	238,704	148,323	152,502	94,760	4	9
BRAIDWOOD NP	3,363	2,090	278,711	33	21	51.80	134.15	52.30%	1,759	1,093	3,529,059	2,192,848	400,204	248,674	1	6
BROWNS FERRY NP	3,216	1,998	322,220	43	27	62.62	162.19	81.33%	2,616	1,625	4,943,677	3,071,847	675,352	419,643	1	8
BRUNSWICK NP	4,845	3,010	772,691	83	51	99.68	258.18	82.81%	4,012	2,493	4,430,750	2,753,130	1,002,838	623,132	3	15
BYRON NP	2,961	1,840	247,557	32	20	52.26	135.34	91.18%	2,700	1,678	3,396,198	2,110,292	384,936	239,187	2	7
CALLAWAY NP	2,805	1,743	180,748	22	14	40.27	104.31	84.58%	2,373	1,474	1,795,748	1,115,822	210,370	130,718	1	7
CALVERT CLIFFS NP	4,324	2,687	1,010,069	146	91	146.00	378.13	96.28%	4,163	2,587	4,942,464	3,071,093	626,980	389,586	2	12
CATAWBA NP	4,382	2,723	612,437	77	48	87.35	226.24	71.63%	3,139	1,951	5,229,466	3,249,427	560,909	348,531	1	13
CLINTON NP	3,230	2,007	354,955	50	31	68.69	177.91	79.99%	2,583	1,605	1,463,125	909,141	209,927	130,442	1	8
COMANCHE PEAK NP	3,085	1,917	270,828	31	19	54.87	142.12	63.00%	1,943	1,208	2,832,990	1,760,332	323,904	201,264	1	6
CONN YANKEE NP	4,641	2,884	1,450,963	209	130	195.39	506.07	94.28%	4,376	2,719	2,360,424	1,466,694	505,891	314,345	2	13
COOK NP	3,186	1,980	637,757	99	62	125.10	324.00	92.93%	2,961	1,840	4,301,830	2,673,023	465,207	289,065	2	9
COOPER STATION NP	2,416	1,501	240,211	36	23	62.15	160.97	89.84%	2,170	1,349	1,106,336	687,443	256,057	159,106	0	5
CRYSTAL RIVER NP	4,809	2,988	667,021	73	45	86.69	224.52	82.41%	3,963	2,463	2,360,462	1,466,717	428,021	265,959	2	14
DAVIS-BESSE NP	3,682	2,288	374,515	52	32	63.57	164.66	80.01%	2,946	1,831	1,873,594	1,164,193	213,549	132,692	1	10
DIABLO CANYON NP	2,630	1,634	913,125	163	101	216.97	561.96	86.29%	2,270	1,410	3,132,503	1,946,440	349,833	217,375	2	3
DRESDEN NP DOCK	3,065	1,904	307,114	40	25	62.63	162.22	92.70%	2,841	1,765	4,362,902	2,710,971	1,087,906	675,991	2	7
FARLEY NP	4,297	2,670	538,172	66	41	78.28	202.75	69.61%	2,991	1,858	4,900,333	3,044,914	528,507	328,398	1	13
FERMI NP	3,899	2,423	1,045,440	159	99	167.57	434.00	95.87%	3,738	2,323	1,953,195	1,213,655	300,246	186,563	2	11
FITZPATRICK NP	4,193	2,606	1,215,458	180	112	181.15	469.19	94.56%	3,965	2,464	2,177,298	1,352,905	306,124	190,216	2	11
FORT CALHOUN NP	2,299	1,429	156,203	21	13	42.46	109.98	93.00%	2,138	1,329	875,228	543,839	204,621	127,145	1	5
GRAND GULF NP	3,688	2,292	320,725	39	24	54.35	140.77	84.07%	3,101	1,927	3,140,837	1,951,618	446,246	277,284	1	11
HANFORD RPSTRY	1,982	1,232	161,468	23	14	50.91	131.86	75.44%	1,495	929	5,982,112	3,717,098	2,398,506	1,490,357	2	5
HARRIS NP	4,731	2,940	755,128	81	50	99.76	258.38	83.74%	3,962	2,462	2,828,951	1,757,822	326,428	202,832	2	16
HATCH NP	4,375	2,718	586,233	69	43	83.75	216.91	77.01%	3,369	2,093	5,828,185	3,621,452	804,974	500,186	1	13
HOPE CREEK NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	3,155,499	1,960,729	444,461	276,174	2	12
HUMBOLDT BAY NP	2,344	1,456	342,699	57	35	91.39	236.71	70.42%	1,650	1,025	67,822	42,142	39,840	24,755	2	3
INEL	1,058	657	98,508	15	10	58.22	150.79	58.99%	624	388	638,870	396,974	244,283	151,790	0	3
KEWAUNEE NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	1,596,280	991,879	202,000	125,517	3	8
LA CROSSE NP	3,211	1,995	259,585	35	22	50.53	130.88	90.18%	2,895	1,799	121,941	75,770	44,949	27,930	1	8
LA SALLE NP	3,131	1,945	197,616	24	15	39.45	102.17	91.78%	2,873	1,785	3,949,573	2,454,142	551,026	342,390	1	9
LIMERICK NP	4,367	2,713	1,301,267	192	119	186.24	482.37	95.84%	4,185	2,600	4,929,692	3,063,157	720,524	447,711	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,898	3,044	1,491,573	207	129	190.33	492.95	85.21%	4,174	2,593	3,511,074	2,181,672	445,723	276,959	4	15
MCGUIRE NP	4,523	2,811	900,396	124	77	124.41	322.23	93.76%	4,241	2,635	6,416,577	3,987,061	683,009	424,401	2	13
MILLSTONE NP	4,759	2,957	1,483,402	211	131	194.82	504.59	93.88%	4,468	2,776	8,251,271	5,127,083	1,651,320	1,026,079	3	13
MONTICELLO NP	2,951	1,834	285,648	35	22	60.50	156.69	71.31%	2,104	1,308	1,162,070	722,074	280,351	174,202	1	8
MORRIS (G E Repro Plnt, IL)	3,061	1,902	307,090	40	25	62.70	162.38	92.80%	2,841	1,765	2,063,565	1,282,235	272,456	169,296	2	7
NINE MILE POINT NP	4,192	2,605	1,215,261	180	112	181.18	469.26	94.59%	3,965	2,464	4,316,033	2,681,849	620,445	385,525	2	11
NORTH ANNA NP	4,512	2,804	1,211,851	180	112	167.86	434.76	93.52%	4,220	2,622	5,185,029	3,221,816	591,090	367,285	2	14
OCONEE NP	4,257	2,645	646,199	79	49	94.88	245.75	80.60%	3,431	2,132	8,076,373	5,018,407	868,340	539,560	1	14
OYSTER CREEK NP	4,615	2,867	1,419,337	203	126	192.23	497.88	91.63%	4,228	2,627	3,006,352	1,868,054	424,548	263,801	2	11
PALISADES NP	3,049	1,894	444,350	69	43	91.09	235.93	94.72%	2,888	1,794	1,752,271	1,088,806	210,364	130,714	1	7
PALO VERDE NP	3,087	1,918	653,624	117	73	132.35	342.79	89.81%	2,772	1,722	5,208,128	3,236,169	629,661	391,252	1	4
PEACH BOTTOM NP	4,282	2,660	1,213,328	181	112	177.12	458.73	95.38%	4,084	2,537	6,859,415	4,262,227	963,341	598,590	3	10
PERRY NP	3,789	2,354	575,428	82	51	94.93	245.86	79.65%	3,018	1,875	2,292,464	1,424,466	325,817	202,453	1	10
PILGRIM NP	4,696	2,918	1,505,940	220	137	200.41	519.07	95.13%	4,468	2,776	2,375,677	1,476,171	549,479	341,429	2	12
POINT BEACH NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	2,867,306	1,781,655	366,339	227,632	3	8
PRAIRIE ISLAND NP	2,882	1,791	261,028	30	19	56.62	146.64	76.50%	2,204	1,370	2,326,528	1,445,632	305,443	189,793	2	7
QUAD CITIES NP	2,940	1,827	298,782	43	27	63.52	164.53	93.27%	2,742	1,704	3,958,282	2,459,553	923,047	573,552	2	7
RANCHO SECO NP	1,879	1,167	273,277	46	29	90.91	235.46	89.89%	1,689	1,049	429,033	266,587	45,090	28,018	1	3
RIVER BEND NP	3,949	2,454	342,083	39	24	54.14	140.23	82.31%	3,250	2,020	1,926,926	1,197,332	272,471	169,305	1	10
ROBINSON NP	4,574	2,842	787,866	90	56	107.65	278.80	81.50%	3,728	2,317	1,576,069	979,320	320,209	198,968	2	14
SALEM NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	5,000,321	3,107,044	541,275	336,331	2	12
SAN ONOFRE NP	2,854	1,773	628,420	110	68	137.64	356.49	90.41%	2,580	1,603	4,192,305	2,604,968	499,369	310,293	2	3
SAVANNA RIVER PLANT	4,410	2,740	719,975	88	55	102.03	264.26	77.23%	3,406	2,117	12,280,377	7,630,644	4,913,033	3,052,806	3	14
SEABROOK NP	4,742	2,947	1,445,184	204	127	190.47	493.32	88.01%	4,174	2,593	2,079,558	1,292,172	222,879	138,490	3	14
SEQUOYAH NP	3,861	2,399	445,638	51	32	72.13	186.83	73.42%	2,835	1,761	3,781,497	2,349,705	397,699	247,118	1	13
SOUTH TEXAS NP	3,966	2,465	521,979	66	41	82.25	213.04	79.08%	3,137	1,949	3,206,509	1,992,425	301,434	187,302	0	9
ST LUCIE NP	5,069	3,150	947,449	112	70	116.83	302.58	87.21%	4,420	2,747	5,831,733	3,623,657	745,091	462,977	3	14
SUMMER NP	4,318	2,683	535,845	68	42	77.56	200.89	69.98%	3,022	1,878	2,264,647	1,407,181	254,746	158,291	1	13
SURRY NP	4,626	2,875	974,341	137	85	131.64	340.94	96.52%	4,465	2,775	5,018,969	3,118,631	555,129	344,940	2	12
SUSQUEHANNA NP	4,365	2,712	1,211,597	179	111	173.47	449.30	92.66%	4,045	2,513	6,418,286	3,988,123	921,057	572,316	3	10
THREE MILE ISLAND NP	4,261	2,647	1,213,718	181	113	178.04	461.14	95.58%	4,072	2,530	2,229,739	1,385,490	238,593	148,254	2	10
TROJAN NP	2,216	1,377	211,007	32	20	59.52	154.17	81.08%	1,796	1,116	795,087	494,043	84,193	52,315	1	4
TURKEY POINT NP	5,271	3,276	1,057,990	139	86	125.44	324.89	79.00%	4,164	2,588	5,329,043	3,311,301	564,043	350,479	2	14
VERMONT YANKEE NP	4,650	2,890	1,373,676	196	122	184.63	478.18	94.69%	4,403	2,736	2,797,617	1,738,352	641,730	398,751	3	13
VOGTLE NP	4,431	2,754	587,374	69	43	82.84	214.57	76.78%	3,402	2,114	4,539,160	2,820,493	966,033	600,263	1	13
WATERFORD NP	3,997	2,484	334,934	39	24	52.37	135.64	84.82%	3,390	2,107	2,384,935	1,481,924	299,786	186,278	0	10
WATTS BAR NP	3,872	2,406	429,573	59	37	69.34	179.59	74.50%	2,885	1,793	1,159,877	720,711	123,902	76,989	1	11
WEST VALLEY	3,951	2,455	1,084,059	166	103	171.49	444.17	94.62%	3,738	2,323	2,630,399	1,634,448	256,802	159,569	3	11
WNP - Washington Nuclear	1,948	1,211	161,501	23	14	51.80	134.17	76.75%	1,495	929	1,080,761	671,551	157,824	98,067	1	5
WOLF CREEK NP	2,682	1,667	212,671	30	18	49.56	128.35	93.28%	2,502	1,555	1,541,079	957,578	168,975	104,996	0	7
YANKEE ROWE NP	4,455	2,768	1,293,656	187	116	181.50	470.08	93.69%	4,174	2,593	566,834	352,213	200,468	124,565	3	13
ZION NP	3,097	1,924	467,032	69	43	94.26	244.15	94.18%	2,916	1,812	4,258,314	2,645,984	445,903	277,070	1	7
Summary	285,262	177,253	52,495,778	7,362	4,575	107.91	279.48	86.19%	245,867	152,774	256,093,230	159,128,363	40,642,948	25,254,263	132	744

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Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,933	1,823	236,519	30	19	50.40	130.53	84.03%	2,465	1,532	3,375,088	2,097,175	375,450	233,293	0	9
ARNOLD NP	2,539	1,578	201,751	26	16	49.66	128.63	92.71%	2,354	1,463	1,159,470	720,458	162,490	100,966	2	6
BEAVER VALLEY NP	3,616	2,247	816,949	120	75	141.21	365.75	95.19%	3,442	2,139	3,671,300	2,281,232	383,267	238,150	3	10
BIG ROCK POINT NP	3,624	2,252	643,485	98	61	110.97	287.41	85.83%	3,111	1,933	226,915	140,998	144,970	90,080	4	9
BRAIDWOOD NP	2,927	1,819	414,211	61	38	88.44	229.06	92.09%	2,696	1,675	3,071,736	1,908,681	348,342	216,449	3	7
BROWNS FERRY NP	3,028	1,881	320,180	43	27	66.09	171.19	80.17%	2,427	1,508	4,654,225	2,891,991	635,811	395,073	1	8
BRUNSWICK NP	4,656	2,893	770,725	83	51	103.45	267.94	82.11%	3,823	2,376	4,258,542	2,646,125	963,861	598,913	3	15
BYRON NP	2,773	1,723	245,697	32	20	55.38	143.44	90.58%	2,512	1,561	3,180,232	1,976,097	360,457	223,977	2	7
CALLAWAY NP	2,617	1,626	178,729	22	14	42.69	110.57	83.47%	2,184	1,357	1,675,200	1,040,917	196,248	121,943	1	7
CALVERT CLIFFS NP	4,136	2,570	1,008,084	146	91	152.34	394.57	96.11%	3,975	2,470	4,727,238	2,937,358	599,678	372,621	2	12
CATAWBA NP	4,194	2,606	610,617	77	48	91.00	235.69	70.36%	2,951	1,834	5,004,761	3,109,803	536,807	333,555	1	13
CLINTON NP	2,964	1,842	307,100	45	28	64.76	167.72	85.58%	2,537	1,576	1,342,754	834,345	192,656	119,711	2	7
COMANCHE PEAK NP	2,754	1,712	148,113	15	9	33.61	87.05	94.68%	2,608	1,621	2,529,561	1,571,790	289,212	179,708	1	5
CONN YANKEE NP	4,453	2,767	1,449,099	209	130	203.39	526.79	94.04%	4,187	2,602	2,264,661	1,407,190	485,367	301,592	2	13
COOK NP	2,998	1,863	635,645	99	62	132.51	343.21	92.48%	2,773	1,723	4,047,618	2,515,064	437,716	271,983	2	9
COOPER STATION NP	2,227	1,384	238,193	36	23	66.84	173.11	88.98%	1,982	1,232	1,020,100	633,858	236,098	146,704	0	5
CRYSTAL RIVER NP	4,621	2,871	665,273	73	45	89.98	233.05	81.69%	3,775	2,346	2,268,043	1,409,291	411,262	255,546	2	14
DAVIS-BESSE NP	3,379	2,099	691,956	108	67	128.00	331.52	93.18%	3,148	1,956	1,719,303	1,068,322	195,963	121,765	2	9
DIABLO CANYON NP	859	534	720,395	136	85	524.40	1,358.21	88.19%	757	471	1,022,510	635,356	114,192	70,956	2	2
DRESDEN NP DOCK	2,876	1,787	305,142	40	25	66.31	171.74	92.22%	2,653	1,648	4,094,832	2,544,401	1,021,062	634,456	2	7
FARLEY NP	4,109	2,553	536,137	66	41	81.56	211.24	68.21%	2,803	1,741	4,685,591	2,911,480	505,347	314,007	1	13
FERMI NP	3,711	2,306	1,043,476	159	99	175.74	455.17	95.66%	3,550	2,206	1,858,877	1,155,048	285,747	177,554	2	11
FITZPATRICK NP	4,005	2,489	1,213,632	180	112	189.38	490.51	94.30%	3,777	2,347	2,079,534	1,292,158	292,379	181,675	2	11
FORT CALHOUN NP	2,111	1,312	154,249	21	13	45.67	118.29	92.38%	1,950	1,212	803,548	499,300	187,863	116,732	1	5
GRAND GULF NP	3,500	2,175	318,717	39	24	56.92	147.42	83.22%	2,912	1,810	2,980,478	1,851,976	423,463	263,127	1	11
HANFORD RPSTRY	1,794	1,115	159,579	23	14	55.60	144.00	72.86%	1,307	812	5,413,867	3,364,009	2,170,670	1,348,787	2	5
HARRIS NP	4,543	2,823	753,338	81	50	103.65	268.45	83.07%	3,773	2,345	2,716,355	1,687,858	313,436	194,759	2	15
HATCH NP	4,187	2,601	584,201	69	43	87.21	225.88	75.97%	3,181	1,976	5,577,339	3,465,585	770,328	478,658	1	13
HOPE CREEK NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	3,020,481	1,876,833	425,444	264,357	2	12
HUMBOLDT BAY NP	1,892	1,176	642,472	114	71	212.20	549.61	71.87%	1,360	845	54,762	34,028	32,169	19,989	2	2
INEL	869	540	96,555	15	10	69.43	179.82	50.10%	435	271	525,116	326,291	200,787	124,763	0	3
KEWAUNEE NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	1,508,490	937,329	190,891	118,614	3	8
LA CROSSE NP	2,862	1,779	276,143	32	20	60.30	156.17	76.35%	2,185	1,358	108,707	67,547	40,071	24,899	2	8
LA SALLE NP	2,945	1,830	185,830	23	14	39.43	102.13	94.15%	2,773	1,723	3,715,692	2,308,816	518,396	322,115	1	9
LIMERICK NP	4,179	2,596	1,299,340	192	119	194.35	503.36	95.65%	3,997	2,483	4,717,127	2,931,076	689,455	428,406	2	10

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Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,710	2,927	1,489,542	207	129	197.67	511.96	84.62%	3,985	2,476	3,376,099	2,097,803	428,588	266,312	4	15
MCGUIRE NP	4,335	2,694	898,347	124	77	129.52	335.46	93.49%	4,053	2,518	6,149,467	3,821,087	654,577	406,734	2	13
MILLSTONE NP	4,571	2,840	1,481,420	211	131	202.58	524.67	93.63%	4,279	2,659	7,924,792	4,924,219	1,585,982	985,480	3	13
MONTICELLO NP	2,763	1,717	283,581	35	22	64.15	166.15	69.35%	1,916	1,191	1,087,924	676,002	262,463	163,087	1	8
MORRIS (G E Repro Plnt, IL)	2,873	1,785	305,117	40	25	66.38	171.91	92.33%	2,653	1,648	1,936,640	1,203,368	255,698	158,883	2	7
NINE MILE POINT NP	4,004	2,488	1,213,478	180	112	189.42	490.60	94.33%	3,777	2,347	4,122,177	2,561,393	592,577	368,209	2	11
NORTH ANNA NP	4,324	2,687	1,210,017	180	112	174.90	453.00	93.24%	4,031	2,505	4,968,655	3,087,368	566,423	351,958	2	14
OCONEE NP	4,068	2,528	644,228	79	49	98.97	256.34	79.71%	3,243	2,015	7,719,106	4,796,412	829,928	515,692	1	14
OYSTER CREEK NP	4,426	2,750	1,417,352	203	126	200.13	518.34	91.27%	4,040	2,510	2,883,683	1,791,831	407,225	253,037	2	11
PALISADES NP	2,860	1,777	442,447	69	43	96.67	250.38	94.37%	2,700	1,677	1,644,049	1,021,561	197,372	122,641	1	7
PALO VERDE NP	1,148	714	139,773	21	13	76.08	197.04	86.62%	995	618	1,937,535	1,203,924	234,247	145,554	1	3
PEACH BOTTOM NP	4,093	2,543	1,211,397	181	112	184.97	479.07	95.16%	3,895	2,420	6,557,749	4,074,781	920,975	572,265	3	10
PERRY NP	3,485	2,166	892,825	138	86	160.10	414.67	92.38%	3,220	2,001	2,108,997	1,310,465	299,742	186,250	2	9
PILGRIM NP	4,508	2,801	1,503,922	220	137	208.50	540.02	94.92%	4,279	2,659	2,280,428	1,416,987	527,449	327,740	2	12
POINT BEACH NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	2,709,614	1,683,670	346,192	215,113	3	8
PRAIRIE ISLAND NP	2,693	1,674	258,967	30	19	60.10	155.65	74.86%	2,016	1,253	2,174,501	1,351,167	285,484	177,391	2	7
QUAD CITIES NP	2,751	1,710	296,731	43	27	67.41	174.58	92.81%	2,553	1,587	3,704,741	2,302,011	863,922	536,814	2	7
RANCHO SECO NP	1,350	839	439,515	79	49	203.44	526.92	97.85%	1,321	821	308,342	191,594	32,406	20,136	1	2
RIVER BEND NP	3,761	2,337	340,294	39	24	56.56	146.48	81.42%	3,062	1,903	1,835,044	1,140,239	259,479	161,232	1	10
ROBINSON NP	4,386	2,725	785,862	90	56	111.98	290.03	80.70%	3,540	2,200	1,511,195	939,009	307,029	190,778	2	14
SALEM NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	4,786,367	2,974,099	518,114	321,940	2	12
SAN ONOFRE NP	761	473	372,627	69	43	305.94	792.40	91.12%	694	431	1,118,358	694,913	133,214	82,775	1	2
SAVANNA RIVER PLANT	4,222	2,623	717,983	88	55	106.29	275.28	76.22%	3,218	2,000	11,756,072	7,304,857	4,703,273	2,922,468	3	14
SEABROOK NP	4,554	2,830	1,443,406	204	127	198.10	513.09	87.52%	3,985	2,476	1,996,985	1,240,864	214,029	132,991	3	14
SEQUOYAH NP	3,673	2,282	443,823	51	32	75.52	195.61	72.05%	2,646	1,644	3,597,087	2,235,118	378,304	235,067	1	13
SOUTH TEXAS NP	3,778	2,348	519,952	66	41	86.02	222.79	78.04%	2,948	1,832	3,054,283	1,897,836	287,124	178,410	0	9
ST LUCIE NP	4,880	3,033	945,707	112	70	121.11	313.68	86.71%	4,232	2,630	5,615,091	3,489,043	717,412	445,778	3	14
SUMMER NP	4,129	2,566	533,917	68	42	80.81	209.30	68.61%	2,833	1,761	2,165,887	1,345,815	243,636	151,388	1	13
SURRY NP	4,438	2,758	972,291	137	85	136.93	354.66	96.37%	4,277	2,658	4,814,684	2,991,694	532,534	330,900	2	12
SUSQUEHANNA NP	4,177	2,595	1,209,566	179	111	180.99	468.77	92.33%	3,857	2,396	6,141,432	3,816,094	881,327	547,629	3	10
THREE MILE ISLAND NP	4,072	2,530	1,211,767	181	113	185.98	481.68	95.38%	3,884	2,413	2,131,197	1,324,260	228,049	141,702	2	10
TROJAN NP	2,027	1,260	209,092	32	20	64.46	166.96	79.32%	1,608	999	727,516	452,056	77,037	47,869	1	4
TURKEY POINT NP	5,083	3,159	1,055,938	139	86	129.83	336.27	78.22%	3,976	2,471	5,138,691	3,193,022	543,895	337,960	2	14
VERMONT YANKEE NP	4,462	2,773	1,371,822	196	122	192.16	497.69	94.46%	4,215	2,619	2,684,337	1,667,964	615,745	382,605	3	13
VOGTLE NP	4,243	2,637	585,290	69	43	86.21	223.29	75.74%	3,214	1,997	4,346,285	2,700,646	924,985	574,757	1	13
WATERFORD NP	3,809	2,367	332,928	39	24	54.63	141.49	84.07%	3,202	1,990	2,272,588	1,412,115	285,664	177,503	0	10
WATTS BAR NP	3,684	2,289	427,631	59	37	72.56	187.92	73.20%	2,696	1,676	1,103,472	685,663	117,877	73,245	1	11
WEST VALLEY	3,762	2,338	1,082,052	166	103	179.74	465.54	94.35%	3,550	2,206	2,505,034	1,556,550	244,562	151,964	3	11
WNP - Washington Nuclear	1,760	1,094	159,473	23	14	56.63	146.66	74.26%	1,307	812	976,318	606,654	142,572	88,590	1	5
WOLF CREEK NP	2,494	1,550	210,769	30	18	52.82	136.81	92.77%	2,314	1,438	1,432,891	890,354	157,112	97,625	0	7
YANKEE ROWE NP	4,267	2,651	1,291,704	187	116	189.22	490.08	93.41%	3,985	2,476	542,876	337,326	191,995	119,300	3	13
ZION NP	2,908	1,807	464,952	69	43	99.92	258.80	93.80%	2,728	1,695	3,999,376	2,485,088	418,789	260,222	1	7
Summary	264,069	164,084	52,477,011	7,406	4,602	122.83	318.14	86.70%	228,943	142,258	234,927,618	145,976,710	37,552,367	23,333,872	137	736

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,887	1,794	233,692	30	19	50.60	131.05	89.35%	2,579	1,603	3,321,386	2,063,806	369,476	229,581	0	9
ARNOLD NP	2,492	1,549	198,924	26	16	49.89	129.20	99.03%	2,468	1,534	1,138,156	707,215	159,503	99,110	2	6
BEAVER VALLEY NP	3,569	2,218	814,037	120	75	142.55	369.21	99.64%	3,556	2,210	3,623,912	2,251,786	378,320	235,076	3	10
BIG ROCK POINT NP	3,578	2,223	640,728	98	61	111.93	289.91	90.15%	3,225	2,004	223,993	139,182	143,103	88,920	4	9
BRAIDWOOD NP	2,881	1,790	411,358	61	38	89.25	231.17	97.55%	2,810	1,746	3,022,761	1,878,249	342,788	212,998	3	7
BROWNS FERRY NP	2,981	1,852	317,337	43	27	66.53	172.32	85.26%	2,542	1,579	4,582,481	2,847,411	626,010	388,983	1	8
BRUNSWICK NP	4,610	2,864	768,081	83	51	104.14	269.72	85.42%	3,938	2,447	4,215,858	2,619,603	954,200	592,910	3	15
BYRON NP	2,726	1,694	242,952	32	20	55.70	144.27	96.32%	2,626	1,632	3,128,702	1,942,836	354,390	220,207	2	7
CALLAWAY NP	2,570	1,597	176,028	22	14	42.81	110.88	89.44%	2,298	1,428	1,645,321	1,022,351	192,748	119,768	1	7
CALVERT CLIFFS NP	4,089	2,541	1,005,347	146	91	153.66	397.99	100.00%	4,089	2,541	4,673,891	2,904,211	592,910	368,416	2	12
CATAWBA NP	4,147	2,577	607,756	77	48	91.59	237.23	73.91%	3,065	1,905	4,949,065	3,075,195	530,833	329,843	1	13
CLINTON NP	2,917	1,813	304,273	45	28	65.19	168.84	90.87%	2,651	1,647	1,321,610	821,207	189,622	117,826	2	7
COMANCHE PEAK NP	2,850	1,771	266,149	31	19	58.37	151.18	65.60%	1,869	1,162	2,617,205	1,626,250	299,233	185,934	1	6
CONN YANKEE NP	4,406	2,738	1,446,145	209	130	205.13	531.28	97.63%	4,302	2,673	2,240,925	1,392,441	480,280	298,431	2	13
COOK NP	2,951	1,834	633,051	99	62	134.06	347.21	97.82%	2,887	1,794	3,984,609	2,475,912	430,902	267,749	2	9
COOPER STATION NP	2,181	1,355	235,478	36	23	67.49	174.80	96.13%	2,096	1,303	998,725	620,576	231,151	143,630	0	5
CRYSTAL RIVER NP	4,574	2,842	662,423	73	45	90.51	234.42	85.02%	3,889	2,417	2,245,136	1,395,058	407,109	252,965	2	14
DAVIS-BESSE NP	3,332	2,070	689,149	108	67	129.27	334.80	97.91%	3,262	2,027	1,695,554	1,053,564	193,256	120,083	2	9
DIABLO CANYON NP	1,608	999	740,144	134	83	287.73	745.21	87.59%	1,408	875	1,914,690	1,189,729	213,830	132,867	2	2
DRESDEN NP DOCK	2,830	1,758	302,295	40	25	66.77	172.94	97.78%	2,767	1,719	4,028,387	2,503,114	1,004,494	624,161	2	7
FARLEY NP	4,062	2,524	533,264	66	41	82.05	212.52	71.81%	2,917	1,812	4,632,364	2,878,407	499,606	310,440	1	13
FERMI NP	3,664	2,277	1,040,835	159	99	177.53	459.80	100.00%	3,664	2,277	1,835,499	1,140,522	282,153	175,321	2	11
FITZPATRICK NP	3,959	2,460	1,210,710	180	112	191.16	495.10	98.30%	3,891	2,418	2,055,302	1,277,101	288,972	179,558	2	11
FORT CALHOUN NP	2,064	1,283	151,444	21	13	45.86	118.77	100.00%	2,064	1,283	785,782	488,260	183,710	114,151	1	5
GRAND GULF NP	3,453	2,146	316,011	39	24	57.20	148.14	87.65%	3,027	1,881	2,940,731	1,827,279	417,816	259,618	1	11
HANFORD RPSTRY	1,747	1,086	156,793	23	14	56.09	145.26	81.35%	1,421	883	5,273,020	3,276,491	2,114,198	1,313,697	2	5
HARRIS NP	4,496	2,794	750,443	81	50	104.32	270.20	86.47%	3,888	2,416	2,688,446	1,670,517	310,216	192,758	2	15
HATCH NP	4,140	2,572	581,562	69	43	87.80	227.40	79.59%	3,295	2,047	5,515,164	3,426,951	761,740	473,322	1	13
HOPE CREEK NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	2,987,015	1,856,038	420,730	261,428	2	12
HUMBOLDT BAY NP	1,321	821	169,747	28	17	80.31	208.02	59.70%	789	490	38,228	23,754	22,456	13,954	2	2
INEL	823	511	93,828	15	10	71.29	184.65	66.84%	550	342	496,920	308,771	190,006	118,064	0	3
KEWAUNEE NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	1,486,730	923,808	188,137	116,903	3	8
LA CROSSE NP	2,816	1,750	273,411	32	20	60.69	157.19	81.67%	2,299	1,429	106,935	66,446	39,418	24,493	2	8
LA SALLE NP	2,899	1,801	183,036	23	14	39.46	102.21	99.61%	2,887	1,794	3,656,816	2,272,232	510,182	317,011	1	9
LIMERICK NP	4,132	2,567	1,296,681	192	119	196.14	508.01	99.49%	4,111	2,554	4,664,440	2,898,338	681,754	423,621	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,663	2,898	1,486,593	207	129	199.25	516.06	87.92%	4,100	2,547	3,342,644	2,077,015	424,341	263,673	4	15
MCGUIRE NP	4,288	2,665	895,665	124	77	130.54	338.10	97.17%	4,167	2,589	6,083,260	3,779,948	647,529	402,355	2	13
MILLSTONE NP	4,524	2,811	1,478,682	211	131	204.29	529.11	97.12%	4,394	2,730	7,843,870	4,873,937	1,569,787	975,417	3	13
MONTICELLO NP	2,716	1,688	280,880	35	22	64.63	167.40	74.75%	2,030	1,262	1,069,546	664,583	258,029	160,332	1	8
MORRIS (G E Repro Plnt, IL)	2,826	1,756	302,427	40	25	66.88	173.21	97.89%	2,767	1,719	1,905,180	1,183,819	251,544	156,302	2	7
NINE MILE POINT NP	3,957	2,459	1,210,513	180	112	191.19	495.18	98.33%	3,891	2,418	4,074,127	2,531,536	585,670	363,917	2	11
NORTH ANNA NP	4,277	2,658	1,207,077	180	112	176.38	456.84	96.93%	4,146	2,576	4,915,024	3,054,043	560,309	348,159	2	14
OCONEE NP	4,022	2,499	641,417	79	49	99.68	258.18	83.47%	3,357	2,086	7,630,553	4,741,388	820,407	509,776	1	14
OYSTER CREEK NP	4,380	2,721	1,414,717	203	126	201.89	522.89	94.86%	4,154	2,581	2,853,277	1,772,938	402,931	250,369	2	11
PALISADES NP	2,814	1,748	439,702	69	43	97.67	252.96	100.00%	2,814	1,748	1,617,224	1,004,893	194,151	120,640	1	7
PALO VERDE NP	2,064	1,283	480,689	88	55	145.56	377.00	92.55%	1,910	1,187	3,482,676	2,164,026	421,054	261,630	1	3
PEACH BOTTOM NP	4,047	2,514	1,208,654	181	112	186.68	483.50	99.09%	4,010	2,491	6,482,977	4,028,320	910,474	565,740	3	10
PERRY NP	3,439	2,137	890,042	138	86	161.77	418.98	96.96%	3,334	2,072	2,080,756	1,292,917	295,728	183,756	2	9
PILGRIM NP	4,461	2,772	1,501,087	220	137	210.29	544.64	98.48%	4,394	2,730	2,256,819	1,402,317	521,988	324,347	2	12
POINT BEACH NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	2,670,528	1,659,383	341,198	212,010	3	8
PRAIRIE ISLAND NP	2,647	1,645	256,152	30	19	60.49	156.67	80.50%	2,130	1,324	2,136,819	1,327,753	280,537	174,317	2	7
QUAD CITIES NP	2,705	1,681	293,879	43	27	67.91	175.89	98.63%	2,668	1,658	3,641,897	2,262,962	849,268	527,708	2	7
RANCHO SECO NP	856	532	100,291	18	11	73.21	189.62	96.62%	827	514	195,516	121,488	20,548	12,768	1	2
RIVER BEND NP	3,714	2,308	337,478	39	24	56.79	147.09	85.52%	3,176	1,974	1,812,270	1,126,088	256,259	159,231	1	10
ROBINSON NP	4,339	2,696	782,947	90	56	112.77	292.06	84.20%	3,654	2,271	1,495,115	929,018	303,762	188,748	2	14
SALEM NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	4,733,335	2,941,147	512,374	318,373	2	12
SAN ONOFRE NP	1,680	1,044	379,923	69	43	141.33	366.04	86.40%	1,452	902	2,468,426	1,533,803	294,028	182,700	1	3
SAVANNA RIVER PLANT	4,175	2,594	715,075	88	55	107.04	277.23	79.81%	3,332	2,071	11,626,116	7,224,107	4,651,282	2,890,162	3	14
SEABROOK NP	4,507	2,801	1,440,457	204	127	199.75	517.34	90.96%	4,100	2,547	1,976,519	1,228,147	211,836	131,628	3	14
SEQUOYAH NP	3,626	2,253	441,058	51	32	76.02	196.89	76.13%	2,761	1,715	3,551,379	2,206,716	373,497	232,080	1	13
SOUTH TEXAS NP	3,731	2,319	517,105	66	41	86.62	224.34	82.08%	3,063	1,903	3,016,552	1,874,391	283,577	176,206	0	9
ST LUCIE NP	4,834	3,004	942,830	112	70	121.91	315.74	89.92%	4,346	2,701	5,561,394	3,455,677	710,551	441,515	3	14
SUMMER NP	4,083	2,537	531,234	68	42	81.32	210.63	72.19%	2,948	1,832	2,141,408	1,330,604	240,883	149,677	1	13
SURRY NP	4,391	2,729	969,607	137	85	138.01	357.44	100.00%	4,391	2,729	4,764,049	2,960,232	526,933	327,420	2	12
SUSQUEHANNA NP	4,130	2,566	1,206,794	179	111	182.62	472.98	96.14%	3,971	2,467	6,072,810	3,773,455	871,480	541,510	3	10
THREE MILE ISLAND NP	4,026	2,501	1,209,136	181	113	187.72	486.21	99.32%	3,998	2,484	2,106,772	1,309,083	225,435	140,078	2	10
TROJAN NP	1,595	991	112,204	13	8	43.98	113.90	53.43%	852	529	572,276	355,594	60,599	37,654	1	4
TURKEY POINT NP	5,036	3,130	1,053,172	139	86	130.69	338.50	81.21%	4,090	2,542	5,091,509	3,163,705	538,901	334,857	2	14
VERMONT YANKEE NP	4,415	2,744	1,368,867	196	122	193.77	501.86	98.05%	4,329	2,690	2,656,260	1,650,517	609,305	378,603	3	13
VOGTLE NP	4,196	2,608	582,390	69	43	86.74	224.66	79.31%	3,328	2,068	4,298,478	2,670,940	914,811	568,435	1	13
WATERFORD NP	3,762	2,338	330,127	39	24	54.84	142.04	88.15%	3,316	2,061	2,244,741	1,394,812	282,163	175,328	0	10
WATTS BAR NP	3,637	2,260	424,744	59	37	72.99	189.05	77.28%	2,811	1,747	1,089,491	676,976	116,383	72,317	1	11
WEST VALLEY	3,716	2,309	1,079,143	166	103	181.51	470.12	98.61%	3,664	2,277	2,473,961	1,537,243	241,529	150,079	3	11
WNP - Washington Nuclear	1,713	1,065	156,777	23	14	57.19	148.11	82.95%	1,421	883	950,430	590,568	138,791	86,241	1	5
WOLF CREEK NP	2,447	1,521	207,960	30	18	53.11	137.56	99.21%	2,428	1,509	1,406,075	873,691	154,172	95,798	0	7
YANKEE ROWE NP	4,220	2,622	1,288,735	187	116	190.87	494.36	97.15%	4,100	2,547	536,937	333,636	189,894	117,995	3	13
ZION NP	2,862	1,778	462,249	69	43	100.96	261.49	99.33%	2,842	1,766	3,935,195	2,445,208	412,068	256,046	1	7
Summary	261,983	162,788	51,858,616	7,320	4,549	116.05	300.57	90.35%	236,706	147,082	235,597,950	146,393,233	37,481,263	23,289,691	137	738

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,200	1,989	285,830	38	24	55.82	144.57	85.37%	2,732	1,698	3,682,487	2,288,183	409,645	254,541	0	9
ARNOLD NP	2,806	1,744	251,106	34	21	55.93	144.86	93.40%	2,621	1,629	1,281,473	796,267	179,588	111,590	2	6
BEAVER VALLEY NP	3,883	2,413	865,557	128	80	139.32	360.85	95.52%	3,709	2,305	3,942,559	2,449,783	411,585	255,746	3	10
BIG ROCK POINT NP	3,891	2,418	692,765	107	66	111.27	288.18	86.81%	3,378	2,099	243,641	151,391	155,656	96,720	4	9
BRAIDWOOD NP	3,194	1,985	462,888	69	43	90.57	234.57	92.76%	2,963	1,841	3,352,074	2,082,875	380,133	236,203	3	7
BROWNS FERRY NP	3,295	2,047	368,804	51	32	69.96	181.19	81.78%	2,695	1,674	5,064,900	3,147,171	691,913	429,933	1	8
BRUNSWICK NP	4,923	3,059	819,551	91	56	.104.04	269.45	83.08%	4,090	2,542	4,502,871	2,797,944	1,019,161	633,275	3	15
BYRON NP	3,040	1,889	294,996	40	25	60.65	157.09	91.41%	2,779	1,727	3,486,645	2,166,493	395,187	245,557	2	7
CALLAWAY NP	2,884	1,792	227,568	30	19	49.32	127.74	85.00%	2,451	1,523	1,846,234	1,147,192	216,285	134,393	1	7
CALVERT CLIFFS NP	4,403	2,736	1,057,327	154	96	150.09	388.74	96.34%	4,242	2,636	5,032,601	3,127,101	638,415	396,691	2	12
CATAWBA NP	4,461	2,772	659,891	85	53	92.45	239.46	72.13%	3,218	2,000	5,323,573	3,307,902	571,003	354,803	1	13
CLINTON NP	3,231	2,008	355,897	53	33	68.84	178.30	86.78%	2,804	1,742	1,463,782	909,548	210,021	130,501	2	7
COMANCHE PEAK NP	2,487	1,546	99,263	7	4	24.94	64.60	94.11%	2,341	1,455	2,284,216	1,419,341	261,161	162,278	1	5
CONN YANKEE NP	4,720	2,933	1,498,253	217	135	198.39	513.83	94.37%	4,455	2,768	2,400,529	1,491,614	514,487	319,686	2	13
COOK NP	3,265	2,029	685,125	107	67	131.14	339.66	93.10%	3,040	1,889	4,408,295	2,739,177	476,721	296,219	2	9
COOPER STATION NP	2,494	1,550	287,119	44	28	71.94	186.32	90.16%	2,249	1,398	1,142,453	709,885	264,416	164,300	0	5
CRYSTAL RIVER NP	4,888	3,037	714,423	81	50	91.35	236.59	82.69%	4,042	2,512	2,399,167	1,490,768	435,039	270,320	2	14
DAVIS-BESSE NP	3,646	2,265	740,692	116	72	126.98	328.87	93.68%	3,415	2,122	1,855,249	1,152,794	211,458	131,393	2	9
DIABLO CANYON NP	591	368	671,091	128	80	709.18	1,836.77	82.86%	490	305	704,353	437,663	78,661	48,878	2	2
DRESDEN NP DOCK	3,143	1,953	353,814	48	30	70.35	182.20	92.88%	2,920	1,814	4,475,171	2,780,732	1,115,901	693,386	2	7
FARLEY NP	4,376	2,719	584,953	74	46	83.55	216.40	70.15%	3,070	1,907	4,990,267	3,100,797	538,206	334,425	1	13
FERMI NP	3,978	2,472	1,092,202	167	104	171.59	444.43	95.95%	3,817	2,372	1,992,696	1,238,199	306,318	190,336	2	11
FITZPATRICK NP	4,272	2,655	1,262,890	188	117	184.75	478.50	94.66%	4,044	2,513	2,218,242	1,378,347	311,881	193,793	2	11
FORT CALHOUN NP	2,378	1,478	203,110	29	18	53.38	138.26	93.23%	2,217	1,378	905,248	562,493	211,640	131,506	1	5
GRAND GULF NP	3,767	2,341	367,684	47	29	61.01	158.01	84.41%	3,179	1,976	3,207,996	1,993,349	455,788	283,213	1	11
HANFORD RPSTRY	2,061	1,281	208,404	31	19	63.20	163.68	76.38%	1,574	978	6,220,095	3,864,973	2,493,924	1,549,647	2	5
HARRIS NP	4,810	2,989	802,488	89	55	104.28	270.09	84.01%	4,041	2,511	2,876,106	1,787,123	331,870	206,213	2	15
HATCH NP	4,454	2,767	633,074	77	48	88.84	230.10	77.42%	3,448	2,142	5,933,239	3,686,730	819,484	509,202	1	13
HOPE CREEK NP	4,479	2,783	1,297,588	194	121	181.05	468.91	95.65%	4,285	2,662	3,212,045	1,995,865	452,426	281,123	2	12
HUMBOLDT BAY NP	1,625	1,010	593,798	106	66	228.37	591.47	67.24%	1,093	679	47,031	29,224	27,627	17,167	2	2
INEL	1,136	706	145,381	23	15	79.96	207.10	61.83%	703	437	686,510	426,576	262,500	163,109	0	3
KEWAUNEE NP	3,503	2,176	695,145	103	64	124.04	321.27	87.81%	3,076	1,911	1,633,047	1,014,725	206,653	128,408	3	8
LA CROSSE NP	3,129	1,945	325,011	40	25	64.91	168.12	78.36%	2,452	1,524	118,854	73,852	43,811	27,223	2	8
LA SALLE NP	3,213	1,996	234,728	31	19	45.67	118.27	94.64%	3,040	1,889	4,052,707	2,518,226	565,415	351,331	1	9
LIMERICK NP	4,446	2,762	1,348,757	200	125	189.62	491.11	95.91%	4,264	2,649	5,018,715	3,118,473	733,535	455,796	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,977	3,093	1,538,081	215	134	193.15	500.26	85.45%	4,253	2,642	3,567,602	2,216,797	452,899	281,418	4	15
MCGUIRE NP	4,602	2,860	947,711	132	82	128.71	333.35	93.87%	4,320	2,684	6,528,443	4,056,571	694,917	431,800	2	13
MILLSTONE NP	4,838	3,006	1,530,157	219	136	197.69	512.01	93.98%	4,546	2,825	8,388,002	5,212,043	1,678,684	1,043,082	3	13
MONTICELLO NP	3,030	1,883	332,357	43	27	68.56	177.56	72.06%	2,183	1,357	1,193,123	741,370	287,843	178,857	1	8
MORRIS (G E Repro Plnt, IL)	3,140	1,951	353,790	48	30	70.42	182.38	92.98%	2,920	1,814	2,116,722	1,315,265	279,475	173,657	2	7
NINE MILE POINT NP	4,271	2,654	1,262,740	188	117	184.78	478.59	94.69%	4,044	2,513	4,397,221	2,732,296	632,116	392,777	2	11
NORTH ANNA NP	4,591	2,853	1,258,575	188	117	171.34	443.77	93.63%	4,299	2,671	5,275,647	3,278,123	601,420	373,704	2	14
OCONEE NP	4,335	2,694	693,021	87	54	99.91	258.76	80.96%	3,510	2,181	8,225,998	5,111,379	884,427	549,556	1	14
OYSTER CREEK NP	4,694	2,916	1,466,860	211	131	195.33	505.91	91.77%	4,307	2,676	3,057,727	1,899,976	431,803	268,309	2	11
PALISADES NP	3,128	1,943	491,180	77	48	98.15	254.22	94.85%	2,967	1,843	1,797,594	1,116,969	215,805	134,095	1	7
PALO VERDE NP	881	548	91,110	13	8	64.63	167.38	82.56%	727	452	1,486,756	923,824	179,748	111,690	1	3
PEACH BOTTOM NP	4,360	2,709	1,260,082	189	117	180.62	467.80	95.46%	4,162	2,586	6,985,753	4,340,730	981,084	609,615	3	10
PERRY NP	3,753	2,332	942,247	147	91	156.94	406.46	92.92%	3,487	2,167	2,270,651	1,410,912	322,717	200,526	2	9
PILGRIM NP	4,775	2,967	1,552,570	228	142	203.20	526.30	95.21%	4,546	2,825	2,415,567	1,500,958	558,706	347,162	2	12
POINT BEACH NP	3,503	2,176	695,145	103	64	124.04	321.27	87.81%	3,076	1,911	2,933,349	1,822,691	374,777	232,875	3	8
PRAIRIE ISLAND NP	2,960	1,840	308,303	38	24	65.09	168.58	77.13%	2,283	1,419	2,390,197	1,485,194	313,802	194,987	2	7
QUAD CITIES NP	3,018	1,876	345,382	51	32	71.51	185.22	93.44%	2,821	1,753	4,064,466	2,525,533	947,808	588,938	2	7
RANCHO SECO NP	1,083	673	390,137	71	44	225.13	583.09	97.33%	1,054	655	247,335	153,686	25,994	16,152	1	2
RIVER BEND NP	4,028	2,503	389,491	47	29	60.44	156.54	82.65%	3,329	2,069	1,965,407	1,221,243	277,913	172,686	1	10
ROBINSON NP	4,653	2,891	835,214	98	61	112.18	290.55	81.81%	3,807	2,366	1,603,239	996,203	325,729	202,398	2	14
SALEM NP	4,479	2,783	1,297,588	194	121	181.05	468.91	95.65%	4,285	2,662	5,089,926	3,162,722	550,974	342,358	2	12
SAN ONOFRE NP	494	307	323,860	61	38	409.68	1,061.08	86.32%	426	265	725,869	451,032	86,462	53,725	1	2
SAVANNA RIVER PLANT	4,489	2,789	767,356	96	60	106.84	276.70	77.63%	3,485	2,166	12,499,957	7,767,084	5,000,881	3,107,392	3	14
SEABROOK NP	4,821	2,996	1,492,041	212	132	193.43	500.99	88.21%	4,253	2,642	2,114,139	1,313,660	226,586	140,793	3	14
SEQUOYAH NP	3,940	2,448	492,418	59	37	78.11	202.31	73.95%	2,914	1,810	3,858,728	2,397,694	405,821	252,165	1	13
SOUTH TEXAS NP	2,987	1,856	191,923	17	11	40.15	103.99	93.24%	2,785	1,731	2,415,193	1,500,726	227,045	141,079	1	5
ST LUCIE NP	5,148	3,199	994,756	121	75	120.78	312.82	87.40%	4,499	2,796	5,922,463	3,680,034	756,683	470,180	3	14
SUMMER NP	4,397	2,732	583,259	76	47	82.91	214.75	70.52%	3,100	1,927	2,306,008	1,432,882	259,398	161,182	1	13
SURRY NP	4,705	2,924	1,021,746	145	90	135.73	351.54	96.58%	4,544	2,824	5,104,525	3,171,793	564,592	350,820	2	12
SUSQUEHANNA NP	4,444	2,761	1,258,996	187	116	177.06	458.59	92.79%	4,124	2,562	6,534,233	4,060,169	937,696	582,655	3	10
THREE MILE ISLAND NP	4,339	2,696	1,261,162	189	118	181.64	470.45	95.66%	4,151	2,579	2,271,008	1,411,134	243,009	150,998	2	10
TROJAN NP	2,294	1,426	257,731	40	25	70.21	181.83	81.73%	1,875	1,165	823,386	511,627	87,189	54,177	1	4
TURKEY POINT NP	5,350	3,325	1,105,451	147	92	129.13	334.46	79.31%	4,243	2,637	5,408,763	3,360,837	572,480	355,722	2	14
VERMONT YANKEE NP	4,729	2,939	1,421,120	204	127	187.82	486.45	94.78%	4,482	2,785	2,845,059	1,767,831	652,612	405,513	3	13
VOGTLE NP	4,510	2,803	634,113	77	48	87.87	227.59	77.18%	3,481	2,163	4,619,937	2,870,685	983,224	610,945	1	13
WATERFORD NP	4,076	2,533	381,582	47	29	58.51	151.54	85.11%	3,469	2,156	2,431,987	1,511,161	305,700	189,953	0	10
WATTS BAR NP	3,951	2,455	476,403	67	42	75.37	195.20	75.01%	2,964	1,842	1,183,500	735,390	126,425	78,557	1	11
WEST VALLEY	4,030	2,504	1,130,747	174	108	175.38	454.23	94.73%	3,817	2,372	2,682,902	1,667,072	261,927	162,754	3	11
WNP - Washington Nuclear	2,027	1,260	208,326	31	19	64.23	166.34	77.65%	1,574	978	1,124,502	698,730	164,211	102,036	1	5
WOLF CREEK NP	2,761	1,716	260,041	38	24	58.86	152.46	93.47%	2,581	1,604	1,586,388	985,732	173,943	108,083	0	7
YANKEE ROWE NP	4,534	2,817	1,340,954	195	121	184.86	478.79	93.80%	4,253	2,642	576,868	358,448	204,016	126,770	3	13
ZION NP	3,175	1,973	513,596	77	48	101.09	261.82	94.32%	2,995	1,861	4,366,758	2,713,368	457,259	284,126	1	7
Summary	280,376	174,217	55,286,495	7,877	4,895	126.87	328.60	87.70%	245,878	152,781	249,407,969	154,974,349	40,113,317	24,925,167	138	732

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,121	1,940	238,384	30	19	47.73	123.62	85.00%	2,653	1,649	3,591,749	2,231,801	399,551	248,269	0	9
ARNOLD NP	2,727	1,695	203,713	26	16	46.69	120.92	93.21%	2,542	1,580	1,245,460	773,890	174,541	108,454	2	6
BEAVER VALLEY NP	3,804	2,364	818,834	120	75	134.53	348.45	95.43%	3,630	2,256	3,862,488	2,400,030	403,226	250,552	3	10
BIG ROCK POINT NP	3,813	2,369	645,418	98	61	105.80	274.04	86.53%	3,299	2,050	238,704	148,323	152,502	94,760	4	9
BRAIDWOOD NP	3,116	1,936	416,027	61	38	83.46	216.16	92.57%	2,884	1,792	3,269,324	2,031,456	370,749	230,372	3	7
BROWNS FERRY NP	3,216	1,998	322,220	43	27	62.62	162.19	81.33%	2,616	1,625	4,943,677	3,071,847	675,352	419,643	1	8
BRUNSWICK NP	4,845	3,010	772,691	83	51	99.68	258.18	82.81%	4,012	2,493	4,430,750	2,753,130	1,002,838	623,132	3	15
BYRON NP	2,961	1,840	247,557	32	20	52.25	135.34	91.18%	2,700	1,678	3,396,198	2,110,292	384,936	239,187	2	7
CALLAWAY NP	2,805	1,743	180,748	22	14	40.27	104.31	84.58%	2,373	1,474	1,795,748	1,115,822	210,370	130,718	1	7
CALVERT CLIFFS NP	4,324	2,687	1,010,069	146	91	146.00	378.13	96.28%	4,163	2,587	4,942,464	3,071,093	626,980	389,586	2	12
CATAWBA NP	4,382	2,723	612,437	77	48	87.35	226.24	71.63%	3,139	1,951	5,229,466	3,249,427	560,909	348,531	1	13
CLINTON NP	3,152	1,959	309,020	45	28	61.27	158.69	86.45%	2,725	1,693	1,428,056	887,350	204,895	127,316	2	7
COMANCHE PEAK NP	2,566	1,595	146,106	15	9	35.59	92.17	94.29%	2,420	1,504	2,356,637	1,464,341	269,441	167,423	1	5
CONN YANKEE NP	4,641	2,884	1,450,963	209	130	195.39	506.07	94.28%	4,376	2,719	2,360,424	1,466,694	505,891	314,345	2	13
COOK NP	3,186	1,980	637,757	99	62	125.10	324.00	92.93%	2,961	1,840	4,301,830	2,673,023	465,207	289,065	2	9
COOPER STATION NP	2,416	1,501	240,211	36	23	62.15	160.97	89.84%	2,170	1,349	1,106,336	687,443	256,057	159,106	0	5
CRYSTAL RIVER NP	4,809	2,988	667,021	73	45	86.69	224.52	82.41%	3,963	2,463	2,360,462	1,466,717	428,021	265,959	2	14
DAVIS-BESSE NP	3,567	2,216	693,956	108	67	121.59	314.93	93.54%	3,337	2,073	1,815,121	1,127,859	206,884	128,551	2	9
DIABLO CANYON NP	670	417	718,569	136	85	670.01	1,735.34	84.87%	569	354	798,267	496,018	89,149	55,395	2	2
DRESDEN NP DOCK	3,065	1,904	307,114	40	25	62.63	162.22	92.70%	2,841	1,765	4,362,902	2,710,971	1,087,906	675,991	2	7
FARLEY NP	4,297	2,670	538,172	66	41	78.28	202.75	69.61%	2,991	1,858	4,900,333	3,044,914	528,507	328,398	1	13
FERMI NP	3,899	2,423	1,045,440	159	99	167.57	434.00	95.87%	3,738	2,323	1,953,195	1,213,655	300,246	186,563	2	11
FITZPATRICK NP	4,193	2,606	1,215,458	180	112	181.15	469.19	94.56%	3,965	2,464	2,177,298	1,352,905	306,124	190,216	2	11
FORT CALHOUN NP	2,299	1,429	156,203	21	13	42.46	109.98	93.00%	2,138	1,329	875,228	543,839	204,621	127,145	1	5
GRAND GULF NP	3,688	2,292	320,725	39	24	54.35	140.77	84.07%	3,101	1,927	3,140,837	1,951,618	446,246	277,284	1	11
HANFORD RPSTRY	1,982	1,232	161,468	23	14	50.91	131.86	75.44%	1,495	929	5,982,112	3,717,098	2,398,506	1,490,357	2	5
HARRIS NP	4,731	2,940	755,128	81	50	99.76	258.38	83.74%	3,962	2,462	2,828,951	1,757,822	326,428	202,832	2	15
HATCH NP	4,375	2,718	586,233	69	43	83.75	216.91	77.01%	3,369	2,093	5,828,185	3,621,452	804,974	500,186	1	13
HOPE CREEK NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	3,155,499	1,960,729	444,461	276,174	2	12
HUMBOLDT BAY NP	1,704	1,059	640,490	114	71	234.92	608.46	68.76%	1,172	728	49,313	30,642	28,968	18,000	2	2
INEL	1,058	657	98,508	15	10	58.22	150.79	58.99%	624	388	638,870	396,974	244,283	151,790	0	3
KEWAUNEE NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	1,596,280	991,879	202,000	125,517	3	8
LA CROSSE NP	3,051	1,896	278,145	32	20	56.99	147.60	77.81%	2,373	1,475	115,859	71,991	42,707	26,537	2	8
LA SALLE NP	3,134	1,947	187,868	23	14	37.47	97.04	94.50%	2,962	1,840	3,953,227	2,456,412	551,536	342,707	1	9
LIMERICK NP	4,367	2,713	1,301,267	192	119	186.24	482.37	95.84%	4,185	2,600	4,929,692	3,063,157	720,524	447,711	2	10

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Not Favoring Originating RR with Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,898	3,044	1,491,573	207	129	190.33	492.95	85.21%	4,174	2,593	3,511,074	2,181,672	445,723	276,959	4	15
MCGUIRE NP	4,523	2,811	900,396	124	77	124.41	322.23	93.76%	4,241	2,635	6,416,577	3,987,061	683,009	424,401	2	13
MILLSTONE NP	4,759	2,957	1,483,402	211	131	194.82	504.59	93.88%	4,468	2,776	8,251,271	5,127,083	1,651,320	1,026,079	3	13
MONTICELLO NP	2,951	1,834	285,648	35	22	60.50	156.69	71.31%	2,104	1,308	1,162,070	722,074	280,351	174,202	1	8
MORRIS (G E Repro Plnt, IL)	3,061	1,902	307,090	40	25	62.70	162.38	92.80%	2,841	1,765	2,063,565	1,282,235	272,456	169,296	2	7
NINE MILE POINT NP	4,192	2,605	1,215,261	180	112	181.18	469.26	94.59%	3,965	2,464	4,316,033	2,681,849	620,445	385,525	2	11
NORTH ANNA NP	4,512	2,804	1,211,851	180	112	167.86	434.76	93.52%	4,220	2,622	5,185,029	3,221,816	591,090	367,285	2	14
OCONEE NP	4,257	2,645	646,199	79	49	94.88	245.75	80.60%	3,431	2,132	8,076,373	5,018,407	868,340	539,560	1	14
OYSTER CREEK NP	4,615	2,867	1,419,337	203	126	192.23	497.88	91.63%	4,228	2,627	3,006,352	1,868,054	424,548	263,801	2	11
PALISADES NP	3,049	1,894	444,350	69	43	91.09	235.93	94.72%	2,888	1,794	1,752,271	1,088,806	210,364	130,714	1	7
PALO VERDE NP	960	597	137,795	21	13	89.71	232.36	83.99%	806	501	1,619,818	1,006,504	195,835	121,686	1	3
PEACH BOTTOM NP	4,282	2,660	1,213,328	181	112	177.12	458.73	95.38%	4,084	2,537	6,859,415	4,262,227	963,341	598,590	3	10
PERRY NP	3,674	2,283	894,825	138	86	152.24	394.29	92.77%	3,408	2,118	2,222,934	1,381,262	315,935	196,312	2	9
PILGRIM NP	4,696	2,918	1,505,940	220	137	200.41	519.07	95.13%	4,468	2,776	2,375,677	1,476,171	549,479	341,429	2	12
POINT BEACH NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	2,867,306	1,781,655	366,339	227,632	3	8
PRAIRIE ISLAND NP	2,882	1,791	261,028	30	19	56.62	146.64	76.50%	2,204	1,370	2,326,528	1,445,632	305,443	189,793	2	7
QUAD CITIES NP	2,940	1,827	298,782	43	27	63.52	164.53	93.27%	2,742	1,704	3,958,282	2,459,553	923,047	573,552	2	7
RANCHO SECO NP	1,162	722	437,574	79	49	235.37	609.60	97.51%	1,133	704	265,343	164,876	27,887	17,328	1	2
RIVER BEND NP	3,949	2,454	342,083	39	24	54.14	140.23	82.31%	3,250	2,020	1,926,926	1,197,332	272,471	169,305	1	10
ROBINSON NP	4,574	2,842	787,866	90	56	107.65	278.80	81.50%	3,728	2,317	1,576,069	979,320	320,209	198,968	2	14
SALEM NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	5,000,321	3,107,044	541,275	336,331	2	12
SAN ONOFRE NP	573	356	370,669	69	43	404.36	1,047.29	88.20%	505	314	841,724	523,021	100,263	62,300	1	2
SAVANNA RIVER PLANT	4,410	2,740	719,975	88	55	102.03	264.26	77.23%	3,406	2,117	12,280,377	7,630,644	4,913,033	3,052,806	3	14
SEABROOK NP	4,742	2,947	1,445,184	204	127	190.47	493.32	88.01%	4,174	2,593	2,079,558	1,292,172	222,879	138,490	3	14
SEQUOYAH NP	3,861	2,399	445,638	51	32	72.13	186.83	73.42%	2,835	1,761	3,781,497	2,349,705	397,699	247,118	1	13
SOUTH TEXAS NP	3,066	1,905	238,846	25	16	48.68	126.09	93.41%	2,864	1,780	2,478,946	1,540,340	233,038	144,803	1	5
ST LUCIE NP	5,069	3,150	947,449	112	70	116.83	302.58	87.21%	4,420	2,747	5,831,733	3,623,657	745,091	462,977	3	14
SUMMER NP	4,318	2,683	535,845	68	42	77.56	200.89	69.98%	3,022	1,878	2,264,647	1,407,181	254,746	158,291	1	13
SURRY NP	4,626	2,875	974,341	137	85	131.64	340.94	96.52%	4,465	2,775	5,018,969	3,118,631	555,129	344,940	2	12
SUSQUEHANNA NP	4,365	2,712	1,211,597	179	111	173.47	449.30	92.66%	4,045	2,513	6,418,286	3,988,123	921,057	572,316	3	10
THREE MILE ISLAND NP	4,261	2,647	1,213,718	181	113	178.04	461.14	95.58%	4,072	2,530	2,229,739	1,385,490	238,593	148,254	2	10
TROJAN NP	2,216	1,377	211,007	32	20	59.52	154.17	81.08%	1,796	1,116	795,087	494,043	84,193	52,316	1	4
TURKEY POINT NP	5,271	3,276	1,057,990	139	86	125.44	324.89	79.00%	4,164	2,588	5,329,043	3,311,301	564,043	350,479	2	14
VERMONT YANKEE NP	4,650	2,890	1,373,676	196	122	184.63	478.18	94.69%	4,403	2,736	2,797,617	1,738,352	641,730	398,751	3	13
VOGTLE NP	4,431	2,754	587,374	69	43	82.84	214.57	76.78%	3,402	2,114	4,539,160	2,820,493	966,033	600,263	1	13
WATERFORD NP	3,997	2,484	334,934	39	24	52.37	135.64	84.82%	3,390	2,107	2,384,935	1,481,924	299,786	186,278	0	10
WATTS BAR NP	3,872	2,406	429,573	59	37	69.34	179.59	74.50%	2,885	1,793	1,159,877	720,711	123,902	76,989	1	11
WEST VALLEY	3,951	2,455	1,084,059	166	103	171.49	444.17	94.62%	3,738	2,323	2,630,399	1,634,448	256,802	159,569	3	11
WNP - Washington Nuclear	1,948	1,211	161,501	23	14	51.80	134.17	76.75%	1,495	929	1,080,761	671,551	157,824	98,067	1	5
WOLF CREEK NP	2,682	1,667	212,671	30	18	49.56	128.35	93.28%	2,502	1,555	1,541,079	957,578	168,975	104,996	0	7
YANKEE ROWE NP	4,455	2,768	1,293,656	187	116	181.50	470.08	93.69%	4,174	2,593	566,834	352,213	200,468	124,565	3	13
ZION NP	3,097	1,924	467,032	69	43	94.26	244.15	94.18%	2,916	1,812	4,258,314	2,645,984	445,903	277,070	1	7
Summary	275,408	171,130	52,320,907	7,365	4,577	121.63	315.01	87.47%	240,910	149,694	245,008,754	152,240,814	39,345,633	24,448,152	138	732

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,933	1,823	236,519	30	19	50.40	130.53	84.03%	2,465	1,532	3,375,088	2,097,175	375,450	233,293	0	9
ARNOLD NP	2,539	1,578	201,751	26	16	49.66	128.63	92.71%	2,354	1,463	1,159,470	720,458	162,490	100,966	2	6
BEAVER VALLEY NP	3,616	2,247	816,949	120	75	141.21	365.75	95.19%	3,442	2,139	3,671,300	2,281,232	383,267	238,150	3	10
BIG ROCK POINT NP	3,624	2,252	643,485	98	61	110.97	287.41	85.83%	3,111	1,933	226,915	140,998	144,970	90,080	4	9
BRAIDWOOD NP	2,927	1,819	414,211	61	38	88.44	229.06	92.09%	2,696	1,675	3,071,736	1,908,681	348,342	216,449	3	7
BROWNS FERRY NP	3,028	1,881	320,180	43	27	66.09	171.19	80.17%	2,427	1,508	4,654,225	2,891,991	635,811	395,073	1	8
BRUNSWICK NP	4,656	2,893	770,725	83	51	103.45	267.94	82.11%	3,823	2,376	4,258,542	2,646,125	963,861	598,913	3	15
BYRON NP	2,773	1,723	245,697	32	20	55.38	143.44	90.58%	2,512	1,561	3,180,232	1,976,097	360,457	223,977	2	7
CALLAWAY NP	2,617	1,626	178,729	22	14	42.69	110.57	83.47%	2,184	1,357	1,675,200	1,040,917	196,248	121,943	1	7
CALVERT CLIFFS NP	4,136	2,570	1,008,084	146	91	152.34	394.57	96.11%	3,975	2,470	4,727,238	2,937,358	599,678	372,621	2	12
CATAWBA NP	4,194	2,606	610,617	77	48	91.00	235.69	70.36%	2,951	1,834	5,004,761	3,109,803	536,807	333,555	1	13
CLINTON NP	2,964	1,842	307,100	45	28	64.76	167.72	85.58%	2,537	1,576	1,342,754	834,345	192,656	119,711	2	7
COMANCHE PEAK NP	2,897	1,800	268,895	31	19	58.02	150.28	60.60%	1,755	1,091	2,660,066	1,652,882	304,133	188,979	1	6
CONN YANKEE NP	4,453	2,767	1,449,099	209	130	203.39	526.79	94.04%	4,187	2,602	2,264,661	1,407,190	485,367	301,592	2	13
COOK NP	2,998	1,863	635,645	99	62	132.51	343.21	92.48%	2,773	1,723	4,047,618	2,515,064	437,716	271,983	2	9
COOPER STATION NP	2,227	1,384	238,193	36	23	66.84	173.11	88.98%	1,982	1,232	1,020,100	633,858	236,098	146,704	0	5
CRYSTAL RIVER NP	4,621	2,871	665,273	73	45	89.98	233.05	81.69%	3,775	2,346	2,268,043	1,409,291	411,262	255,546	2	14
DAVIS-BESSE NP	3,379	2,099	691,956	108	67	128.00	331.52	93.18%	3,148	1,956	1,719,303	1,068,322	195,963	121,765	2	9
DIABLO CANYON NP	2,442	1,517	911,219	163	101	233.21	604.02	85.24%	2,082	1,293	2,908,260	1,807,102	324,790	201,814	2	3
DRESDEN NP DOCK	2,876	1,787	305,142	40	25	66.31	171.74	92.22%	2,653	1,648	4,094,832	2,544,401	1,021,062	634,456	2	7
FARLEY NP	4,109	2,553	536,137	66	41	81.56	211.24	68.21%	2,803	1,741	4,685,591	2,911,480	505,347	314,007	1	13
FERMI NP	3,711	2,306	1,043,476	159	99	175.74	455.17	95.66%	3,550	2,206	1,858,877	1,155,048	285,747	177,554	2	11
FITZPATRICK NP	4,005	2,489	1,213,632	180	112	189.38	490.51	94.30%	3,777	2,347	2,079,534	1,292,158	292,379	181,675	2	11
FORT CALHOUN NP	2,111	1,312	154,249	21	13	45.67	118.29	92.38%	1,950	1,212	803,548	499,300	187,863	116,732	1	5
GRAND GULF NP	3,500	2,175	318,717	39	24	56.92	147.42	83.22%	2,912	1,810	2,980,478	1,851,976	423,463	263,127	1	11
HANFORD RPSTRY	1,794	1,115	159,579	23	14	55.60	144.00	72.86%	1,307	812	5,413,867	3,364,009	2,170,670	1,348,787	2	5
HARRIS NP	4,543	2,823	753,338	81	50	103.65	268.45	83.07%	3,773	2,345	2,716,355	1,687,858	313,436	194,759	2	15
HATCH NP	4,187	2,601	584,201	69	43	87.21	225.88	75.97%	3,181	1,976	5,577,339	3,465,585	770,328	478,658	1	13
HOPE CREEK NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	3,020,481	1,876,833	425,444	264,357	2	12
HUMBOLDT BAY NP	2,155	1,339	340,709	57	35	98.80	255.90	67.83%	1,462	908	62,373	38,756	36,639	22,766	2	3
INEL	869	540	96,555	15	10	69.43	179.82	50.10%	435	271	525,116	326,291	200,787	124,763	0	3
KEWAUNEE NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	1,508,490	937,329	190,891	118,614	3	8
LA CROSSE NP	2,862	1,779	276,143	32	20	60.30	156.17	76.35%	2,185	1,358	108,707	67,547	40,071	24,899	2	8
LA SALLE NP	2,945	1,830	185,830	23	14	39.43	102.13	94.15%	2,773	1,723	3,715,692	2,308,816	518,396	322,115	1	9
LIMERICK NP	4,179	2,596	1,299,340	192	119	194.35	503.36	95.65%	3,997	2,483	4,717,127	2,931,076	689,455	428,406	2	10

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Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CALIENTE	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,710	2,927	1,489,542	207	129	197.67	511.96	84.62%	3,985	2,476	3,376,099	2,097,803	428,588	266,312	4	15
MCGUIRE NP	4,335	2,694	898,347	124	77	129.52	335.46	93.49%	4,053	2,518	6,149,467	3,821,087	654,577	406,734	2	13
MILLSTONE NP	4,571	2,840	1,481,420	211	131	202.58	524.67	93.63%	4,279	2,659	7,924,792	4,924,219	1,585,982	985,480	3	13
MONTICELLO NP	2,763	1,717	283,581	35	22	64.15	166.15	69.35%	1,916	1,191	1,087,924	676,002	262,463	163,087	1	8
MORRIS (G E Repro Plnt, IL)	2,873	1,785	305,117	40	25	66.38	171.91	92.33%	2,653	1,648	1,936,640	1,203,368	255,698	158,883	2	7
NINE MILE POINT NP	4,004	2,488	1,213,478	180	112	189.42	490.60	94.33%	3,777	2,347	4,122,177	2,561,393	592,577	368,209	2	11
NORTH ANNA NP	4,324	2,687	1,210,017	180	112	174.90	453.00	93.24%	4,031	2,505	4,968,655	3,087,368	566,423	351,958	2	14
OCONEE NP	4,068	2,528	644,228	79	49	98.97	256.34	79.71%	3,243	2,015	7,719,106	4,796,412	829,928	515,692	1	14
OYSTER CREEK NP	4,426	2,750	1,417,352	203	126	200.13	518.34	91.27%	4,040	2,510	2,883,683	1,791,831	407,225	253,037	2	11
PALISADES NP	2,860	1,777	442,447	69	43	96.67	250.38	94.37%	2,700	1,677	1,644,049	1,021,561	197,372	122,641	1	7
PALO VERDE NP	2,898	1,801	651,767	117	73	140.55	364.03	89.14%	2,584	1,605	4,890,410	3,038,749	591,249	367,384	1	4
PEACH BOTTOM NP	4,093	2,543	1,211,397	181	112	184.97	479.07	95.16%	3,895	2,420	6,557,749	4,074,781	920,975	572,265	3	10
PERRY NP	3,485	2,166	892,825	138	86	160.10	414.67	92.38%	3,220	2,001	2,108,997	1,310,465	299,742	186,250	2	9
PILGRIM NP	4,508	2,801	1,503,922	220	137	208.50	540.02	94.92%	4,279	2,659	2,280,428	1,416,987	527,449	327,740	2	12
POINT BEACH NP	3,235	2,010	645,754	95	59	124.74	323.08	86.81%	2,809	1,745	2,709,614	1,683,670	346,192	215,113	3	8
PRAIRIE ISLAND NP	2,693	1,674	258,967	30	19	60.10	155.65	74.86%	2,016	1,253	2,174,501	1,351,167	285,484	177,391	2	7
QUAD CITIES NP	2,751	1,710	296,731	43	27	67.41	174.58	92.81%	2,553	1,587	3,704,741	2,302,011	863,922	536,814	2	7
RANCHO SECO NP	1,690	1,050	271,290	46	29	100.30	259.78	88.77%	1,501	932	386,034	239,869	40,571	25,210	1	3
RIVER BEND NP	3,761	2,337	340,294	39	24	56.56	146.48	81.42%	3,062	1,903	1,835,044	1,140,239	259,479	161,232	1	10
ROBINSON NP	4,386	2,725	785,862	90	56	111.98	290.03	80.70%	3,540	2,200	1,511,195	939,009	307,029	190,778	2	14
SALEM NP	4,212	2,617	1,248,234	186	115	185.21	479.69	95.38%	4,018	2,496	4,786,367	2,974,099	518,114	321,940	2	12
SAN ONOFRE NP	2,665	1,656	626,531	110	68	146.92	380.53	89.73%	2,391	1,486	3,915,671	2,433,076	466,418	289,818	2	3
SAVANNA RIVER PLANT	4,222	2,623	717,983	88	55	106.29	275.28	76.22%	3,218	2,000	11,756,072	7,304,857	4,703,273	2,922,468	3	14
SEABROOK NP	4,554	2,830	1,443,406	204	127	198.10	513.09	87.52%	3,985	2,476	1,996,985	1,240,864	214,029	132,991	3	14
SEQUOYAH NP	3,673	2,282	443,823	51	32	75.52	195.61	72.05%	2,646	1,644	3,597,087	2,235,118	378,304	235,067	1	13
SOUTH TEXAS NP	3,778	2,348	519,952	66	41	86.02	222.79	78.04%	2,948	1,832	3,054,283	1,897,836	287,124	178,410	0	9
ST LUCIE NP	4,880	3,033	945,707	112	70	121.11	313.68	86.71%	4,232	2,630	5,615,091	3,489,043	717,412	445,778	3	14
SUMMER NP	4,129	2,566	533,917	68	42	80.81	209.30	68.61%	2,833	1,761	2,165,887	1,345,815	243,636	151,388	1	13
SURRY NP	4,438	2,758	972,291	137	85	136.93	354.66	96.37%	4,277	2,658	4,814,684	2,991,694	532,534	330,900	2	12
SUSQUEHANNA NP	4,177	2,595	1,209,566	179	111	180.99	468.77	92.33%	3,857	2,396	6,141,432	3,816,094	881,327	547,629	3	10
THREE MILE ISLAND NP	4,072	2,530	1,211,767	181	113	185.98	481.68	95.38%	3,884	2,413	2,131,197	1,324,260	228,049	141,702	2	10
TROJAN NP	2,027	1,260	209,092	32	20	64.46	166.96	79.32%	1,608	999	727,516	452,056	77,037	47,869	1	4
TURKEY POINT NP	5,083	3,159	1,055,938	139	86	129.83	336.27	78.22%	3,976	2,471	5,138,691	3,193,022	543,895	337,960	2	14
VERMONT YANKEE NP	4,462	2,773	1,371,822	196	122	192.16	497.69	94.46%	4,215	2,619	2,684,337	1,667,964	615,745	382,605	3	13
VOGTLE NP	4,243	2,637	585,290	69	43	86.21	223.29	75.74%	3,214	1,997	4,346,285	2,700,646	924,985	574,757	1	13
WATERFORD NP	3,809	2,367	332,928	39	24	54.63	141.49	84.07%	3,202	1,990	2,272,588	1,412,115	285,664	177,503	0	10
WATTS BAR NP	3,684	2,289	427,631	59	37	72.56	187.92	73.20%	2,696	1,676	1,103,472	685,663	117,877	73,245	1	11
WEST VALLEY	3,762	2,338	1,082,052	166	103	179.74	465.54	94.35%	3,550	2,206	2,505,034	1,556,550	244,562	151,964	3	11
WNP - Washington Nuclear	1,760	1,094	159,473	23	14	56.63	146.66	74.26%	1,307	812	976,318	606,654	142,572	88,590	1	5
WOLF CREEK NP	2,494	1,550	210,769	30	18	52.82	136.81	92.77%	2,314	1,438	1,432,891	890,354	157,112	97,625	0	7
YANKEE ROWE NP	4,267	2,651	1,291,704	187	116	189.22	490.08	93.41%	3,985	2,476	542,876	337,326	191,995	119,300	3	13
ZION NP	2,908	1,807	464,952	69	43	99.92	258.80	93.80%	2,728	1,695	3,999,376	2,485,088	418,789	260,222	1	7
Summary	270,052	167,802	53,084,527	7,496	4,658	115.33	298.70	86.27%	232,983	144,768	242,779,363	150,855,540	38,480,726	23,910,726	138	742

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Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,887	1,794	233,692	30	19	50.60	131.05	89.35%	2,579	1,603	3,321,386	2,063,806	369,476	229,581	0	9
ARNOLD NP	2,492	1,549	198,924	26	16	49.89	129.20	99.03%	2,468	1,534	1,138,156	707,215	159,503	99,110	2	6
BEAVER VALLEY NP	3,569	2,218	814,037	120	75	142.55	369.21	99.64%	3,556	2,210	3,623,912	2,251,786	378,320	235,076	3	10
BIG ROCK POINT NP	3,578	2,223	640,728	98	61	111.93	289.91	90.15%	3,225	2,004	223,993	139,182	143,103	88,920	4	9
BRAIDWOOD NP	2,881	1,790	411,358	61	38	89.25	231.17	97.55%	2,810	1,746	3,022,761	1,878,249	342,788	212,998	3	7
BROWNS FERRY NP	2,981	1,852	317,337	43	27	66.53	172.32	85.26%	2,542	1,579	4,582,481	2,847,411	626,010	388,983	1	8
BRUNSWICK NP	4,610	2,864	768,081	83	51	104.14	269.72	85.42%	3,938	2,447	4,215,858	2,619,603	954,200	592,910	3	15
BYRON NP	2,726	1,694	242,952	32	20	55.70	144.27	96.32%	2,626	1,632	3,126,702	1,942,836	354,390	220,207	2	7
CALLAWAY NP	2,570	1,597	176,028	22	14	42.81	110.88	89.44%	2,298	1,428	1,645,321	1,022,351	192,748	119,768	1	7
CALVERT CLIFFS NP	4,089	2,541	1,005,347	146	91	153.66	397.99	100.00%	4,089	2,541	4,673,891	2,904,211	592,910	368,416	2	12
CATAWBA NP	4,147	2,577	607,756	77	48	91.59	237.23	73.91%	3,065	1,905	4,949,065	3,075,195	530,833	329,843	1	13
CLINTON NP	2,917	1,813	304,273	45	28	65.19	168.84	90.87%	2,651	1,647	1,321,610	821,207	189,622	117,826	2	7
COMANCHE PEAK NP	2,850	1,771	266,149	31	19	58.37	151.18	65.60%	1,869	1,162	2,617,205	1,626,250	299,233	185,934	1	6
CONN YANKEE NP	4,406	2,738	1,446,145	209	130	205.13	531.28	97.63%	4,302	2,673	2,240,925	1,392,441	480,280	298,431	2	13
COOK NP	2,951	1,834	633,051	99	62	134.06	347.21	97.82%	2,887	1,794	3,984,609	2,475,912	430,902	267,749	2	9
COOPER STATION NP	2,181	1,355	235,478	36	23	67.49	174.80	96.13%	2,096	1,303	998,725	620,576	231,151	143,630	0	5
CRYSTAL RIVER NP	4,574	2,842	662,423	73	45	90.51	234.42	85.02%	3,889	2,417	2,245,136	1,395,058	407,109	252,965	2	14
DAVIS-BESSE NP	3,332	2,070	689,149	108	67	129.27	334.80	97.91%	3,262	2,027	1,695,554	1,053,564	193,256	120,083	2	9
DIABLO CANYON NP	1,608	999	740,144	134	83	287.73	745.21	87.59%	1,408	875	1,914,690	1,189,729	213,830	132,867	2	2
DRESDEN NP DOCK	2,830	1,758	302,295	40	25	66.77	172.94	97.78%	2,767	1,719	4,028,387	2,503,114	1,004,494	624,161	2	7
FARLEY NP	4,062	2,524	533,264	66	41	82.05	212.52	71.81%	2,917	1,812	4,632,364	2,878,407	499,606	310,440	1	13
FERMI NP	3,664	2,277	1,040,835	159	99	177.53	459.80	100.00%	3,664	2,277	1,835,499	1,140,522	282,153	175,321	2	11
FITZPATRICK NP	3,959	2,460	1,210,710	180	112	191.16	495.10	98.30%	3,891	2,418	2,055,302	1,277,101	288,972	179,558	2	11
FORT CALHOUN NP	2,064	1,283	151,444	21	13	45.86	118.77	100.00%	2,064	1,283	785,782	488,260	183,710	114,151	1	5
GRAND GULF NP	3,453	2,146	316,011	39	24	57.20	148.14	87.65%	3,027	1,881	2,940,731	1,827,279	417,816	259,618	1	11
HANFORD RPSTRY	1,747	1,086	156,793	23	14	56.09	145.26	81.35%	1,421	883	5,273,020	3,276,491	2,114,198	1,313,697	2	5
HARRIS NP	4,496	2,794	750,443	81	50	104.32	270.20	86.47%	3,888	2,416	2,688,446	1,670,517	310,216	192,758	2	15
HATCH NP	4,140	2,572	581,562	69	43	87.80	227.40	79.59%	3,295	2,047	5,515,164	3,426,951	761,740	473,322	1	13
HOPE CREEK NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	2,987,015	1,856,038	420,730	261,428	2	12
HUMBOLDT BAY NP	1,321	821	169,747	28	17	80.31	208.02	59.70%	789	490	38,228	23,754	22,456	13,954	2	2
INEL	823	511	93,828	15	10	71.29	184.65	66.84%	550	342	496,920	308,771	190,008	118,064	0	3
KEWAUNEE NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	1,486,730	923,808	188,137	116,903	3	8
LA CROSSE NP	2,816	1,750	273,411	32	20	60.69	157.19	81.67%	2,299	1,429	106,935	66,446	39,418	24,493	2	8
LA SALLE NP	2,899	1,801	183,036	23	14	39.46	102.21	99.61%	2,887	1,794	3,656,816	2,272,232	510,182	317,011	1	9
LIMERICK NP	4,132	2,567	1,296,681	192	119	196.14	508.01	99.49%	4,111	2,554	4,664,440	2,898,338	681,754	423,621	2	10

Table F-14. Detailed Measure / Effectiveness Results, by Option

Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
CARLIN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,663	2,898	1,486,593	207	129	199.25	516.06	87.92%	4,100	2,547	3,342,644	2,077,015	424,341	263,673	4	15
MCGUIRE NP	4,288	2,665	895,665	124	77	130.54	338.10	97.17%	4,167	2,589	6,083,260	3,779,948	647,529	402,355	2	13
MILLSTONE NP	4,524	2,811	1,478,682	211	131	204.29	529.11	97.12%	4,394	2,730	7,843,870	4,873,937	1,569,787	975,417	3	13
MONTICELLO NP	2,716	1,688	280,880	35	22	64.63	167.40	74.75%	2,030	1,262	1,069,546	664,583	258,029	160,332	1	8
MORRIS (G E Repro Plnt, IL)	2,826	1,756	302,427	40	25	66.88	173.21	97.89%	2,767	1,719	1,905,180	1,183,819	251,544	156,302	2	7
NINE MILE POINT NP	3,957	2,459	1,210,513	180	112	191.19	495.18	98.33%	3,891	2,418	4,074,127	2,531,536	585,670	363,917	2	11
NORTH ANNA NP	4,277	2,658	1,207,077	180	112	176.38	456.84	96.93%	4,146	2,576	4,915,024	3,054,043	560,309	348,159	2	14
OCONEE NP	4,022	2,499	641,417	79	49	99.68	258.18	83.47%	3,357	2,086	7,630,553	4,741,388	820,407	509,776	1	14
OYSTER CREEK NP	4,380	2,721	1,414,717	203	126	201.89	522.89	94.86%	4,154	2,581	2,853,277	1,772,938	402,931	250,369	2	11
PALISADES NP	2,814	1,748	439,702	69	43	97.67	252.96	100.00%	2,814	1,748	1,617,224	1,004,893	194,151	120,640	1	7
PALO VERDE NP	2,064	1,283	480,689	88	55	145.56	377.00	92.55%	1,910	1,187	3,482,676	2,164,026	421,054	261,630	1	3
PEACH BOTTOM NP	4,047	2,514	1,208,654	181	112	186.68	483.50	99.09%	4,010	2,491	6,482,977	4,028,320	910,474	565,740	3	10
PERRY NP	3,439	2,137	890,042	138	86	161.77	418.98	96.96%	3,334	2,072	2,080,756	1,292,917	295,728	183,756	2	9
PILGRIM NP	4,461	2,772	1,501,087	220	137	210.29	544.64	98.48%	4,394	2,730	2,256,819	1,402,317	521,988	324,347	2	12
POINT BEACH NP	3,189	1,981	643,059	95	59	126.04	326.44	91.66%	2,923	1,816	2,670,528	1,659,383	341,198	212,010	3	8
PRAIRIE ISLAND NP	2,647	1,645	256,152	30	19	60.49	156.67	80.50%	2,130	1,324	2,136,819	1,327,753	280,537	174,317	2	7
QUAD CITIES NP	2,705	1,681	293,879	43	27	67.91	175.89	98.63%	2,668	1,658	3,641,897	2,262,962	849,268	527,708	2	7
RANCHO SECO NP	856	532	100,291	18	11	73.21	189.62	96.62%	827	514	195,516	121,488	20,548	12,768	1	2
RIVER BEND NP	3,714	2,308	337,478	39	24	56.79	147.09	85.52%	3,176	1,974	1,812,270	1,126,088	256,259	159,231	1	10
ROBINSON NP	4,339	2,696	782,947	90	56	112.77	292.06	84.20%	3,654	2,271	1,495,115	929,018	303,762	188,748	2	14
SALEM NP	4,166	2,588	1,245,454	186	115	186.86	483.98	99.19%	4,132	2,567	4,733,335	2,941,147	512,374	318,373	2	12
SAN ONOFRE NP	1,748	1,086	618,686	110	68	221.22	572.97	93.55%	1,635	1,016	2,567,967	1,595,655	305,885	190,068	2	2
SAVANNA RIVER PLANT	4,175	2,594	715,075	88	55	107.04	277.23	79.81%	3,332	2,071	11,626,116	7,224,107	4,651,282	2,890,162	3	14
SEABROOK NP	4,507	2,801	1,440,457	204	127	199.75	517.34	90.96%	4,100	2,547	1,976,519	1,228,147	211,836	131,628	3	14
SEQUOYAH NP	3,626	2,253	441,058	51	32	76.02	196.89	76.13%	2,761	1,715	3,551,379	2,206,716	373,497	232,080	1	13
SOUTH TEXAS NP	3,731	2,319	517,105	66	41	86.62	224.34	82.08%	3,063	1,903	3,016,552	1,874,391	283,577	176,206	0	9
ST LUCIE NP	4,834	3,004	942,830	112	70	121.91	315.74	89.92%	4,346	2,701	5,561,394	3,455,677	710,551	441,515	3	14
SUMMER NP	4,083	2,537	531,234	68	42	81.32	210.63	72.19%	2,948	1,832	2,141,408	1,330,604	240,883	149,677	1	13
SURRY NP	4,391	2,729	969,607	137	85	138.01	357.44	100.00%	4,391	2,729	4,764,049	2,960,232	526,933	327,420	2	12
SUSQUEHANNA NP	4,130	2,566	1,206,794	179	111	182.62	472.98	96.14%	3,971	2,467	6,072,810	3,773,455	871,480	541,510	3	10
THREE MILE ISLAND NP	4,026	2,501	1,209,136	181	113	187.72	486.21	99.32%	3,998	2,484	2,106,772	1,309,083	225,435	140,078	2	10
TROJAN NP	1,595	991	112,204	13	8	43.98	113.90	53.43%	852	529	572,276	355,594	60,599	37,654	1	4
TURKEY POINT NP	5,036	3,130	1,053,172	139	86	130.69	338.50	81.21%	4,090	2,542	5,091,509	3,163,705	538,901	334,857	2	14
VERMONT YANKEE NP	4,415	2,744	1,368,867	196	122	193.77	501.86	98.05%	4,329	2,690	2,656,260	1,650,517	609,305	378,603	3	13
VOGTLE NP	4,196	2,608	582,390	69	43	86.74	224.66	79.31%	3,328	2,068	4,298,478	2,670,940	914,811	568,435	1	13
WATERFORD NP	3,762	2,338	330,127	39	24	54.84	142.04	88.15%	3,316	2,061	2,244,741	1,394,812	282,163	175,328	0	10
WATTS BAR NP	3,637	2,260	424,744	59	37	72.99	189.05	77.28%	2,811	1,747	1,089,491	676,976	116,383	72,317	1	11
WEST VALLEY	3,716	2,309	1,079,143	166	103	181.51	470.12	98.61%	3,664	2,277	2,473,961	1,537,243	241,529	150,079	3	11
WNP - Washington Nuclear	1,713	1,065	156,777	23	14	57.19	148.11	82.95%	1,421	883	950,430	590,568	138,791	86,241	1	5
WOLF CREEK NP	2,447	1,521	207,960	30	18	53.11	137.56	99.21%	2,428	1,509	1,406,075	873,691	154,172	95,798	0	7
YANKEE ROWE NP	4,220	2,622	1,288,735	187	116	190.87	494.36	97.15%	4,100	2,547	536,937	333,636	189,894	117,995	3	13
ZION NP	2,862	1,778	462,249	69	43	100.96	261.49	99.33%	2,842	1,766	3,935,195	2,445,208	412,068	256,046	1	7
Summary	262,051	162,830	52,097,379	7,361	4,574	117.09	303.25	90.40%	236,890	147,196	235,697,491	146,455,085	37,493,120	23,297,058	138	737

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	2,896	1,799	169,645	16	10	36.62	94.84	88.38%	2,559	1,590	3,331,756	2,070,249	370,629	230,298	1	7
ARNOLD NP	3,436	2,135	223,262	24	15	40.61	105.17	89.70%	3,082	1,915	1,569,282	975,103	219,922	136,653	3	9
BEAVER VALLEY NP	4,302	2,673	521,382	63	39	75.75	196.18	98.77%	4,249	2,640	4,368,238	2,714,287	456,024	283,359	3	13
BIG ROCK POINT NP	4,330	2,691	481,645	62	39	69.52	180.06	91.86%	3,978	2,472	271,109	168,458	173,205	107,624	4	12
BRAIDWOOD NP	3,905	2,426	431,543	59	37	69.08	178.91	90.73%	3,543	2,201	4,097,336	2,545,957	464,648	288,718	1	9
BROWNS FERRY NP	3,801	2,362	423,253	56	35	69.60	180.26	88.44%	3,361	2,089	5,842,707	3,630,476	798,168	495,957	2	9
BRUNSWICK NP	5,126	3,185	1,036,482	124	77	126.37	327.30	90.89%	4,659	2,895	4,688,326	2,913,180	1,061,136	659,357	3	11
BYRON NP	3,553	2,208	264,296	30	19	46.49	120.41	84.84%	3,015	1,873	4,075,290	2,532,258	461,906	287,014	2	10
CALLAWAY NP	3,133	1,947	221,882	29	18	44.26	114.63	91.01%	2,852	1,772	2,005,934	1,246,425	234,993	146,018	2	8
CALVERT CLIFFS NP	4,822	2,996	712,575	89	55	92.36	239.21	99.17%	4,782	2,971	5,511,800	3,424,861	699,204	434,464	2	15
CATAWBA NP	4,852	3,015	1,122,162	143	89	144.54	374.36	89.76%	4,356	2,707	5,790,650	3,598,130	621,101	385,933	2	11
CLINTON NP	3,783	2,351	338,767	45	28	55.97	144.96	97.51%	3,689	2,292	1,713,857	1,064,938	245,901	152,796	3	10
COMANCHE PEAK NP	2,487	1,546	99,263	7	4	24.94	64.60	94.11%	2,341	1,455	2,284,216	1,419,341	261,161	162,278	1	5
CONN YANKEE NP	5,163	3,208	1,206,937	160	100	146.11	378.41	97.91%	5,055	3,141	2,625,776	1,631,575	562,762	349,683	3	16
COOK NP	3,684	2,289	340,918	42	26	57.83	149.78	97.16%	3,580	2,224	4,974,297	3,090,873	537,929	334,252	2	12
COOPER STATION NP	3,090	1,920	202,184	25	16	40.90	105.93	92.14%	2,847	1,769	1,415,093	879,295	327,518	203,509	1	8
CRYSTAL RIVER NP	4,677	2,906	814,497	100	62	108.84	281.90	85.88%	4,017	2,496	2,295,611	1,426,421	416,261	258,652	2	9
DAVIS-BESSE NP	4,082	2,537	406,934	52	32	62.30	161.36	98.30%	4,013	2,494	2,077,430	1,290,851	236,781	147,129	3	12
DIABLO CANYON NP	591	368	671,091	128	80	709.18	1,836.77	82.86%	490	305	704,353	437,663	78,661	48,878	2	2
DRESDEN NP DOCK	3,571	2,219	229,743	25	16	40.21	104.15	98.65%	3,522	2,189	5,083,484	3,158,719	1,267,586	787,639	2	10
FARLEY NP	4,613	2,867	863,617	114	71	117.00	303.03	80.18%	3,699	2,299	5,261,356	3,269,243	567,444	352,592	2	9
FERMI NP	4,421	2,747	800,820	110	69	113.21	293.22	99.93%	4,418	2,745	2,214,546	1,376,050	340,420	211,527	3	14
FITZPATRICK NP	4,715	2,930	971,445	131	82	128.76	333.50	98.51%	4,645	2,886	2,448,197	1,521,233	344,212	213,883	3	14
FORT CALHOUN NP	3,245	2,017	247,363	30	19	47.64	123.38	89.91%	2,918	1,813	1,235,465	767,679	288,842	179,477	2	9
GRAND GULF NP	3,582	2,226	513,284	73	45	89.55	231.93	81.33%	2,914	1,811	3,050,926	1,895,751	433,472	269,346	2	7
HANFORD RPSTRY	2,570	1,597	841,331	151	94	204.59	529.90	94.43%	2,427	1,508	7,756,298	4,819,522	3,109,860	1,932,370	3	4
HARRIS NP	5,012	3,115	1,019,625	123	76	127.14	329.28	91.96%	4,609	2,864	2,997,364	1,862,469	345,861	214,907	2	11
HATCH NP	4,691	2,915	911,842	117	73	121.48	314.63	86.91%	4,077	2,534	6,249,905	3,883,496	863,221	536,378	2	9
HOPE CREEK NP	4,922	3,059	1,006,139	137	85	127.75	330.88	99.25%	4,885	3,036	3,529,626	2,193,200	497,158	308,919	3	15
HUMBOLDT BAY NP	1,625	1,010	593,798	106	66	228.37	591.47	67.24%	1,093	679	47,031	29,224	27,627	17,167	2	2
INEL	2,476	1,538	611,678	110	68	154.42	399.96	88.98%	2,203	1,369	1,495,622	929,333	571,878	355,347	1	4
KEWAUNEE NP	3,976	2,471	569,245	78	49	89.47	231.74	93.31%	3,711	2,306	1,853,948	1,151,986	234,607	145,777	5	11
LA CROSSE NP	3,672	2,282	204,982	22	14	34.89	90.36	95.79%	3,518	2,186	139,465	86,659	51,409	31,944	2	11
LA SALLE NP	3,474	2,159	189,734	20	12	34.13	88.41	99.68%	3,463	2,152	4,382,617	2,723,222	611,442	379,931	1	10
LIMERICK NP	4,889	3,038	1,057,215	144	89	135.16	350.08	99.51%	4,864	3,023	5,518,697	3,429,147	806,613	501,204	3	13

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Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
JEAN	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	5,420	3,368	1,246,793	159	99	143.78	372.38	89.54%	4,853	3,016	3,885,081	2,414,068	493,203	306,461	5	18
MCGUIRE NP	4,881	3,033	1,045,072	129	80	133.82	346.59	92.69%	4,524	2,811	6,924,086	4,302,411	737,031	457,968	2	11
MILLSTONE NP	5,281	3,281	1,239,375	162	101	146.69	379.93	97.47%	5,147	3,198	9,155,925	5,689,207	1,832,368	1,138,576	4	16
MONTICELLO NP	3,987	2,477	363,690	44	28	57.02	147.68	94.36%	3,762	2,337	1,569,812	975,432	378,719	235,325	2	12
MORRIS (G E Repro Plnt, IL)	3,567	2,217	229,721	25	16	40.25	104.24	98.74%	3,522	2,189	2,404,744	1,494,233	317,503	197,286	2	10
NINE MILE POINT NP	4,714	2,929	971,281	131	82	128.78	333.53	98.53%	4,645	2,886	4,853,197	3,015,626	697,664	433,507	3	14
NORTH ANNA NP	5,010	3,113	914,221	122	76	114.04	295.38	96.57%	4,839	3,007	5,757,404	3,577,472	656,340	407,829	2	17
OCONEE NP	4,573	2,842	972,315	127	79	132.88	344.17	90.51%	4,139	2,572	8,677,009	5,391,623	932,918	579,686	2	10
OYSTER CREEK NP	5,136	3,192	1,175,228	154	96	143.00	370.38	95.55%	4,908	3,050	3,346,263	2,079,264	472,649	293,627	3	14
PALISADES NP	3,582	2,226	266,605	31	19	46.52	120.48	100.00%	3,582	2,226	2,058,714	1,279,221	247,153	153,573	2	10
PALO VERDE NP	881	548	91,110	13	8	64.63	167.38	82.56%	727	452	1,486,756	923,824	179,748	111,690	1	3
PEACH BOTTOM NP	4,803	2,985	969,150	132	82	126.11	326.61	99.16%	4,763	2,960	7,695,312	4,781,628	1,080,735	671,535	4	13
PERRY NP	4,189	2,603	608,393	82	51	90.77	235.09	97.50%	4,085	2,538	2,534,847	1,575,075	360,266	223,858	3	12
PILGRIM NP	5,218	3,242	1,261,663	172	107	151.11	391.39	98.64%	5,147	3,198	2,639,604	1,640,168	610,524	379,361	3	16
POINT BEACH NP	3,976	2,471	569,245	78	49	89.47	231.74	93.31%	3,711	2,306	3,330,140	2,069,246	425,473	264,376	5	11
PRAIRIE ISLAND NP	3,868	2,404	285,804	33	21	46.18	119.61	82.22%	3,180	1,976	3,123,043	1,940,562	410,016	254,771	2	10
QUAD CITIES NP	3,419	2,125	260,373	32	20	47.60	123.27	86.10%	2,944	1,829	4,603,838	2,860,682	1,073,586	667,093	2	10
RANCHO SECO NP	1,083	673	390,137	71	44	225.13	583.09	97.33%	1,054	655	247,335	153,686	25,994	16,152	1	2
RIVER BEND NP	3,737	2,322	664,199	91	57	111.09	287.72	87.37%	3,265	2,029	1,823,500	1,133,066	257,847	160,218	2	6
ROBINSON NP	4,856	3,017	1,052,308	132	82	135.44	350.78	90.11%	4,376	2,719	1,673,104	1,039,615	339,924	211,218	2	10
SALEM NP	4,922	3,059	1,006,139	137	85	127.75	330.88	99.25%	4,885	3,036	5,593,177	3,475,426	605,450	376,208	3	15
SAN ONOFRE NP	494	307	323,860	61	38	409.68	1,061.08	86.32%	426	265	725,869	451,032	86,462	53,725	1	2
SAVANNA RIVER PLANT	4,692	2,915	984,354	130	81	131.12	339.61	86.40%	4,054	2,519	13,064,593	8,117,931	5,226,775	3,247,756	3	10
SEABROOK NP	5,264	3,271	1,200,638	156	97	142.56	369.22	92.20%	4,853	3,016	2,308,361	1,434,344	247,402	153,728	4	17
SEQUOYAH NP	4,202	2,611	447,741	49	30	66.60	172.50	79.40%	3,336	2,073	4,114,852	2,556,841	432,758	268,902	2	14
SOUTH TEXAS NP	2,987	1,856	191,923	17	11	40.15	103.99	93.24%	2,785	1,731	2,415,193	1,500,726	227,045	141,079	1	5
ST LUCIE NP	4,980	3,095	1,086,658	135	84	136.37	353.21	90.06%	4,485	2,787	5,729,893	3,560,377	732,080	454,892	3	9
SUMMER NP	4,788	2,975	1,045,543	134	83	136.48	353.48	88.52%	4,238	2,634	2,511,294	1,560,440	282,491	175,531	2	10
SURRY NP	5,124	3,184	676,754	80	49	82.54	213.79	99.21%	5,084	3,159	5,559,366	3,454,417	614,900	382,080	2	15
SUSQUEHANNA NP	4,887	3,037	967,466	130	81	123.73	320.46	96.67%	4,724	2,936	7,185,432	4,464,804	1,031,147	640,723	4	13
THREE MILE ISLAND NP	4,782	2,972	969,852	133	82	126.75	328.28	99.36%	4,752	2,953	2,502,792	1,555,157	267,811	166,410	3	13
TROJAN NP	2,202	1,368	778,808	138	86	221.09	572.63	96.56%	2,126	1,321	790,063	490,920	83,660	51,984	2	3
TURKEY POINT NP	5,139	3,193	1,205,147	166	103	146.56	379.59	82.07%	4,218	2,621	5,195,471	3,228,304	549,905	341,694	2	9
VERMONT YANKEE NP	5,172	3,214	1,129,695	148	92	136.52	353.58	98.27%	5,083	3,158	3,111,508	1,933,394	713,732	443,491	4	16
VOGTLE NP	4,748	2,950	913,284	117	73	120.22	311.38	86.57%	4,110	2,554	4,863,421	3,021,978	1,035,043	643,144	2	9
WATERFORD NP	3,354	2,084	292,731	34	21	54.55	141.29	90.46%	3,034	1,885	2,001,129	1,243,439	251,541	156,300	1	6
WATTS BAR NP	4,212	2,617	431,456	56	35	64.02	165.80	80.39%	3,386	2,104	1,261,840	784,068	134,794	83,757	2	12
WEST VALLEY	4,473	2,779	839,904	118	73	117.37	303.99	98.78%	4,418	2,745	2,977,775	1,850,297	290,715	180,642	4	14
WNP - Washington Nuclear	2,536	1,576	841,317	151	94	207.32	536.95	95.69%	2,427	1,508	1,406,855	874,176	205,443	127,656	2	4
WOLF CREEK NP	2,726	1,694	114,938	10	6	26.35	68.25	95.16%	2,594	1,612	1,566,323	973,264	171,743	106,716	1	7
YANKEE ROWE NP	4,977	3,092	1,049,609	139	86	131.82	341.41	97.52%	4,853	3,016	633,222	393,464	223,947	139,154	4	16
ZION NP	3,649	2,268	387,957	52	33	66.45	172.09	99.47%	3,630	2,256	5,018,308	3,118,221	525,485	326,520	3	10
Summary	305,664	189,930	51,783,035	6,954	4,321	114.35	296.18	92.95%	284,106	176,535	271,234,063	168,536,405	44,059,454	27,377,174	187	794

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
ARKANSAS NP	3,121	1,940	238,384	30	19	47.73	123.62	85.00%	2,653	1,649	3,591,749	2,231,801	399,551	248,269	0	9
ARNOLD NP	2,727	1,695	203,713	26	16	46.69	120.92	93.21%	2,542	1,580	1,245,460	773,890	174,541	108,454	2	6
BEAVER VALLEY NP	3,804	2,364	818,834	120	75	134.53	348.45	95.43%	3,630	2,256	3,862,488	2,400,030	403,226	250,552	3	10
BIG ROCK POINT NP	3,813	2,369	645,418	98	61	105.80	274.04	86.53%	3,299	2,050	238,704	148,323	152,502	94,760	4	9
BRAIDWOOD NP	3,116	1,936	416,027	61	38	83.46	216.16	92.57%	2,884	1,792	3,269,324	2,031,456	370,749	230,372	3	7
BROWNS FERRY NP	3,216	1,998	322,220	43	27	62.62	162.19	81.33%	2,616	1,625	4,943,677	3,071,847	675,352	419,643	1	8
BRUNSWICK NP	4,845	3,010	772,691	83	51	99.68	258.18	82.81%	4,012	2,493	4,430,750	2,753,130	1,002,838	623,132	3	15
BYRON NP	2,961	1,840	247,557	32	20	52.25	135.34	91.18%	2,700	1,678	3,396,198	2,110,292	384,936	239,187	2	7
CALLAWAY NP	2,805	1,743	180,748	22	14	40.27	104.31	84.58%	2,373	1,474	1,795,748	1,115,822	210,370	130,718	1	7
CALVERT CLIFFS NP	4,324	2,687	1,010,069	146	91	146.00	378.13	96.28%	4,163	2,587	4,942,464	3,071,093	626,980	389,586	2	12
CATAWBA NP	4,382	2,723	612,437	77	48	87.35	226.24	71.63%	3,139	1,951	5,229,466	3,249,427	560,909	348,531	1	13
CLINTON NP	3,152	1,959	309,020	45	28	61.27	158.69	86.45%	2,725	1,693	1,428,056	887,350	204,895	127,316	2	7
COMANCHE PEAK NP	3,085	1,917	270,828	31	19	54.87	142.12	63.00%	1,943	1,208	2,832,990	1,760,332	323,904	201,264	1	6
CONN YANKEE NP	4,641	2,884	1,450,963	209	130	195.39	506.07	94.28%	4,376	2,719	2,360,424	1,466,694	505,891	314,345	2	13
COOK NP	3,186	1,980	637,757	99	62	125.10	324.00	92.93%	2,961	1,840	4,301,830	2,673,023	465,207	289,065	2	9
COOPER STATION NP	2,416	1,501	240,211	36	23	62.15	160.97	89.84%	2,170	1,349	1,106,336	687,443	256,057	159,106	0	5
CRYSTAL RIVER NP	4,809	2,988	667,021	73	45	86.69	224.52	82.41%	3,963	2,463	2,360,462	1,466,717	428,021	265,959	2	14
DAVIS-BESSE NP	3,567	2,216	693,956	108	67	121.59	314.93	93.54%	3,337	2,073	1,815,121	1,127,859	206,884	128,551	2	9
DIABLO CANYON NP	2,630	1,634	913,125	163	101	216.97	561.96	86.29%	2,270	1,410	3,132,503	1,946,440	349,833	217,375	2	3
DRESDEN NP DOCK	3,065	1,904	307,114	40	25	62.63	162.22	92.70%	2,841	1,765	4,362,902	2,710,971	1,087,906	675,991	2	7
FARLEY NP	4,297	2,670	538,172	66	41	78.28	202.75	69.61%	2,991	1,858	4,900,333	3,044,914	528,507	328,398	1	13
FERMI NP	3,899	2,423	1,045,440	159	99	167.57	434.00	95.87%	3,738	2,323	1,953,195	1,213,655	300,246	186,563	2	11
FITZPATRICK NP	4,193	2,606	1,215,458	180	112	181.15	469.19	94.56%	3,965	2,464	2,177,298	1,352,905	306,124	190,216	2	11
FORT CALHOUN NP	2,299	1,429	156,203	21	13	42.46	109.98	93.00%	2,138	1,329	875,228	543,839	204,621	127,145	1	5
GRAND GULF NP	3,688	2,292	320,725	39	24	54.35	140.77	84.07%	3,101	1,927	3,140,837	1,951,618	446,246	277,284	1	11
HANFORD RPSTRY	1,982	1,232	161,468	23	14	50.91	131.86	75.44%	1,495	929	5,982,112	3,717,098	2,398,506	1,490,357	2	5
HARRIS NP	4,731	2,940	755,128	81	50	99.76	258.38	83.74%	3,962	2,462	2,828,951	1,757,822	326,428	202,832	2	15
HATCH NP	4,375	2,718	586,233	69	43	83.75	216.91	77.01%	3,369	2,093	5,828,185	3,621,452	804,974	500,186	1	13
HOPE CREEK NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	3,155,499	1,960,729	444,461	276,174	2	12
HUMBOLDT BAY NP	2,344	1,456	342,699	57	35	91.39	236.71	70.42%	1,650	1,025	67,822	42,142	39,840	24,755	2	3
INEL	1,058	657	98,508	15	10	58.22	150.79	58.99%	624	388	638,870	396,974	244,283	151,790	0	3
KEWAUNEE NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	1,596,280	991,879	202,000	125,517	3	8
LA CROSSE NP	3,051	1,896	278,145	32	20	56.99	147.60	77.81%	2,373	1,475	115,859	71,991	42,707	26,537	2	8
LA SALLE NP	3,134	1,947	187,868	23	14	37.47	97.04	94.50%	2,962	1,840	3,953,227	2,456,412	551,536	342,707	1	9
LIMERICK NP	4,367	2,713	1,301,267	192	119	186.24	482.37	95.84%	4,185	2,600	4,929,692	3,063,157	720,524	447,711	2	10

Table F-14. Detailed Measure of Effectiveness Results, by Option

Not Favoring Originating RR without Las Vegas	Total Distance		Population	Urban Dist		Avg Pop Den		Main Line			MTU - Km	MTU - Mi	Cask - Km	Cask - Mi	Number of	
VALLEY MODIFIED	Km	Mi	Persons	Km	Mi	P/sq Km	P/sq Mi	Percent	Km	Mi	MTU*Km	MTU*Mi	Cask*Km	Cask*Mi	RRs	Sts
MAINE YANKEE NP	4,898	3,044	1,491,573	207	129	190.33	492.95	85.21%	4,174	2,593	3,511,074	2,181,672	445,723	276,959	4	15
MCGUIRE NP	4,523	2,811	900,396	124	77	124.41	322.23	93.76%	4,241	2,635	6,416,577	3,987,061	683,009	424,401	2	13
MILLSTONE NP	4,759	2,957	1,483,402	211	131	194.82	504.59	93.88%	4,468	2,776	8,251,271	5,127,083	1,651,320	1,026,079	3	13
MONTICELLO NP	2,951	1,834	285,648	35	22	60.50	156.69	71.31%	2,104	1,308	1,162,070	722,074	280,351	174,202	1	8
MORRIS (G E Repro Plnt, IL)	3,061	1,902	307,090	40	25	62.70	162.38	92.80%	2,841	1,765	2,063,565	1,282,235	272,456	169,298	2	7
NINE MILE POINT NP	4,192	2,605	1,215,261	180	112	181.18	469.26	94.59%	3,965	2,464	4,316,033	2,681,849	620,445	385,525	2	11
NORTH ANNA NP	4,512	2,804	1,211,851	180	112	167.86	434.76	93.52%	4,220	2,622	5,185,029	3,221,816	591,090	367,285	2	14
OCONEE NP	4,257	2,645	646,199	79	49	94.88	245.75	80.60%	3,431	2,132	8,076,373	5,018,407	868,340	539,560	1	14
OYSTER CREEK NP	4,615	2,867	1,419,337	203	126	192.23	497.88	91.63%	4,228	2,627	3,006,352	1,868,054	424,548	263,801	2	11
PALISADES NP	3,049	1,894	444,350	69	43	91.09	235.93	94.72%	2,888	1,794	1,752,271	1,088,806	210,364	130,714	1	7
PALO VERDE NP	3,087	1,918	653,624	117	73	132.35	342.79	89.81%	2,772	1,722	5,208,128	3,236,169	629,661	391,252	1	4
PEACH BOTTOM NP	4,282	2,660	1,213,328	181	112	177.12	458.73	95.38%	4,084	2,537	6,859,415	4,262,227	963,341	598,590	3	10
PERRY NP	3,674	2,283	894,825	138	86	152.24	394.29	92.77%	3,408	2,118	2,222,934	1,381,262	315,935	196,312	2	9
PILGRIM NP	4,696	2,918	1,505,940	220	137	200.41	519.07	95.13%	4,468	2,776	2,375,677	1,476,171	549,479	341,429	2	12
POINT BEACH NP	3,424	2,127	647,793	95	59	118.25	306.28	87.53%	2,997	1,862	2,867,306	1,781,655	366,339	227,632	3	8
PRAIRIE ISLAND NP	2,882	1,791	261,028	30	19	56.62	146.64	76.50%	2,204	1,370	2,326,528	1,445,632	305,443	189,793	2	7
QUAD CITIES NP	2,940	1,827	298,782	43	27	63.52	164.53	93.27%	2,742	1,704	3,958,282	2,459,553	923,047	573,552	2	7
RANCHO SECO NP	1,879	1,167	273,277	46	29	90.91	235.46	89.89%	1,689	1,049	429,033	266,587	45,090	28,018	1	3
RIVER BEND NP	3,949	2,454	342,083	39	24	54.14	140.23	82.31%	3,250	2,020	1,926,926	1,197,332	272,471	169,305	1	10
ROBINSON NP	4,574	2,842	787,866	90	56	107.65	278.80	81.50%	3,728	2,317	1,576,069	979,320	320,209	198,968	2	14
SALEM NP	4,401	2,734	1,250,166	186	115	177.56	459.87	95.57%	4,206	2,613	5,000,321	3,107,044	541,275	336,331	2	12
SAN ONOFRE NP	2,854	1,773	628,420	110	68	137.64	356.49	90.41%	2,580	1,603	4,192,305	2,604,968	499,369	310,293	2	3
SAVANNA RIVER PLANT	4,410	2,740	719,975	88	55	102.03	264.26	77.23%	3,406	2,117	12,280,377	7,630,644	4,913,033	3,052,806	3	14
SEABROOK NP	4,742	2,947	1,445,184	204	127	190.47	493.32	88.01%	4,174	2,593	2,079,558	1,292,172	222,879	138,490	3	14
SEQUOYAH NP	3,861	2,399	445,638	51	32	72.13	186.83	73.42%	2,835	1,761	3,781,497	2,349,705	397,699	247,118	1	13
SOUTH TEXAS NP	3,966	2,465	521,979	66	41	82.25	213.04	79.08%	3,137	1,949	3,206,509	1,992,425	301,434	187,302	0	9
ST LUCIE NP	5,069	3,150	947,449	112	70	116.83	302.58	87.21%	4,420	2,747	5,831,733	3,623,657	745,091	462,977	3	14
SUMMER NP	4,318	2,683	535,845	68	42	77.56	200.89	69.98%	3,022	1,878	2,264,647	1,407,181	254,746	158,291	1	13
SURRY NP	4,626	2,875	974,341	137	85	131.64	340.94	96.52%	4,465	2,775	5,018,969	3,118,631	555,129	344,940	2	12
SUSQUEHANNA NP	4,365	2,712	1,211,597	179	111	173.47	449.30	92.66%	4,045	2,513	6,418,286	3,988,123	921,057	572,316	3	10
THREE MILE ISLAND NP	4,261	2,647	1,213,718	181	113	178.04	461.14	95.58%	4,072	2,530	2,229,739	1,385,490	238,593	148,254	2	10
TROJAN NP	2,216	1,377	211,007	32	20	59.52	154.17	81.08%	1,796	1,116	795,087	494,043	84,193	52,315	1	4
TURKEY POINT NP	5,271	3,276	1,057,990	139	86	125.44	324.89	79.00%	4,164	2,588	5,329,043	3,311,301	564,043	350,479	2	14
VERMONT YANKEE NP	4,650	2,890	1,373,676	196	122	184.63	478.18	94.69%	4,403	2,736	2,797,617	1,738,352	641,730	398,751	3	13
VOGTLE NP	4,431	2,754	687,374	69	43	82.84	214.57	76.78%	3,402	2,114	4,539,160	2,820,493	966,033	600,263	1	13
WATERFORD NP	3,997	2,484	334,934	39	24	52.37	135.64	84.82%	3,390	2,107	2,384,935	1,481,924	299,786	186,278	0	10
WATTS BAR NP	3,872	2,406	429,573	59	37	69.34	179.59	74.50%	2,885	1,793	1,159,877	720,711	123,902	76,989	1	11
WEST VALLEY	3,951	2,455	1,084,059	166	103	171.49	444.17	94.62%	3,738	2,323	2,630,399	1,634,448	256,802	159,569	3	11
WNP - Washington Nuclear	1,948	1,211	161,501	23	14	51.80	134.17	76.75%	1,495	929	1,080,761	671,551	157,824	98,067	1	5
WOLF CREEK NP	2,682	1,667	212,671	30	18	49.56	128.35	93.28%	2,502	1,555	1,541,079	957,578	168,975	104,996	0	7
YANKEE ROWE NP	4,455	2,768	1,293,656	187	116	181.50	470.08	93.69%	4,174	2,593	566,834	352,213	200,468	124,565	3	13
ZION NP	3,097	1,924	467,032	69	43	94.26	244.15	94.18%	2,916	1,812	4,258,314	2,645,984	445,903	277,070	1	7
Summary	284,550	176,811	53,234,809	7,496	4,658	109.78	284.33	86.97%	247,481	153,777	255,667,995	158,864,135	40,590,183	25,221,477	138	742

APPENDIX G

LEVEL OF DETAIL REQUIRED FOR CONCEPTUAL DESIGN TO SUPPORT THE ENVIRONMENTAL IMPACT STATEMENT PROCESS

LEVEL OF DETAIL REQUIRED FOR CONCEPTUAL DESIGN TO SUPPORT THE ENVIRONMENTAL IMPACT STATEMENT PROCESS

Conceptual design will be initiated for rail routes currently deemed feasible (Carlin, Valley Modified, Jean, and Caliente) and the heavy haul truck routes currently deemed feasible to interface with, and provide input to, the following National Environmental Policy Act (NEPA) activities. There are three milestone dates established for the repository/transportation NEPA process (6/95 to 12/96 time period) in the *Civilian Radioactive Waste Management Program Plan* (DOE 1994a) that require engineering input. Those milestones are:

- *National Environmental Policy Act Scoping* (August 1995 to December 1995) - The scoping process requires sufficient information on the transportation system alternatives to allow discussions to be held with affected units of government and the public. *Nevada Potential Repository Preliminary Transportation Strategy* Studies 1 and 2 will provide this information.

- *Environmental Impact Statement Implementation Plan* (to be submitted January 1996) - The Environmental Impact Statement Implementation Plan requires sufficient information on route alternatives to allow planning of the baseline data collection for the route corridors. The Phase 1 portion of the conceptual design work will identify refined route corridors, and will identify the preferred alignment for each route. The design criteria and preliminary plan drawings will be available for support of the Environmental Impact Statement Implementation Plan. The Implementation Plan will be the decision document for identifying a preferred route from the four current route alternatives. The selection process will incorporate input from the NEPA scoping process results in selecting a preferred route.

- *Environmental Impact Statement Preliminary Baseline Data Report* (to be submitted January 1997) - Phase 2 of the Conceptual Design would be completed for the one selected route, based on the proposed schedule, by the end of the baseline data collection period (December 1996). The conceptual design would provide the detail necessary to support the results of the data collection submitted in the Preliminary Baseline Data Report.

A phased approach will be adopted for the rail route conceptual designs to ensure that only the required information is generated, and only the required level of effort is funded for engineering support to the NEPA process. The heavy haul truck transportation system conceptual design (using existing roads) is significantly smaller in scope than the rail/new haul road design, and will be performed in a single phase.

Phase 1 – This will proceed during the first five months of the conceptual design process, supporting the *Environmental Impact Statement Implementation Plan* development. Phase 1 conceptual design will also interface with and obtain input from the NEPA scoping process, to be sure that the Implementation Plan technical basis accurately reflects the outcome of the scoping process negotiations. Phase 1 includes development of preliminary plan and profile drawings for each of the rail routes, development of design criteria for detailed design, and initial evaluation of drainage structures, grade separations, and earthwork quantities for the alternative routes. The Caliente route conceptual design has already been completed.

Phase 2 – This will proceed during the 10 months following completion of Phase 1, supporting the *Environmental Impact Statement Preliminary Baseline Data Report*. Phase 2 will refine and complete the Phase 1 rail Conceptual Design for the one selected route after completion of the NEPA scoping process, U.S. Department of Energy (DOE) review, and issuance of the Implementation Plan, and will reflect any changes that might be mandated by that process. A plus/minus 30 percent cost estimate will be prepared for the selected route.

Heavy Haul Truck – The heavy haul truck transportation system conceptual design (using existing roads) activities are limited to designing road upgrades of unpaved roads, and designing the intermodal transfer facility. Because the level of effort is much smaller for the heavy haul design than the rail design, the conceptual design work will be performed in one phase, at the same time as the rail route Phase 2 work is being performed.

G.1 RAIL/NEW HEAVY HAUL ROAD DESIGN

Phase 1 of the conceptual design for the route alternatives would be completed approximately 5 months following the start of the conceptual design work, with a two-month DOE review period estimated for the Phase 1 design. Phase 1 would include the following:

- Plan and profile drawings of the most favorable alignment for each of the routes, showing the existing grade based on U.S. Geological Survey (USGS) 7.5 minute maps, and the proposed rail alignment and right-of-way, with the required cut and fill shown on the profile drawings. The drawings would be to the same scale as that used for the USGS 7.5 minute maps (1" =2000'). Each drawing would cover a length of approximately 10 miles. The plan view would show a corridor approximately 1-2 miles wide, to show information on existing adjacent land uses. Initial completion of the plan and profile drawings would be approximately three months after the start of the conceptual design work, and would be available to support the Environmental Impact Statement Implementation Plan development.

- The design criteria to be used to develop the detailed design would be included in the Phase 1 conceptual design.

- An initial evaluation of the drainage structures required for the proposed corridors. The evaluation will include the basic size and configuration of the structures based on map review of possible structure locations and map topographical information to allow identification of structure length and configuration.

- An initial evaluation of the grade separation requirements will be included to identify generic grade separation designs, and determine the possible locations of the grade separation structures within the route corridor.

- Earthwork and rock excavation quantity calculations will be initiated for each route design, to be used to compare the routes for level of construction effort. The quantity calculations will be completed in Phase 2 of the conceptual design.

- The cost estimates for the route alternatives will be initiated, and will be completed during Phase 2 of the conceptual design.

Phase 2 of the conceptual design would include activities required to support the draft Environmental Impact Statement development, revise rail corridor drawings as necessary (for route changes or incorporation of additional information) to incorporate comments obtained during the NEPA scoping process and DOE review, complete the evaluation of drainage structures and grade separations, finalize the conceptual design quantity calculations, and complete the conceptual design cost estimates, after comments have been incorporated.

The Phase 2 activities would be performed only on the one selected route identified in the Implementation Plan. The conceptual design for the other route alternatives would not be refined beyond the Phase 1 stage. For this discussion, it is assumed that the longest route initiated in Phase 1 will be fully developed in Phase 2.

The Phase 2 design work is estimated to take approximately five months with a two-month DOE review period and a three month comment incorporation and report finalization period following. Phase 2 would include the following:

- Plan and profile drawings would be refined and revised during Phase 2 to incorporate comments. It is assumed for this discussion that sufficient NEPA scoping and DOE comments will be generated to require all portions of the selected route corridor be adjusted. This will require re-evaluation of corridor obstacles and topography, and will require the profile drawings to be revised.

- The design criteria would be updated in Phase 2 to incorporate comments.

- The evaluation of the drainage structures would continue in Phase 2 to allow the basic size and configuration of the structures to be refined based on preliminary hydrological calculations. Completion of hydrological calculations would allow the drainage structures to be refined, and the basic structure type established.

- Grade Separation requirements would be refined, based on NEPA and DOE input. Input may identify additional grade separation requirements for secondary roads, and may require changes to the initial grade separation sizes and configurations based on existing road right-of-ways, and potential transportation system conflicts with planned changes to road systems.

- Earthwork and rock excavation quantity calculations will be completed in Phase 2 based on the revised corridor and refined structure identification. The route corridor will not be detailed to the point where a balanced cut and fill design is possible. Therefore, the calculated quantities will be greater than the final design quantities. Also, the establishment of a corridor will allow the quantities of ballast and track to be calculated.

- The cost estimates for the selected route will be developed to a ±30 percent level of detail.

The total estimated schedule duration for the conceptual design (Phases 1 and 2), including design report reviews, is 15 months.

Although the Caliente rail route has already been conceptually designed, significant revision may be appropriate in selected area.

G.2 HEAVY HAUL TRUCK TRANSPORTATION (USING EXISTING ROADS) DESIGN

The conceptual design for the heavy haul truck transportation system would be completed approximately 5 months following the start of the conceptual design work, with a two-month DOE review period estimated for the *Heavy Haul Transportation System Conceptual Design Report*. Conceptual design would include the following:

- Plan and profile drawings of the upgraded roads, showing the existing grade based on USGS 7.5 minute maps, and the proposed grades. The drawings would be to the same scale as that used for the USGS 7.5 minute maps (1" =2000'). Each drawing would cover a corridor length of approximately 10 miles. The design drawings and would be available to support the Environmental Impact Statement Implementation Plan development.

- The design criteria to be used to develop the detailed design would be included in the *Heavy Haul Transportation System Conceptual Design Report.*

- The conceptual design for the intermodal transfer facility. Because the site for the facility will not be finalized at the time of conceptual design, the design activities will concentrate on the structure, crane requirements, traffic logistics, and support structures (office, warehouse, shop). The intermodal transfer facility conceptual design will be presented on approximately 10 drawings: 2-civil, 3-structural, 1-crane, 2-architectural, 1-mechanical, and 1-electrical.

- Quantity calculations will be developed for the road upgrades and the intermodal transfer facility.

- The cost estimates will be developed for the road upgrades and the intermodal transfer facility.

The conceptual design would be developed to support the draft Environmental Impact Statement development, and would be revised as necessary to incorporate comments obtained during the NEPA scoping process and DOE review.