A MOUNTAIN OF TROUBLE: *A NATION AT RISK*

REPORT ON IMPACTS OF THE PROPOSED YUCCA MOUNTAIN HIGH-LEVEL NUCLEAR WASTE PROGRAM

Prepared by
The Nevada Agency for Nuclear Projects
Office of the Governor

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Volume I

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February 6, 2002

Hon. Spencer Abraham
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, DC 20585

Dear Secretary Abraham:

Enclosed is the State of Nevada's report on impacts of the proposed Yucca Mountain nuclear waste repository program. This report is being provided pursuant to Section 114(a)(1)(H) and Section 116 of the Nuclear Waste Policy Act of 1982, as amended.

Should you decide to recommend development of Yucca Mountain as a repository in spite of Nevada's strenuous objections, we expect that the State's impact report will be included with the materials that comprise your "comprehensive statement of the basis of such recommendation" to the President, as required by the Act.

The enclosed report was done to inform the you, the President, members of Congress, and other interested parties about the severe and widespread damage the Yucca Mountain program would do to the country and to Nevada if it is permitted to go forward. The report does not seek to make a case for mitigation, compensation, or benefits. It is Nevada's position that there is no form or amount of compensation that will make this fatally flawed and dangerous program acceptable, for Nevada or for the nation as a whole. The only way to "fix" the program is to acknowledge that it is unfixable and, thereby, permit the nation to move on and consider other, more appropriate, less damaging, and more promising approaches to managing spent nuclear fuel and high-level radioactive waste.

Thank you for you attention to this matter.

Sincerely;

--signed--
Robert R. Loux
Executive Director

ACKNOWLEDGMENTS

This report represents the culmination of an impact assessment research effort that spanned two decades and involved scientists and professionals from universities and organizations throughout the country, representing almost every social science discipline. The State of Nevada wishes to acknowledge the contributions of all of these extremely talented and dedicated researchers, with a very special acknowledgment and thanks to Dr. Gilbert F. White, the first chairman of the technical review committee that oversaw the design and implementation of the research effort. Dr. White's unimpeachable integrity and sense of purpose, his wisdom, and his firm hand in guiding the Nevada studies set the tone for the effort from the first and contributed immeasurably to the ultimate success of this extraordinary set of studies.

We wish to also acknowledge the invaluable contributions of Dr. Kai Erikson, Dr. White's successor as chair of the review committee, whose leadership of and dedication to the Nevada studies were in no small way responsible for bringing the effort to its successful fruition.

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JCS
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PREFACE

Reading the following report on how the Yucca Mountain nuclear waste program will affect people and their communities in Nevada and across the country, one cannot help but be struck by the differences – perhaps better described as a perceptual abyss – between how this program is characterized by Secretary of Energy in his recommendation that the Nevada site be developed as a repository, and how the same program is viewed and experienced by the people of Nevada and other affected states.

There are profound and irreconcilable differences between the Department of Energy's (DOE) and Nevada's views of Yucca Mountain reality. These differences are critically important to understand why there is such strong and intractable opposition to the program, and why DOE and its commercial nuclear industry supporters have failed so abysmally in grasping the fundamental flaws of the program.

The overriding flaw that has continually characterized DOE's approach to the Yucca Mountain program and to issues surrounding the massive national nuclear waste shipping campaign required to make the program work has to do with the fact that, from the beginning, DOE has viewed the program not from the perspective of determining whether it ***should*** go forward – i.e., whether the Yucca Mountain site is suitable and whether high-level waste transportation can be done safely in a publicly acceptable way – but rather from the perspective of ***how*** to make the program and its various elements work, despite all the flaws and shortcomings.

This world view has had profound implications not only for how the Yucca Mountain site characterization program was configured and implemented and how the Department has approached the problems of waste transportation, but it also conditioned how DOE viewed – and continues to view – criticism and concerns regarding suitability and safety matters. Put simply, any view that suggests Yucca Mountain and the associated waste shipping campaign are fundamentally flawed and, perhaps, cannot or should not be "fixed" is dismissed out of hand. After all, the goal, in DOE's reality, is to make the program work by whatever means necessary and at any cost.

This view of reality explains, although it does not excuse, how the DOE program and the Secretary of Energy could have missed – or ignored – impacts as significant, far reaching, and profound as those chronicled in the following pages. It also goes a long way towards explaining the escalating levels of official and public opposition to the Yucca Mountain program over the years and the frustration on the part of Nevadans and others in having their concerns and objections constantly ignored and brushed aside. They simply did not fit into DOE's reality.

This report paints a very different picture of the reality that is the Yucca Mountain program and its implications for Nevada and the nation. This is not a program that can be "fixed" or that can be made to work by the application of generous doses of creative engineering and best guesses. It is not a program whose impacts can be dismissed as unimportant because they stand in the way of getting the job done. If there is a single

conclusion to be drawn from this report, it is that the reality of Yucca Mountain is one of massive, pervasive, unavoidable, and unmitigable impacts to Nevada and the nation.

This conclusion leads to another important fact that provides context for the report. The report was done solely to inform the Secretary of Energy, the President, members of Congress, and other interested parties about the severe and widespread damage the Yucca Mountain program would do to the country and to Nevada if it is permitted to go forward. The report does not seek to make a case for mitigation, compensation, or benefits. It is Nevada's position that there is no form or amount of compensation that will make this fatally flawed and dangerous program acceptable, for Nevada or for the nation as a whole. The only way to "fix" the program is to acknowledge that it is unfixable and, thereby, permit the nation to move on and consider other, more appropriate, less damaging, and more promising approaches to managing the disposal of spent nuclear fuel and high-level waste.

Carson City, Nevada
February 2002

TABLE OF CONTENTS

Appendices

EXECUTIVE SUMMARY

The proposed Yucca Mountain high-level nuclear waste repository program has the potential to wreak economic, social, and environmental devastation on at least 44 states, including Nevada, hundreds of major cities, and thousands of communities across the country through which spent nuclear fuel (SNF) and high-level radioactive waste (HLW) must travel. This inescapable conclusion results from over 15 years of intensive research and oversight conducted by the State of Nevada and independent scientists studying the impacts of this major, first-of-a-kind federal program. The findings and conclusions of this research are extensively documented in the subsequent chapters of this report.

The enormous and pervasive potential impacts to the State of Nevada are only part of the problem. There will be massive additional impacts inflicted on at least 43 states, hundreds of major cities, and thousands of communities nationwide as a result of the tens of thousands of shipments of highly radioactive waste that are an inseparable and dominant component of the federal government's repository program. The fact that the Secretary of Energy recommends that Yucca Mountain be developed as a repository without full disclosure of these transportation impacts and without having assessed the implications of the program for the nation as a whole is unacceptable and a reason, of itself, for the President to reject outright the Secretary's recommendation.

What began in 1983 as a noble experiment that promised to place science ahead of politics, and fairness, equity, and openness above parochialism has degenerated into a technical and ethical quagmire, where facts are routinely twisted to serve predetermined ends and where "might makes right" has replaced "consultation, concurrence, and cooperation" as the guiding principle for the program. The shoddy and politically driven science, the heavy-handed federal approach, the constant changing of the rules to negate disqualifying conditions and "inconvenient" findings, and the deliberate avoidance of responsibility for considering socioeconomic impacts have created an atmosphere of severe distrust, where the already significant impacts associated with the nuclear nature of the program are further exacerbated and amplified. The result is a massive suite of negative impacts, national in scope, inextricably linked to the Yucca Mountain program, and unprecedented in the history of federal government domestic projects.

National Transportation Impacts: On the Road to Disaster?

The transportation of spent nuclear fuel and high-level radioactive waste to a Yucca Mountain repository would require an effort of truly epic proportions. More dangerous and highly radioactive waste would be shipped in the first full year of repository operations than has been transported in the entire five-decade history of spent fuel shipments in the United States. The effort would require over 96,000 truck shipments over four decades.

Almost every major east-west interstate highway and mainline railroad in the country would experience SNF/HLW shipments as waste is moved from reactors and other sites in 39 states. In all, 44 states would be directly impacted, including many of the major metropolitan areas in the nation, at least 109 cities with populations exceeding 100,000, hundreds of smaller cities, and thousands of communities. Highway shipments alone will impact at least 703 counties with a combined population of 123 million people.

This unique, never-before-attempted radioactive materials transportation effort would bring with it a constellation of hazards and risks, including potentially serious economic damage and property value losses in cities and communities along shipping routes, increased risks of terrorism and sabotage from shipments that represent numerous mobile targets within some of the country's most populous and vulnerable metropolitan areas, and an increased risk of radiation exposure to workers and the public, not only from potential accidents, but also from routine contact with tens of thousands of radioactive waste shipments on the country's highways and railroads over an extended period of time.

Truck shipments to Yucca Mountain would be a daily occurrence in major metropolitan areas like Atlanta, Nashville, Cleveland, and San Bernardino. Chicago could experience a truck shipment every 15 hours; St. Louis, Kansas City, and Denver, every 13 hours; Des Moines and Omaha, every 10 hours; and Salt Lake City, every 7 hours.

Rail shipments to Yucca Mountain would be a daily occurrence in Nevada, Utah, Wyoming, Nebraska, Colorado, and Illinois. Every other day, rail shipments would cross Iowa, Missouri, Kansas, and Indiana. There would be at least one rail shipment per week through Alabama, Arizona, Georgia, Idaho, Kentucky, Ohio, New York, Pennsylvania, and South Carolina.

Routine radiation exposures from shipping casks pose a clear health threat to certain transportation workers. Safety inspectors, truck drivers, and rail crews could receive cumulative doses large enough to increase their risk of cancer death by up to 15 percent, and their risk of other serious health effects, including genetic damage to future generations, by 50 percent or more. DOE proposes to control these exposures and risks by limiting work hours and doses.

Routine radiation from shipping casks poses a potential health threat to certain members of the public. Service station attendants could receive 100-1,000 millirem (mrem) doses per year. Motorists could receive 40 mrem during a traffic gridlock incident. Residents near certain routes in Nevada could receive 5-45 mrem per year from passing casks. Such exposures increase the risk of certain health effects, such as mental retardation in unborn children.

Routine radiation from passing casks would deliver small radiation doses to members of the public within one-half mile of highway and rail routes. Nationally, 7 - 11 million people reside within one-half mile of a truck or rail route. Even though these dose levels are well below the established thresholds for cancer and other health effects, DOE

has made no effort to analyze these effects, to inform the public of their existence, nor to evaluate their socioeconomic impacts. On this last point, research shows that the mere presence of sustained numbers of such shipments through communities can devalue property. For example, in a jury award upheld by the New Mexico Supreme Court, the lost value of a property adjacent to the Waste Isolation Pilot Plant transportation route was fixed at 4.75 percent, even before waste shipments began. Applied nationally, the economic impacts of such devaluation would be a massive burden on unwilling and unwitting property owners.

A successful terrorist attack on a truck cask involving release of radioactive materials in an urban area could cause 6-165 latent cancer fatalities and $3.1-20.9 billion in cleanup costs. Incidents of greater severity are credible.

Taken together, these national transportation impacts of the Yucca Mountain program, neither examined or even acknowledged by DOE, represent an unacceptable and unnecessary level of risk.

Program Costs: A Financial Albatross for the American Taxpayer

Because of the steadily escalating costs of the Yucca Mountain program, it is expected that the total life cycle cost of the project would leave the federal budget, and by extension the American taxpayer, with an unfunded liability of major proportions, even by federal accounting standards. Current estimates are that the Nuclear Waste Fund, which was originally intended to pay the largest share of repository program costs through the collection of fees on nuclear-generated electricity, would generate, at most, approximately $41 billion. This estimate is generally considered to be extremely optimistic, given the uncertainties surrounding the operational capabilities and lifetimes of existing nuclear power reactors and the future prospects for any new nuclear plants.

Most current estimates by DOE and, independently, by the State of Nevada have placed the total cost of the repository program between $54 (State) to $59 billion (DOE). However, given the continual escalation in program costs over the past five years (in 1998, DOE estimated the total life cycle system cost at just over $28 billion), the actual cost of the program would likely be considerably higher, with informal estimates now approaching as much as $75 billion.

The Yucca Mountain program would mean an overall deficit for the federal budget in the range of $18 to $35 billion or more. This shortfall would occur at a time when the government's ability to assess utility companies additional fees based on nuclear electricity generation (as is currently the case) would have greatly diminished, if not disappeared altogether. If continued, it is inevitable that Yucca Mountain would become a major net drain on the federal budget and a fiscal liability of enormous proportions. These figures do not include the unreimbursed costs to citizens, communities, property owners, and businesses for their losses.

This situation is further compounded by the fact that, in the event of a serious SNF or HLW transportation accident, the nation will incur enormous costs in the form of negative impacts on property values, damages to ongoing economic activities, foregone opportunity costs, and the exploitation of vulnerable individuals and communities who will be directly affected. These costs would be greater than the entire repository program costs by a factor of ten or more.

Impacts to Nevada's Economy

A radioactive waste accident in or near Las Vegas would almost inevitably produce significant visitor losses. Even without such an accident, the mere presence of a repository, less than 90 miles from the State's major economic center, would have a negative effect on the economy of the region and the State.

Given the unique reliance of the Nevada economy on the State's ability to attract tens of millions of tourists and visitors annually, any impacts that reduce the number of visitors, especially to southern Nevada, would have major consequences for the State's economy. Consequently, the most serious and possibly catastrophic economic risk for Nevada stemming directly from the Yucca Mountain project is the potential for stigma impacts on the tourist and visitor industry. Such impacts would produce significant losses to an economy dominated by visitor-based revenues. Dozens of studies spanning two decades show that populations important to Nevada's economic well being are highly sensitive to the radioactive risks associated with a repository and spent fuel/HLW transportation. These studies have interviewed thousands of residents, visitors and tourists, convention planners and hundreds of convention attendees, professional investors, loan officers, and real estate appraisers. Studies have measured actual behaviors of people who hold positive and negative images of places, like Las Vegas, and the considered opinions of people in response to scenarios ranging from a successful, no adverse event case to radiation and non-radiation accidents. In every case and condition, the studies recorded responses that threaten the attractiveness of the State as a place to visit, move to, or invest in. In every case, the responses pointed to major socioeconomic impacts.

A radioactive waste program by itself would produce significant adverse economic impacts. An accident or incident that caused Las Vegas to become even moderately associated with radioactive imagery would have major negative economic impacts for the area's visitor economy, in-migration, and economic development. Estimates between 5 and 30 percent or larger reductions in key economic sectors are consistent with the empirical evidence gathered.

Annual losses to the Las Vegas and Nevada economy would be expected to reach $39 billion or more in the event of a nuclear waste accident. Even without an accident, the Nevada economy stands to lose upwards of $5.5 billion annually as a result of the stigmatizing effects of the repository and high-level nuclear waste shipments through the State.

Reductions in Property Values Along Transportation Routes

State of Nevada and Clark County researchers have found that the value of property, especially along potential nuclear waste shipping routes in Clark, Washoe, and Elko counties, stands to be dramatically affected should the Yucca Mountain project go forward. Even under the most benign conditions (i.e., where there are no projected radioactive waste accidents), significant property value losses are likely along shipping corridors, as well as at distances up to three miles from the actual highway or rail route.

The findings indicate that an accident, even without a release of radioactive waste, would significantly affect property values. If a major accident involving radiological contamination were to occur, property value losses would be devastating.

These studies found that residential property values along nuclear waste shipping routes in Clark County alone could decline an average of 3.5% even without a major accident or incident, due to the irreducible risks from a designated HLW shipping route. In the event of an accident, losses in real market value could be between $5.6 billion and $8.8 billion. In Washoe and Elko Counties, the estimated residential property value losses are between $1.9 billion and $2.2 billion and between $110 million and $129 million, respectively. Percentage declines of comparable magnitudes can be expected in counties and communities all along Yucca Mountain transportation routes, with total property value impacts statewide totaling in the tens of billions of dollars.

Other Impacts to Nevada's Economy

In addition to negatively impacting Nevada's visitor economy and property values along transportation routes, the Yucca Mountain program would also affect the State's economy in other ways. Even the so-called beneficial effects of the program (i.e., jobs, program spending, etc.) would have negative overall impacts on Nevada's economy. This is because, under the State's tax structure, repository-related increases in population cost the State and local governments more for providing public services than they provide in revenues, a difference of between $670 and $1,000 per person, per year (as estimated in 1990). If these very conservative figures are applied to the estimated Yucca Mountain-related peak population increase of 3,716 (per DOE's Draft Yucca Mountain Environmental Impact Statement (DEIS)), the project, absent any other impacts, would cost the State and local jurisdictions between $2.5 million and $3.7 million annually. This is a consequence of the "standard effects" of the project and is separate from and in addition to any stigma-induced economic effects that may occur during the life of the program.

This finding has important implications with regard to the program's potential to result in severe economic consequences to Nevada. If, as State research has shown likely, the Yucca Mountain program is responsible for the loss of economic activities linked to the visitor sector (i.e., conventions, visitors and tourists, new visitor-related projects such as hotels and casinos), not only would the federal program act as a net drain on State and local revenues, but even the so-called "positive" aspects of this large, multi-

year federal program would result in negative overall impacts to the State. In reality, there are ***no*** positive fiscal effects from this project.

Impacts to State of Nevada Agencies and Local Public Safety Agencies

The direct costs of preparing for and dealing with the project and the massive nuclear waste shipping campaign that would accompany it would be staggering for State agencies and for Nevada's General Fund. Estimates for start-up costs and just the first year of operations exceed $657 million. The total costs to agencies over the forty-year life of the Yucca Mountain shipping campaign would be several billion dollars.

Local government public safety agencies would also bear the brunt of fiscal impacts. In Clark County alone, the incremental costs of preparing for waste shipments, excluding operational expenses associated with responding to the actual shipments themselves, are estimated at $360 million. Statewide, public safety agencies costs associated with the federal program would likely total several billion dollars over the life of the shipping campaign. These estimates do not include adequately staffing, training, and equipping medical and hospital personnel to deal with radiological emergencies. Such costs would add considerably to the overall estimate.

Impacts to Nevada Local Governments

At least 13 of Nevada's counties would be directly impacted by Yucca Mountain construction and operation activities, by the performance of the repository system over thousands of years, and/or by the massive and unprecedented SNF and HLW shipping campaign. These impacts would directly affect public health, economic stability, community development, public revenues, essential community services, and damage to the state's system of governance. Significantly impacted localities include Nevada's major population centers, the Las Vegas metropolitan area and the Reno-Sparks metro area, as well as rural counties and communities throughout the State.

The site county - Nye County - would be uniquely affected by the Yucca Mountain Project. Not only is it at "the end of the funnel" for the massive prospective waste shipment campaign, but the Yucca Mountain Project threatens this growing county's efforts to develop and sustain a viable economic and revenue base in the aftermath of 40 years of nuclear weapons testing on DOE's adjacent Nevada Test Site (NTS).

Development in rural Nevada counties, such as that taking place in southern Nye County, depends upon the attractiveness of the State and its communities. Nuclear waste images would diminish the appeal of Nevada's rural communities for business investment, retirement, and job in-migration.

The magnitude of potential economic and fiscal impacts, however, is greatest in Clark County, the state's major metropolitan area, located at the convergence point for

default highway routes and on the corridor for one of the state's two mainline railroads. Over 80% of the state's dominant visitor-gaming industry is located in Clark County and concentrated in areas adjacent to prospective highway or rail shipment routes. The Las Vegas visitor-gaming industry is particularly vulnerable to stigma effects linked to the repository program and the nuclear materials transportation associated with it. The same stigma impact could also negatively affect economic development, migration, and investment in all of southern Nevada.

Rural communities in central Nevada are particularly vulnerable to the effects of an unprecedented shipment campaign for the nation's highly radioactive wastes, the modes and routes for which are uncertain. Typically in these counties, the economies are fragile, the service systems (particularly emergency and medical response services) are very limited, the road systems are inadequate for such uses, and residential and community activity is clustered closely along the prospective nuclear waste routes.

Even counties that are not formally designated as "affected units of government" under the Nuclear Waste Policy Act would be negatively affected by the prospective shipment campaign. Of particular note are Washoe County, the state's second largest metro area and visitor-gaming center, and Elko County, the urban center of northeastern Nevada. Both communities are developed astride an interstate highway and mainline railroad that could be used for high-level waste shipment. Washoe and Elko counties have estimated property value losses at $1.9-$2.2 billion and $109-$129 million, respectively. Other counties and cities along the routes of Interstate 80 and the Union Pacific mainline would experience comparable decreases in property values due to a Yucca Mountain shipping campaign.

Nevada's state-local revenue structure includes critical sales tax and other revenues that are distributed among localities by formula. Thus, stigma-related damage to the state's metropolitan economies (particularly the visitor-gaming economy of Clark County) would have direct fiscal consequences for local governments across the state, many of which are already in fiscal stress. Visitor spending produces 19% of the taxes for local jurisdictions, currently about $1.3 billion per year. A 7% decline in visitor spending, projected for the no-accident scenarios, would reduce local government tax revenues by $91 million annually.

Given the extreme differences among Nevada's local jurisdictions (in economic base, revenue resources, population and growth, federal land presence, political influence, etc.), and the highly differentiated consequences of the Yucca Mountain Project among the state's localities, the Yucca Mountain site characterization process already has caused conflict among localities and in state-local relations and produced damaging impacts on the system for governance within the State. These impacts would increase if the Yucca Mountain project proceeds, with conflicts broadening along rural-urban and north-south lines.

Impacts to Native American Communities

Native American tribes in the immediate vicinity of the Yucca Mountain project area and along potential transportation routes are, for the most part, economically disadvantaged. Reservations and communities in Nye, Lincoln, and Inyo counties are rural and isolated, and either lack a land base or have land bases too small to support their populations by ranching or other locally common means. A large number of people are unemployed, underemployed, and/or are living below the poverty level. Educational levels have improved in recent years, but without job opportunities in local communities, people must leave to take advantage of their training. Any negative statewide economic impacts associated with or caused by the repository or repository-related nuclear waste transportation would have a disproportionate impact on such communities because of these depressed baseline conditions.

Native Americans are especially vulnerable populations when transportation of nuclear waste to the proposed repository is considered. For example, the Moapa Reservation is transected by I-15 and also by a main north-south rail line from Utah. The Las Vegas Colony is on the edge of I-15 and astride the same railroad tracks - and close to a major downtown Las Vegas switching yard, while their Snow Mountain lands are cut by U.S. 95 between Las Vegas and Yucca Mountain and by one of the potential rail lines.

The Duckwater Reservation is very close to U.S. 6, as is the Ely Colony, and to several of the proposed rail spurs that access the NTS from the east. The Timbisha Shoshone Tribe has lands at Scotty's Junction on U.S. 95 and on the proposed Carlin/Caliente/Bonnie Claire rail line. The Wells, Elko, Winnemucca, and Battle Mountain colonies are on I-80 to the north and existing rail lines, while the Yomba Reservation is close to a proposed rail spur from the north. Only Duckwater has any personnel with Emergency Medical Technician training, and they are not prepared for nuclear disasters.

In addition to impacted tribes in Nevada, there are Native American communities and Indian Reservations in 16 states that would be directly impacted by shipments of spent nuclear fuel and high-level nuclear waste to Yucca Mountain. These include reservations crossed by potential shipping routes; off-reservation ceded lands, where tribes retain treaty rights or other legally recognized user rights, crossed by potential shipping routes; reservation lands and off-reservation lands within transportation emergency evacuation zones along potential shipping routes; reservation and off-reservation lands that could be contaminated by air or water transport of radioactive materials released in a severe transportation accident or terrorist incident (generally within 50 miles downwind, downstream, or down gradient of a potential shipping route); reservations whose highway access would be disrupted by a nuclear waste transportation emergency; and off-reservation lands along potential shipping routes where Tribal personnel would likely be involved in emergency response.

DOE has done little or nothing to evaluate impacts to these communities, nor has DOE provided financial support to enable Native American entities to conduct

independent studies of impacts or monitor and evaluate Yucca Mountain plans and activities that affect them.

Spent Nuclear Fuel and High-Level Radioactive Waste Transportation Impacts Within Nevada

In Nevada, 13 counties, including the State's major metropolitan areas, would be directly and significantly affected by Yucca Mountain related nuclear waste transportation. At the end of the shipping 'funnel', Nevada communities would experience up to 96,000 shipments during a shipping campaign that would span four decades. The transportation of such massive quantities of SNF and HLW will be the most visible and dramatic "driver" of impacts for the State of Nevada and affected local communities. There has been intensive news media coverage of the Yucca Mountain "characterization" process, and equal or more scrutiny can be expected for any SNF/ HLW shipment campaign. No doubt stories will be widely broadcast about glitches, problems, issues with contracts and subcontracts, as well as public responses to everything from the program budgets to small events and, of course, to any major accident anywhere in the country.

The Las Vegas metropolitan area could receive more than 2,500 truck shipments per year, an average of one truck every four hours. Under the minimum impact scenario, Las Vegas would receive 620 shipments per year, an average of one truck or rail cask every 14 hours.

In the event of an accident or incident resulting in the release of radiation, property value impacts throughout the State would be in the billions of dollars. Such property value impacts would likely occur in cities and communities throughout the country along nuclear waste shipping routes.

A severe truck accident in Las Vegas involving the release of radioactive material could contaminate up to 4.3 square miles. Acute radiation exposures during the first 24 hours could result in up to 2.7 latent cancer fatalities. Decontamination would cost over $1.7 billion (exclusive of the costs of evacuations and economic disruption caused by the event). A decision not to clean up the contaminated area could result in between 200 and 1,300 cancer fatalities over 50 years. Accidents of greater severity could occur.

A severe rail accident in Las Vegas (or elsewhere) involving the release of radioactive material could contaminate up to 40 square miles. Acute radiation exposures during the first 24 hours could result in up to 400 latent cancer fatalities. Decontamination would cost over $15.4 billion (exclusive of the costs of evacuations and economic disruption caused by the event). A decision not to clean up the contaminated area could result in between 6,000 and 41,000 cancer fatalities over 50 years. Accidents of greater severity could occur.

Even without a serious accident, the extraordinarily large number of continuous SNF and HLW shipments within Nevada over the extended time frame of the required

Yucca Mountain shipping campaign will expose thousands of people throughout the state to low levels of radiation that could increase lifetime cancer risks and present more individuals within the state (i.e., pregnant women and young children) with more immediate health risks.

The amount of radiation exposures allowed under existing regulations, coupled with the large number of legal-weight truck shipments, would result in substantial worker exposures. State safety inspectors could, in theory, receive doses up to 8.5 rem (8,500 mrem) per year. Fulltime truck drivers could receive annual doses exceeding 4 rem per year. DOE calculated that these exposures over 24 years would increase lifetime cancer risk by at least 8 percent for the maximally exposed worker. Nevada studies estimate that cancer risks would be 50% higher than DOE estimates and that other health risks ignored by DOE, such as risks to pregnant female workers, could be 7-10 times higher than cancer risks. Nuclear Regulatory Commission (NRC) and DOE regulations currently restrict occupational exposures to 5 rem per year. The DEIS states that health risks should be further reduced by restricting worker exposures to 2 rem per year.

Service station attendants could also receive doses well in excess of the NRC and DOE regulations. Along the most likely Nevada highway routes, a service station attendant who regularly fuels and services SNF trucks could receive a dose of 500-1,000 mrem per year. The resulting increased lifetime cancer risk, as calculated by DOE's method, would be relatively small, less than 2 percent over 24 years. But the slightly higher annual cancer risk would be more than 5 times higher than the average annual risk for death in an automobile accident, a risk that is considered intolerable and compels intense efforts by many state and Federal agencies directed to lower the risk.

Other members of the public could receive radiation doses while sharing the roadway with SNF trucks. In urban Clark County, traveling on a multilane highway in heavy traffic next to an SNF cask could result in doses of 4-8 mrem per hour. The occupants of a vehicle stuck in traffic gridlock next to a SNF truck for four hours could receive up to 40 mrem. On rural, two-lane highways, where escorts in separate vehicles are not currently required, the driver of a vehicle traveling one truck-length (20 meters) directly behind a SNF truck would receive a dose of about 0.1 mrem per hour. Tailgating the SNF truck could increase the dose rate to about 1 mrem per hour.

Conclusion

The following chapters present the key findings from over 15 years of research dealing with the full range of potential impacts from the Yucca Mountain program. This information has been widely available in the scientific literature for years. It has been made available to DOE in a variety of ways and at numerous times. The fact that the full range of impacts has not been considered and weighed by the Secretary in making the decision to recommend the Nevada site to the President for development as a repository can only be attributed to intentional neglect on the part of DOE.

This failure to undertake a broad-based and comprehensive evaluation of the socioeconomic, environmental, and public health and safety impacts associated with the Yucca Mountain program, both in Nevada and within cities and communities located along nuclear waste shipping routes nationally, renders any site recommendation not only premature, but also fundamentally flawed.

The Nevada research demonstrates that the Yucca Mountain program is both unworkable and unnecessary. One inescapable conclusion is that the federal government is in no way prepared to deal with – or is even aware of – the effects of the Yucca Mountain project on society and the country. The research concludes that DOE and the national government must become much better prepared to solve the array of problems presented by public responses, opposition, and resistance to SNF/HLW facilities and SNF/HLW transportation before proceeding with a high-level radioactive waste program on a scale and consequence of the proposed Yucca Mountain program.

Any successful future program will have to learn from the mistakes of the past. Most importantly, there must be a commitment to fully understand the consequences of a major and unprecedented nation SNF/HLW shipping campaign. This commitment must be coupled with an unimpeachable commitment to scientific and technical integrity in all aspects of the SNF/HLW management and disposal program. Finally, the effort must be governed by the principle of full involvement on the part of affected states and localities, together with an unyielding commitment to a voluntary process by which potential storage and/or disposal sites are identified, studied, and developed.

The opportunity and resources exist today for the nation to embark upon just such a course. New dry storage technologies, not fully developed in 1982 when the Nuclear Waste Policy Act was crafted, are now available to provide safe, efficient, and economical storage of SNF at nuclear power stations. These facilities, already among the most secure commercial installations in the country, can be made even more secure by relatively simple upgrades, many of which are currently being implemented. Such at-reactor storage would have to be implemented for most, if not all, existing nuclear power plants even if the Yucca Mountain program were capable of being implemented, since the lead time for accepting waste at the facility extends from at least 10 to as many as 50 years.

DOE has already created the model for this interim solution to the waste problem in the agreement with Pennsylvania Electric Company (PECO). Under that arrangement, DOE will take title to spent fuel at PECO's Peach Bottom reactor while the waste remains on the grounds of the generating station. Through reductions in the fees DOE assesses PECO for nuclear-generated electricity, DOE will provide compensation to the utility for the costs associated with implementing and maintaining on-site storage and for necessary ongoing upgrades to facilities.

The PECO solution permits DOE and the nation more that enough time to carefully assess how and why the Yucca Mountain program failed and how best to proceed in the future and avoid the mistakes of the past. It also allows time for the

political and social climate surrounding the nuclear waste issue, so fouled by the atmosphere of distrust and cynicism caused by the Yucca Mountain project, to recover, while affording the country the opportunity to devote time and resources to the development of new waste reduction technologies, such as transmutation.

To rush ahead with the failed and dangerous Yucca Mountain program ignoring the legitimate scientific, ethical, social, and political opposition and in the face of the massive and irreparable impacts the program will inflict upon Nevada and the nation is not only unwise, but also entirely unnecessary. The findings and conclusions contained in the following chapters and in the extensive body of literature these chapters are built on demonstrate convincingly the folly of continuing the course with Yucca Mountain. However, they also point the way towards a new, equitable, and ultimately successful approach to the high-level radioactive waste program.

CHAPTER ONE
OVERVIEW AND HISTORICAL CONTEXT

Overview

The Yucca Mountain program presents the nation and the State of Nevada with the prospect of incurring risks and impacts unprecedented in U.S. history - perhaps even in human history - not just for years or decades, but for thousands and even tens of thousands of years into the future. The project represents an undertaking of unprecedented proportions and risks, one that embodies extremely long time horizons, an uncertain political and financial base, a massive, unprecedented radiological materials transportation component, and a long list of site, engineering, and transportation characteristics that result in almost-unheard-of uncertainty levels for every aspect of the program.

A repository at Yucca Mountain, about 90 miles from Las Vegas, and the transportation of spent nuclear fuel (SNF) and high-level radioactive waste (HLW) to such a facility have the potential to significantly and negatively impact not just Nevada and the California region close to the proposed repository facility, but it will also directly and indirectly impact states and communities throughout the nation located along spent fuel and HLW transportation routes.

While the impacts to the State of Nevada from the Yucca Mountain program would be enormous, they pale by comparison to the potential negative impacts that would accrue nationally to the hundreds of cities and thousands of communities along thousands of miles of highways and railroads en route to the Nevada facility, as well as to the federal budget and the American taxpayer.

The transportation of SNF and HLW is ***the*** major source of these impacts, which include potential widespread and substantial damage to public health and safety, the environment, economic development and economic well-being, property values, and a host of other consequences discussed in the pages that follow.

The fact that Yucca Mountain, a project designed to benefit a largely privately owned, for-profit industry, is being forced on one lone state against the strong, consistent, ubiquitous, and irreversible opposition of the State, its people, and its elected officials is unprecedented in the history of American federalism. The conflict and constitutional turmoil potentially created by such a situation exacerbates and amplifies other project impacts and will have consequences, both in Nevada and nationally, that extend far into the future.

Apart from and far surpassing the more traditional impacts of large, complex, and dangerous projects, the Yucca Mountain program and the associated HLW shipping campaign would generate a class of stigma impacts that attach to nuclear and/or hazardous facilities and activities. These are not psychological effects; nor are they inconsequential. These are real, definitive, quantifiable impacts that are directly

manifested in economic indicators such as reduced property values, reduced value for agricultural products, reductions in tourism and conventions, suppressed economic development, and reduced business investment. The costs related to this class of impacts are substantial in the extreme and are not readily subject to avoidance or any form of mitigation. They can occur anywhere in the country affected by nuclear activities associated with the federal program.

Strong public responses to facilities and programs designed to store, dispose of, or transport radioactive wastes have a long history. They have been expressed in every area of the country and have served to initiate important political, social, and economic behaviors. Opposition and aversion as responses to radioactive wastes have been recorded by journalists, economists, sociologists, social geographers, social psychologists, historians, anthropologists, risk analysts, planners, regulators, legislators, physical scientists, social scientists, politicians, business leaders, and local, state, and federal officials. Opposition and aversion are so prevalent that they dominate the range of responses. Failure to recognize this fact and address the implications of such aversion and opposition is a failure to address the most basic and important socioeconomic impact from the proposed repository at Yucca Mountain and the transportation of nuclear waste to such a facility.

Over the past two decades, social scientists have developed the theories, methods, data, and analytical capabilities to describe, understand, and project the range of potential socioeconomic impacts. Information on the public's responses to the repository program and how people's behaviors produce important, concrete, and quantifiable socioeconomic impacts has long been available.

It is irresponsible and unacceptable for the Secretary of Energy to consider recommending the Yucca Mountain site to the President for development as a nuclear waste repository without first having fully studied, understood, and addressed all of the social, economic, health and safety, and environmental impacts of this unique facility and the unprecedented national nuclear waste transportation program it embodies.

Historical Context

The Nuclear Waste Policy Act of 1982

After two decades of failure on the part of the Atomic Energy Commission and its successor agencies to solve the HLW problem, Congress spent five years considering the problem and eventually passed the Nuclear Waste Policy Act of 1982 (NWPA). In direct response to public resistance and aversion to HLW facilities and activities, the NWPA of 1982 incorporated a number of unique and interdependent provisions to obtain congressional approval and to address the concerns of state and local communities.

Several provisions or compromises addressed concerns about an equitable outcome from the program. Two repositories were mandated, one in the West where some potential sites had been looked at, and one in the East where most of the wastes are

created. The principle was established that generators of the wastes would pay for the program, and a fee was imposed on nuclear-generated electricity to create the Nuclear Waste Fund. Compensation was authorized for states and communities that experienced adverse economic impacts.

Provisions of the Act were specifically directed at the need to assess the full range of impacts that would result from the federal program. The Act even requires the Secretary of Energy to make grant funds available to potential host states and, later, to any affected unit of local government for the purpose of "determining any potential economic, social, public health and safety, and environmental impacts of a repository on such State, or affected unit of local government and its residents" [42 U.S.C. 10136(B)(i)].

In addition, the Department of Energy (DOE) was required to report to affected stakeholders (state governments, Indian tribes, the public, etc.) on all activities. The site selection process was to be based on objective technical criteria and was to be subject to outside scrutiny and review. DOE was directed to consult and cooperate with affected states and tribes (including those impacted by HLW transportation) before making key decisions. Participation by the affected states and tribes to oversee the repository program and conduct impact and other studies was to be funded through the Nuclear Waste Fund. Host states were provided with the right to file a notice of disapproval, essentially a veto of the site, which could only be overturned by Congress.

The NWPA assigned the U.S. Environmental Protection Agency the duty to set radiation exposure standards and gave the U.S. Nuclear Regulatory Commission the authority to permit and license the construction and operation of a repository facility. The provisions for fairness and assuring public safety were designed to make the eventual choice of a site acceptable to those directly affected and to the nation as a whole. This attempt was successful to the extent that, in December 1982, there was support for this Act even from congressional representatives from states identified as potential repository host sites.

The finely crafted compromises and protections governing the identification and evaluation of potential repository sites built into the original Act were summarily abandoned in the 1987 amendments that singled out Yucca Mountain as the only site to be considered. The result was an almost total loss of credibility in Nevada and elsewhere for DOE's site characterization effort and the creation of an atmosphere of hostility and distrust – an ideal breeding ground for the massive and pervasive impacts documented in this report.

Nevada Studies to Evaluate Impacts

Key issues, concerns, and problems that produced social and economic impacts and limited public acceptance and support were brought into focus during the early years of the federal program (1983-1987). Public concerns about human and environmental exposure to radiation were clearly articulated in the context of widespread references to

past DOE activities with the nation's weapons program. Expressions of distrust of DOE were raised at the federal, state, and local levels. The ability of DOE to properly manage the program mandated by Congress was called into question on several levels as the schedule for performance slipped, key program goals were ignored, adversarial legal actions were initiated, and costs escalated.

State and local governments raised important questions. In addition to the exposure risks and the questions about DOE management, concerns were expressed that the public would respond adversely to places that hosted HLW facilities. Tennessee, for example, argued that a Monitored Retrievable Storage Facility would stigmatize local communities and the state, adversely impacting attempts at economic development. Along the same lines, the State of Texas and farmers near the Deaf Smith County candidate repository site were concerned that their agricultural crops would be stigmatized. This was also a concern of farmers in Washington State near the proposed facility site on the Hanford weapons complex reservation. In Maine, there was concern that a potential second repository site would ruin the tourist and recreation economy of the area, a potential adverse impact that was also raised in more than a quarter of the statements at public hearings held in Wisconsin and North Carolina (Kraft and Clary, p. 105).

There was also widespread concern about the risks associated with the HLW shipping campaign needed to implement the federal program envision by the Act. As early as 1986, organizations such as the Western Governors' Association and the Western Interstate Energy Board were strongly and persistently urging DOE to move proactively to disclose the various elements of this national transportation system, including the preferred method by which waste would be shipped, the routes that would be used, and the states that would be affected.

This early history of public responses throughout the nation to the NWPA (1982) program served to identify important areas of socioeconomic impact for DOE, state, and local officials responsible for administration and oversight of HLW programs. In terms of socioeconomic impacts, it became clear during this period that HLW possessed the potential to induce a wide range of impacts at all levels of society and to produce "special effects" as a direct result of the nuclear and hazardous nature of the program. In order to evaluate the potential socioeconomic impacts of a repository program, it was clear that these special effects would have to be taken into account, not only as they pertained to the host state, but also to states, cities, and communities affected by shipments of spent fuel and high-level waste destined for a repository.

By virtue of having one of several repository sites being considered, the State of Nevada outlined the requirements for assessing impacts of the proposed facility site at Yucca Mountain in 1985 and initiated a major research effort. The purpose of the effort was to identify and evaluate not only the standard economic-demographic-fiscal impacts based on tried and true methods developed over the preceding decade of experience with the National Environmental Policy Act of 1969, but also to conduct new basic research to address "special effects" that were so obviously important determinants of public

responses to HLW facilities, HLW transportation, and the impacts stemming from such responses. To provide for an objective review of the research effort, the State established a Technical Review Committee made up of distinguished social science researchers and professionals.

The effort to understand project impacts focused on both the unique characteristics of the Nevada economy, especially tourism, gaming, conventions, recreation, outside business investments, and the in-migration of workers and retired people, as well as the nature of the HLW transportation system required to move waste to a repository. The goal was to develop methods to evaluate the potential effects of the repository within the Nevada and national socioeconomic contexts.

The Historical Case for Assessing Impacts

Potential impacts from the federal HLW program stem directly from two interrelated sources: The repository facility itself and the transportation of HLW to the facility. Operating with respect to both of these sources are (1) the interplay of each with the direct physical, environmental, economic, and public health contexts that characterize both elements, and (2) the potent, but less well understood effects that stem from the nuclear nature of the facility and the waste shipments, together with public responses to things nuclear, especially to high-level radioactive waste.

It became clear to Nevada researchers early on that the potential negative impacts stemming from the nuclear stigma associated with the federal program would be substantial, and even DOE initially acknowledged the need for further investigations.

As early as 1986, DOE's final Environmental Assessment (EA) for the Yucca Mountain site acknowledged the potential for impacts to Nevada's tourism-dependent economy and the need for additional research:

> "... the potential for adverse public perception of a repository and its associated waste transportation could adversely affect the tourism industry. The importance of public perception lies in the attractiveness of the image of Las Vegas to potential visitors. Concerns have been expressed that this image could be affected by the visibility of the repository and waste shipments and by safety concerns regarding the high-level radioactive waste-disposal system, particularly when accompanied by extensive media attention. Preliminary research to date concerning the potential effect of a repository on tourism is inconclusive; *therefore further studies would be conducted*" (emphasis added).

Additional commitments to address tourism and so-called risk perception impacts are contained throughout the final EA. Nevertheless, no subsequent work in this crucial impact area by DOE's Yucca Mountain Project was ever carried out - or, if it was, the work was never disclosed.

When Congress redirected the federal HLW program in 1987, it implicitly acknowledged the unique and special nature of the program, the intense public responses to it, and the need for a complete and exhaustive assessment of impacts. Section 175 of the Nuclear Waste Policy Amendments Act of 1987 directed DOE to report to Congress on potential socioeconomic impacts that could occur as a result of locating a repository at the Yucca Mountain site, including those related to the transportation of waste to the facility. DOE was directed to report on fourteen (14) specific areas of potential impacts covering the gamut from education to public health to public lands, emergency response, and transportation, among others. Specifically singled out by Congress was the directive (number 13 on the list) that DOE report on potential impacts to "tourism and economic development, including the potential loss of revenue and future economic growth."

The "Section 175 Report" was released in December 1988. While the treatment of tourism and economic development impacts in the document was cursory at best, the report did conclude that a repository at Yucca Mountain could have negative effects on these important economic areas. With respect to economic development, the report found that, "[b]ecause the repository may be defined by some as a hazardous activity, some limitations on the prospects for economic development … may result."

In evaluating the potential for impacts on tourism and economic development later in the report, DOE concluded that "[p]ossible changes in economic development patterns, generally, and in the tourism industry specifically, in southern Nevada may result from the repository program." Such impacts were to be identified and quantified in subsequent impact assessments. No mention was made of the potential for these impacts to occur throughout the national nuclear waste transportation system.

Following the publication of the Section 175 Report, a June 1992 policy directive was issued by DOE headquarters to Office of Civilian Radioactive Waste Management (OCRWM) Associate Directors and Office Directors stipulating that "... perception-based impacts [i.e., stigma impacts] are of potential concern to affected governments, interested parties and the public and should be appropriately addressed by OCRWM." The memorandum was in response to an earlier memo that sought to limit research in this area. The new directive superceded the prior guidance and specifically noted that "[the previous memorandum] is not viewed as limiting OCRWM-supported research in this area [i.e., stigma and perception impacts on tourism and economic development]."

The June 1992 memorandum was followed in July 1992 with a "Socioeconomic Policy Management Directive" from OCRWM. This directive was intended to serve as "... the program-level policy document that would guide the conduct of all OCRWM socioeconomic activities. Project-level socioeconomic plans for all OCRWM components would be prepared in accordance with the guidance provided in this document, and would serve as the primary source of information about each project's socioeconomic activities" (page 1).

To guide the OCRWM socioeconomic program, the Policy Directive set forth a list of specific objectives "designed to help OCRWM realize its mission." Two of these

objectives are especially relevant to the draft Yucca Mountain Environmental Impact Statement (DEIS):

- Address "standard" impacts arising primarily from program-related employment and population growth as well as expenditures for materials, equipment, and services.

- Address developments, as necessary, in the area of "special" impact assessment arising primarily *from the various components* of the high-level radioactive waste program [emphasis added] (page 2).

In addition to DOE's policy pronouncements regarding the need to assess "special" impacts, there is evidence that DOE considered the State of Nevada's extensive work in identifying potential stigma impacts associated with the high-level radioactive waste program and nuclear waste transportation to be credible and appropriate. In 1993, DOE commissioned Argonne National Laboratory to evaluate research on risk perception and stigma impacts carried out by the State of Nevada. Since much of the State's work involved survey research, Argonne contracted with the National Opinion Research Center (NORC) at the University of Chicago to undertake a technical evaluation of the methodologies used in the State's "special" impact assessment activities. The NORC report is instructive as to the high quality and appropriateness of the Nevada stigma research. The report concluded:

> "... the [State of Nevada] surveys could provide valuable data about risk perceptions and potential behavioral responses. NORC identified a few minor problems with a number of questions and calculated response rates but claimed these problems would probably not have any major biasing effects."

The report went on to praise the creativity and robustness of the survey research, noting that the State surveys "exhibit some considerable creativity in approaching a difficult measurement problem." The report expressed "confidence that the conclusions [of the State's stigma research] are not highly dependent on the measurement technique, that is they are robust across measurement methods," noting that "... such robustness is a very important attribute in assessing the validity of the surveys."

DOE has, in fact, sponsored its own "stigma" research that was not included in the socioeconomic analyses contained in the DEIS or in any other DOE evaluations on Yucca Mountain impacts or suitability. An excellent example of this research, which has direct implications for potential national transportation impacts of the program, is the work done by the University of New Mexico under contract with DOE. Of particular interest is a study by Gawande and Jenkins-Smith (1999) on the effects of stigma on property values along routes in South Carolina that were used to transport spent nuclear fuel from foreign research reactors. The Gawande and Jenkins-Smith findings are extraordinarily important and relevant to the potential for stigma effects stemming from the Yucca Mountain program and related nuclear waste transportation. Specifically, the

researchers found that the hazardous, nuclear nature of these shipments and peoples' responses to them directly caused property values in urban Charleston to be "lowered in a substantive manner":

> "... we are convinced by the results for Charleston County [South Carolina] that real price effects can occur when shipments like those involved in the [foreign spent nuclear fuel] FSNF return program take place. Despite systematic and extensive search for alternative explanations, the onset of the shipments appears to be the best explanation for the drop in housing values close to the route. Moreover, the results are consistent with research regarding the effects of other disamenities (e.g., polluted water, air and Superfund sites), with the self-reports of perceived risk of spent nuclear fuel shipments obtained in public opinion surveys, and with surveys of expected effects of nuclear waste shipments on housing values (Flynn et al, 1997)."

In 1991, Argonne National Laboratory, under contract to DOE, undertook an evaluation of the need for studies into potential stigma-related impacts on business location decisions and economic development in Nevada. The issue of possible impacts of stigma and risk perceptions on small firms' location decisions was addressed:

> "Stigmatization and perceived risk can influence the location decisions of small firms, because of the importance personal preferences play in their location decision-making behavior. Although the impact of changes in behavior as a result of stigma and changes in risk perception is likely to be smaller in terms of total employment and income effects than it would be if a large manufacturing or service firm were forced to move, the effect on the competitiveness of a location can still be substantial. ...Consideration of the location decision-making behavior of small firms would be of great value in assessing the special effects associated with a repository or other hazardous facilities, given the importance of personal preferences in location decisions. ... Systematic consideration of these influences on entrepreneurs of small firms would be important in determining if and how stigmatization and perceived risk would affect the location decisions of small businesses."

Despite all of the information available and DOE's own assurances that the full range of impacts from Yucca Mountain and the associate HLW shipping campaign would be assessed well before any site recommendation was made, the Department failed to accomplish – or even attempt – this work in the single most important environmental document for the repository program, the Draft Yucca Mountain Environmental Impact Statement. Following its release for comment in August 1999, the State of Nevada conducted a comprehensive review of the DEIS and provided several hundred pages of comments. The State found DOE's approach to impact identification and analysis to be both legally and substantially deficient. More importantly, the State perceived a certain

intentionality in the avoidance of an adequate and complete examination of project impacts:

> "The fundamental and irreparable shortcomings of the Draft EIS are all the more disturbing because DOE should have known better. Thousands of pages of comments were provided on the draft and final EA. Nevada alone submitted over 300 pages of detailed, focused, and extremely helpful comments on the [1985] draft EA. Thousands more comments were made by hundreds of people and organizations during the scoping process for the draft EIS in 1995. For the most part, prior comments and criticisms that would have assured an adequate EIS were disregarded. DOE simply moved stubbornly forward in a manner designed to produce a minimalist environmental impact statement ratifying DOE's predetermined and politically driven conclusion that the Yucca Mountain program would result in no significant impacts anywhere, at any time" [State of Nevada Comments of the Draft Yucca Mountain EIS, February 2000].

It is clear from the historical record that DOE, as early as 1988, recognized the potential for "special" or stigma effects of the Yucca Mountain program and HLW transportation to result in significant impacts to Nevada and the nation. DOE took steps to evaluate the extensive body of research on this matter produced by the State of Nevada and found that work to be sound. Finally, DOE undertook its own research on stigma impacts associated with the transportation of spent nuclear fuel and obtained confirmation that such impacts can and do occur and are potentially significant.

Nevada's research has developed a convincing body of evidence that shows the greatest potential socioeconomic threat from the proposed repository stems from impacts related to intense negative perceptions and stigma associated by the public with a high-level radioactive waste repository, combined with the vulnerability of Nevada's and other states'/communities' economies to changes in their public image and stigmatization resulting from program activities. Because of the high profile nature of the whole nuclear waste disposal program, the potential exists for Nevada as well as other locations to become associated with these negative perceptions to the detriment of their ability to attract tourists, conventions, migrants, and diversified new industry. This would be especially troublesome in the event of a nuclear waste accident in or near Las Vegas or another major urban center that might stigmatize the area and cause visitors to stay away in significant numbers or create other forms of significant economic disruption. The work to date demonstrates not only that Nevada is uniquely vulnerable to such stigmatizing effects because of its tourism-dependent economy and State revenue structure, but that other states and cities throughout the country could be impacted as a result of this same stigmatizing processes.

The following chapters reflect the findings from over 15 years of research dealing with the full range of potential impacts from the Yucca Mountain program. This information has been widely available in the scientific literature for years. It has been made available to DOE in a variety of ways and at numerous times. The fact that the full

range of impacts has not been considered and weighed by the Secretary in making the decision to recommend the Nevada site to the President for development as a repository can only be attributed to intentional neglect on the part of DOE.

This failure to undertake a broad-based and comprehensive evaluation of the socioeconomic, environmental, and public health and safety impacts associated with the Yucca Mountain program, both in Nevada and within cities and communities located along nuclear waste shipping routes nationally, renders any site recommendation not only premature, but also fundamentally flawed.

The Importance of Context

It is impossible to overstate the importance that context plays in conditioning both the likelihood of impacts occurring from the Yucca Mountain program as well as the magnitude of those impacts. The fact that the federal high-level nuclear waste repository program is being implemented in a coercive manner that ignores strong, ubiquitous, and long-standing opposition on the part of the State of Nevada and its citizens is an important factor that conditions how the entire array of impacts discussed in this report are manifested.

Context is also important with regard to the credibility of the implementing agency and the trust (or lack of trust) that exists in the agency's ability to implement such an unprecedented and risky program in a manner that is at once competent and safe, scientifically and technically unimpeachable, and ethically and morally legitimate. The manner in which DOE has approached the Yucca Mountain program, including the controversial and questionable science that has characterized the project and DOE's historical track record of contamination and, in some cases, intentional harm inflicted on people and communities throughout the country over the past five decades, all contribute to the atmosphere of pervasive distrust that permeates the Yucca Mountain program (SEAB, 1993).

It is also important to understand the relationship between the credibility and legitimacy of the implementing agency, technical issues associated with site suitability, program-related safety and risk issues such as those associated with the transportation of radioactive waste, and the socioeconomic impacts that would be visited on the State and the nation by this project. A program that lacks technical credibility, that ignores or obfuscates risks, and that fails to address fundamental issues and concerns raised by those most potentially affected (such as states and communities along potential HLW shipping routes) will invariably generate public and official distrust, which in turn exacerbates the risk perception and stigmatizing effects already known to be associated with a HLW repository and HLW transportation.

This lack of credibility is pervasive throughout DOE's HLW program. It is manifest both in the manipulation of "science" at Yucca Mountain and in the almost complete avoidance of the risks and impacts associated with waste transportation nationally.

For more than ten years, Nevada officials have maintained that the Yucca Mountain site should be disqualified from consideration for development of a repository. They have based this conclusion on DOE's own siting guidelines, which require that a repository site be disqualified if it fails to meet certain very specific conditions. DOE has long maintained that any Yucca Mountain siting decision would be based on sound science. However, when it appears that science dictates the site be disqualified, DOE's response has been to change the rules.

As recently as November 2001, DOE issued new site evaluation guidelines when the groundwater travel time from the repository to the accessible environment was shown to be greater than that allowed in the disqualifying condition for this factor under the old guidelines. The new guidelines permit DOE to ignore this critically important safety issue by relying solely on a very complex performance assessment whereby the troubling issue of rapid water movement through the repository becomes lost in an almost unintelligible mix of fact and wishful thinking (i.e., assumptions and expert judgment in place of measurable data).

As more and more problems were discovered about Yucca Mountain's ability to isolate highly radioactive and long-lived waste, DOE has moved farther and farther away from the concept of geologic isolation – the fundamental and guiding principle embodied in the Nuclear Waste Policy Act as ***the*** national policy for disposing of spent nuclear fuel and HLW. DOE now relies almost exclusively on "engineered barriers" to keep deadly radiological materials from migrating out of the repository and into the environment. Among the exotic "fixes" are waste disposal containers that supposedly will last between 10,000 and 700,000 years and over 100 miles of titanium drip shields within the repository tunnels.

DOE's own performance assessment models show that the actual Yucca Mountain site is so poor that it can be counted on for less than 5% of the overall system performance (i.e., the waste isolation capability), while engineering measures make up the remaining 95% of the total performance of the system. Not only is this a clear violation of the underlying premise of the Nuclear Waste Policy Act that geology must be the primary barrier, but it also undermines the foundational recommendation of the National Academy of Sciences that manmade materials not be used in a repository to compensate for faulty geology or hydrology. What DOE has done is to turn the concept of geologic isolation of high-level radioactive waste on its head and turn Yucca Mountain into an environmental and public health and safety time bomb kept in check only by a series of exotic, untested, and highly uncertain manmade barriers.

The technical case against Yucca Mountain is compelling. Twice now the State of Nevada has demonstrated that the Yucca Mountain site cannot meet existing federal regulations and should be disqualified. Each time, however, either the regulation was changed or DOE simply refused to acknowledge the validity of the State's analysis. In a final act of either defiance or desperation, DOE has now completely changed the rules by which the site is evaluated.

A similar situation exists with respect to critical issues involving the safety of nuclear waste transportation to a Yucca Mountain repository, especially as it applies to prospective waste shipments nationally. Since at least 1986, states and states' organizations (such as the Western Interstate Energy Board and the Western Governors' Association) have been calling on DOE to proactively disclose crucial information about the proposed HLW transportation system that would be needed to implement the Yucca Mountain program. It has long been recognized by these states that transportation of SNF and HLW has the potential to inflict substantial risks to states and communities along national shipping routes. These risks are significant "drivers" of many of the socioeconomic and related impacts associated with the federal program. DOE's and the federal government's approach to transportation analysis, planning, risk identification, and risk management has done little to attenuate these risks and, instead, has either served to obfuscate or actually exacerbate risks and their consequences.

It is not coincidental that, after more than 18 years of work and planning for the management and disposal of spent fuel and HLW under the Nuclear Waste Policy Act, most people and public safety officials in states and cities directly affected by tens of thousands of repository-related nuclear waste shipments remain almost entirely ignorant of this impending burden on their communities. Nor is it an oversight that even the most basic transportation decisions – such as the mode of transport or the routes that would be used – have yet to be made (or at least made publicly available) either for Nevada or for the national transportation system. Such lack of planning and disclosure can only be attributed to gross incompetence or intentional withholding of information.

The coercive nature of the federal program, the lack of technical and programmatic integrity, and the willingness of federal actors to ignore risks and safety issues for political or policy reasons combine to create an environment of distrust that has become an ideal breeding ground for the types of severe, pervasive, and long-lasting impacts the State of Nevada has identified in this report.

CHAPTER TWO
NATIONAL IMPACTS OF THE YUCCA MOUNTAIN PROGRAM

While the physical location for the proposed Yucca Mountain repository is within the State of Nevada, the impacts of DOE's high-level nuclear waste program reach well beyond the confines of one state. In fact, the national impacts of this project would far surpass in magnitude and scope those that are specific to Nevada, although the Nevada impacts, as documented in subsequent chapters of this report, would, of themselves, be enormous. Ironically, while the efforts made by DOE to understand risks and impacts to Nevada have been minimal and inadequate, even less has been done to assess the effects of this massive and unprecedented program on the country as a whole.

Of all the impacts associated with the Yucca Mountain program, none are as far-reaching and pervasive as those related to the transportation of SNF and HLW. Tens of thousands of shipments of extremely dangerous radioactive waste would impact 44 states, hundreds of cities, and thousands of communities, day after day, week after week, month after month for 38 years or more. Transportation would be the principal cause of impacts ranging from losses in property values to depressed economic activity to escalating and unfunded preparedness and response costs to social disruption and even civil unrest. The risk of a public health and economic catastrophe following a severe accident or terrorist incident would persist daily for the life of the shipping campaign for hundreds of vulnerable metropolitan areas nationwide.

In addition to the tremendous national transportation implications, the cost impacts of the Yucca Mountain program will be considerable, even for the budget of the federal government. Costs of the program have escalated in just three years from approximately $28 billion to over $59 billion (and may eventually be as high as $75 billion), while the funding mechanism established to pay for it - the fees levied on nuclear-generated electricity - continues to face major uncertainties due to a diminishing revenue base. With an unfunded taxpayer liability of between $17 and $34 billion, the DOE HLW program represents a fiscal time bomb for future federal budgets.

Finally, the damage Yucca Mountain would inflict on future state-federal relations would be considerable. A decision by the President to forge ahead with this transparently flawed project in the face of Nevada's strong, long-standing, consistent, legitimate, and scientifically based opposition would have damaging consequences for the nature and shape of American federalism now and in the future, as the nation pursues solutions to other difficult problems involving hazardous facilities and controversial technologies.

A more comprehensive analysis of these issues is contained below. However, the mere fact that DOE has not considered such crucial areas of national impact is reason, by itself, for the President to reject a decision to forge ahead with the flawed Yucca Mountain program.

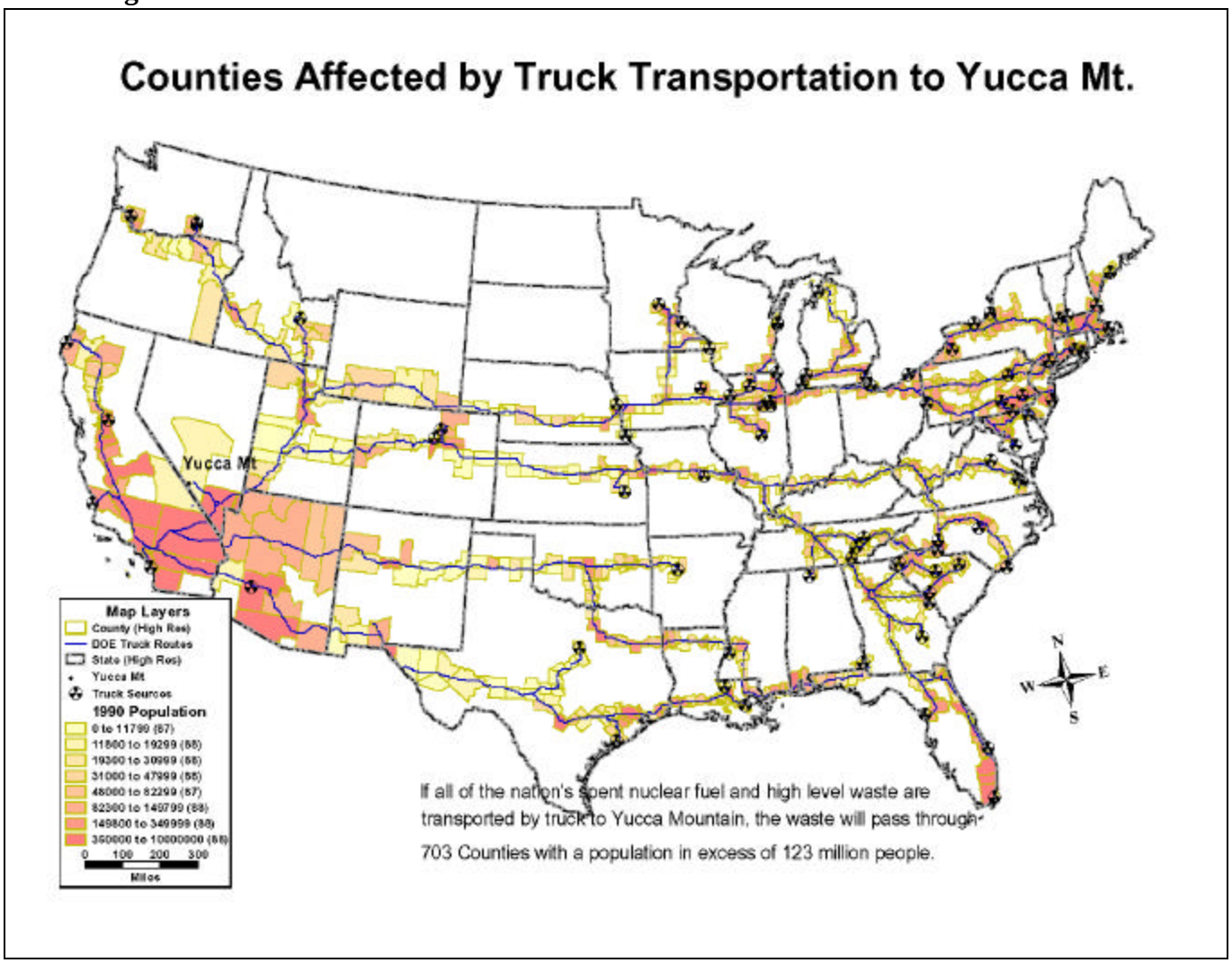
2.1 National High-Level Waste Transportation Impacts

The transportation of spent nuclear fuel and high-level radioactive waste to a Yucca Mountain repository would require an effort of truly epic proportions. More radioactive waste would be shipped in the first full year of repository operations than has been transported in the entire five-decade history of spent fuel shipments in the United States. Shipments from 77 reactor and storage sites in 39 states would travel America's most important east-west interstate highways and mainline railroads. In all, 43 states, besides Nevada, would be directly impacted, including at least 109 cities with populations exceeding 100,000, hundreds of smaller cities, and thousands of communities.

Development of Yucca Mountain would unleash a continental nuclear waste shipping campaign of completely unprecedented size and duration. With these shipments would come a constellation of hazards and risks, including elevated radiation exposures to workers and the public from routine transportation activities; risk of credible severe accidents capable of contaminating tens of square miles, requiring billions of dollars in cleanup costs to prevent thousands of latent cancer fatalities; heightened vulnerability to terrorism and sabotage in metropolitan areas; and significant economic damage and property value losses in cities and communities along shipping routes, even if no severe accidents occur.

Under the only transportation scenario currently feasible, there would be up to 96,000 cross-country truck shipments over 38 years. The most likely truck routes to Yucca Mountain are shown in Figure 2.1.1. The "mostly truck" scenario would affect 44 states, including Nevada. For 38 years, truck shipments to Yucca Mountain would be a daily occurrence. The routes pass through 703 counties with a population in excess of 123 million people. More than 7 million people live within one-half mile of these highway routes.

Figure 2.1.1

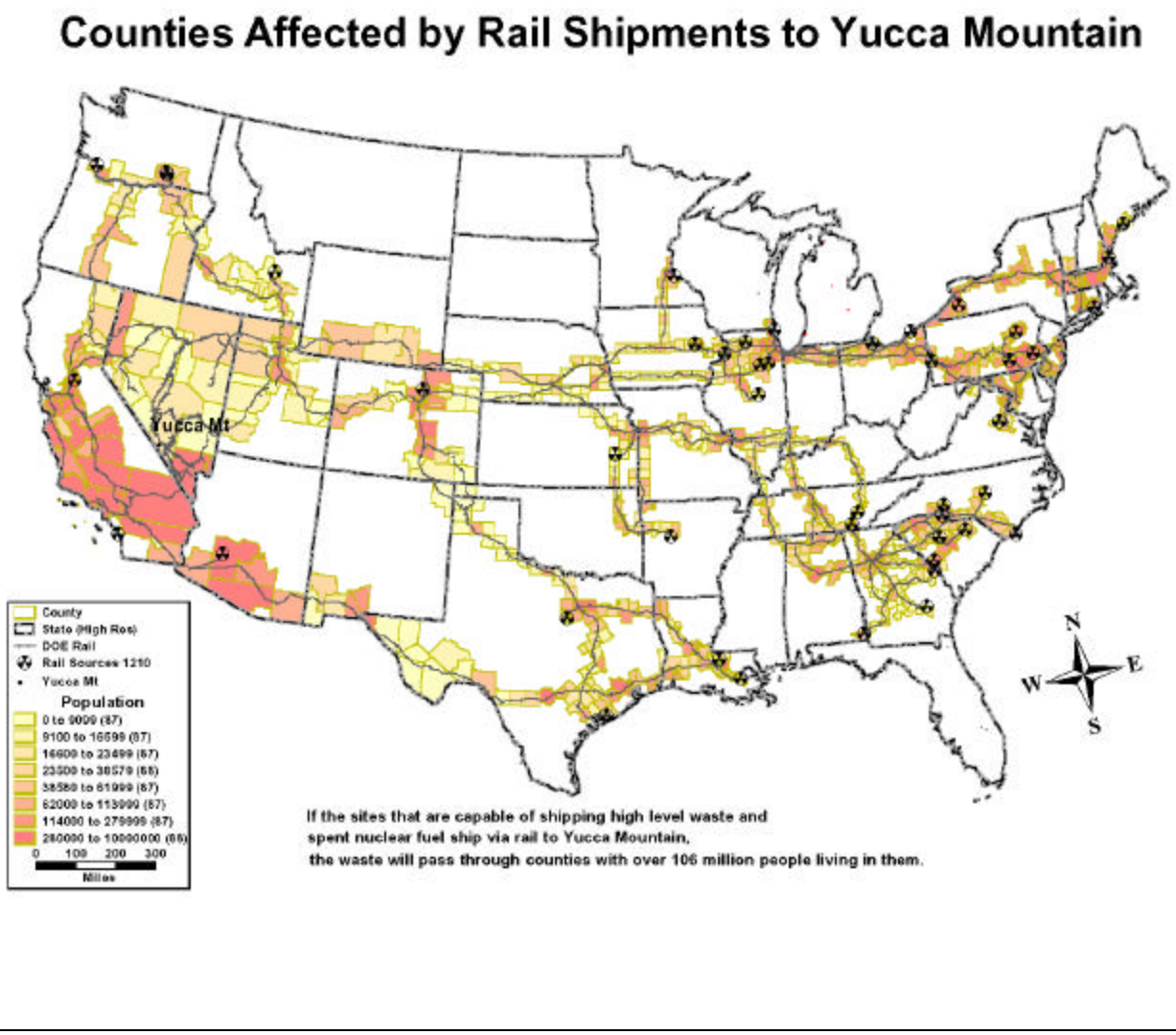


The use of rail as a mode of transport to Yucca Mountain is problematic for several reasons. First, there is no rail access to the Nevada site and providing such access would require construction of anywhere from over 100 miles to almost 500 miles of new rail line at a cost of over $1 billion. Second, many of the nuclear power plant sites either lack rail access altogether or lack the capability to handle very large rail shipping casks. Rail shipments would require major infrastructure expenditures at numerous facility sites, an unprecedented use of heavy-haul truck and/or barge transportation to move casks to a useable railhead, or both. For these reasons, rail shipments to Yucca Mountain are not considered viable at this time.

However, if rail shipments became feasible, according to State of Nevada estimates, 40,300 shipments would be required. The most likely rail routes to Yucca Mountain from sites that can presently ship by rail are shown in Figure 2.1.2. DOE's plan

would route rail shipments through 43 states. The rail routes pass through counties with a combined population over 106 million. More than 11 million people live within one-half mile of DOE's proposed rail routes.

Figure 2.1.2



National Transportation Overview

Recent Spent Nuclear Fuel Shipments

During the past two decades, nuclear power plants and research facilities in the United States have made relatively few off-site shipments of irradiated reactor fuel, more commonly referred to as spent nuclear fuel (SNF). The U.S. Nuclear Regulatory Commission (NRC) regulates such shipments and maintains a detailed SNF shipment database. Between 1979 and 1997, the most recent period reported by NRC, there were

1,334 domestic shipments containing 1,453 metric tons uranium (MTU) of civilian SNF. Table 2.1.1 summarizes significant characteristics of these shipments.

Table 2.1.1 U.S. Civilian SNF Shipment Experience, 1979 - 1997[1]

Amount Shipped	1,453 MTU (76.5 MTU per year)
Total Shipments	1,334 (70 per year)
Truck Shipments	1,181 (62 per year)
Rail Shipments	153 (8 per year)
Truck Share of SNF Shipments	88.5%
Rail Share of MTU Shipped	75.5%
Average Truck Shipment Distance	684 miles (82%<900 miles)
Average Rail Shipment Distance	327 miles (80%<600 miles)
Shipment Origin & Destination	70% East of Mississippi River (935/1334)
Number of Reactor Sites Making One or More Shipments	27 (9 sites>2 shipments)

Source: NRC, NUREG-0725, Rev. 13 (October 1998)

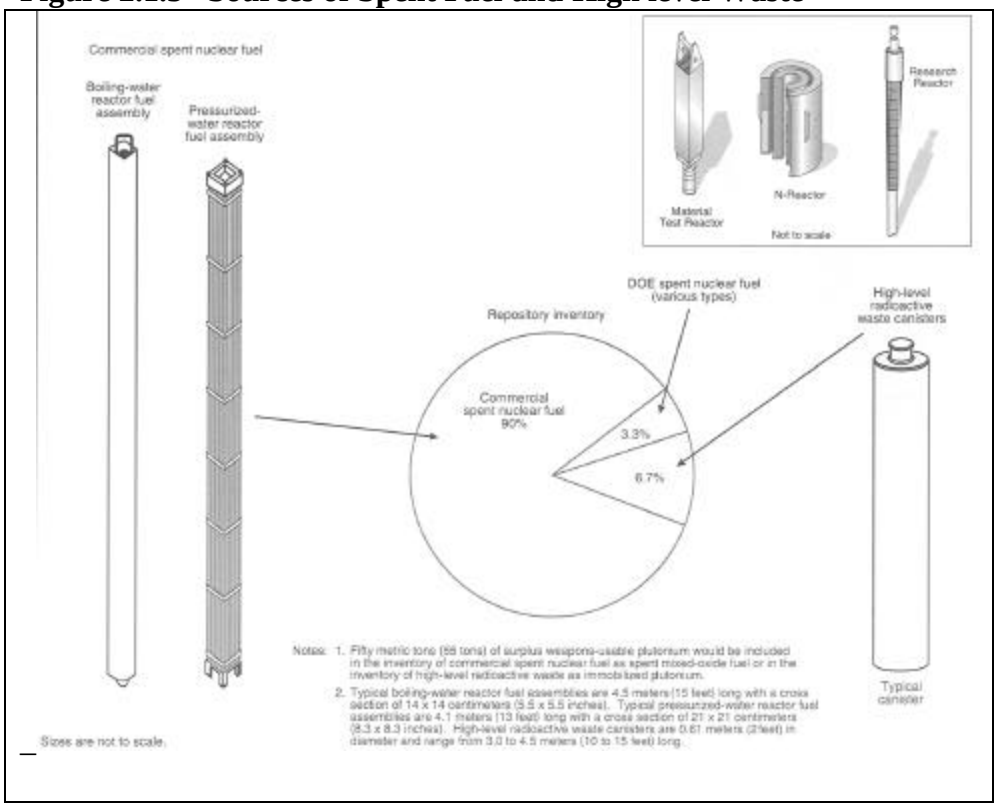
Radiological Hazards of High-Level Radioactive Waste

SNF from commercial power reactors will comprise about 90 percent of the radioactive wastes shipped to a geologic repository. About two-thirds of the SNF will come from pressurized water reactors (PWRs), the remainder from boiling water reactors (BWRs). Figure 2.1.3 shows PWR and BWR fuel assemblies.

Both types of SNF will be highly radioactive for thousands of years and thermally hot for hundreds of years. Nuclear fission inside the reactors transforms some of the original uranium fuel into isotopes of uranium, plutonium and other transuranic elements, and fission products such as strontium-90 and cesium-137. Fission products account for most of the radioactivity in SNF for the first hundred years after removal from reactors. Fission products, which emit both beta and gamma radiation, are the primary sources of exposure during routine transportation operations and the major potential source of irradiation and contamination in the event of a severe transportation accident or successful terrorist attack.

[1] During the same period, the U.S. Department of Energy made several dozen shipments of Three Mile Island reactor core debris and intact commercial reactor SNF. These shipments were not regulated by NRC and were therefore not included in the NRC database. There were also an undisclosed number of naval reactor fuel shipments, estimated at several hundred.

Figure 2.1.3 Sources of Spent Fuel and High-level Waste



When first removed from a reactor core, SNF is so radioactive that it delivers a lethal dose of radiation in seconds. It must be cooled in water-filled storage basins for a minimum of 3-5 years before it can be loaded into a truck transport cask. It must be cooled 10 years before it can be loaded into a rail transport cask or into a dry storage cask or canister. After 50 years of cooling, SNF can still deliver a lethal radiation exposure in minutes. Table 2.1.2 summarizes the two most important radiological characteristics for assessing SNF transportation risks, total activity and surface dose rate, as a function of cooling time or age. The exposure time for a lethal dose (600 rem) from unshielded SNF is less than one minute after 5 years, less than 2 minutes after 10 years, and less than 5 minutes after 50 years.

Table 2.1.2 Radiological Characteristics of Commercial Spent Nuclear Fuel

SNF Age (Years Cooled)	Total Activity (Curies)	Surface Dose Rate (Rem/Hour)
1	2,500,000	234,000
5	600,000	46,800
10	400,000	23,400
50	100,000	8,640

Source: U.S. DOE, DOE/NE-0007, 1980.

High-level radioactive waste (HLW) from atomic weapons production and reprocessing of commercial SNF will make up about 7 percent of the waste inventory shipped to the repository. Figure 2.1.4 shows a representative HLW canister. Because each stainless steel canister of HLW borosilicate glass will contain thousands of curies of cesium-137, strontium-90, and other fission products, HLW will remain a lethal source of gamma and neutron radiation for many decades.

SNF and HLW Inventories to be Shipped to the Repository

SNF is presently stored at 72 utility sites and 5 DOE facilities in 34 states. HLW is presently stored at 4 DOE facilities in Idaho, New York, South Carolina, and Washington. About 80 percent of the SNF from civilian power plants is presently stored at sites east of the Mississippi River.

Over the next five decades, SNF and HLW containing the equivalent of more than 119,000 metric tons of heavy metal (MTHM) will be shipped to the repository.[2] These quantities are shown in Table 2.1.3, along with other radioactive wastes that will go to the repository. Greater-Than-Class-C (GTCC) waste is so-called low-level radioactive waste that cannot be disposed in shallow land-burial facilities. Special-Performance-Assessment-Required (SPAR) wastes include reactor operating and decommissioning wastes, isotope production wastes, naval reactor components, sealed radioisotope sources, and fuel assembly hardware.

Table 2.1.3 Projected Inventory of Radioactive Wastes To Be Shipped To A Repository, 2010 - 2048.

Waste Type	MTHM	Units	Volume (cubic meters)	Mass (metric tons)
Commercial SNF	105,414	359,963 (assemblies)	47,000	161,000 (estimate)
HLW	11,150	22,280 (canisters)	21,000	58,000
DOE SNF	2,500	210,000 (assemblies, bundles, cans, etc.)	1,900	8,150
GTCC		1,096 (truckloads)	2,060	
SPAR		2,010 (truckloads)	3,990	

Source: U.S. DOE, DOE/EIS-0250D, 1999, Appendices A & J

[2] The term metric tons of heavy metal (MTHM) refers to the initial amount of uranium, plutonium, or thorium in the fuel assembly before insertion into a reactor core. It may also be referred to as metric tons of uranium (MTU) or metric tons of initial heavy metal (MTIHM). In addition to uranium or mixed oxide fuel pellets, fuel assemblies contain a considerable amount of zirconium and stainless steel components. A pressurized water reactor (PWR) fuel assembly containing 0.46 MTU has a total weight of 0.66 metric tons. A boiling water reactor (BWR) fuel assembly containing 0.18 MTU has a total weight of 0.32 metric tons. Regarding HLW, the term MTHM historically refers to an estimated curie content equivalent. Each canister of commercial HLW was estimated to contain 2.3 MTHM, and each canister of defense HLW was estimated to contain the equivalent of 0.5 MTHM. Because DOE now uses a variety of calculation methods, the estimated MTHM equivalent of HLW is less meaningful than the estimated number of HLW canisters.

SNF and HLW Shipping Casks

Most of the shipping casks currently used by the nuclear industry were designed in the 1970s and have limited payload capacity. For repository shipments, DOE plans to use new designs that will increase truck cask capacity from 0.5 MTHM to 2.0 MTHM, and increase rail cask capacity from 3.5 MTHM to 10-12 MTHM. Some of the new rail casks are for transport only; others are so-called dual-purpose casks that can be used for transport or storage. The NRC has certified several new designs, but none of the new casks have yet been constructed. Contrary to inferences by DOE and the commercial nuclear power industry, there is no requirement that full-scale casks be physically tested.

Figure 2.1.4 shows a conceptual drawing of a new legal-weight truck cask and vehicle transporter system. Figure 2.1.5 shows a conceptual drawing of a new high-capacity rail cask on a rail car.

Figure 2.1.4 Proposed New Legal-Weight Truck Cask and Transporter

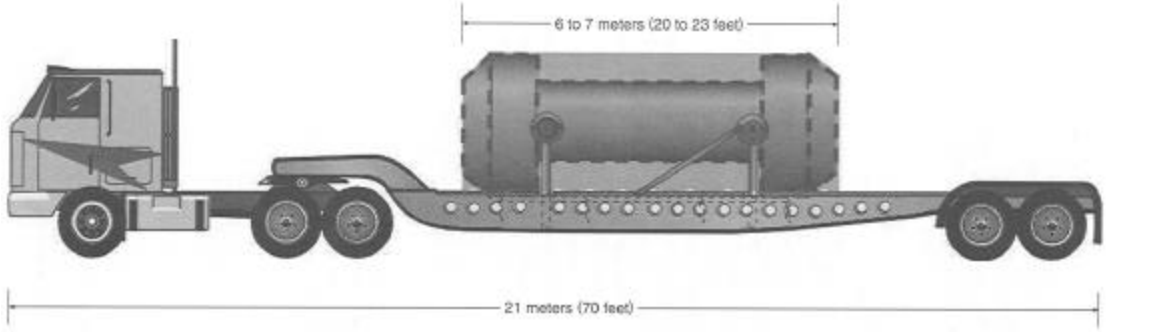
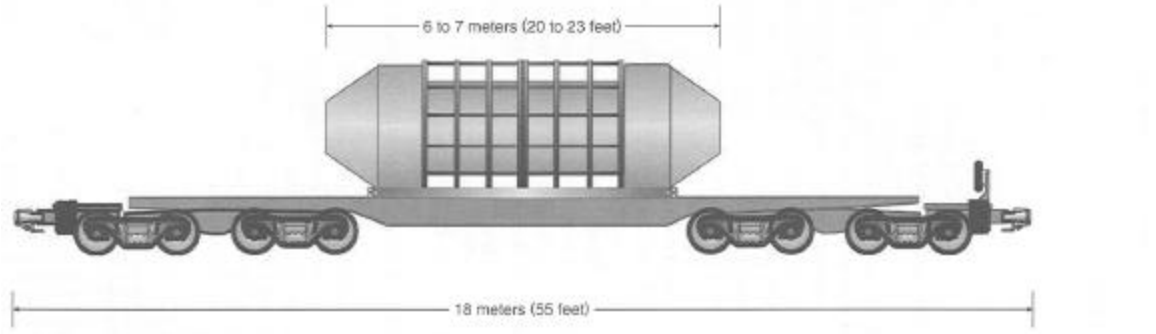


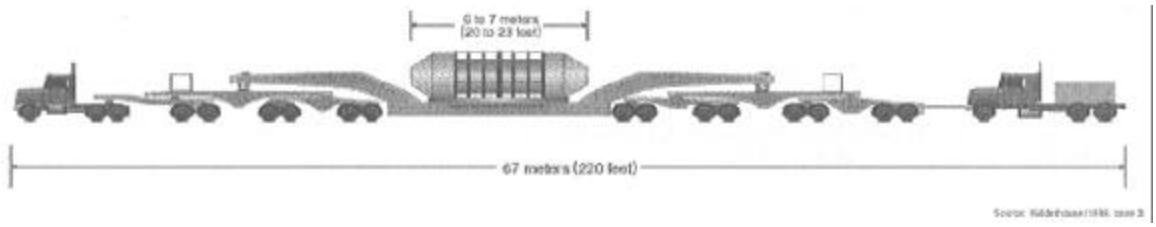
Figure 2.1.5 Proposed New High-Capacity Rail Cask



Legal-weight truck (LWT) casks are designed so that the total loaded weight of the truck does not exceed 40 tons. Compliance with this weight restriction facilitates routing across the federal highway system. Some of the new rail cask designs have a loaded weight of 160 tons or more. Weight restrictions on some rail routes and bridges will limit use of the largest casks. At reactor sites that lack rail access, DOE is considering moving these large casks to railheads by barge or by heavy-haul truck (HHT). DOE is also considering moving these casks by HHT in Nevada. The weight of

the larger rail casks may seriously complicate HHT transport on public highways. HHT transport utilizes a rig 220 feet long, including a pulling diesel tractor, a long trailer with 12 to 16 axles, and a pushing tractor. Figure 2.1.6 shows a conceptual drawing of HHT transport of a large rail cask. HHT shipments also require state permits and operate under time-of-day and other restrictions. There is no actual experience with long-distance HHT transport of such SNF casks in the United States.

Figure 2.1.6 Proposed HHT Transport Cask and Vehicle Configuration



SNF Transportation Modal Choice Options

In the Yucca Mountain DEIS, DOE has taken the position that there is no significant difference between rail and truck transportation risks and impacts. Most stakeholders that have taken a position on this issue believe that a properly designed rail transportation system is preferable. When pressed on the issue in DEIS public meetings, DOE representatives generally stated that DOE would attempt to maximize use of rail, primarily for the purpose of reducing the overall number of shipments. A review of the factors that will determine modal mix suggests that it will be difficult and impractical to maximize use of rail transportation.

Transportation conditions in Nevada will make direct rail delivery difficult. Yucca Mountain lacks rail access at present. Each one of the five potential rail access routes identified in the DEIS involves significant land use conflicts and adverse environmental impacts. Ranging in length from about 100 miles to 320 miles, even the shortest access spur route to Yucca Mountain would be the largest new rail construction project in the United States since World War I. Many operating assumptions and design details are uncertain. Environmental approvals, right-of-way acquisition, and litigation could delay completion for years. Construction costs would exceed $1 billion.

The only other way to utilize national rail transportation as the principal mode for SNF and HLW shipments would be to construct an intermodal transfer facility somewhere along a main line railroad in proximity to Yucca Mountain and use HHT transport from the intermodal facility to the site. However, transportation conditions in Nevada are extremely unfavorable for HHT transport of large rail casks. There are no existing facilities capable of transferring large rail casks (up to 180 tons) to HHTs. Each one of the three sites identified by DOE for potential new intermodal transfer facilities would involve long-distance (120 to 230 mile) HHT shipments on public highways. Route constraints include congested segments through highly populated areas, and steep grades and sharp curves through mountain passes. DOE's proposal for daily SNF and

HLW shipments using 220 foot-long rigs is unprecedented in the United States, and safety issues are largely unknown. HHT costs could exceed rail spur construction and operation. State permit requirements and regulatory restrictions make the feasibility of HHT transport highly uncertain.

Conversely, transportation conditions at many nuclear reactor sites favor use of LWT. All existing reactors and DOE sites can ship by LWT, while 30 or more sites will have difficulty shipping by rail. Even DOE's most optimistic rail shipment plan assumes that nine sites in six states must ship by LWT, and another 18 sites in 13 states must use barges or HHTs to deliver rail casks to the nearest railhead. However, DOE has not addressed the institutional barriers or costs associated with HHT transport from reactors, or barge transport of SNF into Baltimore, Wilmington, Miami, Milwaukee, and other port cities.

Moreover, certain programmatic and policy factors favor shipment by LWT, especially during the first 10-15 years of repository operations. These factors include:

- DOE's "hot repository" thermal loading strategy (which may require LWT shipment of 5-year-cooled SNF);

- The decision by some utilities to exercise contract options to ship 5-year-cooled SNF from storage pools by LWT, rather than shipping older SNF by rail; and

- DOE's current privatization plan, which does not require transportation providers to ship oldest fuel first or to maximize use of rail. Indeed, under DOE's fixed-cost contract approach to privatization, rail transportation may not be cost-competitive with LWT at many sites.

Transportation System Assumed for This Impact Report - Key Assumptions

In order to evaluate the risks and impacts of the proposed SNF and HLW national transportation system, it was necessary to use certain assumptions to deal with the dizzying array of uncertainties and inadequacies in DOE's plans. This report assumes that the entire projected SNF and HLW inventory (presently about 120,000 MTHM) will be shipped to Yucca Mountain over about 38 years, beginning in 2010. The report also assumes the following:

(1) If no rail spur to Yucca Mountain is constructed, the most probable national transportation scenario is the DEIS "Mostly Truck" scenario - about 93,000 LWT shipments of SNF and HLW, plus about 3,000 LWT shipments of "miscellaneous wastes" (GTCC and SPAR). This means about 2,526 truck shipments per year, plus 300 rail shipments of naval reactor SNF.

(2) If a rail spur is constructed, the most probable national transportation scenario is the State of Nevada "Current Capabilities" scenario - about 26,400 LWT shipments of civilian SNF (40% of MTHM) from 32 sites, 8,200 rail cask-

shipments of civilian SNF (60% of MTHM) from 40 sites, and 5,900 rail cask shipments from 5 DOE sites. This means about 1,066 shipments per year.

(3) The DOE "Mostly Rail" scenario is highly improbable, but this report evaluates it because of what it represents for certain worst case impacts.

(4) The DOE proposal for HHT transport of large rail casks from an intermodal transfer facility is highly improbable, but for certain worst case impacts it will be evaluated.

(5) The base case cross-country rail and highway routes identified in the DEIS will be assumed for this report.

(6) Four Nevada rail spur alternatives (excluding Caliente-Chalk Mountain) will be considered technically feasible. These four alternatives have different implications for national rail routing.

(7) The report assumes the status quo regarding regulations and safety/security practices. Therefore, this report assumes no full-scale physical cask testing; no required use of dedicated trains (i.e., all casks are shipped singly in general freight service); no additional safety requirements; and enforcement of existing regulations and work rules at current levels.

(8) The report assumes SNF is cooled only 5 years before truck or rail transport for worst case impacts. NRC regulations require 3-5 years for truck casks, 10 years for rail casks. DOE assumed 26 year-cooled in DEIS analyses.

(9) The report assumes DOE contracts for private sector transportation services per the last transportation system privatization proposal.

National Transportation Routes To Yucca Mountain

The first step in assessing the national impacts of transportation to Yucca Mountain is the identification of the transportation modes and routes. Absent such identification, it is impossible to adequately assess the impacts of the shipping campaign on the country as a whole and on individual states and communities. In 1986, in response to state and local government concerns, DOE promised to provide the necessary information in the Environmental Assessments (EA) for potential repository sites:

> "The DOE believes that the general methods and national average data used [in the 1986 Environmental Assessments] are adequate for this stage of the repository siting process [i.e., the pre-site characterization stage]. Route-specific analyses and an evaluation of the impacts on host States and States along transportation corridors would be included in the environmental impact statement." [Comment Response Document, May, 1986, full citation in NWPO DEIS Comments, p.138]

DOE chose to ignore this promise when the Yucca Mountain Draft EIS was released in July 1999 and during most of the public comment period that followed. The DEIS does not identify the specific routes evaluated by DOE in Chapter 6 and Appendix J. DOE did not identify the routes in its Federal Register notice nor in its public notices of scheduled hearings. During the public hearings that began in September 1999, DOE provided some state-specific transportation maps at individual hearings around the country, but DOE did not release national maps showing the full cross-country routes from shipping sites to Yucca Mountain until sometime in late January 2000, near the end of the public comment process. Interestingly, the maps showing these routes were removed from the DOE website within a short time and have not since been made public.

The irony of the situation is that DOE has, in fact, done the analyses needed to reveal specific highway and rail routes that would be used for waste shipments and to conduct required impact assessments along those routes. That information, however, was buried in data used to run computer models and was never made explicit in the Draft EIS. The Draft EIS contained no maps or other information showing which cities and communities along transportation corridors would be affected by this massive and unprecedented radioactive waste shipping campaign. Nevada concluded that such an oversight can only be seen as intentional and designed to suppress public interest in the project and participation in these public hearings.

Figure 2.1.7 shows the highway routes evaluated, and then suppressed, in the DEIS. These routes were generated by the HIGHWAY computer model and represent the quickest truck travel routes consistent with the current federal routing regulations (HM-164). Ironically, the map is the same one DOE removed from its website shortly after it appeared during the last of the DEIS hearings. The routes shown in Figure 2.1.7 are the base case cross-country routes that connect the 77 shipping sites with Yucca Mountain.

While the State of Nevada believes that DOE would not be able the use the planned I-215 Las Vegas Beltways, this does not affect the point of entry for shipments coming into Nevada. DOE's base case routes to the Yucca Mountain site generally agree with the highway routes identified in previous routing studies by DOE and Nevada contractors. Absent additional states' designations of preferred alternatives or DOE policy decisions, Nevada believes that these are the most likely highway routes to Nevada.

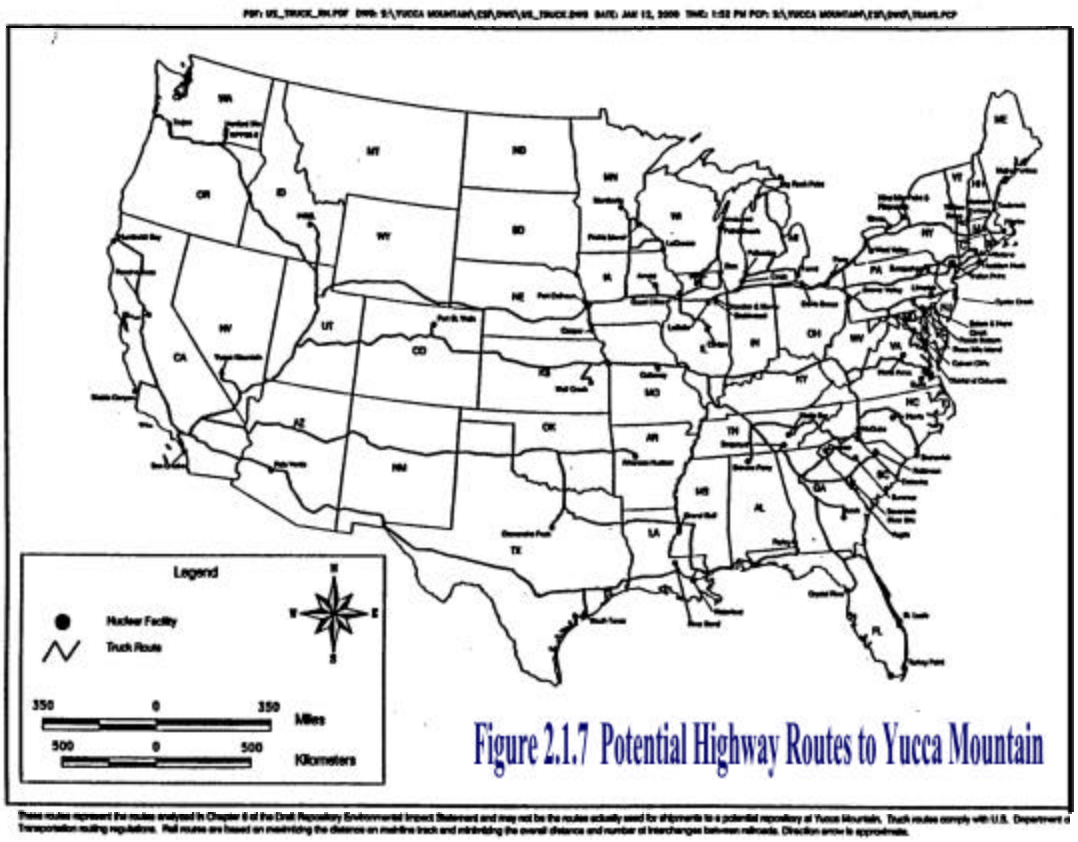


Figure 2.1.7 Potential Highway Routes to Yucca Mountain

The primary truck routes out of New England and the Middle Atlantic states are I-90, I-80, I-76, and I-70. These routes converge on I-80/90 near Cleveland, pick up shipments from midwestern reactors, and follow I-80 west from Chicago through Des Moines, Omaha, Cheyenne, and Salt Lake City to I-15.

The primary truck routes out of the South are I-75 from Florida, I-24 from Atlanta, and I-64 from Virginia. These routes converge on I-70 near St. Louis and follow I-70 west through Kansas City and Denver to I-15 in Utah.

The primary route from the Pacific Northwest is I-84 to I-15 in Utah. Other major routes are I-40 and I-10 from the Mid-South and I-5 in California. These routes converge on I-15 in Southern California.

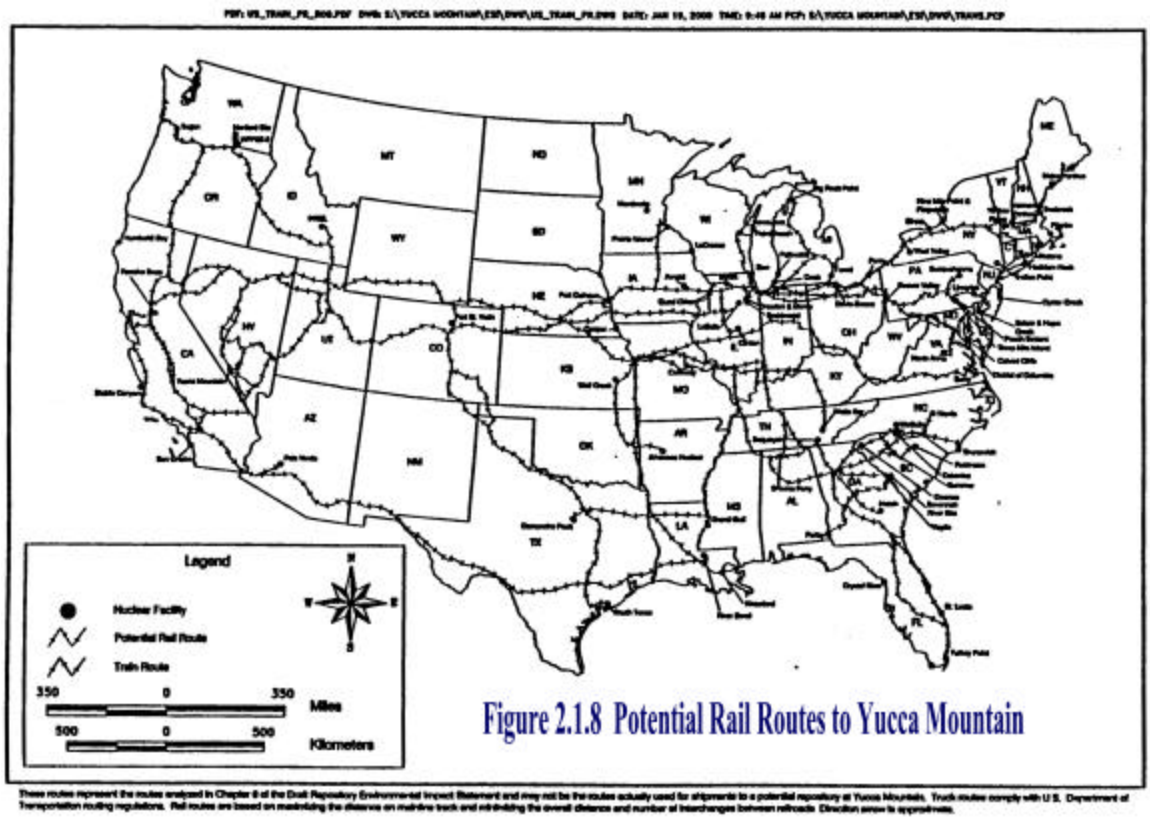


Figure 2.1.8 Potential Rail Routes to Yucca Mountain

Figure 2.1.8 shows the rail routes evaluated in the DEIS. These routes were generated by the INTERLINE computer model and generally represent the most direct routes to Nevada consistent with the current industry practice of maximizing freight-miles on the originating railroad. The map shows the cross-country rail routes for all five rail spur locations in Nevada.

DOE has not yet identified a preferred rail destination in Nevada. Both DOE and Nevada have used Caliente as a default location. Construction of a northern rail spur along the Union Pacific mainline between Salt Lake City and Reno would change the routing for about 10-20 percent of the rail shipments. Otherwise, the cross-country routes to Nevada are generally the same for the three southern rail spur options. The documentation for these routes is available on the DOE Yucca Mountain Project website.

Nevada believes that DOE's entire approach to rail transportation planning is deficient, and that DOE's "mostly rail" transportation scenario is unworkable. Nonetheless, DOE's base case rail routes to Nevada generally agree with the rail routes identified in previous routing studies by DOE and Nevada contractors. While mergers and other rail industry developments would continue to affect routing, Nevada believes that Figure 2.1.8 shows the most likely rail routes to Nevada.

The primary rail routes out of New England and the Middle Atlantic states would be the former Conrail mainlines from Buffalo and Harrisburg to Cleveland and Chicago. These shipments switch to the Union Pacific near Chicago, are joined by shipments from mid-western reactors in Illinois and Iowa, and continue west via Fremont, Gibbon, Cheyenne, and Salt Lake City to Nevada.

The primary routes out of the South would be the CSXT from Atlanta to East St. Louis, and the Norfolk Southern from Atlanta to Kansas City via Birmingham and Cairo. These two streams merge on the Union Pacific in Kansas City, and in turn merge with the northern UP shipments at Gibbon, Nebraska. Other major rail routes are the UP from Oregon via Boise, and the UP and BNSF from California and the Southwest via San Bernardino and Daggett.

Transportation Corridor States To Yucca Mountain

The DOE "mostly truck" and "mostly rail" transportation scenarios have been previously described above. The "mostly truck" scenario is currently feasible for all shipping sites and would require about 96,000 legal-weight truck shipments over 38 years. DOE's "mostly rail" scenario, which is feasible only if a new rail spur is constructed in Nevada and DOE is able to ship rail casks from 18 - 30 difficult sites, would require about 19,800 rail shipments and 3,700 legal-weight truck shipments over 38 years. In order to get the rail casks from 18 reactors to railroads, DOE proposes about 3,980 heavy-haul truck (HHT) shipments, or a combination of about 2,250 barge shipments and 1,000 HHT shipments.

Table 2.1.4 shows the potential numbers of shipments through various states under the "mostly truck" and "mostly rail" scenarios. (Note that shipment column entries cannot be totaled because each shipment goes through more than one state).

The "mostly truck" scenario affects 44 states, including Nevada. Nineteen states would be traversed by more than 13,900 shipments, an average of 366 shipments per year. Thirty-seven states would be traversed by more than 1,980 shipments, or 52 shipments per year. Put another way, for 38 years, truck shipments to Yucca Mountain would be a daily occurrence in 19 states, and a weekly occurrence in 37 states.

Table 2.1.4

POTENTIAL SHIPMENTS TO YUCCA MOUNTAIN, BY STATE, 2010-2048							
STATE	MOSTLY TRUCK	MOSTLY RAIL				MOSTLY RAIL(LOCAL)	
	Truck	Truck	Rail			Barge	HHT
AL	3,193	0	5,479			367	590
AZ	90,111	3,657	708			0	0
AR	963	0	395			0	0
CA	12,867	44	1,279			278	343
CO	27,612	1,013	14,968			0	0
CT	1,924	255	524			0	0
DE	1,992	0	0			362	0
FL	2,399	1,013	368			272	368
GA	15,150	1,013	4,889			0	0
ID	18,707	0	3,959			0	0
IL	57,100	3,278	12,648			0	0
IN	26,782	2,265	8,658			0	0
IA	32,869	2,644	7,427			0	0
KS	27,278	1,013	6,359			0	0
KY	20,566	1,013	5,600			0	0
LA	3,640	0	335			0	0
ME	356	0	60			0	0
MD	3,132	0	470			204	303
MA	2,080	476	864			0	0
MI	2,584	0	670			70	117
MN	1,184	379	221			0	0
MS	2,142	0	1,797			521	143
MO	26,570	1,013	6,359			159	114
NE	33,685	2,644	14,073			159	287
NV	92,851	3,701	19,845			0	19,845
NH	986	0	143			0	0
NJ	5,335	1,155	572			449	572
NM	7,609	0	358			0	0
NY	7,809	2,265	1,432			87	0
NC	4,618	0	1,259			0	0
OH	18,929	2,265	4,163			0	0
OK	4,663	0	833			0	0
OR	16,240	0	3,199			0	0
PA	17,763	2,265	3,866			0	403
SC	11,285	0	3,575			0	373
TN	20,566	1,013	5,600			0	0
TX	7,609	0	939			0	0
UT	80,004	3,657	18,508			0	0
VT	484	0	182			0	0
VA	1,981	0	311			128	144
WA	16,240	0	3,199			0	0
WV	5,269	0	311			0	0
WI	1,180	37	224			172	224
WY	33,685	2,644	13,482			0	0

The "mostly rail" scenario also affects 44 states, including Nevada, over a sustained period of 38 years. Forty-three states would be traversed by rail shipments, and 24 states would be traversed by both rail and legal-weight truck shipments. Additionally, 13 states could have barge shipments through their ports and waterways or HHT shipments on their public highways. Six states would be traversed by more than 13,900 shipments, an average of 366 shipments per year. Twenty-two states could be traversed by more than 1,980 shipments, or 52 shipments per year.

The states most heavily impacted by the "mostly truck" scenario are shown below in Table 2.1.5.

Table 2.1.5

State	Truck Shipments
NV	92,851
AZ	90,111
UT	80,004
IL	57,100
WY	33,685
NE	33,685
IA	32,869
CO	27,612
KS	27,278
IN	26,782
MO	26,570
TN	20,566
KY	20,566
OH	18,929
ID	18,707
PA	17,763
WA	16,240
OR	16,240
GA	15,150
CA	12,867

The states most heavily impacted by the "mostly rail" scenario are shown below in Table 2.1.6.

Table 2.1.6

State	Rail and LWT Shipments
NV	23,546
UT	22,165
NE	16,717
WY	16,126
CO	15,981
IL	15,926
IN	10,923
IA	10,071
KS	7,372
MO	7,372
KY	6,613
TN	6,613
OH	6,428
PA	6,131
GA	5,902
AL	5,479
AZ	4,365
ID	3,959
NY	3,697
SC	3,575

Truck shipments to Yucca Mountain would be a daily occurrence in major metropolitan areas like Atlanta, Nashville, Cleveland, and San Bernardino. Chicago would experience a truck shipment every 15 hours; St. Louis, Kansas City, and Denver, every 13 hours; Des Moines and Omaha, every 10 hours; and Salt Lake City, every 7 hours.

Table 2.1.7. Potential Truck Shipments Through Major Metropolitan Areas, 2010-2048

Metropolitan Area	Population 2000	Cumulative Shipments	Avg. Annual Shipments	Avg. Daily Shipments
Atlanta	4,112,198	15,150	399	1.1
Nashville	1,231,311	16,329	430	1.2
St. Louis	2,603,607	25,835	680	1.9
Kansas City	1,776,062	26,570	699	1.9
Denver	2,581,506	27,612	727	2.0
Cleveland	2,945,831	18,394	484	1.3
Chicago	9,157,540	22,541	593	1.6
Des Moines		32,869	865	2.4
Omaha	716,998	33,685	886	2.4
Cheyenne	53,011	33,685	886	2.4
Salt Lake City	1,333,914	52,392	1,379	3.8
Las Vegas	1,563,282	95,957	2,525	6.9

Truck shipments to Yucca Mountain would impact many of the fastest growing counties in the United States. Even in states that experienced little or no overall growth

between 1990 and 2000, Yucca Mountain transportation would impact the counties in those states that exhibited the highest growth rates. These are often bedroom communities and commercial/industrial parks along suburban interstate beltways. Ironically, the federal routing regulations (HM-164) tend to route shipments through these areas rather than through slower growing or declining downtown areas. Some examples are listed in the following tables. Notable examples are the counties along I-285 in Georgia, I-24 in Tennessee, I-270 in Missouri, I-80 in Illinois, Iowa, and Nebraska, I-70 in Colorado, and along I-10 and I-40 in Texas, New Mexico, Arizona, and California.

Table 2.1.8 Potential Truck Shipments Through Selected Urban Counties, 2010-2048

County/ State	Population 2000	Pop. Growth, 1990-2000	Likely Routes	Cumulative Shipments
Clark, NV	1,375,765	85.5	I-15, I-215	95,957
Maricopa, AZ	3,072,149	44.8	I-10	5,444
Mohave, AZ	155,032	65.8	I-15, I-40	84,667
Washington, UT	90,354	86.1	I-15	80,004
Salt Lake, UT	898,387	23.8	I-80, I-215, I-15	52,392
Utah, UT	368,536	39.8	I-15	52.392
Los Angeles, CA	9,519,338	7.4	I-5, I-210, I-10	2,760
San Bernardino, CA	1,709,434	20.5	I-10, I-15, I-40	12,867
Riverside, CA	1,545,387	32.0	I-10	5,444
Ada, ID	300,904	46.2	I-84	16,240
Cook, IL	5,376,741	5.3	I-80, I-94, I-294, I-88	22,541
Will, IL	502,266	40.6	I-80	21,513
Kendall, IL	54,544	38.4	I-80	21,513
Johnson, IA	111,006	15.5	I-80	
Polk, IA	374,601	14.5	I-80, I-35	32,869
Pottawattamie, IA	87,704	6.1	I-80, I-29, I-680	32,869
Douglas, NE	463,585	11.3	I-680, I-80	33,685
Sarpy, NE	122,595	19.5	I-80	33,685
Lancaster, NE	250,291	17.2	I-80	33,685
Fulton, GA	816,006	25.8	I-285	15,150
De Kalb, GA	665,865	21.9	I-20, I-85, I-285	11,417
Cobb, GA	607,751	35.7	I-285, I-75	15,150
Rutherford, TN	182,023	53.5	I-24, I-65	16,329
St. Charles, MO	283,883	33.4	I-270	25,835
Johnson, KS	451,086	27.1	I-435	26,570
Adams, CO	363,857	37.3	I-70	27,612
Dakota, MN	355,904	29.3	I-35E/W, I-494	1,147
Waukesha, WI	360,767	18.4	I-43	1,143
El Paso, TX	679,622	14.9	I-10	2,946

Risks of Routine Exposures from National HLW Transportation

Spent nuclear fuel is extremely radioactive. Extraordinary precautions and effective shielding are required in order to safeguard workers and the public from the lethal effects. A person standing one yard away from an unshielded, 10 year-old fuel assembly, for example, would receive a lethal dose of radiation (600 rem) in less than four minutes and would incur significant health damage within seconds.

The surface dose rate of spent fuel is so great (10,000 rem/hour or more) that shipping containers with enough shielding to completely contain all emissions are too heavy to transport economically. Consequently, NRC regulations allow a certain amount of neutron and gamma radiation to be emitted from shipping casks during routine operations and transport (1,000 mrem/hr at the cask surface and 10 mrem/hr 2 meters from the cask surface). Even when contained within a cask, SNF produces gamma and neutron radiation exposures up to one-half mile away.

SNF and HLW shipments to Yucca Mountain will contribute to the total radiation exposures received by transportation workers and members of the public. Radiation exposures (effective dose equivalents) are expressed in terms of rem[3] or millirem (one-thousandth of a rem). The average American receives about 360 mrem annually from natural background and manmade sources. One hour of exposure at 2 meters (6.6 feet) from the side of a shipping cask produces about the same dose that a person receives from a whole body medical X-ray. For this reason, shipping casks have been called "portable X-ray machines that can't be turned off."

The precise relationship between low-level radiation exposures and adverse health effects is a matter of continuing debate within both the medical and the health physics communities. Advocates of the linear no-threshold hypothesis believe that all radiation exposures may result in adverse health effects. Many other experts believe that no significant health effects occur until exposures exceed 300-1,000 mrem. The International Commission on Radiological Protection recognizes different radiation health risks for different groups among the public, including young children and pregnant women.

The dose rate allowed under NRC regulations results in near-cask exposures of about 2.5 mrem per hour at 5 meters (16 feet), in measurable exposures (about 0.01 mrem per hour) at 25-30 meters (80-100 feet), and calculated exposures (0.000002 mrem per hour) at 800 meters (one-half mile) from the cask surface. Cumulative exposures at these rates can result in adverse health affects for some workers and some members of public. Moreover, the very fact that these exposures occur has been shown to cause adverse socioeconomic impacts, such as loss of property values, even though the dose levels are well below the established thresholds for cancer and other health effects.

Routine radiation from shipping casks poses a clear health threat to certain transportation workers. Safety inspectors, truck drivers, and rail crews could receive

[3] The DEIS [p. 3-81] defines Rem: "The dose of an ionizing radiation that will cause the same biological effect as one roentgen of X-ray or gamma ray exposure (rem means Roentgen Equivalent in Man)."

cumulative doses large enough to increase their risk of cancer death by up to 15 percent, and their risk of other serious health effects by 50 percent or more. DOE proposes to control these exposures and risks by limiting work hours and doses.

Routine radiation from shipping casks poses a potential health threat to certain members of the public. Service station attendants could receive 100-1,000 mrem doses per year. Motorists could receive 40 mrem during a traffic gridlock incident. Residents near rail yards, truck stops, and certain routes used by SNF and HLW shipments could receive 5-45 mrem per year. Such exposures could increase the risk of certain health effects, such as mental retardation in unborn children and genetic damage in future generations.

Routine radiation from passing casks will deliver small radiation doses to members of the public within one-half mile of highway and rail routes. Nationally, 7-11 million people reside within one-half mile of a truck or rail route. Even though these dose levels are well below the established thresholds for cancer and other health effects, research shows that the mere presence of sustained numbers of such shipments through communities can devalue – and have devalued – property by as much as 4.75 percent. Applied nationally, the economic impacts of such devaluation would be incalculable.

Accident Risks and Impacts from National Transportation of SNF and HLW

Likelihood of SNF and HLW Accidents Occurring

Development of a Yucca Mountain repository would result in the largest, most ambitious, and longest duration SNF and HLW shipping campaign in history. Past performance on the part of the nuclear industry is no assurance that future Yucca Mountain shipments would be safe. Indeed, if future shipments were to experience accidents and regulatory incidents at the same rate as past shipments, the resulting socioeconomic impacts would be unacceptable, even without any releases of radioactive materials.

DOE and the nuclear power industry are quick to point to their record of safely shipping limited quantities of spent fuel during the past 30 years. What DOE and the industry do not publicize is that, prior to 1971, there were, in fact, transportation accidents and incidents that resulted in radiation releases. Between 1957 and 1964, there were 11 transportation incidents and accidents involving spent fuel shipments by the US Atomic Energy Commission and its contractors. Several of these incidents resulted in radioactive releases requiring cleanup, including leakage from a rail cask in 1960 and leakage from a truck cask in 1962. There is no comparable data for the period from 1964 to 1970, when utility shipments to reprocessing facilities began.

Between 1971 and 1990, there were six accidents and 47 regulatory incidents involving spent fuel cask shipments. Most of the regulatory incidents involved excess radioactive contamination of cask surfaces (often referred to as "weeping"), but a few involved violations that could have contributed to increased accident risks. Three

accidents (two truck, one rail) involved casks loaded with spent fuel. Fortunately, no radioactivity was released in these accidents, although one truck accident was severe enough to kill the driver. However, the record clearly indicates that accidents do happen and that the potential for accidents involving radiation releases exists.

A DOE contractor report evaluated these SNF accidents and incidents and developed historical SNF accident and incident rates for use in projecting the impacts of future shipments to a Yucca Mountain repository. These accident and incident rates have not changed appreciably because of the relatively small number of shipments and shipment-miles during the 1990s. DOE chose to ignore this information in preparing the transportation impact analysis for the Yucca Mountain DEIS.

State of Nevada staff and contractors have evaluated the potential for future transportation accidents and incidents during SNF and HLW shipments to Yucca Mountain.[4] The Nevada analysis applied the actual accident and incident rates from past shipments to the projected shipment numbers and distances that would result under DOE's "mostly truck" and "mostly rail" scenarios and under the Nevada "current capabilities" scenario. The Nevada analysis concludes that 130 - 400 accidents and 900 - 1,900 regulatory violations would be expected over 38 years if future shipments were to be as safe as past shipments. Table 2.1.9 shows the results for each scenario.

Table 2.1.9 Projected Repository Transportation Accidents and Incidents, 2010-2048.

Scenario & Mode	Shipments	Shipment-Miles	Accidents	Incidents
Mostly Truck				
Truck	92,871	184,228,600	129	1,934
Rail to NV	300	197,400	2	4
HHT in NV	300	34,100	Not Available	Not Available
Mostly Rail				
Truck	3,701	9,789,800	7	103
Rail to NV	19,643	39,263,000	381	762
Rail in NV	6,548	2,088,700	20	41
Current Capabilities				
Truck	26,375	60,851,300	43	640
Rail to NV	13,969	26,613,200	258	516
Rail in NV	4,656	1,485,300	15	30

By relying upon past accident and incident rates, the Nevada analysis may actually underestimate the potential for accidents and incidents during shipments to Yucca Mountain. In the past, limited numbers of spent fuel shipments have been made

[4] The Nevada analysis assumed that rail casks would be shipped to Nevada individually in general freight service, and that rail shipments from a Nevada interchange facility would be made in dedicated trains consisting of three cask cars on average. There was not sufficient data to accurately project accidents and incidents involving barge shipments of SNF from reactors to port rail facilities, or HHT shipments from reactors to railheads, or HHT shipments from an intermodal transfer facility in Nevada to Yucca Mountain. [Ref. R.J. Halstead, "Projected Accidents and Incidents During SNF and HLW Shipments to Yucca Mountain, 2010-2048," Memorandum Report, January, 2002.]

between and among utilities and to and from storage and research facilities. Shipping campaigns rarely involved more than a few shipments at a time. The average distance of past shipments was less than 600 miles. For Yucca Mountain shipments, the average distance traveled would be over 2,000 miles, creating many more opportunities for human error and equipment failure.

The precautions taken for historical shipments have often been far beyond what is minimally required by regulation. This was possible because the shipments were usually one-time or limited-duration events. In the case of Yucca Mountain, there would be tens of thousands of spent fuel and high-level waste shipments continuously for four decades or more. DOE has stated its intention to operate the Yucca Mountain transportation system based on existing regulatory standards. In the case of rail shipments, DOE's plans actually call for spent fuel casks to be shipped in mixed freight trains, instead of in secure and specially regulated dedicated trains.

DOE is proposing to use a privatized, market-driven system for Yucca Mountain transportation services. Under the DOE approach, cost would constantly be competing with safety when contractors make decisions regarding mode and route selection, frequency of inspections, and other important operating protocols. Fixed-cost contracts will make it difficult to afford the same level of care and attention to each Yucca Mountain shipment that was afforded to utility and DOE shipments of the past.

National Impacts from Severe Transportation Accidents

Each truck shipment to Yucca Mountain would carry an enormous inventory of deadly radioactive materials. Each rail cask shipped to Yucca Mountain would carry four to six times as much highly radioactive material as a truck cask. Casks are not designed to withstand all credible rail and highway accidents. An accident that released even a small fraction of a truck cask inventory could cause catastrophic health and economic impacts. A severe rail accident resulting in a release of cask contents could have adverse health and economic impacts many times greater than a truck accident.

The Yucca Mountain DEIS acknowledged that a very severe highway or rail accident could release radioactive materials from a shipping cask, resulting in radiation exposures to members of the public and latent cancer fatalities (LCFs) among the exposed population. DOE did not evaluate non-cancer health effects and ignored alternative dose risk factors that could have increased the LCF estimate sevenfold. Moreover, DOE completely ignored the potential economic impacts of severe accidents. The cost of cleanup, evacuation, and business loss resulting from a severe transportation accident in a generic urban area could range from several billion to several hundred billion dollars.

The DEIS evaluated what DOE considered to be a maximum reasonably foreseeable accident scenario involving a truck accident at a generic urban location. Following the accident severity categories designated by the NRC Modal Study, DOE estimated the consequences of the most severe (Category 6) truck accident using the

RISKIND computer code. The DOE analysis used weather and demographic inputs based on U.S. national average data and assumed that the maximum long-term exposure following the accident would be one year. DOE assumed the truck cask would be loaded with PWR SNF cooled about 26 years prior to shipment, although NRC regulations would allow shipment of much more dangerous 5-year-cooled SNF.

DOE estimated that the maximum severe truck accident would release and disperse enough radioactive materials to inflict a collective population dose of 9,400 person-rem (that is, enough to give 9,400 persons a one rem dose) and cause about 5 latent cancer fatalities. DOE estimated the probability of such an accident at 1.9 in 10 million per year. Less severe truck accidents (Category 5), also resulting in releases, had estimated probabilities for rural and urban locations ranging from 4 in 100,000 to 3 in 10 million per year.

The DEIS similarly evaluated what DOE considered to be a maximum reasonably foreseeable accident scenario involving a rail accident at a generic urban location. As with the truck accident, DOE evaluated a Category 6 rail accident using RISKIND and the same weather, population, and exposure time assumptions. DOE also assumed the rail cask would be loaded with 26-year-cooled PWR SNF, although rail casks are currently designed to transport more dangerous 10-year-cooled SNF and could be designed for 5-year-cooled SNF.

DOE estimated that the maximum severe rail accident would release and disperse enough radioactive materials to inflict a collective population dose of 61,000 person-rem (enough to give 61,000 persons a one rem dose) and cause about 31 latent cancer fatalities. DOE estimated the probability of such an accident at 1.4 in 10 million per year. Less severe rail accidents (Category 5), also resulting in releases, had estimated probabilities for rural and urban locations ranging from 4 in 100,000 to 7 in 10 million per year.

For this impact report, the State of Nevada commissioned several SNF accident consequence analyses by Radioactive Waste Management Associates (RWMA). In 2000, RWMA reexamined the DEIS truck and rail accident estimates, using the RADTRAN and RISKIND computer models and a range of credible alternative assumptions. In 2001, RWMA estimated the consequences of a SNF rail accident similar to the July 2001 Baltimore rail tunnel fire. Also in 2001, RWMA studied the consequences of credible worst case truck and rail accidents at representative urban and rural locations along potential Nevada highway routes. The Nevada accident analyses are reported in Chapter 3 of this report.

RWMA first replicated the DEIS accident health consequence analyses with RISKIND, and then repeated the analyses using a range of values for SNF age (10 years and 25.9 years), weather conditions (weighted average of all stability categories) and dispersion models, evacuation time (1 day and 7 days), and long term exposure (1 year and 50 years). RWMA concluded that the number of expected latent cancer fatalities

could be up to 40 times higher than the DOE estimates. The RWMA results from RISKIND are reported in Table 2.1.10

Table 2.1.10 Comparison of Truck and Rail Accident Consequences

Long-term Exposure Time (years)	Spent Fuel Age (years)	Atmospheric Dispersion Model	Expected Latent Cancer Fatalities: Truck Accident	Expected Latent Cancer Fatalities: Rail Accident
1	25.9	Pasquill-Gifford	15.9	109
50	25.9	Pasquill-Gifford	135	933
1	10	Pasquill-Gifford	20.8	144
50	10	Pasquill-Gifford	199	1,370
1	25.9	Effective Release ht.	4.6	30.8
50	25.9	Effective Release ht.	38.8	262
1	10	Effective Release ht.	5.96	40.3
50	10	Effective Release ht.	57	386

Source: RWMA, "Health Consequence Assessment: Severe Truck Accident in An Urban Area," June 28, 2000.

RWMA also replicated the DEIS accident health consequence analyses with RATRAN4 and RADTRAN5, and then repeated the analyses using similar range of values for SNF age, weather conditions and dispersion models, evacuation time, and long term exposure. RWMA used the resulting outputs and the RADTRAN models to estimate the economic impacts of the reference truck and rail accidents. RWMA concluded:

> "The results of our analysis suggest that the health and economic consequence estimates calculated by the RADTRAN program vary greatly with assumed meteorological conditions and spent fuel age. The results of both the truck and rail consequence assessments indicate that the greatest economic damage would occur from a severe accident occurring under stability category D-E meteorological conditions. Under these circumstances, vertical atmospheric motion is suppressed, resulting in less dispersion of released contaminants. It appears that stability category F conditions resulted in lower estimated economic costs because the atmosphere under those conditions limited dispersion to a highly concentrated zone in which the released contaminants were confined. Thus, there was much less area contaminated by the release than there was under more dispersive meteorological conditions, resulting in lower economic costs.
>
> For the most economically severe rail accident in an urban area under weighted average meteorological conditions, our RADTRAN 5 analysis has estimated the associated costs to be on the order of $270 billion for 10-year-cooled fuel and $145 billion for 25.9-year-cooled fuel, present-day value. For the most economically severe truck accident, our RADTRAN 5 analysis has estimated the associated costs to be on the order of $36.6 billion for 10-year-cooled fuel and $20.1 billion for 25.9-year-cooled fuel. We need to underline the fact that the economic costs could be 3 to 4 times greater if one assumed a realistic urban population density.

> It is also important to realize that the economic models utilized here make no attempt to include all of the costs associated with the remediation of a severe accident involving a release of radioactive material. They also make no attempt to provide a means of estimating the costs associated with an accident in a specific city. For example, in tourism-driven cities such as Las Vegas, the economic losses stemming from stigma effects would likely be staggering, but are not included in our estimates and are beyond the scope of this report." [RWMA, "Updated Rail and Truck Accident Economic Analysis," July 7, 2000]

The State of Nevada commissioned a study by RWMA of the July 18-23, 2001 Baltimore rail tunnel accident and fire. Preliminary information suggested that the Baltimore accident might be comparable to the Modal Study's Category 5 or Category 6 accidents, which could result in a significant release of cesium-134 and cesium-137. Since current U.S. Department of Transportation (USDOT) regulations allow SNF casks to be shipped in mixed freight trains, it was credible to assume that one or more SNF casks could have been part of such a train. Moreover, the accident occurred on a route identified in the DEIS as a potential corridor for rail shipments of SNF from the Calvert Cliffs reactor to Yucca Mountain.

RWMA concluded that the Baltimore rail tunnel fire burned for three days with temperatures as high as 1500 degrees Fahrenheit, creating a Category 6 accident fire environment sufficient to cause a breach of the cask and a significant release of radiocesium and other radionuclides. RWMA evaluated the potential consequences of an identical accident including a rail cask loaded with 10-year-cooled SNF. RWMA used the RISKIND and HOTSPOT computer models, weather data from Baltimore-Washington International Airport, and Baltimore population data from the 2000 Census. Figures 2.1.9, 2.1.10, and 2.1.11 show the areas receiving radiation doses during the first 24 hours, during the following fifty years, and the contaminated areas requiring cleanup.

Figure 2.1.9

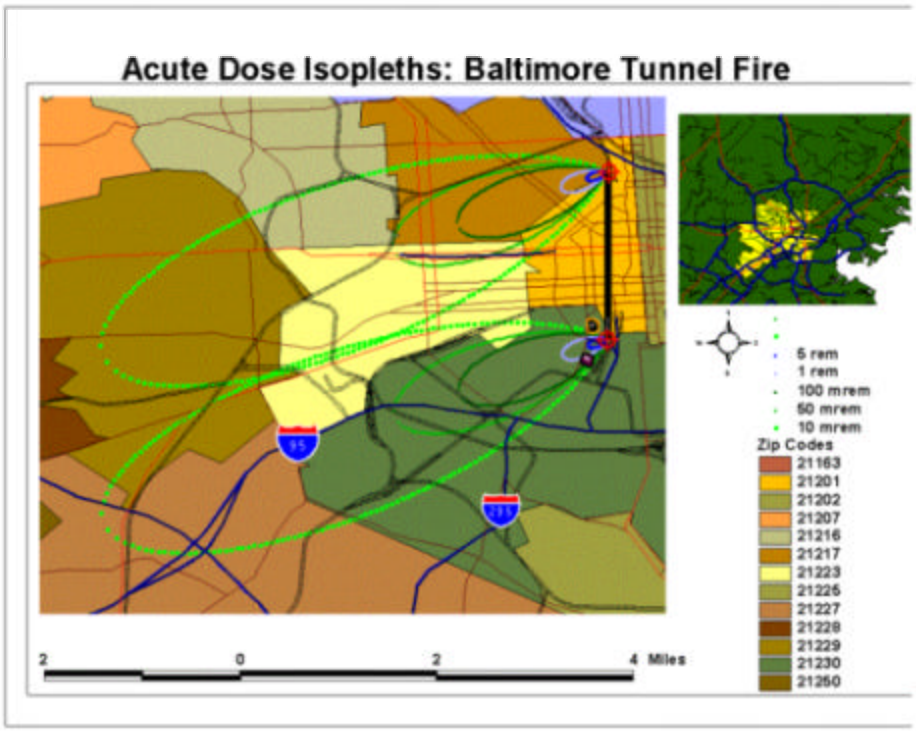


Figure 2.1.10

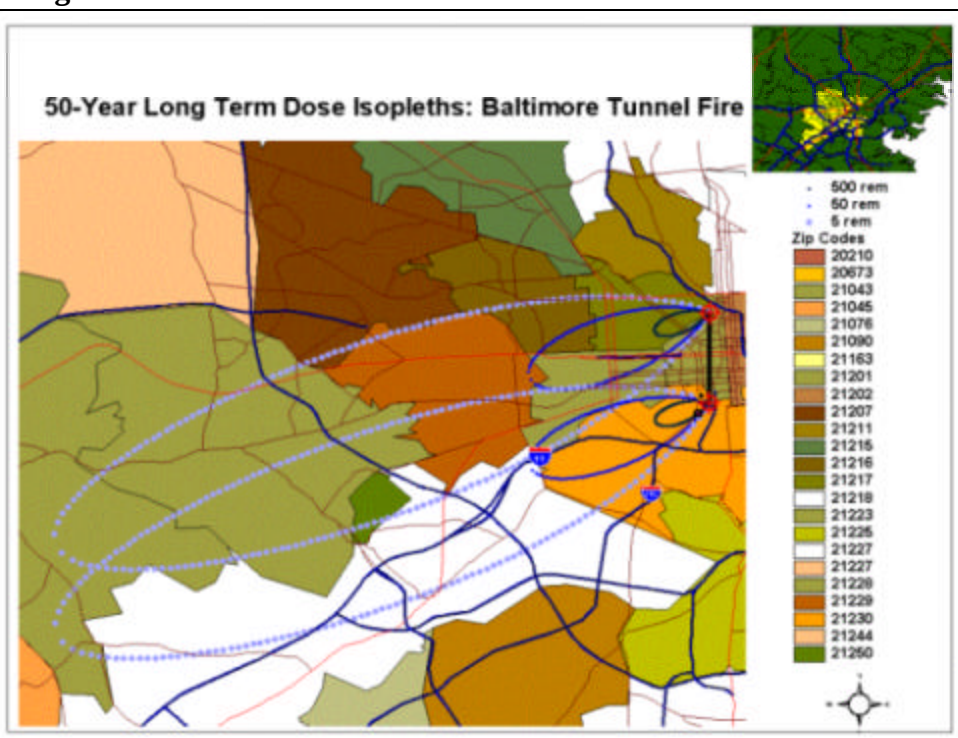


Figure 2.1.11

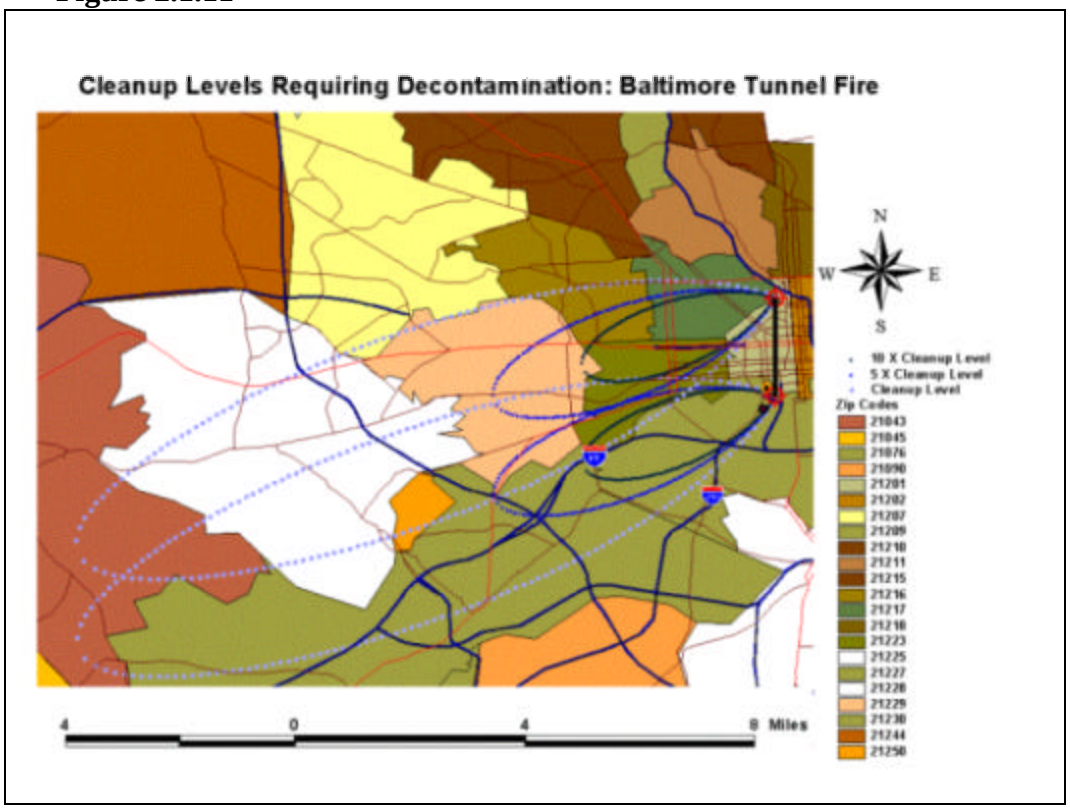


Table 2.1.11, below, presents the results of the differing scenarios for short-term (24-hour) exposure, 1-year exposure, and 50-year exposure. It is important to note that the exposure estimates assume no evacuation or cleanup, in order to provide a bounding result.

Table 2.1.11 Results: Evaluation of Baltimore Tunnel Fire with Hypothetical Spent Fuel Cask

	Baltimore Residents	PCINet Stadium if filled to capacity during incident
Affected Population, 1990 (2000)	390,388 (345,493)	69,400
Area with acute dose of at least 10 mrem	11.0 km^2	11.0 km^2
Max. Downwind Distance of 10 mrem acute dose plume	6.8 km	6.8 km
Area with acute dose of at least 1 mrem	173 km^2	173 km^2
Max. Downwind Distance of 1 mrem acute dose plume	38.7 km	38.7 km
Acute Population Dose, 1990 (2000) [person-rem]	17,509 (15,495)	38,170
Range of Estimated Excess Latent Cancer Fatalities from Acute Dose, 1990 (2000)	9-56 (8-50)	19-122
1-Year Population Dose, 1990 (2000) [person-rem]	495,498 (438,516)	--
Range of Estimated Latent Cancer Fatalities from 1-year Dose, 1990 (2000)	248-1,586 (219-1,403)	--
50-Year Population Dose, 1990 (2000) [person-rem]	9,944,974 (8,801,302)	--
Range of Estimated Latent Cancer Fatalities from 50-year Dose	4,972-31,824 (4,401-28,164)	--

Table 2.1.12 below shows RWMA's estimate of cleanup costs. These cleanup cost estimates would be significantly greater if meteorological conditions were different. For example, a higher wind speed or more stable atmospheric conditions would have contributed to a greater downwind dispersal and, consequently, greater contaminated areas.

Table 2.1.12 Decontamination Cost Estimates: Baltimore Tunnel Fire Spent Fuel Accident

Area heavily contaminated (km^2)	9.9
Area moderately contaminated (km^2)	10
Area lightly contaminated (km^2)	62.4
Cost/km^2, heavy contamination	$394,604,748
Cost/km^2, moderate contamination	$182,592,165
Cost/km^2, light contamination	$128,263,609
Total Cleanup Costs*	$13.7 billion

*Total cleanup costs are the sum of light, moderate, and heavy cleanup costs, all in 1995 dollars.

RWMA concluded that the Baltimore accident conditions were severe enough to have caused the largest release considered in the DEIS for the Yucca Mountain facility. The contamination resulting from the release would cause a policy-maker's nightmare. On the one hand, the cost of cleanup could be $13.7 Billion. On the other hand, failure to clean up could result in up to 1,580 latent cancer fatalities over one year, and up to 31,800 latent cancer fatalities over 50 years. The potential health and economic consequences presented give some indication of the tradeoff likely to take place between preventing future health effects and expending a large amount of money to properly remediate an area.

An additional matter concerns the potential stigma effects that would undoubtedly result from an accident resulting in the radioactive contamination of a major portion of Baltimore, including the locations of its professional sports arenas. These effects, though real and likely more economically devastating than the costs estimated by RWMA, are difficult to quantify. RWMA concluded that an accident involving a release of radioactive material from a transportation container could be economically devastating.

National Risks from Terrorism and Sabotage

Well before the terrorist suicide attacks of September 11, 2001, research conducted by the State indicated that past NRC and DOE evaluations of the terrorist threat against SNF and HLW shipments were seriously deficient. Two Nevada contractor reports published in 1997 documented recent changes in the nature of the terrorist threat and the increased vulnerability of shipping casks to terrorist attacks involving high-energy explosive devices. The State of Nevada filed a petition for rulemaking with the NRC in June 1999, requesting that the NRC completely reexamine the issue of terrorism and sabotage relative to repository shipments of SNF and HLW. Nevada's comments on the Yucca Mountain DEIS advised DOE that the DEIS sabotage scenario was unreasonably constrained, and the impacts of that scenario were insufficiently evaluated. As of February 2002, neither NRC nor DOE has responded to Nevada's evidence regarding the vulnerability of SNF shipments, nor to Nevada's contention that shipments to a geologic repository will be dramatically different from past shipments in the United States, and that these differences will create greater opportunities for terrorist attacks and sabotage.

SNF truck casks are especially vulnerable to terrorist attack and sabotage. DOE and NRC testing in the 1980s demonstrated that a high-energy explosive device (HED), such as a military demolition charge, could breach the wall of a truck cask. DOE sponsored a 1999 study of cask sabotage by Sandia National Laboratories (SNL) in support of the DEIS. The SNL study demonstrated that HEDs are "capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment." [DEIS, p. 6-33] The SNL study also concluded that a successful attack on a truck cask would release more radioactive materials than an attack on a rail cask. [DEIS, p. 6-34]

The DEIS estimated that a successful attack on a GA-4 truck cask in an urban area under average weather conditions would result in a population dose of 31,000

person-rem, causing about 15 cancer fatalities among those exposed to the release of radioactive materials. The maximally exposed individual would receive a dose of 67 rem. The DEIS did not evaluate any environmental impacts other than health effects. In particular, the DEIS ignored the economic impacts of a successful act of sabotage.

An analysis prepared for Nevada by RWMA estimated sabotage impacts would be at least ten times greater than DOE"s estimate. RWMA replicated the DEIS sabotage consequence analysis, using the RISKIND model for health effects and the RADTRAN model for economic impacts, the SNL study average and maximum inventory release fractions, and a range of population densities and weather conditions. Under average weather conditions, RWMA estimated that the same sabotage incident would result in 6-104 latent cancer fatalities and a maximum individual acute dose of 196 rem. Under worst case weather conditions, there would be 14-165 latent cancer fatalities and a maximum individual acute dose of 324 rem. Cleanup costs and other economic impacts ranged from $3.1-13.5 billion (2000$) for average weather conditions, and $10.1-20.9 billion (2000$) for worst case weather conditions.

Other terrorism and sabotage scenarios could result in even more severe impacts. The Sandia study assumed that the reference weapon would not completely penetrate the cask. Full perforation would increase the release and resulting consequences by a factor of ten. The impacts would have also been substantially greater if the cask was assumed to be carrying 5-year-old SNF. DOE assumed 26-year-old SNF. DOE also failed to consider credible attack scenarios involving the use of more than one penetrating weapon, use of an incendiary device in conjunction with a penetrating weapon, and use of commercial shaped charges that are more efficient metal penetrators than the M3A1 military demolition device evaluated by SNL.

The social and economic impacts of an attempted act of terrorism or sabotage, whether successful or unsuccessful, deserve special attention. An incident involving an intentional release of radioactive materials, especially in a heavily populated area, could cause widespread social disruption and substantial economic losses even if there were no immediate human casualties and few projected latent cancer fatalities. Local fears and anxieties would be amplified by national and international media coverage. Adverse economic impacts would include the cost of emergency response, evacuation, decontamination and disposal; opportunity costs to affected individuals, property-owners, and businesses; and economic losses resulting from public perceptions of risk and stigma effects.

Concern about terrorism impacts led Nevada's Attorney General to file a petition for rulemaking with the NRC in June 1999. The petition requested a general strengthening of the current transportation safeguard regulations and a comprehensive reexamination of the consequences of radiological sabotage against SNF shipments. The NRC published the petition (Docket PRM-73-10) in the Federal Register on September 15, 1999. More than 20 parties, including 11 States, filed comments on the petition. The NRC has not officially responded to Nevada as of January 2002.

The petition documented developments that have increased the vulnerability of shipping casks to terrorist attacks involving high-energy explosive devices over the past decade and a half. First, the capabilities and availability of explosive devices, especially antitank weapons and commercial shaped charges, have increased significantly. Second, new spent fuel shipping cask designs, developed to increase payloads without exceeding specified weight limits, appear to be more vulnerable to attacks involving past, current, and future military weapons systems and civilian explosives.

The petition submitted evidence that spent nuclear fuel shipments to a national repository or storage facility will be dramatically different from past shipments in the United States. The following differences will create greater opportunities for terrorist attacks and/or sabotage against SNF shipments and may also increase the consequences of any incidents that occur:

(a) Long-duration, highly visible, nationwide shipping campaign;

(b) Regular and predictable shipments to a single destination;

(c) Large increase in amount of spent fuel shipped and increased numbers of truck and rail shipments annually, averaging several cask shipments per day, every day, for 30 years;

(d) Substantial increase in number of active routes and average shipment distances, with potential implications for selection of targets and attack locations;

(e) Significant concentration of shipments along certain highway and rail routes west of the Mississippi River, with implications for shipments through heavily populated areas and through locations that place shipments in significantly disadvantageous tactical positions; and

(f) Potential use of routes within Nevada with marginal safety design features, limited rest and refueling locations, and low likelihood of swift local law enforcement agency response.

The petition also pointed out that a national repository or storage facility may have a greater symbolic value to terrorists than current at-reactor storage facilities, and that the enhanced symbolic value of the facility as a target may extend to SNF shipments to such a facility. Facilities operated by DOE, the U.S. government agency responsible for producing nuclear weapons, may have greater symbolic value as terrorist targets than commercial nuclear facilities. Two Rand Corporation studies found that DOE nuclear programs may be especially attractive targets for state-sponsored terrorists and domestic right-wing radicals.

The events of September 11th indicate that further reconsideration of potential terrorist attack scenarios is necessary. Nevada previously urged the NRC and DOE to assess of the consequences of attacks against transportation infrastructure used by nuclear

waste shipments, attacks involving capture of a nuclear waste shipment and use of high energy explosives against the cask, and direct attacks upon a nuclear waste shipping cask using antitank missiles. It is now apparent that the risk assessment must consider suicide attacks involving large groups of well-trained adversaries, and previously unanticipated attack modes such as use of hijacked commercial airplanes, tanker trucks, and military vehicles and aircraft.

The events of September 11th reemphasize the importance of comprehensively assessing the consequences of a successful attack. Nevada previously requested that the NRC and DOE assess the full range of human health, environmental, and socioeconomic impacts of a terrorism or sabotage event resulting in a release of radioactive materials. The post-September 11th recovery efforts in New York and Virginia demonstrate the importance of addressing standard socioeconomic impacts, including cleanup and disposal costs and opportunity costs to affected individuals and business, as well as so-called special socioeconomic impacts, including individual and collective psychological trauma, and economic losses resulting from public perceptions of risk and stigma effects. The necessity of addressing impacts on emergency responders and recovery workers is now also clear.

Finally, the events of September 11th underscore the importance of immediately adopting a national policy to protect, in place, the SNF currently stored at commercial nuclear power plants. Existing wet and dry storage facilities will require protection from terrorist attack for the next 40 years, regardless of current proposals for centralized storage or geologic disposal. Protection of SNF at existing facilities is a straightforward task. Existing technologies and tactics can readily turn wet and dry storage installations into hardened targets. Protection of SNF shipments is an entirely different matter. From the standpoint of target attractiveness and vulnerability, shipping SNF to a national repository or centralized storage site will only increase the risk of terrorism and sabotage. (Ballard, 2002) Even if such shipments were to begin within the next decade, it would then be necessary to protect both the storage facilities and the shipments for four decades or more.

Conclusion

State of Nevada research has documented that there are substantial risks to communities located along potential shipping routes from the transport of spent nuclear fuel and high-level waste to a repository in Nevada. These risks are significant "drivers" of the entire array of socioeconomic and related impacts associated with the federal program. DOE's and the federal government's activities in the area of transportation analysis, planning, and risk management have done little to attenuate these risks and, instead, have either obfuscated or actually exacerbated risks and their consequences.

Not only are the risks from spent fuel and high-level waste shipments potentially great, but also they are also unnecessary. These materials have long been, and are currently being, stored in safe, secure, fixed locations where risks are minimized. With currently available dry storage technology, spent fuel can continue to be safely and

economically stored on site for the next 100 years or more. Exposing millions of people in 44 states to needless risks from the transportation of these materials is entirely unwarranted.

2.2 National Transportation Impacts on Native American Communities

Native American communities and Indian Reservations in 16 states besides Nevada would be directly impacted by shipments of spent nuclear fuel and high-level nuclear waste to Yucca Mountain. Figure 2.2.1 depicts the Indian reservations identified as being directly impacted by one or more of the rail and truck routes contained in DOE's DEIS.

Figure 2.2.1 Tribes or Reservations Impacted by National SNF and HLW Shipments

STATE	TRIBES OR RESERVATIONS	ROUTES
Arizona	Hualapai and Navajo	I-10, I-40; BNSF/UPRR
California	Agua Calientes, Cabazon, Chemehuevi Valley, Ft. Mojave, Ft.Yuma, Morongo, Torres Martinez, and Hoopa Valley	I-10, I-40/I-15; SF/UPRR
Florida	Hollywood	I-95, FECR
Idaho	Fort Hall	I-15, UPRR
Iowa	Mesquakie(Sac & Fox)	UPRR
Kansas	Potawotamie	UPRR
Minnesota	Prairie Island	CP/Soo
Nebraska	Omaha and Winnebago	UPRR
New Mexico	Acoma, Canoncito, Isleta, Laguna, Navajo, and Zuni	I-10, I-40; BNSF/UPRR
New York	Cataraugas and Tonawanda	I-90, Conrail
North Carolina	Cherokee	I-40
Oklahoma	Choctaw, E. Shawnee, Kialegee Creek, Kickapoo, Miami, Modoc, Osage, Ottawa, Peoria, Quapaw, Sac & Fox, and Thlopthlocco Creek	I-35, I-40; BNSF/UPRR
Oregon	Umatilla	I-84; UPRR
Utah	Goshute, Ouray, Skull Valley, and Unitah	I-84/I-15/I-80/US93A; UPRR
Washington	Yakima	I-84; UPRR
Wisconsin	Oneida	WCRR

Except for Tribes in Idaho, DOE failed to identify any potentially affected Indian reservations and communities in the DEIS and in notices for public hearings on the DEIS. DOE further failed to provide financial assistance to facilitate independent technical review of the DEIS by potentially affected Indian Tribes.

The State of Nevada has defined transportation-affected Native American lands and resources to included the following:

(1) Reservations crossed by potential shipping routes;

(2) Off-reservation ceded lands, where Tribes retain treaty rights or other legally-recognized user rights, crossed by potential shipping routes;

(3) Reservation lands and off-reservation lands within transportation emergency evacuation zones along potential shipping routes;

(4) Reservation and off-reservation lands that could be contaminated by air or water transport of radioactive materials released in a severe transportation accident or terrorist incident (generally within 50 miles downwind, downstream, or downgradient of a potential shipping route);

(5) Reservations whose highway access would be disrupted by a nuclear waste transportation emergency; and

(6) Off-reservation lands along potential shipping routes where Tribal personnel would likely be involved in transportation emergency response.

The Yucca Mountain DEIS gives insufficient consideration to the major concerns identified by potentially affected Indian Tribes and by the National Congress of American Indians. These concerns include:

(1) Tribal authority to regulate shipments across reservations;

(2) emergency response planning and training for Tribal personnel;

(3) advance notification of shipments and shipment monitoring;

(4) protection of Native American religious and cultural sites, plants, and animals, both on and off reservations;

(5) cultural implications of potential radiological contamination of Indian lands, and the cultural implications of cleanup activities involving non-tribal personnel; and

(6) adverse economic impacts of public perception of risk, especially adverse impacts on tribal tourism and recreation businesses.

2.3 Cost Impacts of the Yucca Mountain Program

In 1998, in order to effectively evaluate the accuracy and appropriateness of DOE's cost estimates for the high-level waste program, the State of Nevada commissioned an independent study of likely costs associated with accepting SNF and HLW at generator sites, transporting the material to Nevada, and ultimately disposing of it in a repository.

The study addressed the entire range of activities associated with the highly complex federal program, including DOE responsibility for at-reactor storage pending shipment, waste acceptance activities, transportation planning and emergency preparedness, shipping assumptions and intermodal transportation, centralized interim storage, repository disposal, and other related aspects of the system. The objective was to understand the ***real*** costs of the program in their totality, rather than approaching cost assessment in an incomplete and often piecemeal fashion as DOE had done in prior assessments.

To assure that the Nevada study would be as accurate and objective as possible, a team of independent consultants was employed to gather information, analyze the data, and develop the ultimate cost conclusions. The accounting firm of KPMG Peat Marwick was commissioned to provide expert peer review of the effort.

The result of this extraordinary independent undertaking was a comprehensive and timely evaluation of the real costs to the nation of the federal high-level nuclear waste program - not just the Yucca Mountain repository component - and the potential taxpayer liability the country would incur as that program moves forward. The full report is attached as Appendix IX to this report.

The findings of the State of Nevada cost assessment are summarized in seven categories, as shown in Table 2.3.1.

Table 2.3.1 Overview of Total System Life Cycle Costs by Major Cost Categories

Major Cost Categories	**Cost (bil FY'96$)**
Expenditures Through Fiscal Year 1996	**6.1**
Estimated Future Costs	**47.8**
1. Onsite Storage	4.3
2. Cross-Country Transportation	6.0
3. Nevada Transportation	3.2
4. Centralized Interim Storage Facility	9.2
5. Geological Repository	23.0
6. Other Development and Evaluation Costs	0.4
7. Other Program Costs	1.7
Total	**$53.9**

It should be noted that, in 1998, when the State's cost assessment was done, DOE's estimate for the total life cycle cost of the federal program was approximately

$43.7 billion. In 2001, DOE released a revised TLCC analysis that put the costs of the program at $57.5 billion (expressed in FY 2000 dollars). If the State estimate were updated using 2000 dollars, the figure would be in the neighborhood of $60 billion, very close to DOE's current estimate.

DOE estimates that the Nuclear Waste Fund (current balance and future revenues) would produce $41.8 billion in constant 2000 dollars.[5] Even if DOE's waste fund estimate were accurate, this would leave a potential taxpayer liability of over $18 billion, a figure that is very likely to grow as Nuclear Waste Fund revenues shrink and program costs escalate, as they inevitably would in a project of this magnitude and complexity.

Implications

The cost-revenue condition of the nation's HLW program and the potential for costly uncertainties are major causes for concern and are of potentially significant impact for the nation as a whole. The key implications are that the probable costs of managing the nation's HLW and the liability for the general taxpayer are substantially greater than have been estimated. The Nuclear Waste Fund under its current fee structure would leave the country with a major unfunded liability that has not been accounted for in expenditure/revenue calculations for the federal budget.

[5] The estimates of revenues from civilian nuclear power plants are based on projected electric generation of existing stations, which are expected to operate in gradually reduced numbers until all currently operating reactors would have completed their license terms. There is some uncertainty about operating projections since several plants already have shut down early and others have applied for license extensions. Any early shutdowns reduce revenues on a one-to-one basis for each kilowatt of power not produced, but the reduced amount of spent fuel reduces costs only at the margin of a program that must be developed in any case. In light of the events of September 11th, it is difficult to see new nuclear power plants coming on line in the foreseeable future, given the heightened public concern over the terrorism risks posed by these high profile and potentially vulnerable facilities.

CHAPTER THREE
IMPACTS TO THE STATE OF NEVADA

Impacts of the proposed Yucca Mountain project and related high-level nuclear waste transportation from around the country to a repository would be ubiquitous, major in scale, and long lasting. This is the conclusion reached as a result of the extensive research program undertaken by the State of Nevada since 1986 and, more recently, by affected units of local government within the State. This chapter summarizes the key findings of that socioeconomic research. More in-depth analyses are to be found in the appendices to this report. In addition, detailed descriptions of the State's impact studies and their findings can be found in the three major summary reports on the Nevada socioeconomic studies published in 1989, 1993, and 1995, respectively.[1] The NANP's study team has also published two major books dealing with the policy implications of the findings of Nevada's socioeconomic research.[2] The NANP Technical Review Committee issued two reports of its findings with respect to the studies, and a summary of the Nevada research was published in the ***Proceedings*** of the National Academy of Sciences.[3] A complete list of references is attached as Appendix I of this report.

3.1 Impacts to Nevada's Major Economic Sectors

The most serious and potentially catastrophic economic risk for Nevada stemming directly from the Yucca Mountain project involves the likelihood of damage to the southern Nevada visitor economy. Studies carried out since 1986 show that the groups and individuals essential to Nevada's economic health are highly sensitive to the radioactive risks associated with a high-level nuclear waste (HLW) repository and with transport of spent nuclear fuel (SNF) and other highly radioactive wastes. The most serious form of such risk is the potential for stigma impacts on the tourist and visitor industry.

State of Nevada research indicates that each one-percent annual decline in visitor spending due to the HLW program would cost the local economy $315 million in lost revenues. Total losses, including a multiplier of 2.5 as a conservative indirect effect on businesses providing services to residents and employees, makes each percentage point drop worth $787.5 million. Estimates of visitor loss range from 7% to 75%, depending

[1] Ref. (1) "An Interim Report on the State of Nevada Socioeconomic Studies," (June, 1989); (2)"State of Nevada Socioeconomic Studies of Yucca Mountain 1986 - 1992: An Annotated Guide and Research Summary," (June 1993); and (3) "State of Nevada Socioeconomic Studies Biannual Report: 1993 - 1995," (June 1995).

[2] Ref. One Hundred Centuries of Solitude, by James Flynn, et al., Westview Press, Boulder, Colorado (1995); and The Dilemma of Siting a High-Level Nuclear Waste Repository, by D. Easterling and H. Kunreuther, Kluwer Academic Publishers (1995).

[3] Ref. "Interim Statement of the Technical Review Committee on the Yucca Mountain Socioeconomic Project," by G. F. White, et al. (January, 1990); "Nuclear Waste's Human Dimension," by K. Erikson, et al., in Forum for Applied Research and Public Policy, Fall, 1994; and "Socioeconomic Studies of High-Level Nuclear Waste Disposal," in Proceedings of the National Academy of Sciences, Vol. 91, pp. 10786 - 10789, November, 1994.

upon the conditions, according to DOE plans and various accident and incident scenarios (Easterling, Appendix II). Even with a perfectly operated repository system and minimal negative impacts, the annual loss to the Las Vegas and Nevada economy could exceed $5.5 billion. With adverse events or accidents, the single case cost could be $39 billion or more.

The Yucca Mountain site is approximately 90 miles northwest of Las Vegas, which serves as the media dateline for reports on repository news stories. This is close enough to tarnish the image of the city. Moreover, the current design of the repository calls for shipments of spent nuclear fuel to pass within view of the huge casino-hotel complexes along the Las Vegas Strip. Despite assurances to the contrary, it is entirely possible that these shipments could lead to a transportation accident or other "risk event" that attracts widespread media attention.

The most serious and potentially catastrophic economic risk for Nevada stemming directly from the Yucca Mountain project involves the likelihood of damage to the southern Nevada visitor economy. Even with a routinely operating repository, annual stigma-related losses to the Las Vegas and Nevada economy could exceed $5.5 billion. In the event of a nuclear waste accident, losses could exceed $39 billion.

An extensive body of empirical research indicates that if such a scenario were to occur, southern Nevada would almost inevitably suffer significant visitor losses. This research, conducted in large part by a team of nationally recognized social scientists under contract to the Nevada Agency for Nuclear Projects (NANP), demonstrated that a nuclear waste repository has a tremendous potential to trigger avoidance behavior on the part of the general public (Chalmers et al., 1993; Flynn et al., 1995; Nevada Commission on Nuclear Projects, 2000). On a general level, this research has supported the notion that nuclear risks are "socially amplified," such that even seemingly minor events have major economic, political, and social repercussions because they send signals of serious underlying risks (Kasperson et al., 1988; 1992; 1996; Pigeon, Kasperson, and Slovic, forthcoming 2002). On a more specific level, the research has shown that a repository at Yucca Mountain could cause visitors to avoid southern Nevada by either: (a) increasing the perceived risk associated with visiting the area (Easterling, 1997); (b) giving rise to noxious imagery that becomes associated with Nevada in the public's mind (Slovic et al., 1991); or (c) conferring a stigma on the area, which would lead to widespread avoidance (Edelstein, 1988; Slovic et al., 1991; Gregory, Slovic & Flynn, 1996; Easterling, 2001a).

Because the southern Nevada economy is based so heavily on tourism and conventions, stigma-induced avoidance would have major repercussions on revenues and employment. Additional economic losses would occur as a result of avoidance on the part of investors and in-migrants. Public services would be adversely impacted across the State due to the decline in tax revenues, which in Nevada are geared to the health of the visitor economy.

The Stakes -- What is at Risk?

Visitor and Tourist Spending

Nevada is unique among all the states in terms of its vulnerability to adverse visitor impacts. According to a 1994 study, almost 40 percent of the state's labor force was employed in tourism-related jobs (e.g., hotels, casinos), more than double the rate of any other state and almost 10 times the national average (Edmonston, 1994). During the year 2000, the Las Vegas metropolitan area attracted 35.8 million visitors who contributed $31.5 billion to the local economy — through gaming, hotel stays, meals, transportation, etc. (Las Vegas Convention and Visitor Authority, 2001).

The number of individuals visiting Clark County in 2000 is five times what is was in 1970, which equates to an average annual growth rate of 5.5 percent. As visitor volume has expanded, the nature of those visitors has changed markedly. No longer simply a gambling destination, southern Nevada now attracts families with children who are drawn to the "theme-park" environment of the new mega-hotels. With the construction of huge new exhibit halls, Las Vegas became the number-one convention destination during the 1990s. In 1999, the city hosted 3,847 conventions, which attracted 3.8 million delegates (Las Vegas Convention and Visitor Authority, 2001). More than anyplace else in the country, Clark County's economy depends on the willingness of out-of-state residents to visit.

State and Local Revenues

Visitor spending in Nevada generated about $3.3 billion in state government revenues in 2000, about 34% of the state total. This revenue source provided 19% ($1.3 billion) of revenues for Nevada local governments. The costs to state and local governments for services to visitors and tourists are about 10-20% of these revenues. Losses in visitor spending would create major negative impacts on funding for essential state and local government services.

Property Values

A repository at Yucca Mountain would require tens of thousands of waste shipments on Nevada highways and rail routes. These shipments would adversely impact the values of adjacent properties. The Komis case in New Mexico that was upheld by the New Mexico Supreme Court fixed the lost value of adjacent property along the Santa Fe bypass built to transport transuranic wastes to the Waste Isolation Pilot Plant (WIPP) at 4.75% of the fair market value. Expert opinion studies show that impacts in Nevada, even in the case of no accident, could be several billion dollars. Privately held property along the transportation routes in Nevada has market values in the tens of billions of dollars, and potential losses would be massive. This problem is most acute for Nevada since all the shipments would eventually go through the state to reach Yucca Mountain. It is also a

serious problem for routes across the country, especially those that would be the major collector highway and rail corridors.

New Business Investments, Retirement, and Job In-migration

Southern Nevada is one of the nation's leading destinations for new investment, retirement location, and job seekers. Nevada growth has increased during the past two decades from less than a million to more than two million, with Las Vegas repeatedly noted as the fastest growing metropolitan area in the country. The attraction of the area is essential to supporting the existing economy and diversifying for greater economic stability in the future. The attractiveness of the state and its communities would be seriously diminished by the location of a repository at Yucca Mountain and the transport of tens of thousands of HLW shipments on the state's highways and/or rail routes.

Concern over the Economic Impacts of a Repository

Business executives in Nevada have become quite vocal in arguing that a Yucca Mountain repository would cause potential visitors to avoid the state. In particular, a study that interviewed executives of the Clark County gaming industry concluded that:

> It is clear that the gaming industry believes that the transportation of high-level waste (HLW) through Clark County would bring increased risk to the primary economic base for the entire state of Nevada. ... According to virtually every gaming industry representative interviewed, the most serious risk is from the stigma that would result if there is any accident of any kind involving the shipment of HLW. . ... Gaming executives described the potential impact of a serious accident on their industry as crippling, devastating and "Chernobyl" like (UER, 2001b, p. 15).

This concern over visitor impacts led a number of industry associations to take official stands in opposition to building a repository at Yucca Mountain. In 1991, the Nevada Resort Association (NRA) passed an anti-repository resolution stating, in part:

> The establishment of a high-level nuclear waste repository is inconsistent with the positive image the state seeks to present to the world. ... [A]ny news stories about the repository and associated transportation of radioactive materials to it could cause special damage to the reputation enjoyed by Las Vegas and the success of its tourism promotion efforts (NRA, 1991).

The Las Vegas Chamber of Commerce voted January 31, 2001 to oppose the repository. According to the Chamber's resolution, "One accident involving the transportation of nuclear waste, no matter how minor, could create fears and hysteria among the general public and cause fewer tourists to travel to Southern Nevada, even if scientists determine these fears are unfounded" (Strow, 2001). The Las Vegas Convention and Visitor Authority followed suit by unanimously approving its own anti-repository resolution.

Similar concerns have been raised within almost every other state that has been named as a candidate to host a nuclear-waste facility. Beginning with the initial attempts to find HLW repository sites in eastern and western states, citizens and public officials have presented stigma-related concerns to DOE in thousands of public comments (Kraft 1992; Brody and Fleishman 1993; Desvousges, Kunreuther et al. 1993; Dunlap, Kraft et al. 1993; Dunlap, Rosa et al. 1993; Kraft and Clary 1993; Rosa and Freudenburg 1993).

Attempts to find a site for a monitored retrievable storage facility during the late 1980s and early 1990s also prompted public and official opposition based upon stigma effects. For example, when DOE proposed to build an MRS facility for nuclear waste in Oak Ridge, Tennessee, Governor Lamar Alexander cited the possibility that an MRS "would impose a negative and economically harmful image on the area" (Sigmon, 1987). In almost precisely the same vein, Utah's Governor Michael Leavitt prevented San Juan County from pursuing the opportunity to volunteer to host an MRS. "I do not believe it is in the best interests of San Juan County or Southeastern Utah to accept an MRS facility. ... The tourism and recreation industries, which are highly important to San Juan County, would suffer significantly from the stigma of being what would be characterized nationally as a 'nuclear dumping ground'" (Leavitt, 1993, p. 1). New Mexico opposed the interest of the Mescalaro Apaches in negotiating with the federal Nuclear Waste Negotiator on the basis that a MRS facility on tribal lands would harm the tourist and visitor industry in the state (Wald, 1993). Governor Mike Sullivan of Wyoming cited risks to tourism while vetoing Fremont County's interest in a MRS facility (Sullivan, 1992).

Concern over stigma has also arisen with regard to repositories for low-level radioactive wastes (LLW) as states have searched for sites to fulfill their obligations under the Low-Level Nuclear Waste Policy Act of 1980. Over 200 proposed communities have opposed the siting of LLW repositories, at least in part on economic grounds (U.S. General Accounting Office, 1999; Weingart, 2001). After more than two decades, not one LLW facility has been built under the federal program due to public opposition. This is both a demonstration of the stigma attached to radioactive wastes and the widespread belief that host communities would suffer economically and socially.

Social Science Methods And Data: Approaches To Measuring And Assessing Socioeconomic Impacts

The possibility of the risk of negative economic impacts has been consistently raised whenever a site has been named as a possible location for a radioactive waste storage or disposal facility. This risk is even more serious in the case of the Yucca Mountain site because of the size of the southern Nevada visitor economy. Still, the mere fact that local officials and business leaders are concerned over a repository does not, in and of itself, mean that such effects are inevitable. In order to substantiate the credibility of the economic risk, the Nevada Agency for Nuclear Projects has sponsored a wide-ranging research program to provide empirical answers to some of the major questions surrounding repository-induced avoidance behavior.

There are a number of valid and reliable ways to assess the socioeconomic impacts from high-level radioactive waste activities (see Nevada Comments on the Yucca Mountain DEIS, 2000, Appendix I). These impact methods employ established scientific approaches, similar in basic ways to research in the physical sciences but with specific application to human individuals, groups, communities, and organizations. These approaches incorporate studies of three overarching types:

1. Basic and Applied Research. Social science research parallels that of other sciences by including observation, experimentation, replication, and development of conceptual models and frameworks. A primary focus for understanding socioeconomic impacts is to conduct experiments in decision-making and judgment about risks. Another approach collects data from relevant populations using interviews, as with survey research. Case studies using existing records, direct observation behaviors in social interactions, and elicitation of social values, motives, and intentions also produce important, independent data and the means for interpreting the results of other studies (e.g., survey results). The development of conceptual and methodological models or frameworks increases the validity and reliability of impact assessments.

2. Examination of past and ongoing analogous cases. This involves a study of the historical record for cases that are the same, similar, or informative about the substance and/or processes that illuminate the evaluation or estimation of impacts from high-level radioactive waste activities. Examples are the case-based data that were used to analyze the Social Amplification of Risk framework (Kasperson, et al., 1988; 1992; 1996; Burns, et al., 1990; 1993; Renn, et al., 1992) and the historical cases of managing nuclear technologies and public responses (Flynn, 2002; Carter, 1987; Welsome, 1999; Kraft, et al., 1993). These studies lead to development of concepts, frameworks, and models that organize data, provide parameters for analysis, and guide forecasts, projections, and the range of potential future impacts.

3. Expert opinions. Experts are individuals who, because of their occupations, education, experience, study, and interests, have developed insights into social processes and the behavior of specific groups under a variety of conditions. Real estate professionals, for example, can offer expert opinions about what conditions are important to the value of properties, how buyers, sellers, and other professionals view risk and real estate values, and the probable effects of various scenarios. Convention planners can consider and provide an informed opinion about risk conditions and their relationship to convention attendance. Certainly, social scientists who have studied the historical data and conducted basic and applied research on questions of human behaviors in response to high-level nuclear waste risks and the resulting socioeconomic impacts are primary sources of expert opinion on effects of a repository program.

Research Demonstrating Why People Would Avoid Areas Near a Repository

In order to determine whether or not there is actually any possibility of visitors avoiding areas near a nuclear-waste repository, NANP commissioned a team of renowned social scientists to study the decision process underlying these behaviors. The results of these studies have been published in a plethora of reports, books, and journal articles (See the attached Bibliography). These studies document that people regard HLW storage, transportation, and management programs as high-risk ventures. They look upon HLW with dread and uncertainty. As a result, they carry extremely negative images of the proposed Yucca Mountain repository program. Following the direct implications of these evaluations and images, the public prefers to avoid places and conditions that might expose them to radiation from HLW.

Slovic and his colleagues (Slovic, et al., 1991) provided a research design and outlined a set of related propositions to examine the connections between images, Yucca Mountain, radioactive waste stigma, and the potential visitor behaviors. The research tested the following three propositions:

1. Images associated with environments have diverse positive and negative affective meanings that influence preferences (e.g., in this case, preferences for sites in which to vacation, retire, find a job, or start a new business).

2. A nuclear waste repository evokes a wide variety of strongly negative images, consistent with extreme perceptions of risk and stigmatization.

3. The repository at Yucca Mountain and the negative images it evokes would, over time, become increasingly salient in the images of Nevada and of Las Vegas (Slovic, et al., 1991, pp. 686-687).

Support for these propositions demonstrates a mechanism whereby the HLW repository would adversely impact tourism, migration, and business development in Nevada. This demonstration is based on established patterns people use to evaluate and characterize information about places as a prelude to making behavioral decisions. As such, these studies do not rely merely upon introspective statements about future behaviors but reveal the underlying rationale for choices about places. The basis for evaluating places as revealed by images applies equally to places with or without radioactive waste facilities and includes the full range of amenities and disamenities as perceived by respondents. This was clearly demonstrated in a test-retest study of Phoenix, Arizona survey respondents. In the retest interviews conducted 16-18 months after the first image elicitation, respondents were asked in which cities or states they had vacationed since the original interviews were conducted. The data showed that the affective quality of the respondent's original image ratings were clearly related to the probability that person subsequently vacationed at places with the highest positive image ratings and avoided places with negative, notably nuclear, images, with the relationship being stronger for states than for cities. Simply, images predicted behaviors.

The relationship between imagery and visitation behavior was replicated in a study of convention attendees (Easterling & Kunreuther, 1993). Namely, members of a professional organization were more likely to attend the organization's annual meeting if the meeting was held in a city that had a more positive image for the individual. This result was also confirmed in a series of studies conducted by Jenkins-Smith (1994) under contract to DOE.

The survey of convention attendees also found that individuals are less likely to visit a city if they believe it involves a high level of risk, either from crime, natural hazards, or pollution (Easterling & Kunreuther, 1993). Likewise, convention planners are less likely to schedule meetings in cities they regard as imposing a heightened sense of risk (Kunreuther, Easterling & Kleindorfer, 1988). These results are consistent with a much larger body of literature in health psychology demonstrating that people take deliberate actions to reduce their vulnerability to harm (Becker, 1974; Weinstein, 1988).

Together, these studies demonstrate that Nevada would experience visitor losses if the repository leads to the public attachment of more risky or negative imagery to Las Vegas and/or Nevada. The degree to which this would occur depends on: a) the specific imagery that is associated with a HLW repository; and b) the degree to which repository-related imagery becomes associated with visitor destinations in Nevada. Thousands of survey respondents have been queried about their images of a HLW repository. These data provide a baseline for answering the first part of the question about the nature of repository images. At present, we know with a high degree of certainty that repository images are overwhelmingly negative. Perhaps this helps explain the unseemly haste by the owners of and communities with nuclear power plants to remove their wastes from current safe storage and advocate transporting it across the country to Nevada, even though they have reached an economic and social accommodation at the current localities.

Slovic and his colleagues conducted four surveys that interviewed 3,334 respondents and produced a total of 10,000 images in response to a question about an "underground nuclear waste repository." The respondents also rated the effect associated with these images. The most arresting and important finding was the extreme negative quality of the images. More than 56 percent of the total images could be classified as negative consequences and negative concepts. These images included danger, toxic, death, sickness, environmental damage, bad, scary, decay, slime, darkness. There were 232 images pertaining to war, annihilation, weapons, and things military. Positive imagery was less than a quarter of the total. The response "safe" was given only 37 times out of the 10,000 images (0.37 percent). Other concepts generally considered positive – "necessary," "employment," and "money/income" combined to total only 2.5 percent of the images.

Prior Instances Where Radiation Events Led to Visitor Losses

It is clear from the research that the more risky or negative the images associated with a place, the less likely that people would visit there. The critical question is whether locating a HLW repository at Yucca Mountain and/or transporting waste through Clark County or other areas of Nevada would lead the public to associate negative imagery with the state and its communities. A review of prior incidents involving nuclear technologies suggests that such an effect is indeed possible.

The March 1979 accident at the Three Mile Island (TMI) nuclear plant near Harrisburg, Pennsylvania provides one of the first documented cases where people have avoided areas affected by radiation events. The near-meltdown of the reactor core transfixed the public, although only a small amount of radiation actually entered the environment. In the first few weeks following the accident, both the Harrisburg area (immediately adjacent to TMI) and the Lancaster area (approximately 50 miles away from TMI) experienced declines in tourism in excess of 50 percent. The National Hardware Dealers' spring convention, scheduled for Harrisburg, was canceled. Within a few months (as it became clear that little if any radiation had been released into the environment), these losses appeared to abate (Pennsylvania Governor's Office on Policy and Planning, 1980; Himmelberger, Ogneva-Himmelberger & Baughman, 1993).

More extreme visitor impacts occurred with the accidental release of radiation into the environment that occurred in Goiânia, Brazil during the fall of 1987 (Petterson, 1988; Brooke, 1995). This happened when two men cut into a discarded radiotherapy machine and released 100 grams of cesium-137. Children playing in the junkyard were attracted to the glowing material and passed it among themselves and their families. Through ingestion and physical contact, 129 individuals were contaminated, of whom 50 were hospitalized and 7 died. This event sparked fears throughout Brazil, with severe economic consequences. Hotel occupancy in the city dropped by about 40 percent for six weeks following the accident. A number of scheduled conventions were canceled. In addition, residents of Goiânia were denied access to planes, buses, and hotels throughout the rest of Brazil; cars with Goiânia license plates were stoned; and local agricultural products would not sell. The impacts from this event persisted in an extreme form for about a year, dissipating as it became clear that the threat of contamination had abated (Brooke, 1995).

Tourism losses were also reported on the Normandy Coast of France following of a highly publicized report in the British Medical Journal (January 1997) that identified the Hague nuclear-fuel processing plant as a suspected cause in 27 leukemia cases found among young persons living near the facility. According to the mayor of Beaumont, the incident was "a catastrophe" for the area's reputation. Correspondingly, "when summer arrived, campers and hikers stayed away" (Whitney, 1997; Balter, 1997).

Urban Environmental Research (2001c) reports two additional case studies in which incidents at nuclear power plants have led to losses in tourists and visitors. An

accident at the Tokaimura nuclear fuel facility power plant in Ibarka Prefecture, Japan produced immediate and dramatic impacts to the local tourism sector. Local hotels, inns, and restaurants suffered a loss of 1.47 billion yen within the first month and one hotel filed for bankruptcy. In the second case, the Dounreay nuclear power plant in Scotland released radioactive contaminants that appeared in the sand on local beaches. A local resort owner has filed suit against the United Kingdom's Atomic Energy Authority to gain compensation for the resulting lost business.

There is also some evidence that the Nevada Test Site (NTS), located just adjacent to Yucca Mountain, had a negative impact on visitor behavior for those communities that were downwind from the aboveground nuclear tests. Specifically, St. George, Utah, which received major doses of radioactive fallout during the 1950s, suffered a drop in its tourism and convention trade when the increased incidence of leukemia in the area was publicized (Fradkin, 1989).

Taken as a whole, the historical record suggests that overt, publicized releases of radiation, particularly those with identifiable health effects, would trigger drops in visitation. If the repository leads to events that are comparable to the examples described here, there is every reason to believe that southern Nevada would experience losses just as large.

Self-Reports Among Potential Visitors to Las Vegas

The plausibility of repository-induced avoidance behavior is corroborated even more by studies that ask economic agents to predict their response to scenarios involving the transport and storage of high-level nuclear waste. In study after study, potential visitors report that they would avoid locations "near" a repository, as well as locations that are "near" routes along which nuclear waste is transported. For example, in a 1987 survey of 1200 individuals from across the country, 57 percent of the sample reported that a HLW repository would make it "less desirable" to vacation in a place located 100 miles away (about the distance between Yucca Mountain and Las Vegas) (Kunreuther, Desvouges & Slovic, 1988).

Following this 1987 survey of the general public, Easterling and Kunreuther (1993) undertook two studies to investigate the potential impacts of a repository on the Las Vegas convention industry. They considered two possible ways that a repository at Yucca Mountain might cause a loss in convention business: a transfer of conventions from Las Vegas to other cities, and a decrease in the number of people who would attend meetings still held in Las Vegas. These possibilities were examined by looking at the convention location process and the role of convention planners and by interviewing convention attendees. In this way, the two important decision levels (planners and attendees) that determine attendance at conventions were addressed.

The convention attendees study, conducted in the fall of 1989, was a telephone survey of 600 individuals who belonged to professional organizations and regularly

attended conventions. In one series of questions, respondents were told to assume that they had made a tentative decision to attend a convention, and then found out that the host city was located 100 miles away from a particular facility (either a prison, a nuclear reactor, a hazardous waste incinerator, a low-level radioactive waste repository, or a high-level nuclear waste repository). When the HLW repository was raised as a possibility, 23 percent of the sample reported that they would not attend the meeting. In contrast, only 1 percent of the sample indicated they would not attend the meeting if a *prison* were within 100 miles of the host city, and only 3 percent reported they would not attend if a *nuclear power reactor* were within 100 miles. This study indicates that the HLW repository elicits much stronger aversion than occurs for existing facilities.

Approximately the same level of avoidance was found in a 1988 survey of convention planners (Kunreuther, Easterling & Kleindorfer, 1988). Each of the 153 planners in this study had selected Las Vegas for a meeting in the past. As part of a longer interview, the planners were provided a description of the proposed repository and asked to reconsider their selection of Las Vegas under the assumption that the repository had recently opened at Yucca Mountain. When confronted with this scenario, 32 percent indicated that they would lower their ranking of Las Vegas and 8 percent reported that they "would no longer consider Las Vegas as an option." Under a more serious scenario (where the repository was plagued by recurrent accidents and safety lapses), 75 percent of the sample lowered their ranking of Las Vegas and 43 percent indicated that they "would no longer consider Las Vegas" for the meeting.

Similar results have been found in studies conducted by researchers working outside the auspices of NANP. For example, Fox et al. (1985) conducted a study for the State of Tennessee to see if vacation behavior might be influenced by the presence of a MRS facility at Oak Ridge. Among a sample of 306 persons living outside the state, 47 percent indicated they would change their vacation plans if they learned that their destination was located "near" an MRS facility.

Even researchers working for DOE have found evidence visitors would change their vacation plans in response to repository scenarios. Among a sample of 2400 individuals from around the country, Jenkins-Smith and Silva (1996) found that 7.7 percent were "very likely" to vacation in Nevada within the next five years. However, when this question was prefaced with information indicating that spent nuclear fuel would be transported through Nevada, only 6.0 percent of the sample indicated that they were "very likely" to vacation in Nevada (a 22% drop in the number of "very likely" visitors).

Across the board, studies that have asked people to project their vacationing and convention-going behavior have found that people want to avoid areas near a HLW repository. The level of avoidance is from 7 to 75 percent, depending on the methodology, the scenario, and the threshold for defining "avoidance behavior" (e.g., "probably would not attend" versus "definitely would not attend").

Scenarios that Produce Visitor Impacts

Taken together, the social science research and analogous cases reviewed here (and described in more detail in the appendices) provide a great deal of evidence that a repository at Yucca Mountain would produce visitor losses because of the nature of public evaluations of radiation hazards and the likelihood of events and/or accidents that increase the perceived risk or negative imagery. This body of research also indicates what types of repository-related events would increase perceived risk or produce negative imagery, and thus lead to visitor impacts (Easterling, 2001b).

On the high end of the economic impacts are repository scenarios that are almost certain to cause losses to the visitor economy. Events such as transportation accidents involving the release of radiation in or near Las Vegas fall within this category. More specifically, the analogous cases indicate that visitor impacts would be greatest if there is radiation release with death or illness. In this class of conditions causing severe impacts are media stories of radioactive contamination in the area.

Even for less extreme repository scenarios, negative visitor impacts are predictable. Again, based on analogous cases, it is likely that southern Nevada would experience visitor losses with a report of increased incidence of cancer among residents that could be plausibly connected to the HLW program activities. A comparable condition would result with media reports of transportation accidents anywhere in the country because this would suggest a special danger for Nevada, which would be the final destination of all HLW shipments to Yucca Mountain. Media stories about terrorism risks with regard to the transport of nuclear waste would have adverse effects, as would accounts of mismanagement in the transportation, handling, or storage of HLW.

Only if all these scenarios can be *ruled out*, is it legitimate to conclude that a repository at Yucca Mountain would not lead to visitor impacts for Nevada.

Levels of Impact

The large body of research leaves little doubt that a repository at Yucca Mountain would produce visitor losses under a range of different scenarios. However, the number of visitors who avoid Nevada would be greater or lesser depending on the severity and duration of the risk events that define the scenario. Thus, any assessment of how the repository would impact Nevada's visitor economy must rely on scenario-specific forecasts.

The most reliable forecasts would be those using scenarios that are comparable to events that have occurred in the past. For example, consider the cases of Goiânia, Brazil and Three Mile Island described above. In Goiânia, 50 people were hospitalized and 7 died from exposure to cesium from a salvaged radiotherapy machine, while the accident at the Three Mile Island reactor resulted in only a "minor" release of radiation into the atmosphere. Despite the difference in the severity of radiation contamination, the two

incidents produced very similar levels of visitor impact. Namely, in the months immediately following the two events, hotel occupancy rates dropped by 40-50 percent in nearby areas.

Interestingly, the September 11th attacks produced a very similar level of visitor loss in New York City. A month following the attack, hotel occupancy was off by 45 percent (the initial impact during the first week was even higher).

Extending these experiences to the case of a HLW repository, it would appear that Nevada could expect to suffer at least 40-50% declines in the case of a transportation accident that releases radioactive material in or near Las Vegas. This conclusion is reinforced by the convention planners survey, which found that a "moderate" transportation accident would cause 64 percent of planners to lower their ranking of Las Vegas and 31 percent to avoid Las Vegas altogether (Easterling, 2001b). The duration of these losses would depend on whether or not there were any lasting effects of the accident – persistent radioactive contamination, a lingering sense that more accidents could occur in the future, or even an undefined stigmatization of Nevada as an undesirable place to visit.

In considering the impact of a repository on the Las Vegas visitor economy, it is important to recognize how many visitors correspond to each percentage-point drop in visitor volume. Compared to Goiânia and central Pennsylvania, Las Vegas would lose a much higher **number** of visitors in response to a radiation event. For example, the cities of Harrisburg and Lancaster in Pennsylvania experienced a 50% decline in visitors following the accident at Three Mile Island, which translated into a $5 million impact. If Las Vegas experienced a month-long 50% drop in tourists, this would amount to losing 1.5 million visitors and $1.2 **billion** dollars in revenue (using the Las Vegas Convention and Visitor Authority's figures for 2000 as the base).

Moreover, if repository-related accidents lead to longer-lasting public concern, those losses would quickly mount. For example, consider the case where a transportation accident produces a 50% decline the first month and then visitation gradually rebounds over the next 11 months -- so that one year after the event, visitor volume is back to its pre-event level. Under this pattern of visitor impact, the cumulative loss for the year would be 9 million visitors and $8 billion in revenue.

With an even more extreme repository scenario, Nevada could experience even longer-lasting visitor losses. For example, a serious transportation accident within the city of Las Vegas could lead to a situation where nuclear waste imagery and a sense of danger become more permanent features of the "image set" that people associate with the city. If public perceptions change in this manner, visitor losses would likely persist well into the future. Visitor volume would probably begin to climb again at some point in time, but it may take years to reach levels that Clark County has enjoyed in the absence of a repository. Certainly, the rate of increase in visitor volume would fall short of the 5.5% figure that Las Vegas has experienced over the past 30 years.

An innovative University of Nevada Las Vegas study by Riddel and Shaw (2001) was designed to determine the economic value of tolerating exposure to transportation of high-level nuclear wastes through Southern Nevada communities. The study used a modified contingent valuation method design with an individual auction procedure to arrive at a dollar amount for willingness to accept the HLW shipment-exposed property.

A three-step survey process was employed. Residents of Southern Nevada were contacted by telephone and, when they agreed to participate, they were sent a printed booklet with a description of potential risks, including transportation of HLW, presented on a "risk ladder." These respondents were then interviewed by telephone. The scenario presented to them offered the choice of moving away from the transportation route, with moving costs paid by a special public program, or staying at their residence with compensation for the risk. The interview was interactive and offered lower or upper bounds depending upon the initial consideration of compensation. This was accomplished through a bid-and-response module in the survey. Compensation was described as an annual federal income tax rebate for the term of the HLW transportation program.

The average price per household for the annual compensation option was $10,050. Riddel and Shaw conclude: "Our results indicate that the costs of the risks borne by households near the transportation route exceeds $10,000 annually." These costs are free choice estimates (i.e., not constrained by the expenses of relocation) of the individually calculated risk versus no-risk from the proposed DOE transportation program. These results apply to several hundred thousand households in Southern Nevada, but they could also apply to households in 43 states nationwide along the transportation corridors.

Conclusion

Since 1986, the Nevada Agency for Nuclear Projects has supported a comprehensive research program to understand the potential for a repository at Yucca Mountain to cause visitors to avoid coming to Nevada (Chalmers et al., 1993; Flynn et al., 1995; Nevada Agency for Nuclear Projects, 2000). This research program (which has resulted in over 200 technical reports and 100 publications in professional journals) has demonstrated that a large fraction of people predict that a repository would have a negative influence on their willingness to visit a nearby area, particularly if the repository is accompanied by accidents that release radiation into the environment. These studies have also established the credibility of perceived risk and negative imagery as pathways through which visitor impacts could occur.

On the basis of this body of research, the independent Technical Review Committee concluded that:

> The greatest potential socioeconomic difficulty of the proposed repository stems from the intense negative imagery associated by the public with a high-level radioactive waste repository, combined with the vulnerability of the Nevada economy to changes in its

public image. Because of the high profile nature of the whole nuclear waste disposal program, the potential exists for Nevada to become associated with this negative imagery to the detriment of its attempts to attract tourists, conventions, migrants and new industry to the state (White et al., 1990, p. 4).

This conclusion is even more prescient in the aftermath of the September 11th attacks. Economies that rely heavily on visitors to generate revenues can be quickly upended when an "unforeseen" incident raises the specter of danger.

Las Vegas attracts most of its visitors by offering entertainment, gaming, and a carefree, carnival-like atmosphere. Most of the casinos, particularly the larger ones, are designed so visitors can leave their daily existence and experience a world of opulence or excitement. The imagery associated with a HLW repository (e.g., danger, poison, contamination, wrong) is antithetical to the view the city seeks to project. If repository-laden images displace the city's current imagery, there is every reason to expect that many potential visitors would find other destinations.

Based on analogous cases where visitors have avoided areas following radiation releases, environmental contamination, violence, or earthquakes, it is reasonable to conclude that southern Nevada could suffer a 30% drop in visitation following "moderate" repository-related accidents. More extreme incidents could easily lead to a 50% drop, possibly lingering well into the future.

Table 3.1.1 Summary of Las Vegas Visitor Economy and Potential Impacts of a HLW Repository at Yucca Mountain

Visitors to Las Vegas Metropolitan Area (2000)*	35.8 million
Total Visitor Annual Spending (2000)*	$31.5 billion
Regional economic effect (indirect) @ 2.5 multiplier	$78.75 billion
Value of each percent of annual visitor spending (Direct + Indirect)	$787.5 million
Benign Scenario Impact @ 7% visitor decline	$5.5 billion
Moderate Scenario Impact @ 15% visitor decline	$23.8 billion
Accident Scenario Impact @ 30% visitor decline	$39.4 billion

*Las Vegas Convention and Visitor Authority, 2001 (data for 2000)

With a visitor economy as substantial as Nevada's, these declines represent devastating losses to income, property value, and tax revenues. The cumulative impact following a serious transportation accident near the Strip could easily reach almost $40 billion, which is substantially more than the $7 billion that the United States has invested in the entire repository program over the past 20 years. This possibility imposes a huge risk on the one state that has been unlucky enough to draw the short straw in shouldering the country's nuclear waste burden.

Table 3.1.2 "Analogous Events" That Have Produced Visitor Impacts: Radiation-Related Incidents

1. Accident At Three Mile Island (Pennsylvania Governor's Office On Policy And Planning, 1980; Himmelberger, Ogneva-Himmelberger & Baughman, 1993)
   Incident: In March 1979, a loss-of-coolant event occurred at the TMI nuclear power plant near Harrisburg, Pennsylvania, leading to partial meltdown of reactor core and "slight" release of radiation into the atmosphere.
   Visitor Impact: Tourism declined by approximately 50% in the Lancaster and Harrisburg areas during the month following the incident. One convention was cancelled. Visitor volume returned to prior levels within a few months.

2. Contamination from Nuclear Testing into Utah (Fradkin, 1989)
   Incident: A series of aboveground nuclear explosions at the Nevada Test Site during the 1950s (e.g., "Shot Harry" in 1953) spread plumes of radioactive fall-out that contaminated areas of southern Utah.
   Visitor Impact: Tourism and convention business declined in St. George, Utah following the release of data indicating an increased rate of leukemia in the area.

3. Contamination in Goiania, Brazil (Petterson, 1988; Brooke, 1995)
   Incident: In September 1987, radioactive cesium-137 was released from a discarded radiotherapy machine, contaminating 129 individuals and killing 7.
   Visitor Impact: Hotel occupancy in Goiania dropped by about 40% during the six weeks following the incident. Numerous conventions cancelled. Visitor volume approached prior levels within a year.

4. Leukemia Cluster on the Normandy Coast in France (Whitney, 1997)
   Incident: In January 1997, a scientific report was published in the *British Medical Journal* implicating the Hague nuclear-fuel processing plant as a suspect in 27 cases of leukemia among young persons living nearby.
   Visitor Impact: Local officials reported that tourists avoided the Normandy Coast area the following summer.

5. Tokaimura Nuclear Plant, Japan (UER, 2001c)
   Incident: In September, 1999 an accident occurred at the Tokaimura nuclear power plant in Ibarki, Japan
   Visitor Impact: Local hotels, inns and restaurants lost 1.47 billion yen. One hotel filed for bankruptcy. Tourism had not fully recovered 10 months later.

6. Dounreay Nuclear Plant, Scotland (UER, 2001c)
   Incident: In 2000, spent nuclear fuel stored at the Dounreay nuclear power plant released radioactive contaminants that appeared in the sand on local beaches.
   Visitor Impact: Owner of a resort in Caithness considering legal action to gain compensation for lost business.

Table 3.1.3 "Analogous Events" That Have Produced Visitor Impacts: Other Incidents that Suggest Visitors Would be at Risk

1. September 11th Terrorist Attacks (Bagli, 2001; Sharkey, 2001; Burghart, 2001)
   Incident: On September 11, 2001, terrorists crashed two jetliners into the World Trade Centers in New York City, another crashed into the Pentagon in Washington, and a fourth went down in Pennsylvania. These attacks were followed by the appearance of anthrax-contaminated letters in New York, Washington and other East Coast cities.
   Visitor Impact: Hotel rates fell from 84% to 20% during the first week. A month after the attack, occupancy was down by 45%. Two months later, visitor volume was beginning to rebound, but only because of deep discounts.

2. Violence Against Tourists in Miami (Navarro, 1995)
   Incident: In 1993, nine tourists (four of them Germans) were murdered, many when they became lost coming out of the airport.
   Visitor Impact: Between 1993 and 1994, Miami suffered a 57% drop in German visitors and a 7% decline among all international tourists.

3. Violence Against Tourists in New York City (Hays, 1990)
   Incident: In 1990, a Utah tourist was shot on the subway when trying to protect his parents from robbers.
   Visitor Impact: Unspecified decline in tourists.

4. Rodney King Riots (*Rochester Times-Union, 1992)*
   Incident: In 1992, riots broke out throughout Los Angeles when the police accused of beating Rodney King were found innocent by a jury.
   Visitor Impact: The Los Angeles Convention and Visitors Bureau predicted that the city would lose $1.1 billion in revenue the following summer.

5. Hoof and Mouth Disease in Britain (UER, 2001c)
   Incident: Beginning in 2000, livestock throughout rural Britain were infected with hoof-and-mouth disease.
   Visitor Impact: During the first year of the outbreak, tourism revenues declined by 80% in the most impacted areas of Devon and Cumbria, and 10% for the country as a whole

6. Medical Waste Along the New Jersey Shore (Lyall, 1991)
   Incident: During the summer of 1988, medical waste washed ashore on beaches in New Jersey and New York.
   Visitor Impact: Visitor losses in the amount of $1.5 billion.

7. Legionnaires Disease (Morgan-Witts, 1982)
   Incident: Outbreak of a fatal respiratory disease during a convention of the American Legion at the Bellevue-Stratford Hotel in Philadelphia in 1976.
   Visitor Impact: The hotel in which the convention was held lost so much business that the new owners decided to change its name.

8. Mount St. Helens (Kreck, 1981)
   Incident: In March 1980, Mt. St. Helens in southern Washington State erupted, decimating the nearby forest, sending a plume of ash across the Pacific Northwest and killing a number of individuals in the immediate vicinity.
   Visitor Impact: Short-term 30% decline in tourism in the region.

Table 3.1.4 Studies Where Individuals Report That A Repository Would Impact Their Own Visitor Behavior

Stimulus = Nuclear Waste Repository near the Vacation Destination

1. 1987 NWPO Surveys (Kunreuther, Desvousges & Slovic, 1988)
Sample: 1201 US residents and 804 Nevada residents
Questions: "Think about a community that would be located about 100 miles from a high-level nuclear waste repository. Would this make the community a less desirable place for you to visit on vacation? Would it be a less desirable place to attend a convention?"
Results: 57% of National sample and 51% of Nevada sample reported that a repository 100 miles away would make the community less desirable to visit on vacation. 43% of each sample reported that the community would be less desirable for attending a convention.

2. Convention Attendees Survey (Easterling & Kunreuther, 1993)
Sample: 600 members of professional organizations that regularly attend annual conventions.
Questions: "How would your decision to attend a convention be influenced by the following factors, if at all? If you learned that a [prison, hazardous waste incinerator, nuclear power plant, low-level radioactive waste repository, high-level nuclear waste repository] was located within 100 miles of the convention city, would you definitely attend, probably attend, probably not attend, or definitely not attend the convention?"
Results: If a high-level nuclear waste repository were within 100 miles, 7% would *definitely* not attend their convention and another 16% *probably* would not attend (i.e., 23% unlikely to attend).

3. Tennessee MRS Study (Fox et al., 1985)
Sample: 306 persons living outside Tennessee
Question: "Would you change your vacation plans if you learned that a monitored retrievable storage facility for nuclear waste was located near your destination?"
Results: 47% indicated they would change their plans.

Stimulus = Nuclear Waste Transported Through Vacation Destination

DOE Survey of HLW Transport Impacts (Jenkins-Smith & Silva, 1996)
Sample: 2,400 U.S. residents
Questions: "How likely are you to take a vacation in Nevada in the next five years? If you knew that the government was going to transport spent fuel from nuclear power plants through Nevada, how likely would you be to take a vacation in Nevada in the next five years?"
Results: Whereas 7.7% of sample were "very likely" to take a vacation in Nevada in the next five years, this figure dropped to 6.0% when the repository was added to the scenario (a 22% reduction in the number of "very likely" visitors).

Stimulus = Accident Involving Nuclear Waste Occurring Near Vacation Destination

Convention Planner Survey (Kunreuther, Easterling & Kleindorfer, 1988)
Sample: 157 meeting planners who had scheduled a convention for Las Vegas within the past year.
Questions: "For the next set of questions, we would like you to tell us which city you would prefer for *this meeting* [the meeting for which the planner had selected Las Vegas] under the following set of conditions… We would present you with a scenario describing a hypothetical situation relating to the high level nuclear waste repository that might be located in southern Nevada… After reading each scenario, we want you to indicate how you would rank Las Vegas relative to the other possible locations."
Results: For a "moderate-severity" transportation accident involving a small release of radiation 40 miles from Las Vegas, 64% of the planners lowered their ranking of Las Vegas relative to other cities, with 31% reporting they would "no longer consider" Las Vegas for the meeting. For a "minor-severity" transportation accident (i.e., no release of radiation) accompanied by significant media attention, 49% would lower their ranking and 21% would no longer consider Las Vegas for the meeting.

3.2 Impacts to Property Values

Studies undertaken by State of Nevada and Clark County researchers have found that the value of property, especially along potential nuclear waste shipping routes in Clark, Washoe, and Elko counties, stands to be dramatically affected should the Yucca Mountain project go forward.[4] Even under the most benign conditions (i.e., where there are no projected radioactive waste accidents), property value losses are likely along shipping corridors, as well as at distances up to three miles from the actual highway or rail route.

Property values along nuclear waste shipping routes in Clark County alone could decline an average of 3.5%, even without a major accident or incident. In the event of an accident, losses in real market value could be between $5.6 billion and $8.8 billion. In Washoe and Elko counties, property value losses between $1.9 billion and $2.2 billion and between $110 million and $129 million, respectively, are possible.

The findings indicate that an accident, even without a release of radioactive waste, would significantly increase the rate of property value diminution. If a major accident involving radiological contamination were to occur, property value losses would be devastating. Research shows that residential property values along nuclear waste shipping routes in Clark County alone could decline an average of 3.5%, even without a major accident or incident, due to the irreducible risks from a designated HLW shipping route. In the event of an accident, losses in real market value could be between $5.6 billion and $8.8 billion. In Washoe and Elko Counties, the estimated residential property value losses are between $1.9 billion and $2.2 billion and between $110 million and $129 million, respectively. Percentage declines of comparable magnitudes can be expected in counties and communities all along Yucca Mountain transportation routes.[5]

Stigma that is related to risk has been associated with all aspects of nuclear energy including property value diminution. If DOE goes ahead with its program, it is likely that over the next 30 years, 77,000 metric tons of spent nuclear fuel and high-level nuclear waste may be shipped to a repository at Yucca Mountain. It is also likely that proposed routes for transporting nuclear waste would go through Clark County, Washoe County, and Elko County, Nevada. Given the high level of public concerns over the risks of

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[4] "Final Report: Results From Key Informant Interviews About Potential Property Value Impacts From the Shipment of High-Level Nuclear Waste and Spent Fuel Through Clark County, Nevada," by Urban Environmental Research, LLC (August, 2000) and "Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts From the Shipment of High-Level Nuclear Waste and Spent Fuel Through Clark County, Nevada," by Urban Environmental Research, LLC (December, 2000).

[5] As discussed in succeeding sections of this report, specific research initiatives clearly demonstrate the likelihood and magnitude of property value impacts in Clark, Washoe, and Elko counties. Due to funding and time limitations, it was not possible to apply the research findings to property values in all communities along potential shipping routes. However, the work done in the three major Nevada counties is applicable to other jurisdictions. Potential property value impacts to Nevada as a whole stand to be considerably larger than the figures reported for the studied counties.

shipping nuclear waste, the mere possibility of an incident (even with no release of radioactive material) could result in significant property value diminution over an extended period of time.

Findings in this section of the report are derived from the results of two surveys, one of the public and the other of property value experts, and the application of the findings from the experts survey to actual property value data in the three counties.

Approaches To Evaluating Property Value Impacts

To assure confidence in the findings of the property value studies, the research involved the convergence of three methods: (1) Analysis of literature on property value impacts from nuclear and other hazardous facilities and activities; (2) A survey of Clark County residents; and (3) A survey of property value experts - Clark County lenders and appraisers - that was subsequently applied to appraisal data for three land use classifications (residential, commercial, and industrial) within the three counties to determine the range of potential losses.

The work undertaken by State and Clark County researchers is the first time an estimation of property value diminution resulting from DOE's proposal to construct the Yucca Mountain repository has been undertaken. The study did not address the full range of land uses in the targeted counties and did not attempt to extrapolate findings to other locales along shipping routes.

While all residential properties in the studied counties were included in the research, only a limited number of commercial and industrial land uses were considered. Of particular note, this study did not address the many land uses associated with Nevada's dominant economic sector, casinos and hotel-casino related properties. As a result, the substantial property losses that are likely to occur because of nuclear waste shipments and are reported here underestimate the actual potential magnitude of losses and the real vulnerabilities to future property values.

The studies also did not examine the large number of land parcels that are yet undeveloped. Land uses associated with tourism and undeveloped parcels represent an important component of the study area's current economic base and its future. The impacts of Yucca Mountain nuclear waste transportation on these land uses must be considered to obtain a more complete understanding of the full extent of property value diminution that could - and likely would - occur.

When these limitations on the scope of the property studies are taken into account, the conclusions about negative property value impacts must be viewed as extremely conservative and, as such, they likely understate the full costs for each scenario evaluated.

The Clark County Public Survey

The Clark County public survey involved a randomly selected sample of 512 county residents. It was conducted by telephone in August 2000 by the Cannon Center for Survey Research at the University of Nevada, Las Vegas. Assuming a 95% confidence interval, the sampling error for the survey was approximately +/- 4.5%.

In the telephone survey of Clark County residents, respondents were first asked whether various "environmental conditions" or facilities would increase, decrease, or have no effect on nearby residential property values. The responses were similar to the Santa Fe, New Mexico survey described below. Residents stated that a polluting manufacturing plant, a landfill, and a freeway used to ship nuclear waste would have the most negative effects on property values of the twelve facilities that were provided in the survey.

Almost 82% of the respondents stated that a nearby shipping route would either 'decrease a lot' or 'decrease' the likelihood of their purchasing residential property. Almost 41% indicated that commercial property values would decrease.

The survey found that almost three-fourths of the respondents would not purchase properties near nuclear waste shipping routes ***under any conditions***. In addition, the mean expected drop in selling prices for homes near a transport route compared to a similar home at a considerable distance from such a route was approximately 25%.[6]

The Komis Case in New Mexico

The Clark County survey questionnaire was closely adapted from a seminal New Mexico study (Zia Research Associates, 1990). This survey is important in three ways. First, it demonstrated that residents believe the transportation of radioactive waste would adversely impact property values, and that they are unwilling to purchase properties near these routes. Second, the survey results were central to a New Mexico legal case demonstrating that damages for property value losses can be compensated because of stigma associated with the shipment of nuclear waste (City of Santa Fe versus John and Lemonia Komis, 1992). Third, the survey design was readily adaptable to the Clark County survey, thereby allowing comparison of findings between the two surveys and supporting the conclusion that both populations consider property values to be diminished because of radioactive waste transport.

In estimating the impact of stigma effects on property that is located near a transportation route, it is informative to examine the data from the New Mexico case and calculate the jury award of damages, which were upheld by the New Mexico Supreme

[6] For illustration purposes, the application of this perceived diminution rate for residential properties to the current assessed valuations of residential properties within one mile of the I-15 transportation corridor results in an estimated loss of $604.6 million in residential assessed valuation.

Court. Table 3.2.1 below gives the basic facts about the property and the jury award. Notice the remaining Komis property is close to one square mile (630.339 of 640 acres).

Table 3.2.1 Descriptive Facts Of Komis Property And Jury Award

Total Komis property in acres	673.77
Property taken by Santa Fe	43.431
Value of taken property	$489,582.50
Value of taken property per acre	$11,272.65
Property remaining with Komis, in acres	630.339
Stigma award for value loss of remaining property	$337,815
Stigma award per acre of remaining property**	$535.93
Stigma value as a percent of market value of $11,272.65 per acre***	4.75%

*Stigma Value from the Jury Findings in the Santa Fe v. Komis, upheld by New Mexico State Supreme Court (26 August 1992, Case #20,325). Descriptive facts are from the opinion written by Justice Gene E. Franchini.

**$337,815 ÷ 630.339 = $535.9259;

***$535.93 ÷ $11,272.65 = 4.75425

It should be noted that the findings from the Komis case demonstrated the existence of significant property value impacts just from the designation of a highway as a nuclear waste shipping route, without any actual shipments occurring and in the absence of any nuclear waste accidents or incidents. As such, these findings lend strong support to the empirical findings of the Clark County lenders-appraisers study.

The Lenders and Appraisers Study

In face-to-face interviews, Clark County lenders and appraisers were asked to estimate potential property value changes for three different transportation scenarios. The three scenarios involved (1) a benign, no-incident scenario, (2) a transportation accident involving a Yucca Mountain shipment that results in no release of radiation, and (3) a significant but plausible accident event resulting in the release of radiation along the shipping route. The transportation routes were defined as Interstate 15 in Clark County and the proposed northern Beltway, identified in DOE Yucca Mountain DEIS as a preferred shipping route.

Based on the three scenarios, the two professional groups were asked to evaluate property value changes to an average residential single-family home, a 250,000 square-foot office building, and a 100,000 square-foot industrial warehouse at two distances from a proposed shipment route. The resulting diminution factors (see Table 3.2.2) were then used as assumptions in estimating real dollar losses in assessed valuation for three property value types along shipment corridors in Clark County, Washoe County, and Elko County, Nevada.

Application of Diminution Factors to Property Values

In Clark County, the assessors' valuation data by parcels were integrated by property type and placed on a Geographic Information System (GIS) framework. One mile and one to three mile distances were applied to the GIS base. Two proposed routes, I-15 through Las Vegas and the Beltway route, were evaluated for real dollar impacts to assessed value by applying the different diminution rates to three property types at two distances. The diminution in property values was then expressed as losses in fair market value.

The diminution factors derived from the survey of two professional groups were also utilized to estimate property value changes in Washoe and Elko Counties. Assessor's data from Washoe and Elko Counties were used as a basis to calculate the diminution in property values from the proposed shipment of high-level nuclear waste. Washoe County includes the Reno-Sparks metropolitan area, while Elko county includes the smaller urban area of the City of Elko.

Different methods were used to estimate the loss in property values in both counties. Washoe County, like Clark County, possesses a high-resolution GIS, enabling a very precise estimate of diminution based on proximity to the transportation route. While tabulations for Elko did not include the use of a GIS, the data available were sufficient to devise an acceptable database for the calculations.

Clark County Property Value Impacts

Clark County lenders and appraisers provided data on diminution factors that would result from the transportation of nuclear waste through Clark County. The diminution factors affecting property values vary by distance from routes (one mile and one to three miles), the three scenarios, and land use type-light industrial, commercial-office, and residential. Although small differences appear between lenders and appraisers in the diminution factors for Scenario 1 (no accident) and Scenario 2 (minor accident), there is a strong consistency in their evaluation of property value impacts under Scenario 3 (major accident). Table 3.2.2 shows the diminution factors by distance, scenario, and property type in mean percentages.

Under Scenario 1, appraisers and lenders both indicated that residential properties would lose the most value in percentage terms. Appraisers indicated that, within one mile of a shipment route, residential properties would decline on the average of 3.5%, while lenders indicated the decline would be approximately 2.0%.

Table 3.2.2. Property Value Diminution Factors (in Percent) by Distance, Scenario, and Land

Use	Scenario 1		Scenario 2		Scenario 3	
	Lender	Appraiser	Lender	Appraiser	Lender	Appraiser
One-mile Distance						
Residential	2.00	3.50	6.18	7.96	29.00	33.79
Commercial	0.56	3.21	4.00	7.39	22.00	31.88
Industrial	0.56	1.25	4.00	5.29	21.25	25.54
One-three miles						
Residential	0.50	1.46	1.64	4.00	20.00	23.65
Commercial	0.56	1.25	1.00	3.04	16.67	20.50
Industrial	0.56	0.83	1.00	2.08	10.00	16.73

As the table shows, commercial property values could be expected to decline by 3.2 % and industrial property values by 1.25% within one mile of a shipment route under Scenario 1.

Under Scenario 3, substantial property value declines should be anticipated. Residential property values could drop approximately 30% at one mile and over 20% at one to three miles from a route. Appraisers indicated that the potential property value loss for commercial property could be 32% at one mile and 20.5% at one to three miles. Industrial property value losses could range from 21.3% to 25.5% within one mile of the transportation routes for nuclear waste, and from 10% to 16.7% at one to three miles.

Table 3.2.3 shows the actual dollar declines when these diminution factors are applied to fair market values for the three property types along two potential routes, I-15 and the Beltway route within Clark County. Even under Scenario 1, a no-event characterization, property value losses would occur in all three market segments - residential, commercial, and industrial.

The largest declines in present market values ($6.2 - $7.3 billion) would be experienced in the residential sector within three miles of the I-15 route in the event a serious accident occurs along the shipping route. The rate of decline under this scenario is less for commercial and industrial properties, with losses of up to $927 million estimated for commercial properties within three miles of I-15.[7]

The results demonstrate the potential that significant adverse impacts can be anticipated along either of the Clark County routes proposed and for all property types, even under the most benign transportation scenario.

[7] It should be noted that the I-15 corridor is more fully built than the Beltway. This study did not examine the property value impacts on undeveloped land or land uses other than the three that were addressed. Thus, a direct comparison between the routes in terms of route selection should not be made based on these data. However, the results should be seen as significantly understating the magnitude of potential impacts along either shipping route.

Table 3.2.3 Cark County Transportation Impacts on Adjacent Property Values (in millions $)*

Transportation Route	I-15	Beltway
Residential Market Value	$27,983	$23,817
Scenario One Decline**	$243/$550	$204/$463
Scenario Two Decline	$773/$1,393	$646/$1,176
Scenario Three Decline	$6,219/$7,319	$5,270/$6,203
Commercial Market Value	$3,820	$1,003
Scenario One Decline	$21/$73	$5/$15
Scenario Two Decline	$77/$171	$12/$34
Scenario Three Decline	$704/$927	$172/$214
Industrial Market Value	$2,518	$1,057
Scenario One Decline	$14/$23	$6/$9
Scenario Two Decline	$54/$84	$16/$27
Scenario Three Decline	$362/$508	$126/$192
Total Decline Scenario 1 Scenario 2 Scenario 3	 **1) $279 to $646** **2) $904 to $1,648** **3) $7,285 to $8,754**	 **1)$215 to $487** **2)$674 to $1,237** **3)$5,568 to $6,609**

* See Appendix III. Distances of 1-mile and 1-to-3-mile properties are combined.
**Dollar amounts show expert opinion of lenders/appraisers, in that order, applied to current market value of adjacent properties.

The findings of this research indicate that increasing the severity of potential nuclear waste transportation events results in significantly larger impacts on property values. There is compelling evidence that property value impacts in Clark County could be substantial and that, in the event of a serious nuclear waste accident, estimated losses for the three property types could exceed $6.6 billion along the Beltway route and $8.7 billion along the I-15 corridor.

Washoe County Property Value Impacts

The Washoe County Assessor's data included 132,778 land parcels with a total assessed value of over $9.4 billion. Of these parcels, $8.1 billion falls within the 3-mile Interstate 80 corridor, which is a potential shipment route for SNF and HLW. The impacts on property values addressed three land use types in Washoe County - residential properties, commercial-office, and light industry.[8]

[8] As with Clark County, other property types were not included in the study. Therefore, the findings can be expected to underestimate potential impacts.

Table 3.2.4 Washoe County Transportation Impacts on Adjacent Property Values (in millions $)*

Transportation Route	Highway
Residential Market Value	$6,672
Scenario One Decline**	$71.5/$149.20
Scenario Two Decline	$224.8/$367.5
Scenario Three Decline	$1,563/$1,835.5
Commercial Market Value	$459
Scenario One Decline	$2.5$11.5
Scenario Two Decline	$13.5/$26.7
Scenario Three Decline	$92.2/$127.5
Industrial Market Value	$864
Scenario One Decline	$6.3/$13
Scenario Two Decline	$37.2/$51.1
Scenario Three Decline	$209.7/$264.4
Total Decline Scenario 1 Scenario 2 Scenario 3	 **1) $80.3 to $173.74** **2) $275.5 to $445.3** **3) $1,864.9 to $2,227.4**

* Appendix IV. Distances of 1-mile and 1-to-3-mile properties are combined.
**Dollar amounts show expert opinion of Lenders/Appraisers, in that order, applied to current market value of adjacent properties.

As in the Clark County evaluation, to calculate diminution estimations for Washoe County, property loss factors for each of the three scenarios were applied to parcels within the one-mile corridor and multiplied by the total assessed value for each of the land uses addressed. Similar calculations for the corridor of one to three miles from the route were undertaken. The sum of these calculations is the estimate of property value diminution for the three miles from the route that can be anticipated if nuclear waste shipments occur through Washoe County. Table 3.2.4 shows the potential property value losses in market value by property type and scenario within a 3-mile distance from the shipment route.

Under a Scenario 3 event, it is possible that property losses in market value could exceed $2.2 billion.

Elko County Property Value Impacts

The property value impact study for Elko County examined property parcels within the Elko municipal area. All parcels are within three miles of the interstate highway that would be used to transport high-level nuclear waste. To be consistent with the methodologies used in Clark and Washoe Counties, the evaluation considered three land use types (residential, commercial-office, and light industrial), two distance factors (one mile and one to three mile distances from the route), and the three transportation scenarios.

Table 3.2.5. Elko Highway Transportation Impacts on Adjacent Property Values (in thousands $)*

Transportation Route	Highway
Residential Market Value	$308,050
Scenario One Decline**	$6,402/$11,490
Scenario Two Decline	$19,827/$24,715
Scenario Three Decline	$98,965/ $115,478
Commercial Market Value	$13,354
Scenario One Decline	$55/$303
Scenario Two Decline	$374/$698
Scenario Three Decline	$2,120/$3,052
Industrial Market Value	$35,028
Scenario One Decline	$252/$521
Scenario Two Decline	$1,501/$2,062
Scenario Three Decline	$8,446/$10,624
Total Decline Scenario 1 Scenario 2 Scenario 3	 **1) $6,709 to $12,314** **2) $21,702 to $27,475** **3) $109,531 to $129,154**

* See Appendix IV. Distances of 1-mile and 1-to-3-mile properties are combined.

**Dollar amounts show expert opinion of Lenders/Appraisers, in that order, applied to current market value of adjacent properties.

Table 3.2.5 shows the results of the property value diminution in market value that are likely to result from transporting nuclear waste through Elko County. Property value impacts for the entire 3-mile corridor would result in estimated losses of over $115 million in fair market value for residential property, $3 million for commercial property and $10.6 million for industrial property. In all, Elko County property values losses along the I-80 corridor could total more than $129 million.

3.3 Other Economic Impacts

In addition to negatively impacting Nevada's visitor economy and property values along transportation routes, the federal high-level nuclear waste program would also affect the State's economy in a number of other ways. Even the so-called beneficial effects of a program of this size (i.e., jobs, program spending, etc.) would have negative overall impacts on Nevada's economy. This is because, under the State's tax structure, repository-related increases in population would cost the State and local governments more for providing public services than they provide in revenues, a difference of between $670 and $1,000 per person, per year (as estimated in 1990).[9] If these very conservative figures are applied to the estimated Yucca Mountain-related peak population increase of 3,716 (per DOE's Draft Yucca Mountain Environmental Impact Statement), the project, absent any other impacts, would cost the State and local jurisdictions between $2.5 million and $3.7 million annually. This is a consequence of the "standard effects" of the project and is separate from and in addition to any stigma-induced economic effects that may occur during the life of the program.

Not only would the Yucca Mountain program act as a net drain on State and local revenues, but the overall negative impact to Nevada's economy would not be mitigated by future increases in Yucca Mountain-related economic activity. Even the "positive" aspects of this program would result in negative overall impacts to the State.

Further, studies show that Yucca Mountain site characterization has been a very minor contributor to the state's economy, and that the construction and operations phases of the project would be minor contributors as well. The program's contribution to statewide gross regional product (GRP) is only 0.2%, as compared to 35% for visitor spending. The per dollar contributions are also small compared to visitor spending:

- At $1.33, statewide GRP per dollar of YMP appropriation is 48% below GRP per dollar of visitor spending.
- At 5.5 cents, net state government revenue per dollar of YMP appropriation is 48% below that of visitor spending.
- At 0.9 cents, net local government revenues are about 41% below that of visitor spending.

[9] The dependence of Nevada state and local jurisdictions on revenue contributions of visitors is unique and results from the fiscal structure of the state. Other economic developments, private or public, that do not expand the contributions of visitor spending also would have negative fiscal impacts. Public expenditures per person would have to be provided for repository-related population in excess of the revenues that these people would contribute through taxes, fees, etc. This means that, in the absence of payments made by DOE for mitigation or compensation or changes in the Nevada tax/revenue structure, the repository program would consistently produce significant negative fiscal impacts even without negative stigma-related effects.

These comparisons reflect the historical fact that Nevada's economic and revenue bases are built around the visitor-gaming economy. While the Yucca Mountain project provides a certain amount of employment and procurement, the structure of Nevada's economic and revenue base limits its contribution to the GRP or to state/local revenues.

This finding has important implications with regard to the program's potential to result in severe economic consequences to Nevada. If, as State research has shown likely, the Yucca Mountain program is responsible for the loss of economic activities linked to the visitor sector (i.e., conventions, visitors and tourists, new visitor-related projects such as hotels and casinos), not only would the federal program act as a net drain on State and local revenues, but the overall impact to Nevada's economy would not be mitigated by future increases in Yucca Mountain-related economic activity. In this regard, even the "positive" aspects of this large, multi-year federal program would result in negative overall impacts to the State.

3.4 Impacts to State of Nevada Agencies

The Yucca Mountain repository project, even if it were not accompanied by risk/stigma effects, would act as a net drain on the State of Nevada's General Fund. The direct costs of preparing for and dealing with the project and the massive nuclear waste shipping campaign that would accompany it would be staggering for State agencies. Estimates for start-up costs plus the costs associated with the first year of operations exceed $657 million. The total costs to agencies over the forty-year life of the Yucca Mountain shipping campaign would likely be in the range of several billion dollars.

Beginning in 1987, the State of Nevada, through the Agency for Nuclear Projects, funded a series of studies designed to project the fiscal impacts on Nevada State agencies from the siting of the high-level nuclear waste repository at Yucca Mountain. While the studies employed a combination of methods, the basic methodology for these studies included a mandate driven approach that utilized scenarios in order to project impacts and their fiscal costs to state agencies (Mushkatel and Pijawka, 1995) combined with the more traditional fiscal impact analysis used by municipalities in forecasting public costs resulting from increased demands caused by growth. (Advisory Commission on Intergovernmental Relations, 1992; Ross and Thorpe, 2000; Urban Environmental Research, 2001a).

The costs of preparing for and dealing with the project and the related massive nuclear waste shipping campaign would be staggering for State agencies. Estimates for start-up costs plus costs associated with just the first year of operations exceed $657 million. The total costs to agencies over the forty-year life of the Yucca Mountain shipping campaign would be in the range of several billion

Three separate series of studies were undertaken to assess potential fiscal impacts of the Yucca Mountain project on State of Nevada agencies. While these studies were done at different times and utilized slightly different assumptions regarding the nature and timing of repository events, the fundamental elements of the research are consistent enough to permit findings to be discussed in an integrated fashion.

1998 and 2001 Cost Studies

In 1998, research on potential cost impacts of the Yucca Mountain program was conducted for four other State agencies: the Nevada Department of Transportation (NDOT), the Nevada Highway Patrol (NHP), the Division of Emergency Management (DEM), and the Nevada Public Service Commission (PSC) (since renamed the Nevada Public Utilities Commission). [See Appendix V] During 2001, fiscal impacts to the Bureau of Federal Facilities (BFF) located in the Division of Environmental Protection (DEP) and the Radiological Health Section (RH) within the Bureau of Health Protection Services within the Nevada State Health Division (NHD) were assessed. [See Appendix VI]

In addition to these studies, additional fiscal impacts were assessed for other State level activities. These included costs to the State of Nevada for ongoing monitoring and technical oversight of the Yucca Mountain project by the Governor's Office through the Agency for Nuclear Projects and two critical health effects monitoring efforts that would be need to be implemented to assure adequate monitoring of the health impacts on Nevada citizens. Fiscal cost projections from the 1998 and 2001 research are provided in Table 3.4.1. The projections are for start up costs and costs of year one operations. The total costs associated with 30 or more years of repository operations would be much greater – several times the amounts shown in Table 3.4.1.

The studies that were done to generate this estimate assumed that the agencies would need to be fully prepared to deal with Yucca Mountain nuclear waste shipments beginning in 2007. The date was selected because legislation was pending in Congress at the time that would have accelerated waste shipments to Nevada and allowed HLW shipments to begin in 2007. The estimates include the costs of gearing up for the shipping campaign plus the operational costs associated with the first year of shipments. The estimates include only the incremental or additional costs State agencies would incur as a result of the Yucca Mountain program. Actual total costs, especially with respect to operational expenses, would be significantly greater.

Table 3.4.1 The 2001 and 1998 State Fiscal Cost Projections

Agency	Personnel	Training	Contractual/ Equip./Other	Purpose/Impact
DEP (Bureau Fed. Facilities) (2001 study)	$1,677,643		$505,566	Annual cost beginning 2007-monitoring site-AIP is Model $103 million over 30 years
NHD (Radiological Health Section) (2001)	1,051,439		71,829	Annual Cost beginning 2007-Monitor POE-total has $15,545 of miscellaneous-$53 million over 30 years
Agency for Nuclear Projects (2001)	1,375,000		11,770,700	Continuing technical and regulatory oversight-per annum cost computed at 3% increases from 2001
			2,957,782	Urban Health Effects Monitoring-Clark County-start-up and development costs
	591,556		134,009	Annual costs of the Clark County health effects Monitoring beginning 2006
			1,971,855	Rural Health Effects monitoring for 15 counties @100,000 per community start-up
			938,978	Annual cost of rural health effects monitoring studies beginning 2006
	125,197		250,394	State-wide integration & administration for rural monitoring programs-startup and annual cost of $250,394 beginning 2006
NDOT (1998)	156,273		500,302,372	Highway infrastructure upgrades
			35,225,371	Construction of 2 Ports of Entry
			5,743	Equipment for additional personnel
NHP (1998)	3,166,389	2,164,473	2,053,095	Escorts for shipments and POS personnel
			1,818,538	Annual operating expenses-reoccurring
NHP and/or NDOT	152,118		30,224,698	Emergency Communications System including annual operations costs
DEM (1998)	501,821	1,619,984	36,298,679	Radiological detection equipment
			522,730	HAZ/MAT vans &equipment
			247,550	Space and operations
PSC (1998)	72,248			One additional rail inspector
Education (1988)			1,727,675	Not all equipment-some ED driven costs
Human Resrcs (1988)			11,920,958	Not all equipment-some ED driven costs
Emplymt Secur. (1988)			1,727,675	Not all equipment-some ED driven costs
Taxation (1988)			3,714,501	Additional programs and personnel
Totals	**$ 8,869,684**	**$3,784,457**	**$ 644,390,698**	**Overall Total: $ 657,044,839 (Start-up + year 1)**

1987 Through 1994 Fiscal Studies

The mandate driven fiscal impact studies from 1987 through 1994 were carried out in three distinct investigations that culminated in a 1995 report that simply identified State agencies that already had or would likely be impacted by a repository siting (Mushkatel and Pijawka, 1995). This 1995 summary deviated substantially from previous

and future efforts in that it attempted to project likely types of mandate impacts that would affect State agencies, rather than actually projecting dollar impacts.

The 1995 summary report is helpful in that it affords insight into the actual number of State agencies that are likely to be affected by the Yucca Mountain project and in what manner. The three distinct investigations during this period were organized as follows:

1. A 1987 study designed to identify those agencies that were already impacted, had undertaken some planning, or had responded to DOE plans. This study used intensive face-to-face interviewing and did make dollar estimates for impacts already sustained. It also provided estimates of costs to the agency if the siting of Yucca Mountain as a repository were to be completed. Finally, State agency impacts were tracked as they migrated down to local governments.

2. A 1988-1989 study extended the earlier 1987 effort by including a number of additional agencies in the investigation as well as updating information for the agencies studied in 1987. The same methodology consisting of case studies and marginal cost analysis using intensive interviews was employed.

3. A 1994 series of individual agency studies that once again updated the cost projections for selected agencies thought to be critical to any State efforts at preparedness. For this study, actual dollar projections were not obtained for the impacts to State agencies. Instead, the likely impacts to State agencies were categorized.

These series of studies identified over thirty State agencies where impacts were likely to occur as a result of the repository program. A summary of agencies identified as impacted through the 1987 – 1994 studies is contained in Table 3.4.2, together with the categories of likely impacts.

Table 3.4.2 The Affected State Agencies by Type of Impact

Agency	Programmatic	Fiscal	Personnel	Planning/Eval.
I. Department of Transportation	I	I	I	I
II. Conservation & Natural Resources				
Division of Environmental Protection	I	I	I	I
Division of Forestry		I	I	I
Agency for Nuclear Projects (reorganized into Governor's Office)	I	I	I	I
Division of Water Resources etc.		I	I	I
Bureau Federal Facilities				I
Bureau Waste Management				
Bureau of Air Quality		I	I	I
III. Department of Library Museum etc.				I
IV. Department of Motor Vehicles and Public Safety				
Division of Emergency Management	I		I	I
Highway Patrol Division	I	I	I	I
Data Processing	?	I	I	I
Registration Division/Motor Carrier	I	I	I	I
State Emergency Response Commission		I	I	I
State Fire Marshal		I	I	I
V. Department of Human Resources				
Radiological Health Section	I	I	I	I
Division Mental Hygiene and Mental Retardation			I	I
VI. Department of Business and Industry—Division of Minerals				P
VII. Nevada Energy Office				?
VIII. Division of Industrial Relations: Occupational Health & Safety Section			?	I
IX. Mine Safety & Training Section				I
X. Division of Agriculture				I
XI. Department of Taxation		I	I	I
XII. Public Service Commission	?	I	I	I
XIII. Attorney General's Office		I	?	I
XIV. Department of Administration		?	I	I
XV. Nevada University System	G			
XVI. State Legislature Budget Office And Various Committees				I
XVII. Indian Commission			?	I
XVIII. Department of Education			I	I

I= Already incurred projected impact; P = possible projected impact; ? = unclear at this time; G = currently receiving direct grants from DOE for research and other activities

While planning and evaluation impacts are most often projected, personnel and fiscal impacts are also quite prevalent. The nature and scope of these impacts are consistent through all of the studies. What is clear from the table is that the number of agencies projected to be impacted by the Yucca Mountain program is very large indeed.

Table 3.4.3 below presents an integrated summary of the various studies and findings with respect to impacts that are likely to occur to State of Nevada agencies as a result of the Yucca Mountain project. Taken together, the research indicates that these impacts would be pervasive and extremely costly to affected agencies.

TABLE 3.4.3 THE INTEGRATED NEVADA PROJECTED GOVERNMENTAL FISCAL IMPACTS

1. Agency	2. Source	3. Data Base	4. Information	5. Major Results	6.Type & Range of Impacts	7. Degree of Potential Impacts
Bureau Federal Facilities	Urban Environmental Research (UER, 2001a)	Mandate Fiscal Impact Projection-Agency Interviews	Benign Scenario to determine impacts on agency	$2,183,209 in personnel & equipment costs starting in 2007	Annual Major impacts to Bureau	Personnel, monitoring and permitting
Radiological Health Section	UER, 2001a	Same	Same	$1,123,268 beginning 2007, $53 million over 30 years	Annual Major impacts-Monitoring Ports of Entry	Personnel, monitoring
Agency for Nuclear Projects	UER, 2001a	Mandate Fiscal Impact Projection-Agency Interviews	Same Benign Scenario	$19,176,493 in Monitoring, Health Effects in Clark Co. and Rural Counties, personnel, equipment and start-up costs, annual costs high	Severe Impacts-Health effects Monitoring studies are annual costs-see Table - Regulatory Oversight	Oversight mandate involves agency in a wide variety of activities
Nevada Department of Transportation	PIC & Mushkatel, 1998	Mandate Fiscal Impact Projection Agency interviews	Interim Storage Scenario —no Accidents	$535,689,759 projected fiscal impacts in infrastructure	Severe Impacts equipment, Engineering costs-personnel	
Nevada Highway Patrol	PIC & Mushkatel, 1998	Same	Interim Storage Scenario -no accidents	$39,579,311 projected fiscal impacts	Severe Impacts-included State Emergency Communication System	Escort Vehicles and personnel, training, annual operating expenses occurring
Nevada Division Emergency Management	PIC & Mushkatel, 1998	Same	Interim Storage Scenario -no accidents	$39,190,764 Projected fiscal impacts	Severe Impacts-Rad Detection Equipment Training, Haz/Mat Van	See Table
Public Service Commission	PIC & Mushkatel	Same	Interim Scenario No accident	$72,248 fiscal impacts	Minor	Mission changing

3.5 Impacts to the Public Safety Sector

The Fiscal Impacts to Clark County Public Safety Agencies

Local government public safety agencies would bear the brunt of fiscal impacts associated with preparing for and dealing with the massive SNF and HLW shipping campaign that would accompany a Yucca Mountain repository. In Clark County alone, the incremental costs of preparing for shipments, excluding operational expenses associated with responding to the actual shipments themselves, are estimated at approximately $360 million. Statewide, public safety agencies' costs associated with the federal program would likely total several billion dollars over the life of the shipping campaign.

In Clark County alone, the incremental costs of preparing for shipments, excluding operational expenses associated with responding to the actual shipments themselves, are estimated to be at least $360 million. Statewide, public safety agencies' costs associated with the federal program would likely total several billion

The same technique used for estimating the State agency fiscal impacts (referred to as the mandate approach at the State level) that utilizes marginal cost analysis through a case study technique was applied to the public safety agencies in Clark County.[10] The study focused on assessing only the incremental or additional costs to public safety entities within Clark County that would be directly attributable to the siting of the repository at Yucca Mountain and the subsequent shipping campaign. Impacts to public safety agencies in other counties are summarized in Chapter 4 and addressed in more detail in the individual county reports included in Appendix VII.

Three scenarios were presented to public safety personnel in the County that described the "future" shipping campaign. They were then asked to describe how the events in each scenario would affect their respective agencies. The major characteristics of each scenario can be found in Table 3.5.1.

[10] As the largest metropolitan area to be impacted by Yucca Mountain-related waste transportation, and as the most densely populated region in Nevada, Clark County public safety agencies are expected to be the most heavily impacted in the State. In addition, Clark County agencies have mutual aide and other agreements with various other jurisdictions that will be heavily affected by SNF and HLW shipments, including Nye County (the situs jurisdiction) and Lincoln County (the location of a potential intermodal facility).

Table 3.5.1 The Scenarios Major Characteristics

Scenarios	Description
1	No accident of any kind has occurred. However, anti-nuclear environmental groups and property owners along the route (who claim that their property values would decrease) have generated considerable publicity.
2	Shipments of nuclear waste to the Yucca Mountain repository site have progressed for several years without incident. Three days after New Year's Day 2010, the driver of a truck transporting nuclear waste loses control of the vehicle and runs into the median of Interstate 15. The cask containing the nuclear waste breaks away from the trailer and skids 50 yards along the median of I-15 in North Las Vegas. The cask remains intact and no radiation is released, but the national media covers the event heavily.
3*	An accident involving a truck carrying spent nuclear fuel and a gasoline tanker on I-15 near the Las Vegas Strip. The accident triggers a chain reaction collision. Twenty-seven civilians, four sheriff's deputies, and seven firefighters are hospitalized after exposure to radiation at the site of accident. Another 1,000 or more persons are exposed to radiation from the fire's radioactive plume. Experts indicate that 5 to 200 latent cancer fatalities may result from the accident. The affected highway and several access ramps are closed for four days. The two drivers of the spent fuel hauler and the gasoline tanker, and one driver-escort, died from head injuries and burns. Six months later, the cleanup effort is still under way, and thousands of lawsuits have been filed. Preliminary reports estimate cleanup costs and economic losses in excess of $1 billion.

***Source: State of Nevada, Agency for Nuclear Projects**

The major characteristics of each scenario are based on the DOE Draft Environmental Impact Statement for the Yucca Mountain project. The location of the accident (in Scenarios 2 and 3) varied, depending on which community was being studied. Public safety officials consisting of firefighters, police officers, and emergency management personnel from Clark County, the City of Las Vegas, Henderson, North Las Vegas, Boulder City, Mesquite, and the Moapa Band of Paiutes participated in the study (Urban Environmental Research, 2001a, b, c, d, e, f, g). Additional data on the vulnerability and capacity of hospitals in southern Nevada were also collected, but no fiscal cost estimate was projected for them.

The results of the series of studies reveal major negative impacts on the public safety agencies within Clark County and its local jurisdictions. One important finding is that none of the public safety agencies studied is currently adequately prepared or equipped to respond to any of the three HLW shipping scenarios used in the study. This lack of adequate preparation is consistent with the 1995 Public Safety Advisory Committee's report examining public safety needs in the county. Table 3.5.2 provides a summary of the projected fiscal impacts from the maximum reasonably foreseeable accident (MRFA) under Scenario 3 on the police departments in the entities being examined.[11]

[11] It should be noted that the State level cost projections discussed above were done assuming the benign scenario would be applicable. The cost projections in Table 2-9 are based on what is believed necessary to be prepared for a Scenario 3 event. Hence, the fiscal cost projections for the State agencies are much lower than would be the case if the MRFA had been used in those studies.

Table 3.5.2 Projected Fiscal Impacts Costs on Police Departments in Clark County

	Personnel	Training	Equipment	Cost
Clark County	$17,582,464	$8,080,604	$42,023,301**	$67,686,369
Las Vegas	*	*	*	*
North Las Vegas	0	711,021	0	711,021
Henderson	510,195	0	442,232	952,427
Mesquite	1,876,446	34,754	917,760	2,828,960
Boulder City	186,000	18,880	200,000	404,880
Moapa	0	0	0	0
Totals	**$20,155,105**	**$8,845,259**	**$43,583,293**	**$72,583,657**

* Las Vegas Metro provides services to both Clark County and the City of Las Vegas
** Equipment includes capital costs
Source: *Impacts to Clark County and Local Governmental Safety Agencies Resulting from the Yucca Mountain Project*. A Clark County Nuclear Waste Division, Comprehensive Planning Department Report, prepared by Urban Environmental Research LLC: 2001.

As can be seen from Table 3.5.2, the major impact on police departments is on the Las Vegas Metro Department, the largest force in the State. The projected impacts for this department are over $67 million. The total for all of the police forces examined is more than $72.5 million (for details see Urban Environmental Research, 2001a, and the series of reports issued by Clark County on each of these projected fiscal impacts).

Table 3.5.3 presents the projected fiscal impacts on fire departments in Clark County to prepare for a Scenario 3 event. As can be seen from the table, Clark County's Fire Department estimates fiscal impacts of over $195.8 million dollars. These costs are, in part, driven by the large geographic area encompassed by the county, much of it in remote areas that the Fire Department must be prepared to serve. The total projected cost to fire departments is over $275 million.

Table 3.5.3 Projected Fiscal Impact Costs on Fire Departments in Clark County

	Personnel	Training	Equipment	Cost
Clark County	$25,991,241	$13,615,031	$156,289,783**	$195,896,055
Las Vegas	5,711,370	4,044,588	34,840,835	44,596,793
North Las Vegas	3,851,129	5,121,073	13,449,200	22,421,402
Henderson	140,592	70,296	75,045	285,933
Mesquite	1,874,429	333,133	1,943,889	4,151,451
Boulder City	0	0	0	0
Moapa	1,791,292	94,584	6,152,768	8,038,644
Totals	**$39,360,053**	**$23,278,705**	**$212,751,520**	**$275,390,278**

** Equipment includes capital costs
Source: *Impacts to Clark County and Local Governmental Safety Agencies Resulting from the Yucca Mountain Project*. A Clark County Nuclear Waste Division, Comprehensive Planning Department Report, prepared by Urban Environmental Research LLC: 2001.

The projected fiscal costs to Offices of Emergency Management in Clark County can be found in Table 3.5.4. While emergency management functions are housed within fire departments, these offices maintain identifiable staff and functions separate from the

larger fire department. As can be seen from the table, the estimated projected fiscal impacts on emergency management offices to be prepared for a MRFA event by the year 2007 is just over $12 million.

Table 3.5.4 Projected Fiscal Impact Costs on Offices of Emergency Management

	Personnel	Training	Equipment	Cost
Clark County	$340,340	$9,552	$10,264,493**	$10,614,385
Las Vegas	561,265	0	0	561,265
North Las Vegas	0	207,623	0	207,623
Henderson	61,463	13,401	73,705	148,569
Mesquite	0	0	0	0
Boulder City	0	0	0	0
Moapa	203,353	0	277,500	480,853
Totals	**$1,166,421**	**$230,576**	**$10,615,698**	**$12,012,695**

** Equipment includes capital costs

Source: *Impacts to Clark County and Local Governmental Safety Agencies Resulting from the Yucca Mountain Project*. A Clark County Nuclear Waste Division, Comprehensive Planning Department Report, prepared by Urban Environmental Research LLC: 2001.

Table 3.5.6 presents a summary of projected costs to these Clark County public safety entities, along with the Moapa Band of Paiutes.[12]

Table 3.5.6 Total Projected Costs by Community/County

	Police	Fire	Emergency Management	Cost
Clark County	$67,686,369	$195,896,055	$10,614,385	$274,196,809
Las Vegas	*	44,596,793	561,265	$45,158,058
North Las Vegas	711,021	22,421,402	207,623	$23,340,046
Henderson	952,427	285,933	148,569	$1,386,929
Mesquite	2,828,960	4,151,451	***	$6,980,411
Boulder City	404,880	**	**	$404,880
Moapa	N/A	8,038,644	480,853	$8,519,497
Totals	**$72,583,657**	**$275,390,278**	**$12,012,695**	**$359,986,630**

* Las Vegas Metro provides services to both Clark County and the City of Las Vegas

** Because of the projected distance to the HLW shipment corridor, Boulder City estimated impacts only for the Police Department.

*** In Mesquite, Emergency Management is a function of the Fire Department and thus costs are combined under Fire.

Source: UER

As can be seen from the tables, the fiscal impacts from siting the repository at Yucca Mountain on the public safety agencies are extraordinary. The total cost to community/county public safety agencies is projected to be almost $360 million. This includes just the start up costs for responding to a Scenario 3 event. The projection does

[12] The Moapa Bad of Paiutes occupy reservation land that encompasses stretches of both I-15 and the Union Pacific main railroad in Clark County. The Band maintains a separate fire and emergency response capability and must be prepared to deal effectively with a nuclear waste accident on reservation lands.

not include costs that would be incurred annually in response to the continued operation of a repository and the transportation of HLW. These estimates do not include the fiscal impacts to the southern Nevada hospitals that are not adequately prepared in terms of training, decontamination facilities, and other necessary personnel and equipment.

3.6 Impacts to Native American Communities

Native American tribes in the immediate vicinity of the Yucca Mountain project area and along potential transportation routes are, for the most part, economically disadvantaged. Reservations and communities in Nye, Clark, Lincoln, and Inyo counties are rural and isolated, and either lack a land base or have land bases too small to support their populations by ranching or other locally common means. A large number of people are unemployed, underemployed, and/or living below the poverty level. Educational levels have improved in recent years, but without job opportunities in local communities, people must leave to take advantage of their training. Any negative statewide economic impacts associated with or caused by the repository or repository-related nuclear waste transportation would have a disproportionate impact on such communities because of these depressed baseline conditions.

Native American communities are extraordinarily vulnerable to negative impacts associated with the Yucca Mountain project and nuclear waste transportation. Any negative statewide economic impacts associated with or caused by the project would have a disproportionate impact on such communities because of their depressed baseline conditions.

Major Native American concerns and issues include the following: (1) lack of any type of voice other than the most minimal in the siting of this repository; (2) lack of any designation and funding by DOE as "affected tribes" to conduct their own studies; (3) vulnerabilities of rural reservation tribes and persons to specific economic and health effects based on their cultural subsistence patterns (cattle, local plants, animals); (4) vulnerabilities of rural and urban populations and lands to contamination of reservation and aboriginal lands and water from repository and transportation-related accidents and incidents; (5) fiscal impacts to tribal governments to provide emergency preparedness equipment and services as well as social services to members for stress and loss of quality of life; (6) fiscal impacts to tribes for loss of present as well as potential economic revenue; (7) fiscal impacts to tribes to develop technological infrastructure to deal with the requests for monitoring; (8) vulnerabilities to further cultural loss, based on fear of engaging with their lands as previously; (9) violation of treaty rights and individual rights and international law in the repository construction and operation; and (10) further erosion of trust in government to respect tribal sovereignty and land and resource dignity. Impacts to Native American communities are addressed in more detail in Chapter Three.

3.7 Environmental Impacts

Environmental impacts of the federal high-level nuclear waste program in Nevada are driven largely by the construction and operation of facilities for transporting spent nuclear fuel and high-level radioactive waste to the proposed Yucca Mountain repository site. As such, this section of the State Impact Report should be interpreted in conjunction with the discussion of transportation impacts contained in section 3.8, below.

The lack of definition with respect to the transportation system DOE proposes to use to ship waste to Yucca Mountain makes the assessment of environmental impacts extraordinarily difficult. The "system" described in the draft Yucca Mountain EIS is in reality a series of alternatives involving various highway and rail routes, differing modes of transport, alternative rail spur corridors, and alternative intermodal/heavy-haul transport (HHT) facilities and routing options. Even the number and types of shipments are left undefined and uncertain, with ranges that make planning and impact assessment extremely problematic.

The Yucca Mountain program, especially the transportation elements of that program, is a potential major source of environmental impacts that would affect wide areas of the State, both rural and urban. Absent a complete and adequate evaluation of the environmental impacts associated with the Yucca Mountain program, any recommendation to move ahead with the repository project in Nevada is not only premature, but also legally deficient.

The discussion of environmental impacts contained in this report is to be governed by the following caveat: The assessment of environmental impacts is necessarily done at a very general level of analysis. It is by no means complete, comprehensive, or definitive. The discussion is included to demonstrate that the Yucca Mountain program, especially the transportation elements of that program, is potentially a major source of environmental impacts that would affect wide areas of the State, both rural and urban, if this project is permitted to go forward. It is Nevada's contention that, absent a complete and adequate evaluation of the environmental impacts associated with the Yucca Mountain program, any recommendation to move ahead with the repository program in Nevada is not only premature, but also legally deficient.

DOE's HLW Transportation System

The U.S. Department of Energy's Draft Environmental Impact Statement for Yucca Mountain (DEIS) identified fourteen "implementing alternatives" for possible use in transporting HLW and spent nuclear fuel to the Yucca Mountain site. These implementing alternatives were defined as potential rail, heavy-haul, or legal-weight truck. While the transportation corridors are identified in the referenced DEIS, DOE has yet to disclose HLW shipment numbers, modal mix, and the specific resources that would be impacted along routes in Nevada or the national as a whole. In effect, DOE has not

demonstrated the technical, economic, or environmentally acceptable feasibility of transporting spent nuclear fuel and HLW waste to the proposed repository in Nevada. Absent this information, communities throughout Nevada and the nation, which could experience HLW transportation related impacts, have no way of determining the level and type of impacts that might occur. Example of such impacts might include:

- Release of radiation due to a transportation accident or terrorist attack and the resulting costs for assessing radiation doses to humans and/or contamination of the natural environment;

- Fiscal impacts to State and local agencies responsible for addressing HLW transportation accidents caused by human error and/or natural disasters for both highways and railroad accidents; and,

- Impacts to the environment and subsequent loss of productive resources caused by hundreds of miles of rail line construction. Examples include effects on endangered species, contamination of surface and groundwater resources, degradation of soils and vegetation, impacts to archaeological resources, despoiled wildlife habitats, declines in usable grazing allotments, and restrictions on mining exploration and development.

Since risk assessments and environmental impact analyses have not been performed for each potential rail corridor or highway route in Nevada, or the nation as a whole, DOE has deferred the legally required analysis for selecting a preferred HLW transportation route(s). This means the Department has sidestepped the legally required process for disclosure of environmental impacts for shipping HLW to Nevada (see 10 CFR 1021).

State officials contend that such information and analysis is needed to define the minimum and maximum environmental risks associated with moving spent nuclear fuel and HLW to a repository at Yucca Mountain. Defining such impacts is an essential component in determining HLW modal-mix and routing decisions. To date, however, this decision making process has been ignored by DOE. Moreover, State officials contend that construction in Nevada of a rail line, intermodal waste transfer facility, and/or road reconstruction to support heavy haul trucks cannot be completed without environmental impacts that may or may not be amenable to mitigation. Yet without a detailed description of those construction activities, it is impossible to assess impacts and evaluate how or whether they can be safely and legally managed.

Areas of Environmental Impact

Air Quality: In terms of air quality impacts, the Las Vegas Valley has been classified by the U.S. Environmental Protection Agency as a serious non-attainment area for carbon monoxide (CO) and particulate matter (PM10). Because Clark County is in non-attainment for air quality emissions, the pollutants generated by the Yucca Mountain

project are of concern. While the referenced DEIS did translated some of the air quality impacts into fatalities estimates, air quality impacts important to Clark County for regulatory purposes (i.e., community growth) were not considered in the DEIS.

The construction and operation of transportation facilities to support the Yucca Mountain project would greatly affect the ability of Clark County to meet national air quality standards. Failure to meet these standards would harm the community's ability to obtain federal funding for transportation facilities and would generally harm the quality of life in Clark County.

Vehicular emissions are the primary source of CO pollutants in the Las Vegas Valley. In addition to vehicle miles of travel, traffic congestion is also a significant contributor to increased CO emissions. Over 35 million tourists visit Las Vegas each year, which translates to an at-capacity traffic situation throughout most of the major interstate road systems in Las Vegas Valley -- including all systems that would be used to move spent fuel and HLW to Yucca Mountain.

As noted in the repository DEIS, the Department is considering using heavy-haul trucks on existing highways as one option for delivering spent fuel and high-level nuclear waste to Yucca Mountain. Under this scenario, nuclear waste would be delivered by rail and then transferred to heavy-haul tractor-trailers at an intermodal transfer station. DOE has proposed three possible locations for intermodal transfer stations: Caliente, located in Lincoln County; Apex/Dry Lake, located north of Las Vegas; and Sloan/Jean, located south of Las Vegas. Five possible routes along existing highways would be used to move the waste from an intermodal station to Yucca Mountain. One-way travel distances for these routes range from a low of 114 miles (Apex/Dry Lake) to 330 miles (Caliente). The heavy-haul tractor-trailer would be 220 feet in length, with an unloaded weight of 200,000 pounds. (For comparison, a commercial semi-truck hauling triple trailers is only 115 feet in length and grosses 80,000 pounds.) In terms of potential threats to increasing air pollution in the Las Vegas Valley, the operation of DOE's "heavy-haul truck" alternative would cause enormous traffic delays that would greatly impact air quality in the local air basin. Because heavy-haul trucks travel at 20 to 30 mph, they would cause significant delays and slow traffic substantially. These delays would multiply by causing additional delays for the vehicles following the heavy-haul trucks. Cars would be unable to pass the heavy-haul trucks, and the congestion caused by those trucks would dissipate slowly.

The impacts on air quality due to heavy-haul and legal-weight truck shipments would be very substantial in Las Vegas -- given the State's intent to have all HLW waste shipments escorted by the Nevada Highway Patrol. Needless to say, DOE has yet to fully assess the air quality impacts in the Las Vegas Valley from the various transportation alternatives defined for moving HLW and spent nuclear fuel to Yucca Mountain.

Wildlife Habitat: DOE has yet to clearly define specific effects to biological resources, which would result from construction and operation of new rail lines, intermodal transfer

stations, and/or road reconstruction activities needed to support heavy-haul trucks. State officials note that several transportation corridors cross or pass near crucial habitats for sensitive species including big game and wild horses. Examples of critical habitats include bighorn sheep crucial winter range, mule deer crucial winter range, pronghorn winter range, sage grouse strutting areas, sage grouse nesting areas, and chucker and quail crucial habitat. Frequent trains passing through or near to crucial habitat areas could significantly reduce the value of that habitat even though the habitat was not physically disturbed by construction or operation. The region of influence for biological resources must include all habitats potentially affected, not just disturbed by construction and operation of a rail line, intermodal waste transfer facility, or areas affected by road reconstruction to support use of heavy-haul trucks.

Range Resources: Most ranching operations in Nevada are based on a combination of privately owned lands and grazing leases on publicly owned lands (i.e., grazing allotments). In many, if not all cases, these ranching units depend on grazing allotments to be economically viable. Splitting an existing operation with a rail line that would limit access to the leased land can have significant adverse effects on the operation of the ranch. The degree of impact from splitting a ranching operation would be much greater if the railroad right-of-way is fenced. The DEIS and supporting DOE documents contain conflicting information regarding whether or not railroad right-of-way would be fenced.

Cultural Resources: State officials note that archaeological inventories and testing have occurred at Yucca Mountain itself, as part of site characterization activities; however, historic property surveys meeting the Secretary of Interior's standards have not been conducted for the railroad corridors. The question of whether any of the rail routes were used historically as transportation routes has not been answered. This means that direct impacts would occur as a result of the construction of new rail lines, and yet DOE has not identified potential effects on historic or cultural landscapes from rail line construction. The same situation exists for highway corridors and intermodal transfer sites. DOE has not provided sufficient data to determine the location and number of historic properties that would be impacted by spent fuel and HLW shipping routes and modes. DOE must consult with the State Historic Preservation Office and must prepare a new programmatic agreement that details how it would identify, evaluate, and treat historic properties and how the consultation process would occur. This process must be accomplished before Nevada can assess the environmental and fiscal impacts of HLW transportation on cultural resources.

Vegetation and Soils: Since DOE has avoided a detailed analysis of the rail line corridors and heavy-haul transportation routes for moving spent fuel and HLW to a repository in Nevada, there has <u>not</u> been a rigorous analysis of potential impacts caused from the spread of noxious weeds or invasive plant species. The disruption of soils that would result from rail spur construction, heavy-haul highway improvements, and other activities that facilitate or promote the proliferation of noxious weeds and invasive plants are issues of significant concern in Nevada. Once a population of noxious weeds is in place, Nevada's open range can become highly susceptible to repeated occurrences of

wild land fires. When this occurs, the highly fragile ecological balance between natural vegetation and soils is lost.

Groundwater: DOE has avoided a discussion of groundwater impacts associated with the transportation of spent nuclear fuel and HLW to a repository in Nevada. Most of the rail corridors proposed by DOE traverses rugged terrain where significant cuts would be required. While these cuts could intercept groundwater flow, DOE has not provided sufficient information on the actual routes and the location and depth of cuts to assess these potential impacts. In addition, DOE has yet to recognize the fact that an accident during waste transport could result in long-term impacts to surface water and groundwater resources.

Leaseable Minerals & Energy Resources: DOE has yet to evaluate the costs and environmental impacts of obtaining material for rail bed construction. To maintain required grades for a rail line, significant cut and fill would be required. Cut material would be used as fill; however, additional fill requirements (sub-ballast) would likely require development of borrow areas outside of the rail line right-of-way. In cases where terrain crossed by rail lines is relatively flat (e.g., the Carlin route), significant borrow material would be needed to construct the rail bed. DOE has not, however, identified a source for sub-ballast material; moreover, while such material is usually obtained locally from gravel pits, this would likely not be the case in many remote areas of central and southern Nevada. In some situations, obtaining borrow materials could affect groundwater resources as well, thus triggering permitting for reclamation actions. Once again, none of these issues have been adequately address by DOE.

In terms of energy resources, DOE has acknowledged that the existing electric power services are inadequate to serve a repository at Yucca Mountain. The environmental impacts of obtaining power upgrades have simply not been defined or evaluated in terms of costs and/or environmental impacts.

Land Use: DOE has not accurately identified or assessed the land use impacts of HLW transportation alternatives in Nevada. Even where DOE has identified land use impacts, the Department has understated the nature and severity of the impacts. The failure by DOE to accurately describe a proposed action in the repository DEIS for moving spent nuclear fuel and HLW to a repository in Nevada severely limits state and local authorities in developing an adequate assessment of land use impacts. For example, the land use impacts associated with the development of sand and gravel resources, solid waste disposal facilities, construction lay-down areas, and construction staging areas cannot be assessed until these areas are identified.

For linear facilities such as a rail line, an assessment of land use impacts must include costs associate with right-of-way and private land acquisitions as well as an evaluation of the impacts of bisecting current and future land uses. Splitting an area with a rail line can have significant impacts on the entire area, not just the area within the right-of-way. This is particularly true for ranching and mining operations.

Since DOE has not selected a proposed rail route, the State cannot define land use impacts at roads and rail crossings, at construction initiation points, and at construction camps. In addition, a new rail line across Nevada would require construction of major structures such as bridges across drainages and highway grade separations. Most of these construction activities would involve the placement of pre-cast concrete structures – yet DOE has not identified locations for siting concrete pre-cast plants.

While DOE has identified a number of land use conflicts with the proposed rail line, the Department has not accurately characterized the impacts. Examples include potential rail corridors through the Simpson Park Habitat Management Area (Carlin rail alternative), the Old Spanish Trail/Mormon Road Recreation Area (Jean rail alternative), and other special use areas such as wilderness study areas and wildlife range (i.e., the Desert National Wildlife Range -- Valley Modified rail alternative). A rail line through any of these special land use areas would have significant impacts on the purpose and use of these special areas, yet DOE has not even discussed these impacts.

In terms of highway transportation of spent nuclear fuel and HLW, DOE has assumed that 0.04 square kilometers could be needed to construct a bypass near Beatty, Nevada. However, the Department has not assessed nor admitted that two additional bypasses would also be required. To avoid risks associated with accident free radiological exposures and transportation accidents, bypasses would need to be constructed to avoid the towns of Tonopah and Goldfield, Nevada. DOE has never considered the requisite environmental impacts or <u>costs</u> associated with construction of these bypasses.

Floodplain and Wetlands: DOE has yet to adequately study the potential surface water impacts of either rail or the heavy-haul transportation alternatives for shipping spent fuel and HLW to a repository at Yucca Mountain. In fact, DOE openly admits that no field searches or formal delineations of wetlands have been conducted along any of the proposed transportation routes. State officials note that some of the alternative rail corridors are known to cross or be near significant springs, groups of springs, streams designated as riparian areas, or reservoirs associated with wetlands.

In addition, potential impacts to wetlands have not been delineated for the intermodal transfer station sites identified by DOE in the repository DEIS. In Nevada, wetlands and riparian areas are unique, scarce resources and are generally considered irreplaceable. While DOE has stated that impacts to wetlands and riparian areas would be mitigated, State officials contend that any loss of these limited resources cannot be replaced or replicated in most areas because of Nevada's arid climate and fragile groundwater and spring sources. Hence, assigning impact assessment costs to lost wetland resources may be impossible.

Impact Assessment and the NEPA Process: The State of Nevada has long opposed DOE's interpretation and implementation of the National Environmental Policy Act (NEPA) requirements for assessing the Yucca Mountain project, including alternative

transportation routes and modes for shipping spent nuclear fuel and HLW (see State of Nevada DEIS comments dated 02/2000). State officials note the DEIS failed to integrate NEPA documentation for the Yucca Mountain project with other ongoing and anticipated federal activities. For example, only biota and soils were addressed in the DEIS, the former only at the population and community levels. Ecosystems were avoided, as was their role in the regional landscape. Consequently, impact analysis was not performed in the context of regional plans to assess the carrying capacity of the region's resources as well as the cumulative effects that could occur from the transportation of HLW to Yucca Mountain.

In fact, DOE's failure to designate a preferred rail access corridor violates the National Environmental Policy Act. NEPA procedures are designed to "insure that environmental information [including information on the human environment as well as public health and safety] is available to public officials and citizens before decisions are made and before actions are taken." DOE's approach for the DEIS denied the affected public a meaningful opportunity to participate in the rail corridor evaluation process before DOE prepares the Final EIS for Yucca Mountain. Moreover, DOE's refusal to narrow the choice of corridors extends the region of influence of the Proposed Action in the DEIS to thirteen Nevada counties traversed by the five rail corridors and their existing mainline rail connections. This means that virtually the entire population of Nevada is being held hostage by DOE's indecision. Yet the Secretary of Energy, per the Nuclear Waste Policy Act, expects Nevada to submit a comprehensive impact assessment report as part of the site recommendation process -- when DOE has yet to adequately evaluate and/or choose a preferred transportation route or modal mix.

Virtually the entire population of Nevada is being held hostage by DOE's indecision. Yet the Secretary of Energy, per the Nuclear Waste Policy Act, expects Nevada to submit a comprehensive impact assessment report as part of the site recommendation process -- when DOE has yet to adequately evaluate and/or choose a preferred transportation route or modal mix.

Intergovernmental Institutional Impacts: By not assessing the transportation routes for shipping HLW and spent nuclear fuel to Yucca Mountain, DOE has created a significant impact on other public agencies at the federal, state, and local levels. Without definitive knowledge of DOE's transportation plan, state and local agencies cannot engage in planning practices that would minimize harm in the event of an accident resulting in a radiological release. Such plans should be prepared in accordance with the Statewide Planning/Metropolitan Planning regulations. These statutes require a continuing, comprehensive, and coordinated transportation planning process in the State and metropolitan areas.

Conclusion

Since DOE has not evaluated in detail all potential highway or rail routes in Nevada for waste shipments to Yucca Mountain, with the same level of information and analysis for each, the Secretary cannot consider the minimum and maximum risks to the human and natural environment. Without such consideration, the State of Nevada contends that it is premature to recommend Yucca Mountain as suitable for development as repository for disposal of spent fuel and HLW.

3.8 Transportation Impacts

The transportation of spent nuclear fuel and high-level radioactive waste to the proposed Yucca Mountain repository site in southern Nevada has the potential to dramatically and significantly impact communities throughout Nevada and across the nation. Depending on assumptions about the mix of shipping modes, handling and shipping capabilities at points of origin (e.g., reactor sites), size of the shipping canister or cask, and other factors, a Yucca Mountain repository, if constructed and opened, would receive between 23,500 and 96,300 shipments[1] of spent nuclear fuel from civilian nuclear power plants and high-level radioactive waste from DOE weapons facilities. The repository would also receive an unknown number of shipments of so-called "miscellaneous wastes requiring geologic disposal," adding to the overall number of radioactive waste shipments that would be required.

Nuclear waste transportation would be the most visible and dramatic "driver" of potential repository impacts. Tens of thousands of shipments would directly impact communities in Nevada and throughout the nation.

Transportation issues are critically important to the State and local Nevada communities. Nuclear waste transportation would be the most visible and dramatic "driver" of potential repository impacts. Despite this fact, DOE has done almost nothing to evaluate impacts, either in Nevada or nationally. The few feeble attempts DOE has made to address the transportation issue, as in the Yucca Mountain DEIS, have been wholly inadequate and designed to obfuscate risks and impacts rather than deal with them forthrightly.

The DEIS identified seven potential highway routes within the State of Nevada for legal- weight truck (LWT) shipments to Yucca Mountain; two existing railroads and five new rail spur corridors for direct rail shipments; and five potential highway routes for heavy-haul truck (HHT) transport of rail casks delivered to three intermodal transfer facilities near existing railroads. Ten of Nevada's sixteen counties could be directly impacted. Tables 3.8.1 – 3.8.3 show potential shipments through southern Nevada when the DEIS routing options are combined with the mostly truck, mostly rail, and current capabilities transportation scenarios. Tables 3.8.4 – 3.8.6 show potential shipments through northern Nevada.

[1] Under a scenario where most of the waste is shipped using legal-weight trucks, there would be 96,000 truck shipments plus 300 Naval spent fuel shipments that would have to come by rail from Idaho National Engineering and Environmental Laboratory, due to the size and configuration of the Navy packaging. Under a scenario where most waste is transported by rail, there would be 19,800 rail shipments plus 3,700 truck shipments from reactors that are not rail capable. (Both of these shipment scenarios are taken from DOE's Draft Environmental Impact Statement for the Yucca Mountain Repository project, released in August 1999.) Due to the fact that there is no rail access to Yucca Mountain or the Nevada Test Site and the cost of constructing such access could exceed $1 billion, the State of Nevada considers it much more likely that spent fuel and high-level waste would be transported to the site by legal-weight truck.

Table 3.8.1 Potential Shipments Through Nevada Counties, 2010 - 2048: Southern Nevada Routes, Mostly Truck Scenario

County	LWT	Rail Casks, Existing Lines	Rail Casks, New Access Spur	HHT
State Total	95,957	300		300
Carson City				
Churchill				
Clark	95,957			
Douglas				
Elko				
Esmeralda				
Eureka				
Humboldt				
Lander				
Lincoln				
Lyon				
Mineral	95,957			
Nye				
Pershing				
Storey				
Washoe				
White Pine				

Table 3.8.2 Potential Shipments Through Nevada Counties, 2010 - 2048: Southern Nevada Routes, Mostly Rail Scenario

County	LWT	Rail Casks, Existing Lines	Rail Casks, New Access Spur	HHT
State Total	3,701	19,845	19,845	19,845
Carson City				
Churchill				
Clark	3,701	19,845	19,845	19,845
Douglas				
Elko				
Esmeralda			19,845	19,845
Eureka				
Humboldt				
Lander				
Lincoln		19,845	19,845	19,845
Lyon				
Mineral				
Nye	3,701		19,845	19,845
Pershing				
Storey				
Washoe				
White Pine				

Table 3.8.3 Potential Shipments Through Nevada Counties, 2010 - 2048: Southern Nevada Routes, Current Capabilities Scenario

County	LWT	Rail Casks, Existing Lines	Rail Casks, New Access Spur	HHT
State Total	26,375	14,179	14,179	14,179
Carson City				
Churchill				
Clark	26,375	14,179	14,179	14,179
Douglas				
Elko				
Esmeralda			14,179	14,179
Eureka				
Humboldt				
Lander				
Lincoln		14,179	14,179	14,179
Lyon				
Mineral				
Nye	26,375		14,179	14,179
Pershing				
Storey				
Washoe				
White Pine				

Table 3.8.4 Potential Shipments Through Nevada Counties, 2010 - 2048: Northern Nevada Routes, Mostly Truck Scenario

County	LWT	Rail Casks, Existing Lines	Rail Casks, New Access Spur	HHT
State Total	95,957	300		300
Carson City				
Churchill	5,344			
Clark				
Douglas				
Elko	95,957			
Esmeralda	95,957			
Eureka	5,344			
Humboldt	5,344			
Lander	5,344			
Lincoln				
Lyon				
Mineral				
Nye	95,957			
Pershing	5,344			
Storey				
Washoe	5,344			
White Pine	95,957			

Table 3.8.4 Potential Shipments Through Nevada Counties, 2010 - 2048: Northern Nevada Routes, Mostly Rail Scenario

County	LWT	Rail Casks, Existing Lines	Rail Casks, New Access Spur	HHT
State Total	3,701	19,845	19,845	
Carson City				
Churchill	44			
Clark				
Douglas				
Elko	3,701	15,707		
Esmeralda	3,701		19,845	
Eureka	44	19,845	19,845	
Humboldt	44	4,138		
Lander	44	4,138	19,845	
Lincoln				
Lyon				
Mineral				
Nye	3,701		19,845	
Pershing	44	4,138		
Storey				
Washoe	44	4,138		
White Pine	3,701			

Table 3.8.6 Potential Shipments Through Nevada Counties, 2010 - 2048: Northern Nevada Routes, Current Capabilities Scenario

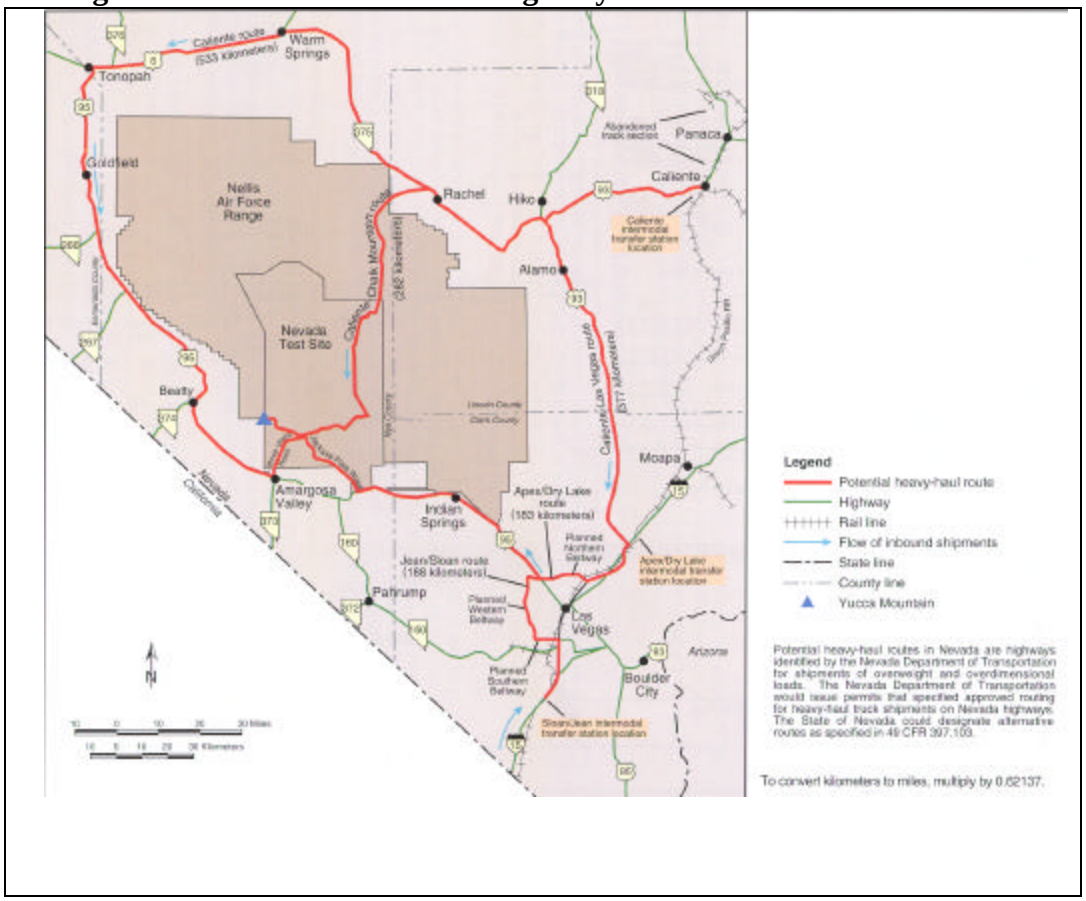
County	LWT	Rail Casks, Existing Lines	Rail Casks, New Access Spur	HHT
State Total	26,375	14,179	14,179	
Carson City				
Churchill	1,352			
Clark				
Douglas				
Elko	26,375	10,384	14,179	
Esmeralda	26,375		14,179	
Eureka	1,352	14,179	14,179	
Humboldt	1,352	3,795		
Lander	1,352	3,795	14,179	
Lincoln				
Lyon				
Mineral				
Nye	26,375		14,179	
Pershing	1,352	3,795		
Storey				
Washoe	1,352	3,795		
White Pine	26,375			

Nevada Highway Impacts

Highway impacts in Nevada would be greatest under the DEIS mostly truck transportation scenario, involving 96,000 legal-weight truck (LWT) shipments of SNF, HLW, and miscellaneous radioactive wastes over 38 years. There would be about 2,526 truck shipments per year, or 7 trucks per day. Under the current capabilities scenario, there would be about 26,400 LWT shipments, an average of 695 truck shipments per year or about 2 per day. The lowest number of truck shipments, under DOE's mostly rail scenario, would be 3,700 LWT shipments over 38 years, or 97 truck shipments per year.

The only highway route currently available for truck shipments to Yucca Mountain under U.S. Department of Transportation's regulations governing route selection for SNF and HLW shipments is I-15 to US 95 via the downtown Las Vegas interchange known as the Spaghetti Bowl. The DEIS assumes that shipments would also use the planned Northern, Southern, and Western Las Vegas Beltways (I-215), although there is debate over the legality of making shipments over these county-funded roadways. The DEIS also identified and partially evaluated six alternative routes that would avoid downtown Las Vegas (see Figure 3.8.1).

Figure 3.8.1 Southern Nevada Highway Routes To Yucca Mountain



This report evaluates the impacts of truck shipments using I-15 and US 95 through downtown Las Vegas. It also evaluates one of the alternative routes identified in the DEIS, referred to as NDOT Route B, by reference to its designation in a 1989 report prepared for the Nevada Department of Transportation [Ardila-Coulson, 1989]. NDOT Route B enters Nevada from Utah on I-80, travels south on U.S. 93A and U.S. 93, west on U.S. 6, and south again on U.S. 95. The route travels through the cities of West Wendover and Ely and the towns of McGill, Tonopah, Goldfield, and Beatty. The distance from the Nevada state line to Yucca Mountain by this route is about 430 miles.

Radiological Impacts Of Routine Highway Shipments

Overall radiological impacts of incident-free shipments would be greatest under the "mostly truck" national transportation scenario. If the Yucca Mountain repository project goes forward, this may be the operative transportation system. Yucca Mountain currently lacks rail access. Construction of a new rail access spur would be difficult and costly, as would heavy-haul truck delivery of rail casks from an intermodal transfer station. All 77 utility and DOE storage sites can ship SNF and HLW by legal-weight truck, and LWT transport is economically competitive with rail transport. DOE's "hot repository" thermal loading strategy, coupled with many utilities' desire to ship SNF to the repository directly from wet storage, particularly favors LWT transport during the first 10 to 20 years of operation.

Radiation exposures allowed under existing regulations, coupled with the large number of LWT shipments, would result in substantial worker exposures, up to 8.5 rem (8,500 mrem) for workers that come in regular contact with shipments.

Truck shipments to Yucca Mountain would contribute to the total radiation exposures received by Nevada transportation workers and by some members of the public along Nevada highway routes. This section of the report, like the DEIS, expresses radiation exposures (effective dose equivalents) in terms of rem or millirem (one-thousandth of a rem). According to the DEIS, the Nevada average annual background radiation from natural sources (radon, rocks and soil, outer space, food and water) ranges from 330 to 390 millirem (mrem), compared to the national average of 300 mrem. [DEIS, Table 3-28, p. 3-81] The average American also receives about 65 mrem annually from medical X-rays and treatments, consumer products, and miscellaneous sources. [DEIS, Figure F-1, p. F-5]

Shipping casks operate under Nuclear Regulatory Commission (NRC) regulations that allow a routine dose rate of 10 millirem (mrem) per hour at 2 meters from the cask surface. One hour of exposure at 2 meters (6.6 feet) produces about the same dose that a person receives from a whole body medical X-ray. For this reason, shipping casks have been called "portable X-ray machines that can't be turned off." The DEIS argues that the actual dose rate from LWT casks would be "50 to 70 percent of the regulatory limits." [DEIS, p. J-48] However, most of the SNF shipped by truck would likely be cooled less than 20 years, with an expected dose rate equal to the regulatory rate. Truck casks fully

loaded with some SNF cooled 10 years or less would exceed the regulatory limit by 20 to 40 percent. [DEIS, Table J-7]

This report assumes that truck shipments to Yucca Mountain would operate at the regulatory dose rate of 10 mrem/hour at 2 meters. This dose rate results in near-cask exposures of about 2.5 mrem per hour at 5 meters (16 feet) and 0.2 mrem per hour at 20 meters (66 feet). Exposures of this magnitude are of great concern to transportation workers and certain members of the public and can result in adverse health effects. This dose rate also results in measurable exposures (about 0.01 mrem per hour) at 25-30 meters (82-98 feet), and calculated exposures (0.000002 mrem per hour) at 800 meters (one-half mile) from the cask surface. Moreover, the very fact that these exposures occur is a major contributor to the stigmatizing effects of the Yucca Mountain shipping campaign, resulting in adverse socioeconomic impacts discussed above, such as loss of property values, even though the dose levels are well below the established thresholds for cancer and other health effects.

The amount of radiation exposures allowed under existing regulations, coupled with the large number of LWT shipments, would result in substantial worker exposures. State safety inspectors could, in theory, receive doses up to 8.5 rem (8,500 mrem) per year. Fulltime truck drivers could receive annual doses exceeding 4 rem per year. DOE calculates that these exposures over 24 years would increase lifetime cancer risk by at least 8 percent for the maximally exposed worker. Nevada studies estimate that cancer risks would be 50% higher than DOE estimates and that other health risks ignored by DOE, such as risks to pregnant female workers, could be 7-10 times higher than cancer risks. NRC and DOE regulations currently restrict occupational exposures to 5 rem per year. The DEIS states that health risks should be further reduced by restricting worker exposures to 2 rem per year.[2]

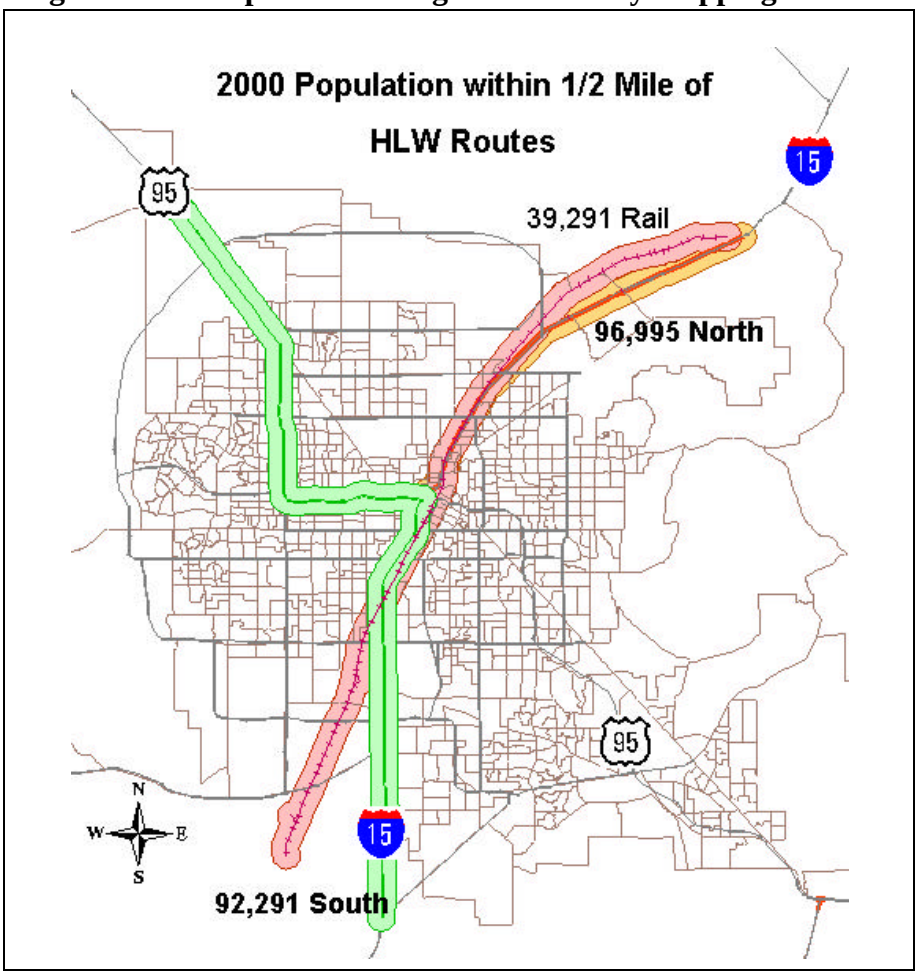
Service station attendants, who are considered members of the public, could receive doses well in excess of the NRC and DOE regulations. Along the most likely Nevada highway routes, a service station attendant who regularly fuels and services SNF/HLW trucks could receive a dose of 500-1,000 mrem per year. The resulting increased lifetime cancer risk, as calculated by DOE's method, would be relatively small, less than 2 percent over 24 years. But the slightly higher annual cancer risk would be more than 5 times higher than the average annual risk for death in an automobile accident, a risk that is considered intolerable and compels intense efforts by many state and Federal agencies directed to lower the risk.

Other members of the public could receive radiation doses while sharing the roadway with SNF/HLW trucks. In urban Clark County, traveling on a multilane

[2] The precise relationship between low-level radiation exposures and adverse health effects is a matter of continuing debate within both the medical and the health physics communities. Advocates of the linear no threshold hypothesis believe that all radiation exposures may result in adverse health effects. Many other experts believe that no significant health effects occur until exposures exceed 300-1,000 mrem, and that additional chronic exposures up to 1,000 rem increase cancer risks proportionately. The International Commission on Radiological Protection recognizes different radiation health risks for different groups among the public, including young children and pregnant women. For repository transportation activities, NRC and DOE regulations restrict annual exposures to 100 mrem for members of the public.

highway in heavy traffic next to an SNF/HLW cask could result in doses of 4-8 mrem per hour. The occupants of a vehicle stuck in traffic gridlock next to a SNF/HLW truck for four hours could receive up to 40 mrem. On rural, two-lane highways, where escorts in separate vehicles are not currently required, the driver of a vehicle traveling one truck-length (20 meters) directly behind a SNF/HLW truck would receive a dose of about 0.1 mrem per hour. Tailgating the SNF/HLW truck could increase the dose rate to about 1 mrem per hour.

Figure 3.8.2 Population Along Clark County Shipping Routes



The routine radiation dose to residents along highway routes through urban areas is a major concern because of the large number of shipments under the mostly truck scenario (see Figure 3.8.2). The Nevada Agency for Nuclear Projects (NANP) and Clark County selected three potential route segments through Las Vegas for impact analysis: I-15 South from SR604 (Las Vegas Blvd.) to the Spaghetti Bowl; I-15 North from SR146 (Lake Meade Blvd.) to the Spaghetti Bowl; and US 95 West from the Spaghetti Bowl to SR157 (Kyle Canyon Rd.). According to the 2000 Census, about 120,000 people resided within one-half mile of the potential routes to Yucca Mountain. When the resident population is combined with the school population, estimated average daily workers, and

estimated hotel/casino guests, the average daily exposed population within one-half mile of the routes is currently about 188,000 (see Table 3.8.7).

Table 3.8.7 Population Within 1/2-Mile of Highway Routes to Yucca Mountain through Las Vegas

Route Segment Data	I-15 South from SR604 to US95	I-15 North from SR146 to US95	US95 West from I-15 to SR157
LWT Shipments/year	2187	338	2525
Corridor Length (miles)	16	16	17
2000 Resident Population	25,186	19,981	74,470
Total Employment	15,702	86,397	9,579
Est. Avg. Daily Hotel/Casino Guests	475	25,532	43
School Population	441	166	4,478
Est. Avg. Daily Exposed Population	31,336	74,478	82,190

Source: Clark County Nuclear Waste Division

A separate analysis of the DOE proposed route, which uses the planned I-215 Beltways to bypass the Spaghetti Bowl, was not performed. However, if current development plans proceed and past growth rates continue, the potentially exposed population with one-half mile of DOE's proposed route is expected to be similar to the routes analyzed for this report by 2010-2020.

There are locations along the highway routes through Clark County where residents within 30 meters (98 feet) of passing truck casks could receive doses of 0.2-0.3 mrem or more per year. The vast majority of residents would be expected to receive annual doses less than 0.2 mrem per year. The DEIS estimates of routine radiological impacts in Clark County are wholly inadequate. An expert review concluded that the DEIS may have underestimated these impacts by a factor of 8 to a factor of 50. Nevada is currently evaluating alternative methods for more precisely modeling collective and maximum routine doses along these routes, and the resulting health effects.

What is not disputed is the certainty that tens of thousands of Clark County residents and properties along transportation routes would be exposed to small additional radiation doses as a result of truck shipments to Yucca Mountain. Moreover, these shipments could continue for a period of four decades or more.

Tens of thousands of Clark County residents and properties along transportation routes would be exposed to radiation doses as a result of truck shipments to Yucca Mountain.

In preparation for this report, State researchers also studied the potential routine radiological impacts along routes that avoid Clark County. LWT shipping scenarios and routes that present the greatest risks for routine exposures were examined. These studies also analyzed locations where exposures would be maximized by proximity to casks during required transport vehicle stops and/or travel at slow speeds. The selected locations

included residential and commercial buildings, parking lots, sidewalks, and pedestrian crosswalks. While members of the public are frequently present at these locations, these analyses estimated the maximum annual dose at a particular location without regard to the actual presence of an exposed individual or individuals at that location.

One of the alternative routes identified in DOE's DEIS is the "NDOT Route B." The DEIS assumed that this route could be used by all LWT shipments, an average of 2,525 per year for 38 years. NANP believes that NDOT Route B could reasonably be used for shipments from all sites identified in the DEIS except five reactor sites in Arizona and California. For this analysis, NANP assumed that about 87,600 LWT shipments of SNF and HLW, 94% of the total LWT shipments to the repository, would use this route. This would result in an average of 2,305 SNF and HLW shipments per year, or 6.3 shipments per day. There would also be about 80 LWT shipments per year of miscellaneous radioactive wastes.

For the DEIS mostly truck scenario, NANP found that annual exposures at certain locations near intersections ranged from 46 mrem (at 10 meters) to 4 mrem (at 21 meters). A location near a pedestrian crosswalk requiring brief stops (15 seconds) received an annual dose of 47 mrem (at 4 meters). Near-route locations where trucks slowed down, but did not stop, received annual exposures ranging from 28 mrem (at 4 meters) to 6 mrem (at 4 meters). The estimated annual doses for each location are shown in Table 3.8.8.

Table3.8.8 Estimated Annual Doses at Locations Along LWT Routes to Yucca Mountain.

Location	Distance from Cask (meters)	Stop Time (seconds)	Travel Speed (miles/hour)	Annual Dose (millirem)
W. Wendover #1	10	38 – 52	15 - 25	22 - 30
Ely #1	10	24 – 72	20 – 35	18 - 43
Ely #2	10	24 – 72	20 – 35	20 - 46
Ely #3	21	24 – 72	20 – 35	4 - 11
Ely #4	4	0	3	28
Goldfield #1	4	0	20	6
Goldfield #2	4	15	20	47
Goldfield #3	4	0	11	11

Source: State of Nevada, Agency for Nuclear Projects

The DEIS estimates that a resident living 30 meters (98 feet) from a route used by all shipments to Yucca Mountain would receive up to 5.4 mrem over 24 years, an average of 0.2 mrem per year. The DEIS made no effort to assess routine radiological impacts along specific Nevada highway routes where unique local conditions could result in doses much higher than DOE's generic approach. The DEIS borrowed its maximally exposed resident along route example from the 1995 DOE Programmatic EIS and Idaho National Engineering and Environmental Laboratory Final EIS [DOE/EIS-0203-F, p. I-52].

Nevada's preliminary assessment identified locations along the NDOT Route B where annual doses could exceed DOE's estimated 24-year dose by a factor of 8 or more.

Moreover, the analyses prepared for this report may have significantly underestimated routine doses by ignoring the impacts of inclement weather, traffic congestion, installation of new traffic signals, and other factors on stop times.

While additional studies are needed, the preliminary estimates of annual doses on private properties along the NDOT Route B constitute a major finding. The large number of shipments projected under the mostly truck transportation scenario combine with unique local conditions to produce doses of unprecedented magnitude. The truck shipments to Yucca Mountain would clearly create elevated radiation exposure zones on private properties along the route. Further analysis of socioeconomic impacts needs to consider the extent to which the SNF and HLW shipping campaign associated with the Yucca Mountain program constitutes an actual 'taking' of property rights, both in terms of lost value and involuntary assignment of risk of radiological exposure.

Severe Truck Accidents

Each truck shipment to Yucca Mountain would carry an enormous inventory of deadly radioactive materials. Each cask would contain enough strontium-90 to contaminate Lake Mead, and enough cesium-137 to contaminate the City of Las Vegas. Casks are not designed to withstand all credible highway accidents. An accident that released even a small fraction of a truck cask inventory could cause catastrophic health and economic impacts.

The Yucca Mountain DEIS did not consider the potential consequences of a worst case truck accident in Nevada. The DEIS did evaluate what DOE considered to be a maximum reasonably foreseeable truck accident (Category 6) at a generic urban location. DOE's truck accident would release and disperse enough radioactive materials to give 1800 people a 5 rem dose and cause about 5 latent cancer fatalities. DOE estimated the probability of such an accident at 1.9 in 10 million per year. Less severe truck accidents (Category 5), also resulting in releases, had estimated probabilities ranging from 4 in 100,000 to 3 in 10 million per year.

Between 204 and 1,306 latent cancer fatalities would result from exposure to radiation from a severe truck accident in Las Vegas. Costs of clean up could reach $28 billion. In rural Nevada, a comparable truck accident would cause between 194 and 1,243 latent cancer fatalities and cost over $500 million to clean up.

Previous studies sponsored by the State of Nevada concluded that the DEIS systematically underestimated the likely human health impacts of severe truck accidents. Moreover, the DEIS completely ignored the potential economic impacts of severe accidents. The cost of cleanup, evacuation, and business loss resulting from a severe accident in a generic urban area can range from several billion to several hundred billion dollars.

For this impact report, the State of Nevada commissioned Radioactive Waste Management Associates (RWMA) to undertake a more realistic study of credible worst

case truck accidents at representative urban and rural locations along potential Nevada highway routes. RWMA used the same Modal Study accident severity categories considered in the DEIS, but assumed that the accidents involved hotter SNF (5 year-cooled PWR) and used higher (more conservative) cesium gap inventory estimates. Table 3.8.9 compares the RWMA and DEIS accident scenarios.

Table 3.8.9 Comparison of RWMA and DEIS Accident Scenarios

Yucca Mountain DEIS	RWMA
"Maximum Reasonably Foreseeable" accident scenario based on probability	No estimate of probability
Risk and Consequence Assessments performed	Consequence Assessment only
Estimated consequences for severity Category 6 truck accidents in urban locations and a severity Category 6 truck accident in a rural location	Estimated consequences for severity Category 5 and 6 truck accidents in urban and rural locations
26-year-cooled PWR fuel having a burnup of 39,560 MWD/MTU assumed	5-year-cooled PWR fuel having a burnup of 39,560 MWD/MTU assumed
0.3% of cesium inventory assumed in Fuel-Clad Gap	9.9% of cesium inventory assumed in Fuel-Clad gap
Meteorological conditions based on national averages	Site-specific meteorological averages used
CRUD inventory not explicitly modeled	Assumes that all CRUD is released to environment in the event of a rod failure
No discussion of economic impacts	Economic impacts, including cost of decontamination and evacuation, discussed

For each accident scenario, RWMA provided two separate consequence assessments: a Category 5 and Category 6 accident. The Category 6 accident scenario is considered by DOE to be the most severe accident that could credibly happen en route to the Yucca Mountain repository. For the specific accident locations chosen in this study, RWMA concentrated on the category 5 accident scenarios, after judging them to be the most credible severe accidents. Therefore, the accidents postulated in the RWMA report are not "worst-case" scenarios since even more serious situations are possible. Rather, they are severe, yet credible, accidents, with the understanding that they are meant to be representative of the types of severe accidents that could readily happen in different areas of Nevada and the country.

The RWMA study was a consequence assessment for a hypothetical truck accident occurring at a specific location in order to more realistically estimate damages and to test the capacity of emergency response. The RWMA study was not intended to predict the precise location of an accident, its severity, and the meteorological conditions at the time of the accident.

The interchange of US 95 and I-15 in Las Vegas, referred to as the "Spaghetti Bowl," was selected as the location for the urban truck accident. Specifically, the scenario involved a truck traveling on I-15 going into the Spaghetti Bowl. Speeds at this location can approach 70 miles per hour, and there is the possibility of a severe crash into a bridge abutment, a fall from an elevated highway structure, and/or collision with other vehicles hauling gasoline or other hazardous materials. Wind data from the McCarran International Airport was employed to obtain an average wind direction, speed, and stability category.

I-80 at the West Wendover exit, near the Utah/Nevada border was identified as the location for the rural truck accident. At this location, trucks can be expected to travel at fairly high speeds, allowing the possibility of a severe impact scenario. Truck speeds at this location approach 75 mph. The narrow median strip and absence of dividers between the east- and westbound lanes creates the possibility for high-speed, head-on collisions. Rocky outcroppings along the westbound highway wayside create the possibility of an impact collision onto a hard surface. Wind data was obtained from the Wendover Air Field in Utah, very close to the potential accident location.

Two computer programs, RISKIND and HotSpot, were used to develop contaminant plumes for the two truck accident scenarios. Both use standard Gaussian plume dispersion equations to estimate airborne concentrations and ground deposition of radionuclides. The spent nuclear fuel inventory obtained from RISKIND was used to develop the spent fuel inventory for use in both computer simulations. Figure 3.8.3 shows the plume and 24-hour dose for the hypothetical truck accident in Las Vegas.

Figure 3.8.3 Dispersal Pattern for Hypothetical Truck Accident in Las Vegas

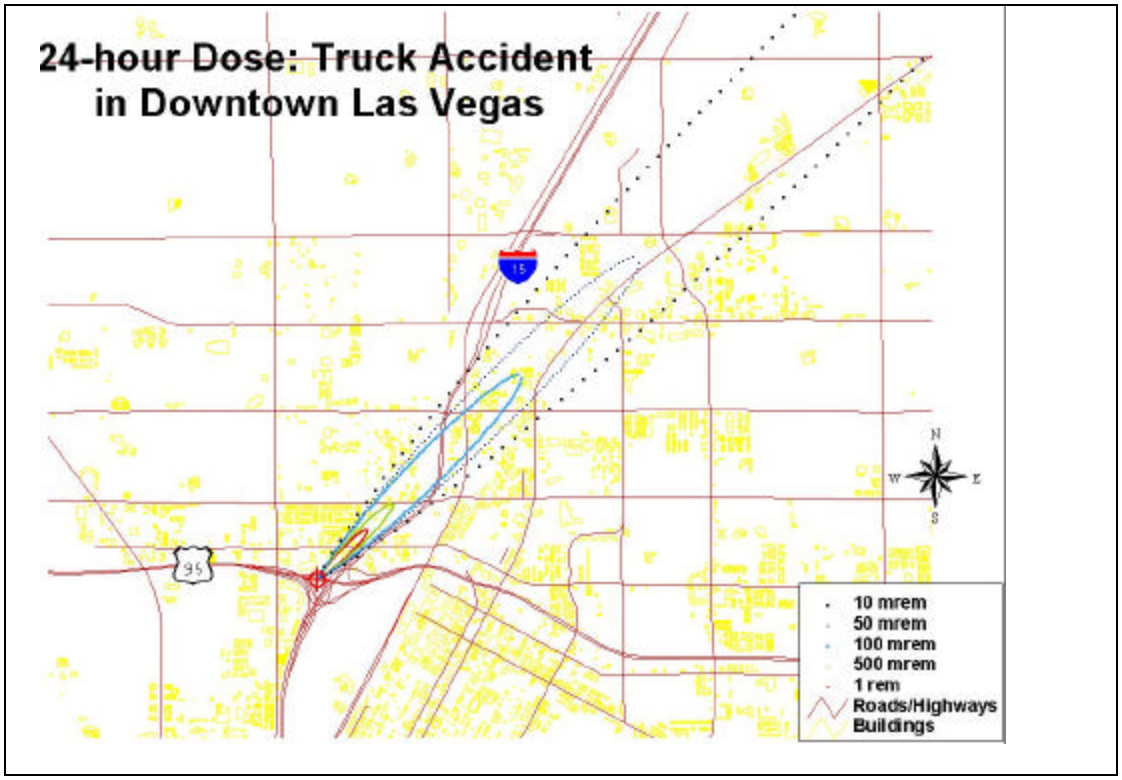
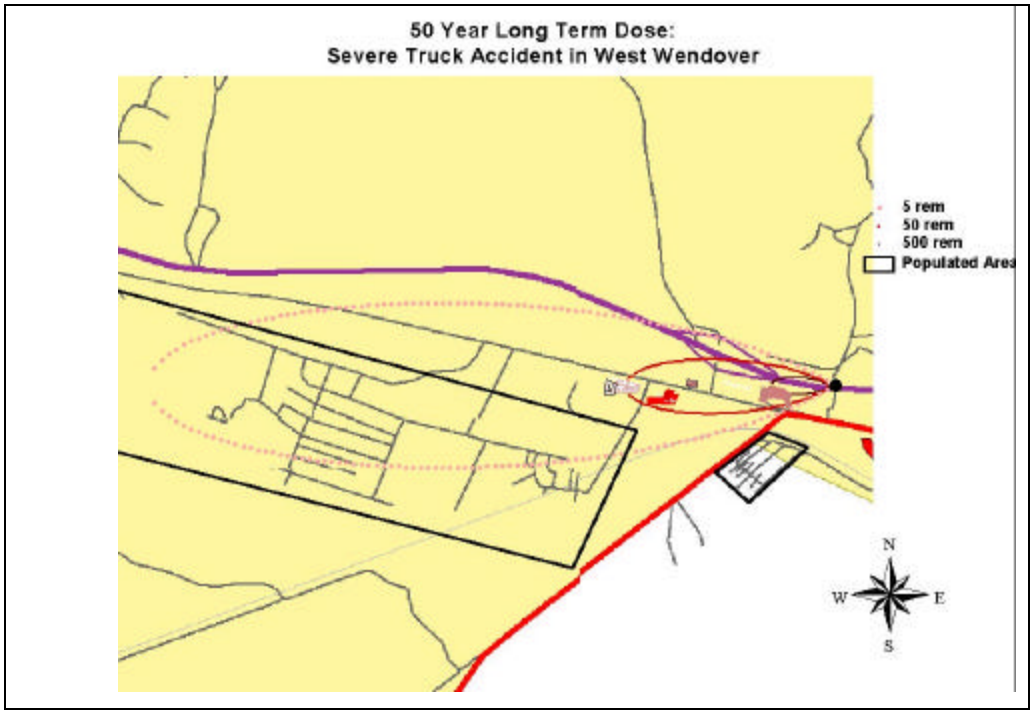


Figure 3.8.4 shows the plume and 24-hour dose for the hypothetical truck accident near West Wendover.

Figure 3.8.4 Dispersal Pattern for Hypothetical Truck Accident in W. Wendover



Following the truck accident, acute radiation doses due to inhalation of a passing radioactive cloud could exceed 100 rems close to the release location. This is several hundred times what a person receives from background radiation in a year. In Las Vegas, thousands of people are likely to be in the downwind path. Persons indoors would also be exposed. If ventilation systems were not shut off, radioactive particulates would settle within hotels and other buildings, contaminating rugs, furniture, beds, and causing a radiation dose to those inside.

Discussions with emergency personnel in Las Vegas and Clark County clearly indicate the accident would overwhelm local response capabilities. Before local emergency responders could accurately assess the problem, the radioactive plume would have already contaminated an extensive area. Radioactive particulates settling on roads and highways are likely to be spread by traffic, possibly contaminating distant locations and extending the area of contamination well past that assumed in this study. This may result in the contamination of many more people than were estimated in this report.

Given the high number of people exposed, local responders would not be able to identify, let alone effectively quarantine, contaminated people. Thus, it would be extremely difficult to stop the spread of contamination. Initial decontamination efforts

would probably be limited to emergency responders and people in the nearest proximity to the accidents. Decontamination of the affected population in general would be a massive effort.

Evacuation would be difficult at best. Spontaneous evacuation by people not in the contaminated area would probably occur in great numbers, making the targeted evacuations much more difficult to complete. At a minimum, the evacuation of highly contaminated areas would be necessary. In both Las Vegas and West Wendover, evacuation would be complicated by the need to close the segments of I-15 and I-80 contaminated by the plume.

In the case of an accident in Las Vegas, consideration would have to be given to closing McCarran airport in order to prevent the migration of contaminated persons. Alternately, all passengers would have to be screened for contamination. This would require a huge amount of resources that could be better utilized dealing with the major issues.

The incident would quickly overwhelm the capability of the local medical community. Blood and urine samples of contaminated people should be taken to track the levels of contamination and exposure, but this would be very difficult given the number of contaminated and potentially contaminated individuals. Mental health resources would be overwhelmed as well.

Unless radionuclides, particularly cesium, were removed from surfaces, remaining residents would be exposed for long time periods. Complete decontamination would be prohibitively expensive and would also expose workers; a balance would take place between clean-up costs and long-term radiation exposures. RWMA chose the EPA's Protective Action Guide as a criteria for decontamination; assuming that a person should not receive more than 5 rems over a 50-year period, including initial inhalation due to the passing cloud.

If areas are not decontaminated, RWMA estimated between 204 and 1,306 latent cancer fatalities would result from exposure to radiation resulting from the truck accident in Las Vegas, depending on the risk model. If radioactive contaminants were not remediated, there would be continuous direct gamma exposure to remaining residents and the potential stigmatization of the area. This would result in an extraordinary concomitant economic cost to the tourist industry, as discussed in Section 2.1 of this report.

Using the economic model of RADTRAN 5, evacuation and decontamination costs in Las Vegas were estimated to exceed $2 billion for the Category 5 accident evaluated by RWMA. The same costs for the Category 6 truck accident described in the DEIS could exceed $28 billion.

An accident in West Wendover on I-80 would also have serious consequences. RWMA did not separately calculate decontamination costs for West Wendover, but the

relative area requiring cleanup suggests costs of about $500 million. If areas were not decontaminated, between 194 and 1,243 latent cancer fatalities would result in West Wendover from exposure to radiation from the truck accident. I-80 is the main route into and out of West Wendover, as well as a major cross-country thoroughfare. An accident that spreads radioactive contamination could cut off the exit and either leave cars trapped or have vehicles spread the contamination for miles along the highway.

The RWMA study concludes that the consequences of an accident leading to the release of radioactive material from a truck cask would be disastrous and extremely costly. The tables below summarize the findings of the RWMA study. Table 3.8.10 presents a comparison of the Las Vegas truck accident with the urban 'maximum reasonably foreseeable' accident scenario listed in the DEIS. Table 3.8.11 presents a comparison of the West Wendover truck accident with the rural 'maximum reasonably foreseeable' accident scenario listed in the DEIS. The consequences estimated by RWMA are significantly higher than those estimated in the DEIS, primarily due to the assumption of a higher population density and an increased release fraction for cesium.

Table 3.8.10 Comparison of RWMA and DEIS Urban Truck Accident Consequence Assessments

	Urban Truck Accident			
	State of Nevada, Cat.5	State of Nevada, Cat.6	YM DEIS, Cat. 5	YM DEIS, Cat. 6
Acute (24-hour) Population Dose (person-rem)	846	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	0.42-2.7	Not calculated	Not calculated	Not calculated
1-year Population Dose (person-rem)	29,514	Not calculated	Not calculated	9,400
Expected Latent Cancer Fatalities	15-94	Not calculated	Not calculated	5
50-year Population Dose (person-rem)	407,024	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	204 - 1,306	Not calculated	Not calculated	Not calculated
Dose to Maximally Exposed Individual (rem)	3.9	38.5	Not calculated	4
Area contaminated to greater than 5 rem long-term dose (km^2)	11.1	192.2	Not calculated	Not calculated

Table 3.8.11 Comparison of RWMA and DEIS Rural Truck Accident Consequence Assessments

	Rural Truck Accident			
	State of Nevada, Cat.5	State of Nevada, Cat.6	YM DEIS, Cat. 5	YM DEIS, Cat. 6
Acute (24-hour) Population Dose (person-rem)	799	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	0.4-2.6	Not calculated	Not calculated	Not calculated
1-year Population Dose (person-rem)	27,886	Not calculated	Not calculated	430
Expected Latent Cancer Fatalities	14-89	Not calculated	Not calculated	0.2
50-year Population Dose (person-rem)	388,326	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	194-1,243	Not calculated	Not calculated	Not calculated
Dose to Maximally Exposed Individual (rem)	1.73	17.1	Not calculated	3.9
Area contaminated to greater than 5 rem long-term dose (km^2)	3.4	33.1	Not calculated	Not calculated

Impacts Of Terrorism Or Sabotage Against Truck Shipments

SNF/HLW truck shipping casks are especially vulnerable to terrorist attack and sabotage. DOE and NRC testing in the 1980s demonstrated that a high-energy explosive device (HED) such as a military demolition charge could breach the wall of a truck cask. DOE sponsored a 1999 study of cask sabotage by Sandia National Laboratories (SNL) in support of the DEIS. The SNL study demonstrated that HEDs are "capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment." [DEIS, p. 6-33] The SNL study also concluded that a successful attack on a truck cask would release more radioactive materials than an attack on a rail cask. [DEIS, p. 6-34]

Studies show that a successful terrorist attack on a truck cask in the Las Vegas urban area could result in as many as 165 latent cancer fatalities, with a maximum individual acute dose of 324 rem. Cleanup costs and other economic impacts could exceed $20 billion.

The DEIS estimated that a successful attack on a GA-4 truck cask in an urbanized area under average weather conditions would result in a population dose of 31,000 person-rem, causing about 15 cancer fatalities among those exposed to the release of radioactive materials. The maximally exposed individual would receive a dose of 67 rems. The DEIS did not evaluate any environmental impacts other than health effects. In particular, the DEIS ignored the economic impacts of a successful act of sabotage, which

have been dramatically demonstrated by the September 11th World Trade Center and Pentagon attacks.

An analysis prepared for Nevada by RWMA estimated sabotage impacts would be at least ten times greater than DOE's estimate. RWMA replicated the DEIS sabotage consequence analysis, using the RISKIND model for health effects and the RADTRAN model for economic impacts, the SNL study average and maximum inventory release fractions, and a range of population densities and weather conditions. Under average weather conditions, RWMA estimated that the same sabotage incident would result in 6-104 latent cancer fatalities, and a maximum individual acute dose of 196 rems. Under worst case weather conditions, there would be 14 - 165 latent cancer fatalities and a maximum individual acute dose of 324 rem. Cleanup costs and other economic impacts ranged from $3.1 - 13.5 billion (2000$) for average weather conditions, and $10.1 - 20.9 billion (2000$) for worst case weather conditions.

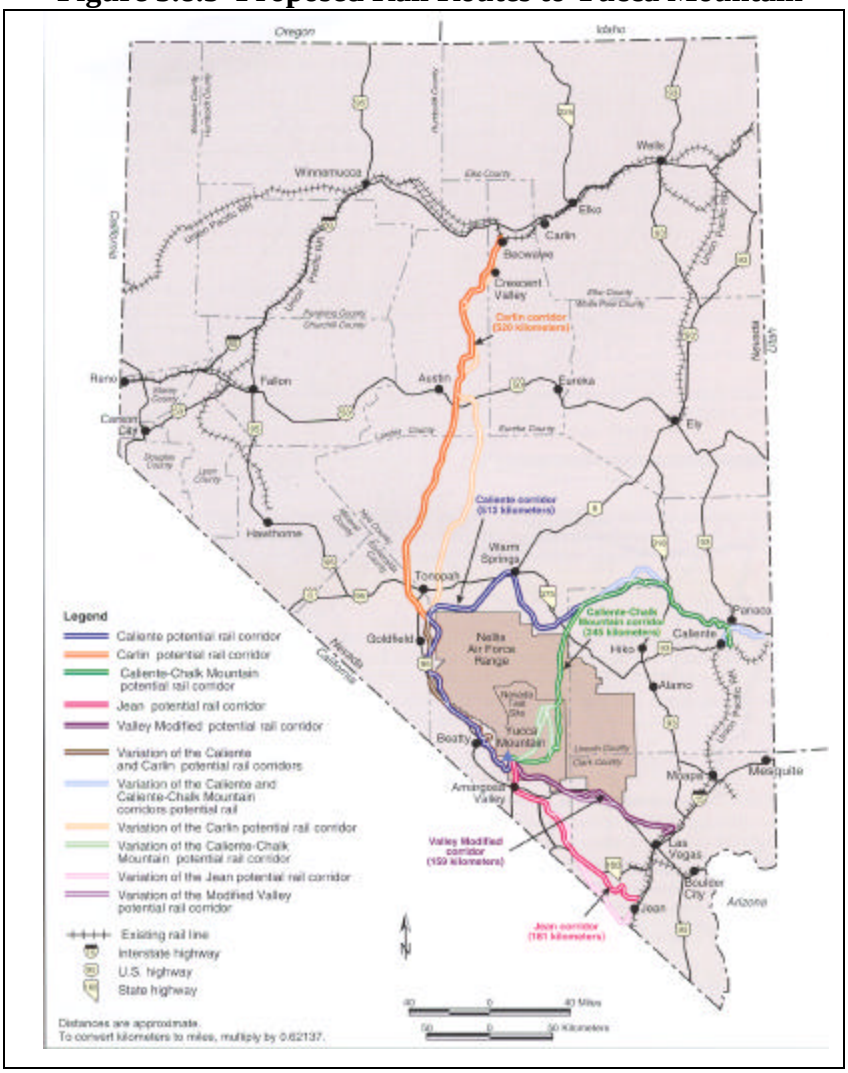
Other terrorism and sabotage scenarios could result in even more severe impacts. The Sandia study assumed that the reference weapon would not completely penetrate the cask. Full perforation would increase the release and resulting consequences by a factor of ten. The impacts would have also been substantially greater if the cask was assumed to be carrying 5-year-old SNF. (DOE assumed 26-year-old SNF.) DOE also failed to consider credible attack scenarios involving use of more than one penetrating weapon, use of an incendiary device in conjunction with a penetrating weapon, and use of commercial shaped charges that are more efficient metal penetrators than the M3A1 military demolition device evaluated by SNL.

The social and economic impacts of an attempted act of terrorism or sabotage, whether successful or unsuccessful, deserve special attention. An incident involving an intentional release of radioactive materials, especially in a heavily populated area, would cause widespread social disruption and substantial economic losses, even if there were no immediate human casualties and few projected latent cancer fatalities. Local impacts would be amplified by national and international media coverage. Adverse economic impacts would include the cost of emergency response, evacuation, decontamination and disposal; opportunity costs to affected individuals, property owners, and businesses; and economic losses resulting from public perceptions of risk and stigma effects.

Nevada Rail Impacts

Rail impacts in Nevada would be greatest under the DEIS mostly rail transportation scenario, involving 19,800 rail shipments of SNF, HLW, and miscellaneous radioactive wastes over 38 years. There would be about 520 rail shipments per year. Under the current capabilities scenario, there would be about 14,100 rail shipments, an average of 370 shipments per year. The lowest number of rail shipments, under DOE's mostly truck scenario, would be 300 shipments over 38 years, or about 8 shipments per year.

Figure 3.8.5 Proposed Rail Routes to Yucca Mountain



There is currently no railroad to Yucca Mountain. The DEIS identified five potential corridors for construction of a new rail access spur (see Figure 3.8.5). The DEIS also identified three locations for intermodal transfer stations (rail to heavy-haul truck). Four of the rail access spurs would originate from the Union Pacific (UP) mainline across southern Nevada. All of the intermodal transfer stations would use the same UP mainline. The Beowawe access corridor would originate from the UP mainline across northern Nevada.

This section of the report evaluates the impacts of SNF and HLW rail shipments on existing mainlines and on the proposed new rail access spur. The impacts of rail spur construction are addressed later in this section.

The DEIS assumes that SNF/HLW rail casks would be shipped in general freight service, although the railroads and many stakeholders believe that all SNF/HLW

shipments should be made by dedicated train. Indeed, many experts believe DOE would be forced to use dedicated trains. However, for purposes of evaluating a credible maximum impact scenario, this report assumes each rail cask would be shipped to Nevada separately by general service in a different train.

Radiological Impacts Of Routine Rail Shipments

The "mostly rail" national transportation scenario would result in lower overall radiological impacts of incident-free shipments. However, certain groups of workers and residents near rail stop locations would receive significant radiation exposures from routine rail operations. General aspects of background radiation levels and radiation health effects are discussed in the highway impacts section of this report.

This report assumes that rail shipments to Yucca Mountain would operate at the regulatory dose rate of 10 mrem/hour at 2 meters. This dose rate results in near-cask exposures of about 2.5 mrem per hour at 5 meters (16 feet) and 0.2 mrem per hour at 20 meters (66 feet). Exposures of this magnitude are of great concern to transportation workers and certain members of the public. This dose rate also results in measurable exposures (about 0.01 mrem per hour) at 25-30 meters (82-98 feet), and calculated exposures (0.000002 mrem per hour) at 800 meters (one-half mile) from the cask surface. Even these relatively small exposures can result in adverse health affects for some workers and some members of public. Moreover, the very fact that these exposures occur may cause adverse socioeconomic impacts, such as loss of property values, even though the dose levels are well below the established thresholds for cancer and other health effects.

Even without an accident, rail shipments of SNF and HLW would expose workers and members of the public to significant amounts of radiation. Rail safety inspectors could receive up to 6.3 rem (6,300 mrem) annually, with train crew members receiving annual doses in excess of 2 rems.

The regulatory dose rate, coupled with the number of rail shipments and the duration of rail stops, results in substantial exposures for some workers. A state safety inspector could, in theory, receives up to 6.3 rems (6,300 mrem) per year. Train crew members could receive annual doses exceeding 2 rems per year. A rail shipment escort following the cask car in a chase vehicle could receive an annual dose of 1.4 rem. Rail yard crew members would receive annual doses of about 180 mrem.

DOE calculates that these exposures over 24 years would increase lifetime cancer risk by 6 percent for the maximally exposed worker. Nevada studies estimate that cancer risks would be 50% higher than DOE estimates, and that other health risks ignored by DOE, such as risks to pregnant female workers, could be 7-10 time higher than cancer risks. NRC and DOE regulations currently restrict occupational exposures to 5 rems per year. The DEIS states that health risks should be further reduced by restricting worker exposures to 2 rem per year.

For repository transportation activities, NRC and DOE regulations restrict annual exposures to 100 mrem for members of the public. The DEIS estimates that a resident living 200 meters (660 feet) from a switchyard used by all shipments to Yucca Mountain would receive up to 310 mrem over 24 years, an average of 12.9 mrem per year. The DEIS estimates that a resident living 30 meters (100 feet) from a rail route used by all shipments to Yucca Mountain would receive up to 3 mrem over 24 years, an average of 0.125 mrem per year.

The DEIS made no effort to assess routine radiological impacts along specific Nevada rail routes where unique local conditions could result in doses much higher than DOE's generic approach. Again, the DEIS borrowed its maximally exposed resident along route examples from the 1995 DOE Programmatic EIS and Idaho National Engineering Laboratory FEIS [DOE/EIS-0203-F, p. I-52].

In preparation for this report, M.H. Chew and Associates (CAI) conducted a study to evaluate routine radiological impacts at maximum exposure locations along one of the existing Nevada rail routes that could be used for shipments to Yucca Mountain. From the DEIS, a rail shipping scenario and route that would maximize opportunities for routine exposures were selected, together with locations where exposures would be maximized by proximity to casks during planned and unplanned stoppages. The selected locations included parking lots and entrances to major commercial buildings (see Figure 3.8.6). While members of the public are frequently present at these locations, the CAI analysis estimated the maximum annual dose at a particular location without regard to the actual presence of an exposed individual or individuals at that location.

Figure 3.8.6 Clark County Government Center. The railroad crosses diagonally from the lower left-hand side of the picture and passes adjacent to the parking lot area.

The Union Pacific mainline through Las Vegas between Apex Siding on the north and Arden Siding on the south was selected for analysis. This rail segment is about 36 miles long. According to the 2000 Census, more than 39,000 people reside within one-half mile of the rail line. A number of large hotel-casinos are also located within one-half mile. When the resident population is combined with the school population, estimated average daily workers, and estimated hotel/casino guests, the average daily exposed population within one-half mile of the routes is currently about 86,000.

Table 3.8.12 Population Within 1/2-Mile of Union Pacific Railroad through Las Vegas

Route Segment Data	Union Pacific Mainline through Las Vegas
Shipments/year	457
Corridor Length (miles)	35.74
2000 Resident Population	39,291
Total Employment	83,976
Est. Avg. Daily Hotel/Casino Guests	18,032
School Population	597
Est. Avg. Daily Exposed Population	85,912

Source: Clark County Nuclear Waste Division

The heaviest routine rail transportation impacts on downtown Las Vegas would likely result from the Jean rail spur or Sloan/Jean intermodal transfer options. DOE's rail routing analysis for Jean indicates that about 87% of all rail shipments to Yucca Mountain would use the Union Pacific mainline through downtown Las Vegas. There would be 17,364 rail cask shipments through Las Vegas over 38 years, an average of 457 cask shipments per year. SNF/HLW rail casks would be shipped in general freight service.

There are a number of locations in downtown Las Vegas along the Union Pacific where entire trains and groups of freight cars are routinely stopped for varying periods of time. For the CAI analysis, NANP selected two such locations near large casino hotels and one location near a major government building.

The DEIS provides few details about expected rail operations, other than the decision that dedicated trains would not be required. Train stops occur for many reasons. Stops for carrier interchange or train assembly could require from 2 to 24 hours. Stops for crew changes, car changes, engine refueling, train maintenance, regulatory inspections, and traffic control could range from 15 minutes to more than 2 hours. In planning for receipt of casks shipped by general freight service, DOE has indicated its intention to

take advantage of USDOT regulations that allow stoppage of railcars carrying SNF/HLW for periods up to 48 hours (DEIS, p. 2-50).

CAI evaluated exposures under two rail-stop scenarios: (1) A one-time cask car stoppage at the designated location for 48 hours, the regulatory maximum; and (2) the cumulative annual exposure assuming that each cask shipment stops at the designated location one time for one-hour only (a total of 457 hours per year).

CAI calculated routine doses at the rail route locations selected by NANP using the code RISKIND 1.11. The cases of 48 hour and 457 hour stops were examined. Since RISKIND does not allow calculations for stop times greater than 100 hour, the 48 hour doses were multiplied by (457/48) to give the doses for the longer time. Since the doses are only reported to two significant figures, this may slightly degrade the accuracy of the results for the 457-hour doses due to round-off problems. Because the stop doses would be considerably larger than passing doses, the latter were not examined. The cask was assumed to be the large (21 PWR) MPC. Table G.4 in the RISKIND users manual gives a length of 5.29 meters and a radius of 1.086 meters. No gamma fraction was listed, so the value of 0.83 was taken. The loading is assumed to give a dose of 10 mrem/hr at a distance of 2 meters from the cask surface**.**

Table 3.8.13 reports the results obtained by CAI. The cumulative annual doses (457 hours) in the hotel parking lots ranged from 200 mrem (at 15 meters) to 36 mrem (at 35 meters). The cumulative annual doses (457 hours) at hotel-casino entrances ranged from about 28 mrem (at 40 meters) to about 1 mrem (at 160 meters). At the Government Center, the cumulative annual dose (457 hours) is 114 mrem in the parking lot (at 20 meters), about 50 mrem at the nearest entrance (at 30 meters), and about 3 mrem at another entrance (at 100 meters). The 48-hour doses ranged from 21 mrem (at 15 meters) to 0.1 mrem (at 160 meters).

Table 3.8.13. Estimated Doses at Locations Along Las Vegas Rail Route

Location	Distance from Cask (meters)	48 hour dose (mrem)	457 hour dose (mrem)
Hotel/Casino A, Loc #1	40	2.9	27.6
Hotel/Casino A, Loc #2	15	21	200
Hotel/Casino B, Loc #1	35	3.8	36.2
Hotel/Casino B, Loc #2	160	0.11	1.05
Govt. Center, Loc #1	20	12	114
Govt. Center, Loc #2	30	5.2	49.5
Govt. Center, Loc #3	100	0.36	3.43

Source: CAI, July 2001, Table 1.

Tens of thousands of Clark County residents and their real properties would be exposed to small additional radiation doses as a result of rail shipments to Yucca

Mountain. Moreover, these shipments could continue for a period of four decades or more.

While additional studies are needed, the preliminary estimates of annual doses on private properties along rail routes constitute a major finding. The rail shipments to Yucca Mountain would clearly create elevated radiation exposure zones on private properties along the route. Further analysis of socioeconomic impacts would consider the extent to which DOE's proposed action constitutes a taking of property rights.

Severe Rail Accidents

Each rail cask shipped to Yucca Mountain would carry four to six times as much highly radioactive material as a truck cask. DOE's representative large rail cask loaded with 26-year-cooled SNF would contain a total activity of about 2 million curies, including 810,000 curies of cesium-137. Casks are not designed to withstand all credible rail accidents. A severe rail accident resulting in a release of cask contents could have adverse health and economic impacts many times greater than a truck accident.

Each rail cask shipped to Yucca Mountain would carry four to six times as much highly radioactive material as a truck cask. A severe rail accident in urban Las Vegas would cause between 6,000 and 41,000 latent cancer fatalities, with clean up costs in the tens or even hundreds of billions of dollars.

The Yucca Mountain DEIS did not consider the potential consequences of a worst case truck accident in Nevada. The DEIS did evaluate what DOE considered to be a maximum reasonably foreseeable rail accident (category 6) at a generic urban location. DOE's rail accident would release and disperse enough radioactive materials to give 12,000 people a 5 rem dose and cause about 31 latent cancer fatalities. DOE estimated the probability of such an accident at 1.4 in 10 million per year. Less severe rail accidents (category 5), also resulting in releases, had estimated probabilities ranging from 4 in 100,000 to 7 in 10 million per year.

Previous studies sponsored by the State of Nevada concluded that the DEIS systematically underestimated the likely human health impacts of severe rail accidents. Moreover, the DEIS completely ignored the potential economic impacts of severe accidents. The cost of cleanup, evacuation, and business loss resulting from a severe accident in a generic urban area can range from several billion to several hundred billion dollars.

For this impact report, Radioactive Waste Management Associates (RWMA) conducted a study of credible worst case rail accidents at representative urban and rural locations along potential Nevada highway routes. Using the same Modal Study accident severity categories considered in the DEIS, RWMA evaluated Category 5 rather than Category 6 accidents. RWMA assumed that the accidents involved hotter SNF than the DEIS and used higher cesium gap inventory estimates. Current rail cask designs assume shipment of 10-year-cooled SNF. RWMA assumed that 5-year-cooled fuel, which has a

30 percent higher fission product inventory, represents a credible worst case accident source term. Table 3.8.14 compares the RWMA and DEIS accident scenarios.

Table 3.8.14 Comparison of RWMA and DEIS Accident Scenarios

Yucca Mountain DEIS	RWMA
"Maximum Reasonably Foreseeable" accident scenario based on probability	No estimate of probability
Risk and Consequence Assessments performed	Consequence Assessment only
Estimated consequences for severity Category 6 rail accidents in urban locations and a severity category 6 rail accident in a rural location	Estimated consequences for severity Category 5 and 6 rail accidents in urban and rural locations
26-year-cooled PWR fuel having a burnup of 39,560 MWD/MTU assumed	5-year-cooled PWR fuel having a burnup of 39,560 MWD/MTU assumed
0.3% of cesium inventory assumed in Fuel-Clad Gap	9.9% of cesium inventory assumed in Fuel-Clad gap
Meteorological conditions based on national averages	Site-specific meteorological averages used
CRUD inventory not explicitly modeled	Assumes that all CRUD is released to environment in the event of a rod failure
No discussion of economic impacts	Economic impacts, including cost of decontamination and evacuation, discussed

For each accident scenario, RWMA provided two separate consequence assessments: a Category 5 and Category 6 accident. The Category 6 accident scenario is considered by DOE to be the most severe accident that could credibly happen en route to the Yucca Mountain Repository. For the specific accident locations chosen in this study, RWMA concentrated on the Category 5 accident scenarios, after judging them to be the most credible severe accidents. Therefore, the accidents postulated in the RWMA report are not "worst-case" scenarios in the sense that one could not imagine a worse situation happening. Rather, they are severe, yet credible, accidents, with the understanding that they are meant to be representative of the types of severe accidents that could happen in different areas of Nevada and the country.

For the urban accident evaluation, a location was identified on the Union Pacific (UP) rail line between Flamingo Avenue and Spring Mountain Road in Las Vegas. Along this stretch, the UP goes underneath I-15 and at one point is approximately 20 feet from the parking lot of a hotel. Potential accident scenarios include derailment of a runaway train and/or collision with a train hauling explosive or flammable materials. There is a petroleum pipeline running alongside the railroad tracks at this point, creating the possibility for a severe thermal environment in the event of an accident. The same meteorological data used in the Las Vegas truck accident scenario was employed here.

A rural rail accident location was also identified on the Union Pacific line that runs near I-80 in Elko County at the entrance to the Carlin Tunnel. This accident location was chosen because it is upwind of farming areas, a major river, and the City of Elko. An accident at this location would also likely cause the closure of I-80. Hazardous

materials are routinely shipped along this route, including tanker shipments of propane to a terminal at Beowawe. In the event of a derailment involving cars containing flammable materials, the tunnel creates the possibility of a long-duration fire. Wind data were obtained from the Elko Airport in Elko, approximately 20 miles to the northeast of the proposed accident location.

Two computer programs, RISKIND and HotSpot, were used to develop contaminant plumes for the two rail accident scenarios. Both use standard Gaussian plume dispersion equations to estimate airborne concentrations and ground deposition of radionuclides. The spent nuclear fuel inventory obtained from RISKIND was used to develop the spent fuel inventory for use in both computer simulations.

RWMA assumed average, site-specific meteorological conditions and wind speeds. RWMA further assumed a severe impact would lead to a ground level puff release of radioactive particulates. The release estimates did not consider the accident scenario involving "fire-only" conditions, which would result in a more protracted release of material and a higher effective release height.

Figure 3.8.7 shows the plume and 24-hour dose for the hypothetical accident in Las Vegas.

Figure 3.8.7

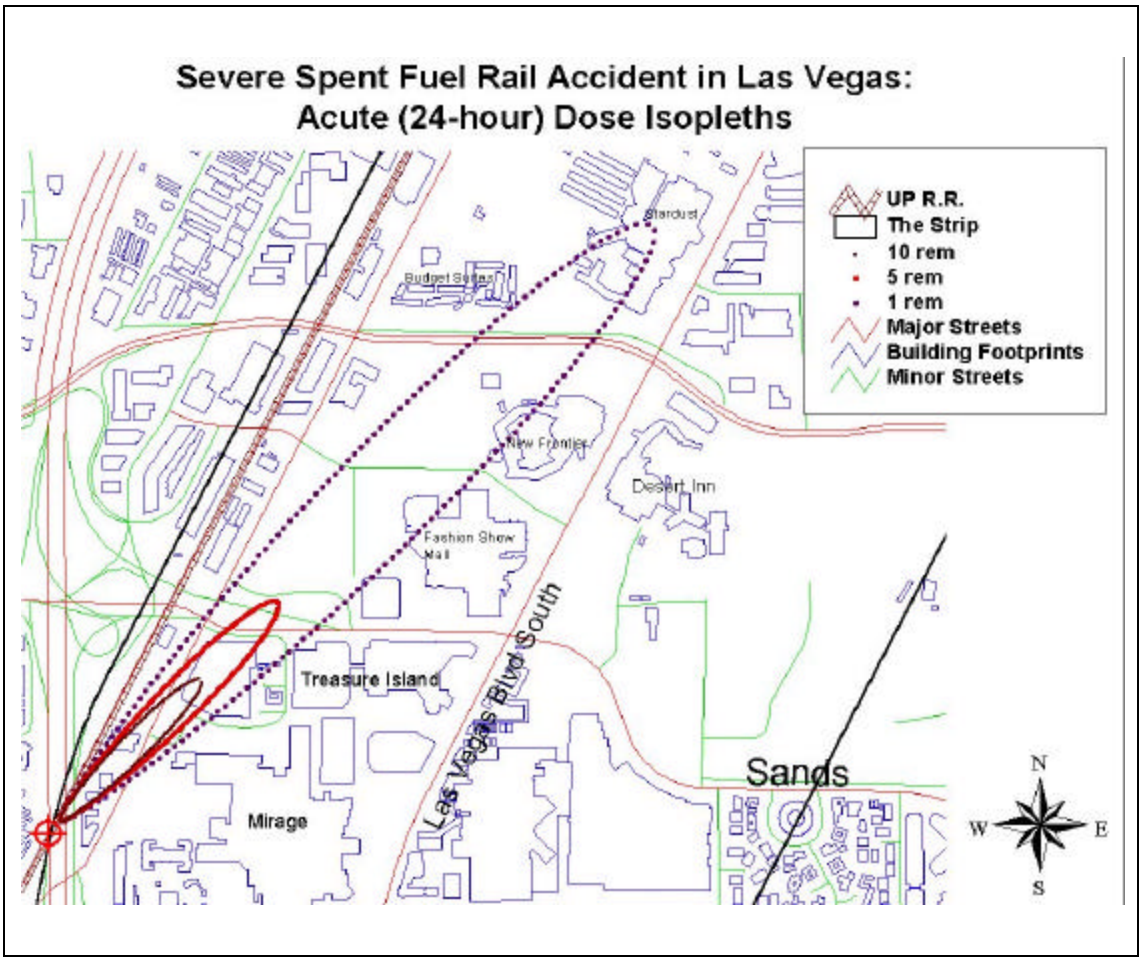

Severe Spent Fuel Rail Accident in Las Vegas:
Acute (24-hour) Dose Isopleths
UP R.R.
The Strip
10 rem
5 rem
1 rem
Major Streets
Building Footprints
Minor Streets
Stardust
Budget Suites
New Frontier
Desert Inn
Fashion Show Mall
Treasure Island
Las Vegas Blvd South
Sands
Mirage
N
W
E
S

Figure 3.8.8 shows the plumes and 50-year dose for the severe hypothetical rail accident in Las Vegas.

Figure 3.8.8

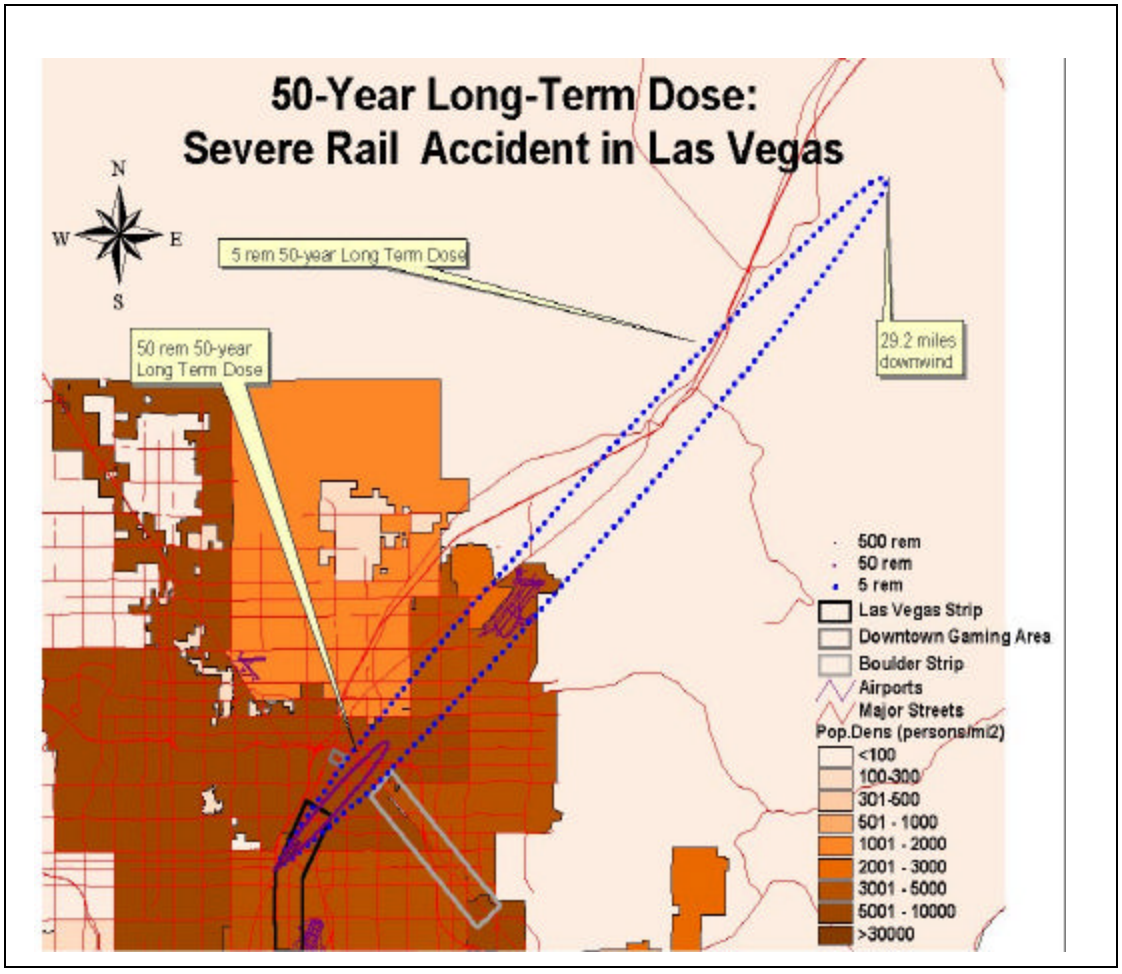


Figure 3.8.9 shows ground contamination near the Las Vegas Strip following the hypothetical rail accident in Las Vegas.

Figure 3.8.9

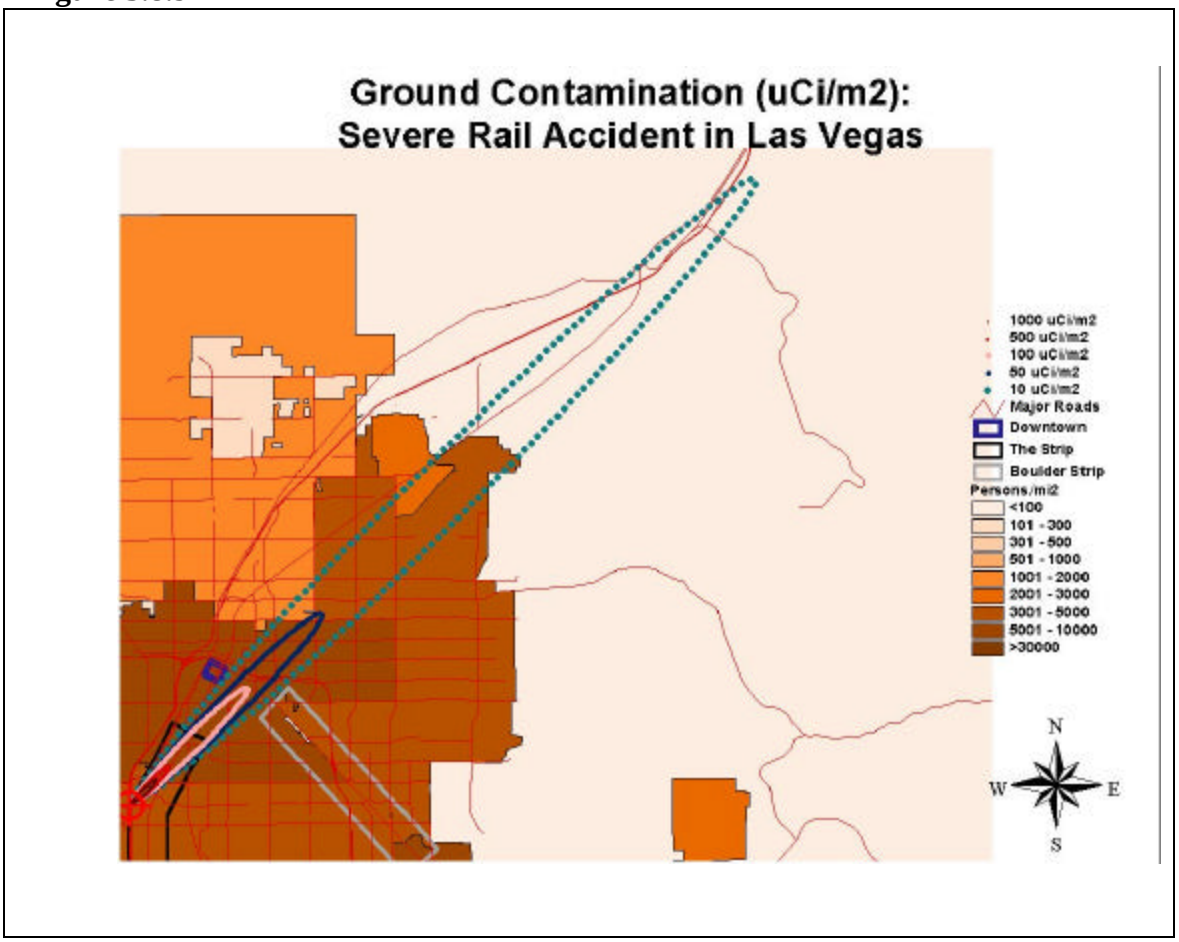


Figure 3.8.10 shows the plume and 24-hour dose for the hypothetical rail accident at the Carlin Tunnel in Elko County.

Figure 3.8.10

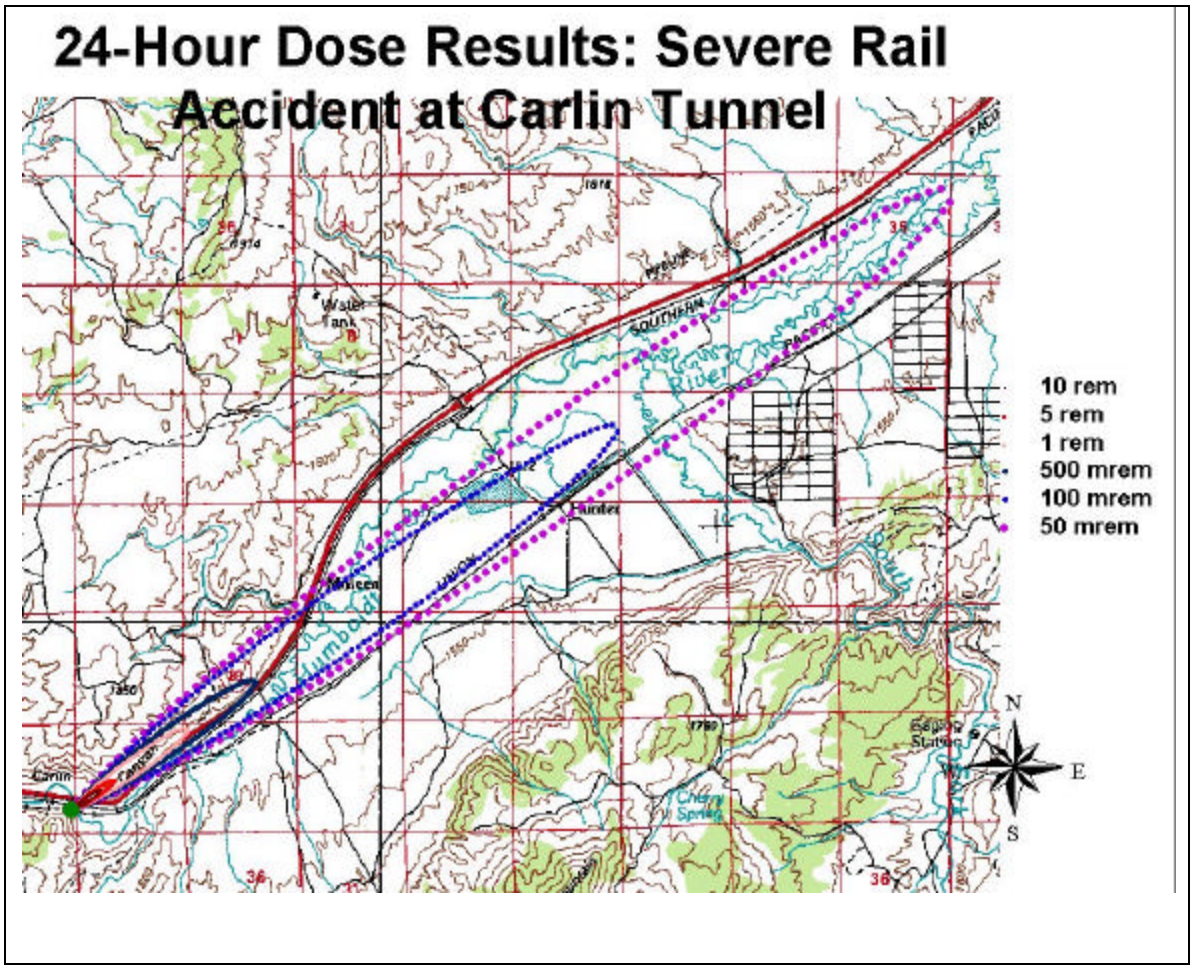
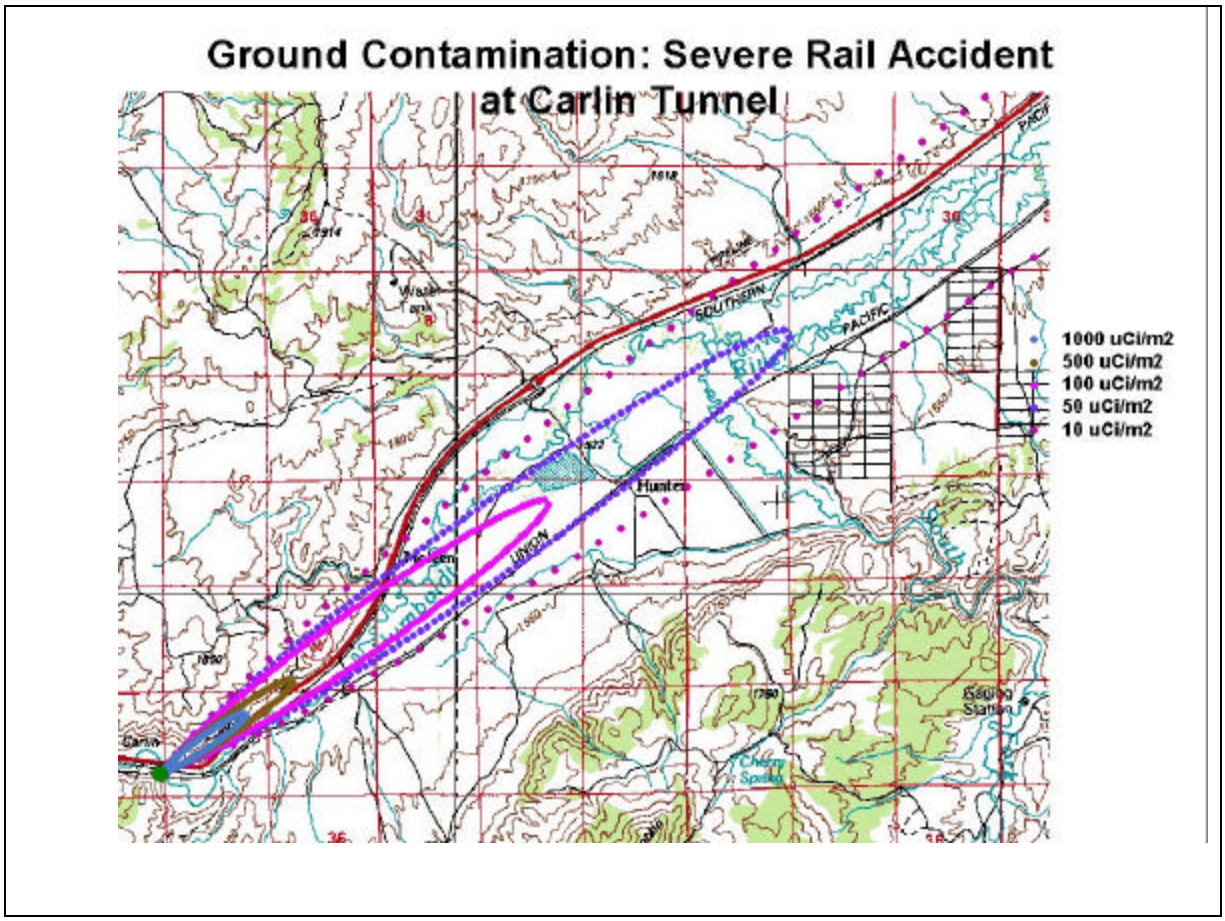


Figure 3.8.11 shows ground contamination following the hypothetical rail accident at the Carlin Tunnel in Elko County.

Figure 3.8.11



Following a rail accident at either location, acute radiation doses due to inhalation of a passing radioactive cloud would be in the hundreds of rems close to the release location. This is a thousand times what a person receives from background radiation in a year. Thousands of people are likely to be in the downwind path. RWMA estimated that over 138,000 persons would be affected by a severe rail accident releasing radioactive material in Las Vegas. Persons indoors would also be exposed. If ventilation systems were not shut off, radioactive particulates would settle within hotels and other buildings, contaminating rugs, furniture, beds, and causing a radiation dose to those inside.

Discussions with emergency personnel in Las Vegas and Clark County clearly indicate the accident would overwhelm local response capabilities. Before local emergency responders could accurately assess the problem, the radioactive plume would have already contaminated an extensive area. Radioactive particulates settling on roads

and highways are likely to be spread by traffic, possibly contaminating distant locations and extending the area of contamination past that assumed in this study. This may result in the contamination of many more people than was estimated in the report.

Given the high number of people exposed, local responders would not be able to identify, let alone effectively quarantine, contaminated people. Thus, it would be extremely difficult to stop the spread of contamination. Initial decontamination efforts would probably be limited to emergency responders and people in the closest vicinity of the accidents. Decontamination of the affected population in general would be a massive effort.

Evacuation would be difficult at best. Spontaneous evacuation by people not in the contaminated area would probably occur in great numbers, making the targeted evacuations much more difficult to complete. At a minimum, the evacuation of highly contaminated areas would be necessary. For a rail accident, evacuation would have to be in a radius greater than one kilometer; this would represent a large number of people if the accident took place near the Las Vegas Strip. In both Las Vegas and Elko, evacuation would be complicated by the need to close the segments of I-15 and I-80 contaminated by the plume.

In the case of an accident in Las Vegas, consideration would have to be given to closing McCarran airport in order to prevent the migration of contaminated persons. Alternately, all passengers would have to be screened for contamination. This would require a huge amount of resources that could be better utilized dealing with the major issues.

The incident would overwhelm the capability of the local medical community. Blood and urine samples of contaminated people should be taken to track the levels of contamination and exposure, but this would be very difficult given the number of contaminated and potentially contaminated individuals. Mental health resources would be overwhelmed as well.

Unless radionuclides, particularly cesium, were removed from surfaces, remaining residents would be exposed for long time periods. Complete decontamination would be prohibitively expensive and would also expose workers; a balance would take place between clean-up costs and long-term radiation exposures. RWMA chose the EPA's Protective Action Guide as the criteria for decontamination that assumed a person should not receive more than 5 rems over a 50-year period, including initial inhalation due to the passing cloud. If areas are not decontaminated, RWMA estimated between 6,000 and 41,000 latent cancer fatalities would result from exposure to radiation resulting from the accident in Las Vegas, depending on the risk model. If radioactive contaminants were not remediated, there would be continuous direct gamma exposure to remaining residents. Further, this would result in a tremendous concomitant economic cost to the tourist industry. Social stigma costs are beyond the scope of this report.

Using the economic model of RADTRAN 5, evacuation and decontamination in Las Vegas would cost $15.4 billion for the Category 5 accident evaluated by RWMA. The same costs for the Category 6 accident described in the DEIS would be $189.7 billion. These potential costs greatly exceed the amount of insurance coverage held by nuclear utilities or the Department of Energy. This raises the question of how such an expensive endeavor would be financed. Government financing of cleanup would require an act of Congress, which would significantly delay remedial action.

A rail accident near the Carlin tunnel in Elko County would also have serious consequences. RWMA did not separately calculate decontamination costs for the Elko County accident, but previous studies indicate cleanup could cost as much as $500 million to $1 billion. [Sandquist, et al., 1985] If areas were not decontaminated, between 100 and 600 latent cancer fatalities would result from exposure to radiation resulting from the rail accident.

I-80 is the main route across Northern Nevada, as well as a major cross-country thoroughfare. A rail accident that spread radioactive contamination could force closure of I-80 and either leave cars trapped or have vehicles spread the contamination miles down the highway. A rail accident near the Carlin tunnel, in a canyon adjacent to the Humboldt River, would result in contamination of the riverbed and water for miles downstream and lead to accumulations in slowly moving sections of the river. Use of the river for recreation or drinking water would be curtailed for years to come.

The RWMA study shows the potentially disastrous consequences of an accident leading to the release of radioactive material from a spent fuel transportation cask. It also underscores the importance of preparation of emergency response for such an accident. Acknowledgement of the potential for disaster, even if the probabilities are not high, is important in attempting to prepare for an unprecedented spent fuel transportation campaign.

The tables below summarize the findings of the RWMA study. Table 3.8.15 presents a comparison of the Las Vegas rail accidents with the urban 'maximum reasonably foreseeable' accident scenarios listed in the DEIS. Table 3.8.16 presents impact estimates for the Elko County accidents. DOE did not evaluate a rural 'maximum reasonably foreseeable' accident scenario in the DEIS. The consequences estimated by RWMA are significantly higher than those estimated in the DEIS, primarily due to the assumptions of a higher population density and an increased release fraction for cesium.

Table 3.8.15 Comparison of RWMA and DEIS Urban Rail Accident Consequence Assessments

	Urban Rail Accident			
	State of Nevada, Cat.5	State of Nevada, Cat.6	YM DEIS, Cat. 5	YM DEIS, Cat. 6
Acute (24-hour) Population Dose (person-rem)	26,171	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	13-444	Not calculated	Not calculated	Not calculated
1-year Population Dose (person-rem)	915,968	Not calculated	Not calculated	61,000
Expected Latent Cancer Fatalities	458-2,931	Not calculated	Not calculated	31
50-year Population Dose (person-rem)	12,771,207	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	6,386-40,868	Not calculated	Not calculated	Not calculated
Dose to Maximally Exposed Individual (rem)	22.5	224	Not calculated	26
Area contaminated to greater than 5 rem long-term dose (km^2)	104.7	1208.4	Not calculated	Not calculated

Table 3.8.16 Comparison of RWMA and DEIS Rural Rail Accident Consequence Assessments

	Rural Rail Accident			
	State of Nevada, Cat.5	State of Nevada, Cat.6	YM DEIS, Cat. 5	YM DEIS, Cat. 6
Acute (24-hour) Population Dose (person-rem)	393	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	0.2-1.3	Not calculated	Not calculated	Not calculated
1-year Population Dose (person-rem)	13,760	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	7-44	Not calculated	Not calculated	Not calculated
50-year Population Dose (person-rem)	191,859	Not calculated	Not calculated	Not calculated
Expected Latent Cancer Fatalities	96-614	Not calculated	Not calculated	Not calculated
Dose to Maximally Exposed Individual (rem)	26.9	267	Not calculated	Not calculated
Area contaminated to greater than 5 rem long-term dose (km^2)	118.6	1202	Not calculated	Not calculated

Impacts Of Terrorism Or Sabotage Against Rail Shipments

Rail shipping casks for SNF and HLW are vulnerable to terrorist attack and sabotage. DOE sponsored a 1999 study of cask sabotage by Sandia National Laboratories (SNL) in support of the DEIS. The SNL study demonstrated that HEDs are "capable of penetrating a cask's shield wall, leading to the dispersal of contaminants to the environment." [DEIS, p. 6-33] The SNL study also concluded that the radioactive release from a rail cask, following a successful attack, would be less than the release from a truck cask, even though the amount of SNF/HLW in a rail cask could be six times greater than in a truck cask. [DEIS, p. 6-34]

DOE estimated that a successful attack on a rail cask in an urban area would result in a population dose of 4,900 person-rem, 2.4 fatal cancers, and a maximum individual dose of 11 rems. The DEIS did not evaluate any environmental impacts other than health effects. In particular, the DEIS ignored the economic impacts of a successful act of sabotage.

An analysis prepared for Nevada by RWMA estimated rail cask sabotage impacts would be at least ten times greater than DOE's estimate. RWMA replicated the DEIS sabotage consequence analysis, using the RISKIND model for health effects and the RADTRAN model for economic impacts, the SNL study average and maximum inventory release fractions, and a range of population densities and weather conditions. Under average weather conditions, RWMA estimated that the same rail cask sabotage incident would result in 1-17 latent cancer fatalities, and a maximum individual acute dose of 34 rems. Under worst case weather conditions, there would be 2 - 27 latent cancer fatalities, and a maximum individual acute dose of 56 rem. Cleanup costs and other economic impacts ranged from $0.5-2.0 billion (2000$) for average weather conditions, and $2.2-6.7 billion (2000$) for worst case weather conditions.

As was the case with DOE's truck cask analysis, other rail cask terrorism and sabotage scenarios could result in even more severe impacts. The selection of the reference weapon is extremely important. Maximum damage to a large rail cask requires a weapon capable of penetrating layered shield walls containing 4-6 inches of stainless steel and 2 inches of depleted uranium. The Sandia study was constrained by the military definition of man-portability rather than the NRC's design basis threat in selecting the reference weapons used in the analysis. As a result, Sandia failed to consider larger, state-of-the-art anti-tank weapons such as the TOW and Milan missiles, which are designed to penetrate 24 to 38 inches of armor. Sandia also ignored the use of more than one penetrating weapon, use of an incendiary device in conjunction with a penetrating weapon, and use of commercial shaped charges. Assuming full perforation of a rail cask would increase both the DOE and RWMA release estimates, and the resulting health and economic consequences, by at least a factor of ten.

The impacts would have also been substantially greater if the rail cask was assumed to be carrying 10-year-old SNF. DOE assumed 26-year-old SNF. Assuming 10-

year-cooled SNF would result in a 30 - 40 percent increase in the release of cesium-137, a particularly important radionuclide in determining acute radiation doses.

As with the truck cask analysis, the social and economic impacts of an attempted act of terrorism or sabotage, whether successful or unsuccessful, deserve special attention. An incident involving an intentional release of radioactive materials, especially in a heavily populated area, could cause widespread social disruption and substantial economic losses, even if there were no immediate human casualties and few projected latent cancer fatalities. Local fears and anxieties would be amplified by national and international media coverage. Adverse economic impacts would include the cost of emergency response, evacuation, decontamination and disposal; opportunity costs to affected individuals, property owners, and businesses; and economic losses resulting from public perceptions of risk and stigma effects.

Rail Spur Construction and Operation Impacts

Operation of the Rail Line

The impacts of the construction and operation of the proposed rail corridor may be greatly influenced by design and operating criteria. DOE has used a wide range of assumptions that make it difficult to accurately identify the impacts.

Use of general freight would result in significant delays during shipping, will require shipments to pass through many rail yards that could be avoided, and will probably result in shipments being switched in the UP rail yard near Las Vegas. These actions increase potential exposure to workers and the general population and increase the probability of accidents in yards in general and during switching activities.

Impacts Outside of Identified Corridors

DOE's impact assessment was limited to assessing impacts within a set distance of the identified corridor. Railroad yards, borrow areas, areas for disposal of surplus fill, staging areas, construction camps, lay down areas, access roads to construction initiation points, and other construction activities will result in impacts outside of the identified corridors.

Support Facilities

Support facilities, such as interchange tracks, turning tracks, and maintenance facilities, will be required at the interchange points where the cars loaded with radioactive waste will be transferred from the Union Pacific to the new rail line.

These facilities will require a significant area at the connection point. The exact size and location has not been specified.

Borrow and Fill Areas

Significant quantities of cut and fill material will be required for roadbed construction. In many areas, the amount of cut and fill will not balance within reasonable hauling distances, requiring disturbance of up to 2,400 additional acres for borrow and fill areas outside of the corridor. Construction of the railroad in any of the proposed rail corridors will require up to 1,736,000 cubic yards of sub-ballast.

Land Use

DOE's corridor selection study is flawed. The first selection criteria used by DOE to select potential routes was land use compatibility based on using public land to minimize land-use conflicts. Most of the private land in the West has gentle topography. By using land ownership for the first selection criteria, DOE's selection process actually favored more rugged terrain where construction of the proposed rail line will be more difficult. This creates many additional land use impacts due to the extensive cuts and fills required by unfavorable topography.

Land ownership does not accurately reflect land use. Most western ranching operations are based on a combination of privately owned fee land and grazing leases on publicly owned lands. Splitting an existing operation with a rail line that will limit access to the leased land can have significant adverse effects on the operation of the ranch. If the rail line right-of-way is fenced, the splitting of ranching operations will be perhaps the most significant impact to the residents of Nevada.

Barrier to Movement

The rail line will bisect many local roads. Grade-separated crossings will be limited to major roads. Only a few of the at-grade crossings will be signaled. For example, there are 123 crossings on the Caliente route. Two are grade-separated, one is a signaled at-grade crossing, and 120 are at-grade non-signaled crossings.

Ranching operations will be the most affected by the barrier to movement created by the proposed rail lines. Box culverts and bridges are commonly used to provide underpasses under railroad tracks for the movement of livestock and equipment. Underpasses will be limited to locations where underpasses can be constructed based on the topography and the profile of the proposed rail line. The degree of impact is a combination of the proposed at-road crossings (either at-grade or grade-separated) and proposed drainage structures. For the Caliente/Carlin route, the average distance between potential crossing locations is 19.2 miles. The longest distance is 39 miles. The distances between crossings are similar for other routes.

Land Use Constraints

There are a number of land use conflicts with the proposed rail line. It is particularly difficult to understand why DOE has not eliminated the Caliente-Chalk Mountain alternative. The U.S. Air Force has unequivocally stated that this alternative is unacceptable due to its impacts on the Nellis Air Force Range.

Many of the areas crossed by potential rail corridors are currently remote, undeveloped areas. Much of the area is currently roadless, including Wilderness Study Areas.

The land-use impacts associated with the development of ballast and sub-ballast quarries, solid waste disposal facilities, construction lay-down areas, and construction staging areas cannot be assessed until these areas are identified.

From a land-use perspective, the only rail alternative that does not have serious land-use conflicts is the Caliente corridor. Even this corridor could impact the Nellis Air Force Range. All other rail alternatives cross or impact areas designated as special purpose land-use, including Bates Mountain Antelope Release Area, Simpson Park Habitat Management Area, Old Spanish Trail/Mormon Road Special Recreation Management Area, Stateline Wilderness Area, the Desert National Wildlife Range, Quail Spring WSA, Nellis AFB small arms range, and Indian Springs Auxiliary Field facilities.

Land Ownership

Although the percentage of private land crossed is low overall, most of this land is concentrated in a few areas, primarily flat land along streams and rivers. Ranch homesteads, hay fields, and other primary components of a ranching operation are usually located in these areas.

Community Growth Areas

Proposed rail line corridors also cross areas of potential future community growth for North Las Vegas and Las Vegas. Both cities have proposed land transfers from the Bureau of Land Management in the area for future community development. Other community growth areas include Pahrump in Nye County and Beowawe and Crescent Valley in Eureka County.

Solid Waste

Significant volumes of solid waste will be generated by rail line construction in comparison to the capacity of waste disposal facilities in rural Nevada. Given the remote, sparsely populated areas crossed by the proposed rail line, solid waste disposal facilities probably do not have sufficient capacity to handle waste generated during rail construction. Commonly, construction waste is not compatible with the waste handling facilities at existing sites.

Water Resources

Some of the rail corridors are known to cross or be near significant springs, groups of springs, streams designated as riparian areas, or reservoirs associated with wetlands. Wetlands and riparian areas are a valuable resource in Nevada. Most of the rail corridors cross rugged terrain where significant cuts will be required. These cuts could intercept groundwater flow.

Biological Resources

The rail corridors pass through or adjacent to many significant biological resource areas, including critical habitat and migration corridors. The construction and operation of the rail line would reduce the value of these areas, resulting in significantly greater losses in resources than just the area physically within the rail line right-of-way.

Critical habitat is absolutely necessary for wildlife. Human activity, such as the operation of a rail line, in or even near critical habitat can seriously degrade the value of that habitat for wildlife. This is especially true of linear facilities, such as a rail line, that pass through habitat areas. Without undisturbed access to critical habitat, the wildlife using that habitat may abandon large areas. Critical habitat crossed by or near to rail corridors includes bighorn sheep crucial winter range, mule deer crucial winter range, pronghorn winter range, sage grouse strutting areas, sage grouse nesting areas, chuckar crucial habitat, and quail crucial habitat. Corridors also cross migration corridors for big game. Linear facilities such as rail lines can significantly impact the movement of big game, particularly in areas where steep cuts or fills are required.

The Valley Modified corridor crosses the Desert National Wildlife Refuge (DNWR) in several places. The DNWR, set aside primarily for desert bighorn sheep, provides habitat for mule deer, other desert mammals, and migratory birds. The Corn Creek area contains an environment filled with trees, pasture, and spring-fed ponds that attract a large number of migrating birds not common to the desert environment. The ponds are home to the endangered Pahrump poolfish.

Depending on the types and locations of fencing, the proposed rail line could create significant impacts to wildlife, particularly where the proposed corridors cross critical habitat areas.

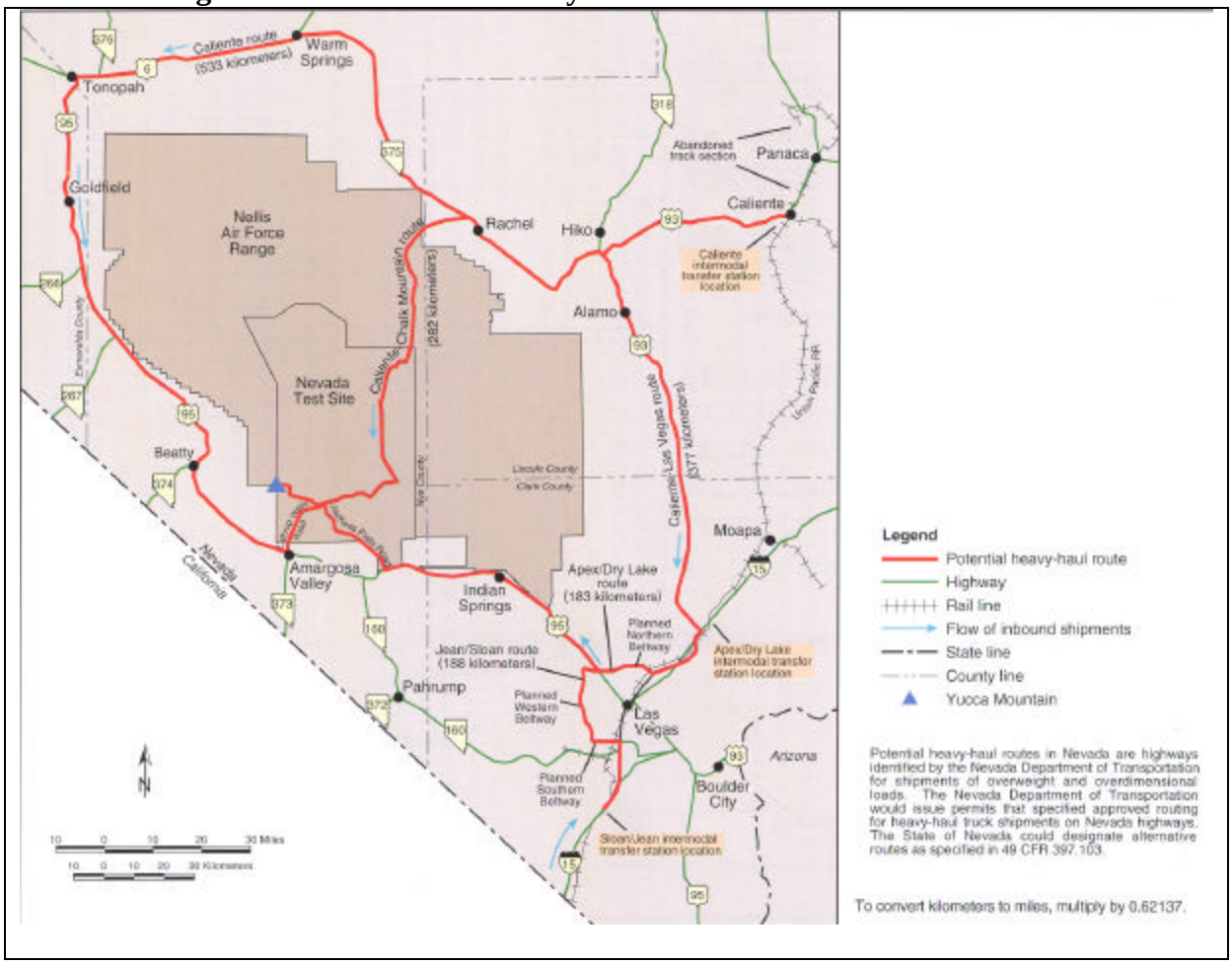
Soils

The proposed rail corridors pass through many areas where soil types will make reclamation difficult. Several of the corridors pass through playa deposits that consist of finer grained sediments and alkali flats. These soil types are generally more difficult to re-vegetate following disturbance. Re-vegetation will also be difficult due to the arid climate. Construction of the rail line will result in loss of soils through wind erosion, with some degradation of air quality as a result.

Heavy-Haul Truck Impacts In Nevada

The U.S. Department of Energy is considering using heavy-haul trucks on existing highways as one option for delivering spent fuel and high-level nuclear waste to the proposed repository at Yucca Mountain. Under this option, nuclear waste casks would be delivered to Nevada primarily by rail. At an intermodal transfer station, the casks would be unloaded from the rail cars and transferred to heavy-haul tractor-trailers. Under this option, there would be no rail access provided to Yucca Mountain.

Figure 3.8.12 Potential Heavy-Haul Routes to Yucca Mountain



DOE has proposed three possible locations for the intermodal transfer station. These are Caliente, located in Lincoln County; Apex/Dry Lake, located north of Las Vegas; and Sloan/Jean, located south of Las Vegas. Five possible routes along existing highways are being considered from these intermodal transfer station sites to Yucca Mountain, as described below.

Caliente: From the intermodal transfer station at Caliente, shipments would follow U.S. 93 to State Route (SR) 375, SR 375 to Warm Springs, U.S. 6 to Tonopah,

U.S. 95 to the Lathrop Wells road to Yucca Mountain. The total length of this route is 331 miles. Travel time would be 10 hours at 35 mph.

Caliente/Chalk Mountain: From the intermodal transfer station at Caliente, the shipments would follow U.S. 93 to SR 375 near Rachel, then through Nellis Air Force Base to Yucca Mountain. The total length of this route is 175 miles.

Caliente/Las Vegas: From the intermodal transfer station at Caliente, the shipments would follow U.S. 93 to I-15, I-15 to the proposed North Las Vegas Beltway, the proposed Beltway to U.S. 95, and U.S. 95 to Yucca Mountain. The total length of this route is 234 miles.

Apex/Dry Lake: From the intermodal transfer station at Apex/Dry Lake, the shipments would follow I-15 to the proposed North Las Vegas Beltway, the proposed Beltway to U.S. 95, and U.S. 95 to Yucca Mountain. The total length of this route is 114 miles.

Sloan/Jean: From the intermodal transfer station at Sloan/Jean, the shipments would follow I-15 to the proposed Southern Las Vegas Beltway, the proposed Beltway to U.S. 95, and U.S. 95 to Yucca Mountain. The total length of this route is 117 miles. (DOE, p. 2-54)

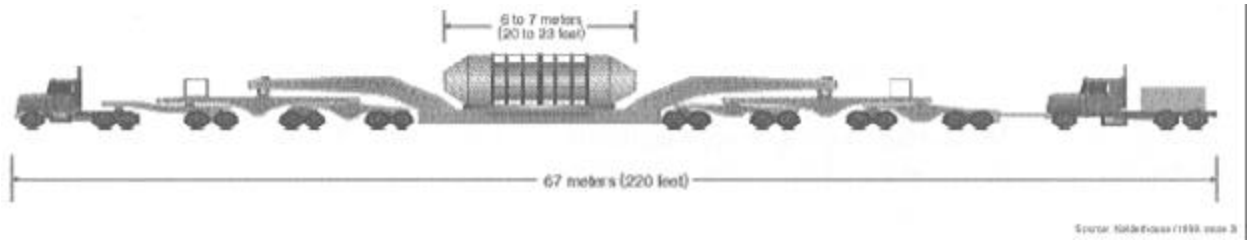


Figure 3.8.13 Heavy Haul Rig for Use With Yucca Mountain Shipments

The tractor-trailer rig used for these shipments would be a custom rig built specifically for this project. The custom built trailer is required because the proposed spent fuel casks create a more concentrated load than used on existing heavy-haul trailers. The tractor-trailer would be designed for maximum axle loads of 20,000 pounds for single axles and 34,000 pounds for tandem axles. For the proposed 125-ton spent fuel casks, the trailer would be 148 feet long. With tractors, the vehicle would be 220 feet long, with an unloaded weight of the vehicle of 200,000 pounds. According to DOE, the unit would operate at an average speed of 20 to 30 mph.

There would be a total of 19,800 shipments over 38 years, with an average of 521 shipments per year. Shipments would be allowed only during daylight hours, Monday through Friday.

Uncertain Feasibility Of Heavy-Haul Transport In Nevada

The use of heavy-haul trucks on Nevada highways requires that DOE obtain overweight truck permits for each truck from the Nevada Department of Transportation. The issuance of an overweight permit is dependant on the determination that the load is a non-divisible load. A regulatory analysis prepared for NANP concluded that DOE would have great difficulty meeting the Federal Highway Administration definition (23 CFR 658) of non-divisible load. Because the transport vehicle would be 220 feet in length, an oversize vehicle permit would also be required.

Since the use of rail casks is clearly optional and the waste could be shipped in legal-weight casks, DOE's proposed use of rail casks transported on overweight and oversize vehicles clearly does not meet the definition of non-divisible load and does not qualify for an overweight and oversize permit. The State of Nevada would therefore not be required to issue the permits needed to make HHT a feasible option in Nevada.

Heavy-haul of the magnitude and duration on State highways proposed by DOE has little precedent, raising questions concerning the feasibility of the operation. There is little, if any information regarding the performance over time of bridges, structures, culverts, and pavement subjected to heavy loads of this magnitude and frequency. Specific obstacles to DOE's proposed HHT plan of operations include day-of-week and time-of-day travel restrictions, frost restrictions, bridge weight restrictions, route closure during resurfacing operations, limited safe parking areas, and limited turning areas large enough for HHTs to turn around.

Southern Nevada experiences extreme heat during summer months. The heavy-haul trucks could cause severe rutting of asphalt surfaces during times of excessive heat. In areas that experience winter snowfall, snowmelt could create saturated roadbed conditions, resulting in pavement damage from heavy-haul trucks. The feasibility of some heavy-haul route options depends on upgrades required to remove frost restrictions on some road segments. There is also inadequate information to demonstrate that the heavy-haul trucks would not significantly reduce the expected life of pavement surfaces.

All of the proposed HHT routes through Clark County involve severe traffic and safety impacts. The extreme length of the heavy-haul vehicle and its slow speed would result in a significant impact to traffic flow on all the highways considered.

DOE believes that this problem could be reduced once the planned Las Vegas Beltway is completed. This very well might not be the case. Studies have demonstrated that in growing urban areas, growth takes place along transportation corridors, negating any improvement in traffic flow from route improvements. This was recently demonstrated for the Denver urban area where studies of an extensive improvement planned for the highways in that area predicted insignificant changes in traffic flow.

DOE's plan to construct climbing lanes only where grades exceed four percent and turnout lanes every 5 to 20 miles, depending on traffic volumes, is inadequate. The

average speed of the transport vehicle is 30 mph. At a length of 220 feet, with two escort vehicles and two Highway Patrol escorts, the "convoy" would be over 400 feet in length. If another vehicle attempts to pass the convoy at an average speed of 45 mph, it would take over a quarter of a mile to pass the convoy. Safe passing by triple-trailers (115 feet in length) would require a one-mile passing lane every five miles.

Radiation Exposures From Heavy-Haul Transport

In preparation for this report, CAI studied the potential routine radiological impacts along routes that could be used for HHT transportation of SNF and HLW to Yucca Mountain. An HHT shipping scenario and route that would maximize opportunities for routine exposures were selected from the DEIS, and locations in Nevada where exposures would be maximized by proximity to casks during required transport vehicle stops and/or travel at slow speeds were identified. The selected locations include sidewalks and road shoulders near residential and commercial buildings, and pedestrian crosswalks. While members of the public are frequently present at these locations, the CAI analysis estimated the maximum annual dose at a particular location without regard to the actual presence of an exposed individual or individuals at that location.

NANP selected for analysis a segment of US 95 through Goldfield that could be used for shipments from an intermodal transfer facility in Caliente to Yucca Mountain. Under DOE's mostly rail scenario, over 38 years, an average of 521 HHTs and 96 LWTs per year could traverse Goldfield on US 95. HHTs would likely operate at substantially slower speeds than LWTs, about 10-15 mph in towns. The restricted hours of operation could increase the number of shipments required to stop for pedestrians in cross walks. The size and weight of the HHT would increase stop and restart times.

CAI calculated cumulative annual doses at the HHT route locations selected by NANP using the code RISKIND 1.11, supplemented with analytical modeling. Total doses for the HHT scenario represent the sum of the doses for 521 HHT shipment and 96 LWT shipments per year.

CAI found that a location near a pedestrian crosswalk requiring brief stops (30 seconds) received an annual dose of 30 mrem (at 3.4 meters). Near-route locations (at 3.4 meters from the cask) where trucks slowed down, but did not stop, received annual exposures ranging from 3.4 mrem to 5.8 mrem. The estimated annual doses for each location are shown in Table 3.8.17.

Table 3.8.17 Estimated Annual Doses at Locations Along HHT Route to Yucca Mountain

Location	Distance from Cask (meters)	Stop Time (seconds)	Travel Speed (miles/hour)	Annual Dose (millirem)
Goldfield #1	3.4	0	10 - 15	3.4
Goldfield #2	3.4	30	10 - 15	30.0
Goldfield #3	3.4	0	5 - 6	5.8

Considering the lack of precedents for large-scale HHT operations, the analyses prepared for this report may have underestimated routine doses by a factor of 2 or 3. The State is currently evaluating alternative methods of more precisely estimating maximum routine doses along HHT routes and the resulting health effects.

While additional studies are needed, the preliminary estimates of annual doses on private properties along the HHT constitute a major finding. HHT shipments to Yucca Mountain would clearly create elevated radiation exposure zones on private properties along the route. Further analysis of socioeconomic impacts would consider the extent to which DOE's proposed action constitutes a taking of property rights.

CHAPTER FOUR
IMPACTS TO LOCAL GOVERNMENTS AND NATIVE AMERICAN COMMUNITIES

4.1 Local Government Impacts

Local governments and communities throughout Nevada stand to be impacted in significant ways by the Yucca Mountain project and activities associated with the transportation of high-level radioactive waste to the facility. The many uncertainties surrounding DOE's implementation of the program and the failure to identify shipping routes and modes make impact assessment especially problematic for local governments and tribes. For the purpose of this report, it is assumed that waste shipments to Yucca Mountain would use some combination of highway and rail transport, including intermodal/heavy-haul shipments.

At least 13 Nevada counties will be adversely affected by repository construction and operations or by the transportation of SNF and HLW to the facility. The only local jurisdiction to be affected both by the repository itself and the transportation of spent fuel and high-level waste is the situs jurisdiction, Nye County. However, due to the characteristics of the State's highway and rail infrastructure and the unique nature of Nevada's economy, the largest impacts from the repository and related waste shipments are expected in Clark County and the metropolitan Las Vegas area (which includes the incorporated cities of Las Vegas, North Las Vegas, Henderson, Mesquite, and Boulder City). Other Nevada counties would be impacted in different ways as a result of the unprecedented high-level waste shipping campaign associated with the project.

Nine Nevada counties and Inyo County, California have been designated as "affective units of local government" (AULG) under the provisions of the Nuclear Waste Policy Act, as amended. In addition to the site county, the 1897 amendments to the Act authorized the Secretary of Energy to formally designate a unit of general government, such as a county or city, as "affected" if it is contiguous with the site county. After several counties initiated legal action the late 1980s, the Secretary of Energy belatedly bestowed "affected" status on each of the counties that share a common border with Nye County.

Detailed information on AULG-specific impacts is contained in the local government appendices to this report. A summary of impacts by affected county is presented in Table 4.1.1, below.

Table 4.1.1 Local Government Impacts

Topic\County	1. Nye County	2. Clark County	3. Lincoln Co.
Report	Nye County, NV: Community Protection Plan (Aug. 2001, 46 pgs)	Draft Impact Assessment Report: An Analysis of Potential Impacts to Clark County Resulting from Site Selection, Construction, and Operation of a High-Level Nuclear Waste Repository at Yucca Mtn. (Dec. 2001, 74 pgs)	In Search of Equity: A Preliminary Assessment of the Impacts of Developing and Operating the Yucca Mountain Repository on Lincoln County and the City of Caliente, Nevada (Dec. 2001, 90 pgs)
Project Description	All aspects of the YMP: Transportation, regardless of mode-route choice. Above ground waste handling & lag storage. YMP constr, emplacement, monitor & retrieval. YMP performance: pre-& post-closure.	Mainly Transportation: DOE doesn't build rail. NV doesn't designate alternate hwy routes. Legal-wt truck shipments on interstate system, using I-15 or Beltway route. Transp. Scenarios: 1. No accident, adverse publicity. 2. Accident, no release. 3. Accident, with release.	Mainly Transportation: Transp. Scenarios: 1. DOE builds, operates Chalk Mtn or Caliente rail spur. 2. DOE builds IMF in Caliente; heavy-haul west on US-93 & NV-375 to Yucca Mtn. 3. NV designates hwy routes for LWT shipm: US-93 &/or NV-319.
Local Vulnerabilities	Amargosa Valley groundwater: the major exposure path. Towns astride possible 2-lane transp. routes. Dominant federal land presence: 98%. Traditional DOE mgt. practices in NV. NV political structure.	LVV econ. growth depends on intricate factors. In visitor-gaming industry, perception is reality, & high fixed costs. Calif. visitors, vulnerable to I-15 congestion, disruption. Beltway Route: major role in future growth.	The legacy of nuclear testing. Weak local economy, dependent on tourism, retirees & government. Air quality class makes industry permit easier. Most Caliente residents, business w/in 1/2 mile. Hwy routes not suitable. ER providers ill-equipped; help 3-4 hours away.
YMP Impacts	Impacts Identified: Transportation risk on 317 miles of county roads. Uncertain empowerment of elected site co. gov. DOE implementation vigilance, mgt. practices. Equity: transfer to a single county, already used for weapons testing.	Impacts Assessed: Possible stigma effects on visitation, migration, investments. Property value reduction: $236-$463 million No accident rad dose: 28-200 mrem @ casino site. Transp. accident cost: $103 mil, $31 mil unreimbursed. Public safety impacts: $360 million Non-Public safety impacts: $121 million.	Impact Scenarios: LWT/gas tanker collision. Rail collision; casks fail. Volcanic eruption at YM. Impacts Described: Physiographic Radiation Exposure Sociocultural Community cohesion Public infra. & services Local gov. finance Land Use Transp accident risk Public perception, stigma

Topic\County	4. White Pine County	5. Eureka County	6. Lander County
Report	DOE Yucca Mountain Repository Program: Preliminary Impact Report for White Pine County, NV (Dec. 2001, 75 pgs)	Impact Assessment Report on Proposed Shipments of Spent Nuclear Fuel and High-Level Radioactive Waste through Eureka County (Aug. 2001, 86 pgs)	Lander County Impact Report (Aug. 2001, 58 pgs)
Project Description	Mainly Transportation: DOE doesn't build rail. NV designates hwy routes for LWT shipment: US-93 to Ely, US-6 to Nye County. 55,000+ LWT shipments projected.	Mainly Transportation: DOE builds Carlin rail spur: 18 miles & terminal facility in Eureka Co./Beowawe. Possible occasional LWT shipment on I-80, US-50.	Mainly Transportation: DOE builds Carlin rail spur from Crescent Valley south to US-50 & Smoky Valley. I-80 could be used for LWT shipment to Skull Valley Interim Storage Facility.
Local Vulnerabilities	Hwy routes 2-lane, no facilities, winter weather. 50% resident pop w/in .5 miles of route. Motels, schools etc. w/in .5 miles of route. Ely: possible stopping place for LWT shipments. Inadeq. Emerg. response. Fiscal links to Las Vegas.	Humboldt River water system in northern Nevada. Crescent Valley: shallow water table, 100-year flood plain crossing, two grazing allotments, fragile soils. Private lands converted to public use. Historic western way of life.	UP & I-80 follow Humboldt River, major water system of northern NV. Mining-related hazmat uses roads crossed by rail line. Cortez Mine mineral rights. Grass Valley streams, groundwater recharge. Rail 10 miles from Austin, 3 miles from Kingston.
Yucca Mountain Project Impacts	Impact Scenarios: LWT/gas tanker collision: - Summer, low release - Winter, high release - Volcanic erupt at YM. Impacts Described: Radiation Exposure Socioeconomic Public infrastructure & services Local government. finance Transportation. accident risk Public perception, stigma	Impacts Described: (rail & truck shipment, accident-free & with accident): Hydrology Air Resources Vegetation & soils Wildlife & fish Range resources Scenic resources Cultural resources Population & demography Land Ownership Economy Housing Mining & minerals Infrastructure Public finance Outdoor recreation Public health & safety Noise, land use, qual. of life	Impacts Assessed: Five grazing allotments affected, depending on route, fencing. 10% stigma effect on visits est. at $8 mil per year. Re: Clark survey, prop value losses est. at $10-21 mil. (no accident) to $34-48 mil. (accident, no release). EM/ER upgrade estimated at $31 million. Loss in state gov. services est. at $3.5-$5 million. Loss in state-distributed revenues est. at $10-21 mil. Economic benefits of rail spur uncertain & possibly contentious.

Topic\County	7. Churchill County	8. Mineral County	9. Esmeralda County
Report	Churchill County Impact Report (Aug. 2001, 59 pgs)	Mineral County Impact Report: A Preliminary Assessment of the Proposed Yucca Mountain Project and the Transportation and Socioeconomic Impacts to Mineral County (July 2001, 39 pgs)	The Long Haul to Equity: A Strategy to Protect Esmeralda County's Residents, Environment, and Economy from the Potential Adverse Effects of the Yucca Mountain Project (Dec. 2001, 36 pgs)
Project Description	Mainly Transportation: DOE doesn't build rail. NV designates hwy routes for LWT shipment: US-50A & US-95 thru Fallon. 5,450-19,200 LWT shipments projected.	Mainly Transportation: DOE doesn't build rail. NV designates hwy routes for LWT shipment: US-95 thru Hawthorne. 5,450-19,200 LWT shipments projected.	Mainly Transportation: Transportation Scenarios: 1. NV designates rural hwy routes (incl. US-95) for all LWT shipment. 2. DOE builds Carlin or Caliente rail spur, 10 miles east or 5 miles west of Goldfield.
Local Vulnerabilities	90% of county pop. w/in 1 mile of corridors. Motels, public facilities, resident encroachment on ROW. Fallon intersections are confined, inadequate, with high accident rates. Carson River valley one of NV's prime agric. areas. Fallon Naval Air Station.	County pop. w/in 0.5 mile of ROW est. at 4,300. Motels, public facilities, resident encroachment on ROW. Hawthorne Ammo Depot: a current hazardous activity. Route crosses Walker River Indian Reservation.	Federal land presence (98% of total), plus pop-based distrib. of PILT. Mining bust and effects on econ. & revenue base, local demographics. Tourism activity, centered in Goldfield. Emergency responders all volunteer, not prepared for radwaste shipments.
Yucca Mountain Project Impacts	Impacts Assessed: 10% stigma effect on visits est. at $19 M/year. Re: Clark survey, prop value losses est. at $29-$186 M (no accident) to $81-$430 M (accident, no release). EM/ER upgrade estimated at $30 million. Loss in state gov. serv. est. at $47-$92 million. Loss in state-distributed revenues est. at $85 M.	Impacts Assessed: 10% stigma effect on visits est. at $34 M/year. Re: Clark survey, prop value losses est. at $6-$62 M (no accident) to $28-$141 M (accident, no release). EM/ER upgrade estimated at $28 million. Loss in state gov serv. est. at $3.5-$5 million. Loss in state-distributed revenues est. at $11-21 M.	Impacts Described: Effects of contentious issue on community cohesion. Uncertain effects on future economic activity. Transportation accident in Goldfield could cause pop. exodus, tourism decline.

In addition to the counties formally designated as AULGs, several other Nevada counties that are not contiguous with Nye County also stand to be significantly impacted by shipments of radioactive waste to a Yucca Mountain repository. Nevada's second largest county, Washoe, and the metropolitan areas of the cities of Reno and Sparks

straddle both Interstate 80 and the northern Union Pacific mainline, both of which are potential SNF/HLW shipping routes. In addition, Pershing, Humbolt, and Elko counties all lies along both potential rail and highway corridors. Impacts to these other counties are addressed in the Section 3.2 (Property Value Impacts) and Section 3.8 (Nevada Transportation Impacts) of this report.

Specific findings for each individual formally designated "affected" county are discussed below, beginning with the site county (Nye County) and proceeding counterclockwise from the south around the site county.

4.1.1 Nye County, Nevada

The site county's perspective regarding the Yucca Mountain Project (YMP) is described in Appendix VII, "Nye County, Nevada: Community Protection Plan" (46 pgs), adopted by the Board of County Commissioners in August 2001. After an introduction, the Plan includes sections on the effects of the YMP, the rationale and objectives of the proposed protections and ten proposed "protections," presented in summary form.

Project Description

The Plan states that the site county would prefer a future without the proposed repository. Yet Nye County is the single local jurisdiction selected by the federal government to receive the nation's entire inventory of highly radioactive wastes. Should the federal government site the repository at Yucca Mountain, the Plan states all aspects of the federal program would affect the site county:

- The transportation (mode, route, and operations) of highly radioactive wastes in an unprecedented cross-country shipment campaign. Regardless of the choices, Nye County would be the destination for all shipments.

- The above ground lag storage and waste handling activities. All risks in 30 years of above ground operations would be concentrated in the site county.

- The construction of the repository, the emplacement of highly radioactive wastes, and the monitoring and, potentially, the retrieval of such wastes. All risks and uncertainties in these activities are concentrated in the site county.

- The performance of the repository system, both pre- and post-closure. Again, the risks and uncertainties are concentrated in the site county.

Local Vulnerabilities

The Plan refers to several special vulnerabilities of the site county:

- The major exposure pathway is the groundwater system down-gradient from the proposed repository, in the Nye County community of Amargosa Valley, a system on

which current and proposed economic and community development in the area are completely dependent (p. 13).

- Several site county communities, included the county seat, are located astride two-lane rural roads, which are currently used for shipment of low-level radioactive wastes to the Nevada Test Site and which could, in the absence of DOE action to create an alternative, may also be used for shipment of high-level radioactive wastes (p. 17).

- The dominant federal presence in the site county and the legacy of DOE use of the Nevada Test Site for 40 years of nuclear weapons testing have frustrated the county's efforts to develop a viable revenue base and to promote economic and community development along one of the county's major infrastructure assets—the US-95 corridor linking Nevada's two major metro areas. Almost 98% of the county's land area is managed by federal agencies, and 2.7 million centrally located acres have been withdrawn for special federal purposes (p. 29).

- DOE management has used its Nevada site county for field activities only and has encouraged its workforce to commute from Las Vegas. As a result, the contribution to the site county economy of a $17 million local dairy operation is 50% greater than the $250 million DOE site characterization project (p. 23, 25). The Plan views this as an outdated legacy of the Cold War.

- The Plan views the political structure of Nevada as a site county vulnerability. Of 42 representatives in the State Assembly, Nye County shares a single representative to the state legislature with three other central Nevada counties (p. 26). The Nye County Commissioners are the only elected officials whose first and only responsibility is the safety and welfare of the site county. Other state or national interests dominate other levels of government.

Impacts of the Yucca Mountain Project

The Plan describes the effects of the Yucca Mountain Project in several categories:

- Transportation effects include the radiological exposure of incident-free shipment along up to 317 miles of two-lane rural roads in the site county, the risks of transport accidents and incidents, the inadequate local radiological emergency response capability, the uncertainty of DOE mode-route transportation decisions, and the possibility of politicized intrastate routing (p. 10-11).

- Another category of effects is the uncertainty of whether the site county would be empowered to conduct rigorous independent oversight and monitoring during implementation of a prospective Yucca Mountain Project and the resulting site county concerns regarding safety of the Yucca Mountain Project (p. 14).

- A third category is the future threat of contamination to groundwater systems in the Amargosa Valley, combined with the prospective threat of contamination from underground nuclear weapons tests at the Nevada Test Site (NTS). The threat includes the stigma threat to property values and development potentials as well as the threat to health (p. 14, 16).

- A fourth category of effects is the prospect that the vigilance of DOE implementation of the Yucca Mountain Project, perhaps due to federal funding constraints, may fall short of the representations made in site recommendation and licensing (p. 16, 18).

- Another category is the prospect that, due to bureaucratic inertia or intrastate politics, DOE would continue its Cold War patterns in the management of its activities in Nevada. The Plan states that the federal withdrawal of 2.7 million centrally located acres in the site county has caused major disruption of its development potentials, while DOE management practices have provided meager economic benefits for its Nevada site county (p. 18, 20).

- A final category is the inequity of requiring the county used for 40 years of nuclear weapons testing to now provide the site for disposal of the nation's unwanted highly radioactive wastes (p. 20).

4.1.2 Clark County, Nevada

The Clark County perspective is presented in Appendix VII, "Draft Impact Assessment Report: An Analysis of Potential Impacts to Clark County Resulting from the Site Selection, Construction, and Operation of a High-Level Nuclear Waste Repository at Yucca Mountain, Nevada" (74 pgs). The Report "is intended to address the interests of not only unincorporated Clark County, but also, wherever possible and appropriate, the interests of the Cities of Las Vegas, North Las Vegas, Henderson, Boulder City, and Mesquite, as well as the Las Vegas Band of Paiutes and the Moapa Band of Paiutes" (p. 6). Supplementary reports present details of the County's assessments of property value and public safety impacts.

Project Description

The Report states "Congress identified the interstate highway system as the default route for the transportation of HLW" (p. 40). While the State of Nevada may designate alternative routes (based on an analysis that demonstrates no negative effect on public health and safety), it is unclear whether the State would conduct such an analysis or what the findings might show (p. 40, footnote). Furthermore, "In this region of the country, no practical alternatives to I-15 and US 93/95 are available for transit (to Yucca Mountain) from Los Angeles, Salt Lake City, Phoenix, or Reno (p. 18). Therefore, the Report assumes that the interstate highway system through Clark County would be the primary route used to transport waste to Yucca Mountain (p. 41). If DOE's 'mostly highway' scenario is selected, almost 93,000 shipments would traverse through Clark County over 24 years" (p. 18).

In its assessment of property value impacts, the Report makes the further assumption that highway shipments through Clark County could be routed either on I-15 and US-95 (the "I-15 Route") or on the northern and western segments of the Las Vegas Valley Beltway (the "Beltway Route").

To assess the severity of property value impacts, the Report posits three transportation operations scenarios: Scenario 1 assumes no accident of any kind. However, there is "adverse publicity, particularly at the onset of the shipment campaign" (p. 25); Scenario 2 assumes one accident involving a truck shipment on I-15 in North Las Vegas. No radiation is released, but there is heavy national media coverage (p. 11); Scenario 3 assumes an accident involving a high-level waste shipment and a gasoline tanker on I-15 near the Las Vegas Strip. The truck drivers are killed; radiation is released; emergency service workers are hospitalized; I-15 is closed for four days; many lawsuits are filed; and cleanup and economic costs total $1 billion (p. 11).

Generally, the impact assessment assumes legal-weight truck transport, generally on the I-15 route. However, to assess routine radiation exposure from HLW transport and potential impacts to endangered species, the Report considers rail transport via the Jean corridor from the Union Pacific (UP) railroad to Yucca Mountain (p. 51). This route requires "about 87% of all rail shipments to Yucca Mountain (to) use the UP mainline through downtown Las Vegas" (p. 42), and allows evaluation of "a maximum credible incident-free scenario" (p. 42) for these impact categories.

Local Vulnerabilities

While the Report does not include a section describing the "affected environment," it refers to several special Clark County vulnerabilities:

- "Clark County …has been the fastest growing county (of its size) in the United States for many years. Over 5,000 new residents per month have been arriving here to live, work, and play since the early 1990s. (p. 5) The continued economic viability of the Southern Nevada region depends on an intricate balance of factors[1] …. Any threat to that balance could topple the region's economy like the proverbial 'house of cards'." (p. 72).

- The visitor-gaming industry and its related services—the "primary engine that drives our economic growth" (p. 5)—has developed along the Las Vegas Strip and in downtown Las Vegas, locations adjacent to the I-15 Route. Due to the dominance of this industry, "the doctrine of 'perception is reality' applies to Las Vegas like no other region in the world" (p. 17).

[1] Factors mentioned include gaming and related service and construction oriented businesses, the pro-business climate, the diversity of lifestyle choices (p. 5), and the effective management of energy costs, road congestion, air pollution, education systems, and immigration (p. 14-15).

- Up to 30% of Las Vegas visitors come from California, many by auto using I-15. Congestion on I-15 makes it vulnerable to traffic disruptions that could directly affect visitation (p. 15).

- The visitor-gaming industry has a high level of fixed costs (p. 16) that makes it particularly vulnerable to downturns in revenues.

- The Beltway Route is "not expected to be completed before HLW shipments are to commence" (p. 24). As it is developed, however, the Beltway "is expected to play a major role in the Valley's future development" (p. 31).

Impacts of the Yucca Mountain Project

The Report states, "The DOE must address the direct, indirect, and cumulative impacts of transporting waste through Clark County to Yucca Mountain. All other impacts … dovetail from the issues surrounding the transportation of high-level waste through Clark County" (p. 73). The Report defines "cumulative impacts" as those "caused by the DOE's use of the NTS as a disposal site for the ongoing program to clean up nuclear weapons production facilities … For the foreseeable future, the most likely mode of transport for these wastes is by legal-weight truck on the highway system" (p. 40). The major impacts assessed include:

- Impacts on the gaming industry are based on "confidential interviews … conducted with 14 key leaders representing 10 (Strip and downtown) casinos, and one of the leading (Clark County) industry associations" (p. 13). The respondents indicated, "the most serious risk is from the stigma that would result if there is any kind of accident involving the shipment of HLW" (p. 15). The stigma could make "convention planners less likely to hold a convention in Las Vegas" (p. 15), and reduce the "attractiveness of Clark County as a place for families (and retirees) to live, … (and as an) area for investment" (p. 16).

- The assessment of property value impacts "is not based upon the formal appraisal of specific properties … (but) on the opinions, perceptions, and beliefs of Clark County residents, lenders, and appraisers" (p. 18). The Report states "knowledge of an undesirable environmental condition (and the perceived risk from that condition) is closely associated with declines in property values" (p. 34). The rate of diminution is associated with distance from the undesirable environmental condition (p. 34).

  A survey of 512 Clark County residents was conducted in August 2000.[2] "Of the 369 … respondents who expect lower selling prices for homes near shipment routes, the mean expected drop in selling price … is estimated at approximately 25% compared to identical homes not near a highway (used for transport of) high-level nuclear waste" (p. 21). "When the mean diminution rate … is applied to (current) residential

[2] Details are presented in "Clark County Residents and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Values Impacts from Shipment of High-Level Waste through Clark County, Nevada," May 2000.

properties …the resulting diminution of assessed property values is $492.3 million (within one mile of the Beltway Route) or $604.6 million (within one mile of the I-15 Route)" (p. 24).

Another survey, "of 18 Clark County lenders and 35 certified appraisers" (p. 25), was conducted in May 2000. These respondents were asked to distinguish expected property value effects between three classes of property (residential, commercial, and industrial) located within one or three miles of a HLW route under the three operations scenarios. When the Scenario 1 responses are applied to the current valuation of residential property, the estimated diminution is about $39-$69 million within one mile of the Beltway Route, or about $48-$85 million within one mile of the I-15 Route (p. 27, 28). When the Scenario 2 responses are applied to the current valuation of all property, the estimated diminution is about $236-$463 million within three miles of the Beltway Route, or about $316-$579 million within three miles of the I-15 Route (p. 29, 30). The ranges in the above figures reflect the differing percentage estimates of lenders and appraisers.

- The assessment of transportation impacts states "not enough is known about the DOE transportation program to assess it" (p. 37). Doses from a "maximum credible incident-free scenario (are estimated assuming that) each rail cask is shipped through Las Vegas (via the Jean corridor) separately by general service in a different train … (with) stops for carrier interchange or train assembly (ranging from) 2 to 24 hours" (p. 42). At a selected casino location, the maximum dose is estimated at 28 to 200 mrem (at distances of 40 to 15 meters). At the Clark County Government Center, the dose is estimated at 3 to 114 mrem (at distances of 100 to 20 meters) (p. 43).

- The cost impacts of transportation accidents are based on a 1997 Federal Highway Administration study, which estimated the "costs for combination trucks on urban highways (at) $1.24 per vehicle mile" (p. 43). Applied to rail shipment miles via the Jean corridor in Clark County, the estimated accident costs are $103 million, of which $31 million would not be reimbursed (p. 44).

- Estimates of public safety impacts use "a case study approach that provides each county and local government public safety personnel with three scenarios describing a 'future' shipping campaign, and asks … how the events would impact their agency" (p. 53). The finding is that "Despite a very high degree of professionalism and effort, none of the public safety agencies are currently adequately prepared, trained, or equipped to respond to any of the three HLW shipping scenarios … The total projected costs … to be adequately prepared for (Scenario 3) is $360 million" (p. 54).

- Estimates of non-public safety impacts use the same case study approach (p. 57). The Scenario 3 estimate is $121 million and includes personnel, equipment, training and planning, and loss revenue costs to social services, park and recreation, the county clerk, and other agencies (p. 66).

4.1.3 Lincoln County, Nevada

The Lincoln County perspective is presented in Appendix VII, "In Search of Equity: A Preliminary Assessment of the Impacts of Developing and Operating the Yucca Mountain Repository on Lincoln County and the City of Caliente, Nevada" (90 pgs).

Project Description

The Report addresses "the burden if Lincoln County is selected as part of a transport route to bring … high-level nuclear waste to Yucca Mountain" (p. ES 2). The Report identifies three possible ways that Lincoln County could be selected:

- "If DOE builds a rail line between the City of Caliente and the Yucca Mountain repository" (p. ES 2). Such a rail line would depart from the Union Pacific mainline at Caliente and extend west to Yucca Mountain, either on the "Chalk Mountain Route" across the Nevada Test Site, or on the "Caliente Route" around the Nellis Air Force Range.

- "If the DOE sites an intermodal transfer facility near the City of Caliente" (p. ES 2). At such a facility, rail casks arriving via the Union Pacific mainline would be transferred to heavy-haul trucks for shipment on US-93 west from Caliente and (probably) SR-375 around the Nellis Air Force Range.

- "If the State of Nevada designates a … legal-weight truck route through Lincoln County" (p. ES 2). While US Department of Transportation "regulations require that truck transport of … high-level radioactive waste occur along the U.S. interstate system to the maximum extent possible … a desire to protect the State's gaming-based tourist economy would likely result in Nevada's governor recommending that the shipments utilize routes that impact rural locations such as Lincoln County" (p. ES 1). While "the legal-weight route that DOE is presently considering does not pass through Lincoln County" (p. 49), possible routes include US-93, north and west of Caliente, SR-319, which extends from Panaca east to the Utah state line, and SR-375, which extends northwest from Ash Springs-Hiko to the Nye County line (p. 9).

Local Vulnerabilities

The Report's major sections are a characterization of impacts and a discussion of mitigation options. However, in these and other sections, the Report refers to several special Lincoln County vulnerabilities:

- During weapons testing at NTS, the objective was "to minimize the aggregate dose received by the population in the region" by directing "the plume of radioactivity toward low population areas" (p. 20) such as Lincoln County. Further, "much of Lincoln County was designated as an 'Offsite Uncontrollable Area,' meaning that (its) communities could not be effectively evacuated in the event of an unanticipated

atmospheric venting" (p. 20). As a consequence, "Many area citizens have … feelings of powerlessness in the face of government, and a sense of injustice. (Further,) there is a long-standing distrust of the federal government and dissatisfaction with its responses to residents' concerns about the effects of nuclear weapons programs" (p. 21).

- Like other rural counties, Lincoln County is "already vulnerable to economic adjustments, (and thus is) ill-equipped to deal with even minor disturbances to the local economic base. As a consequence, Lincoln County views any (negative) repository system related impact, regardless of scale, to require mitigation" (p. ES 1).

- "Since the early 1960s, the economy of the County has become highly dependent on government-related employment, tourism, and retirees" (p. 8). Growth of the County and City would likely depend on the success of efforts to attract new business to the area. Expansion of tourist related visitation is also viewed as key to the area's future" (p. 9).

- "At this time, permitting for new industries is not difficult" (p. 16) in Lincoln County, since its Class 2 designation under Nevada's air quality classification system "allows for moderate degradation" (p. 16). "If repository related activities result in unmitigated declines in area air quality, the County or the City may find it more difficult to attract desirable businesses into the region" (p. 17). In addition, "current residents may feel compelled to move away and prospective new residents may pass up Lincoln County in favor of areas with lesser levels of emissions" (p. 17).

- "Most of the City of Caliente, including the higher density residential neighborhoods, fall within (the) ½ mile (non-incident exposure) zone" (p. 22) assumed in transportation assessment models. Also, "Kershaw-Ryan State Park is … ¼ mile from the proposed site for the intermodal facility (p. 22).

- "The viewshed in the vicinity of the entrance to Rainbow Canyon may be altered" and the "viewshed surrounding the Kershaw-Ryan State Park … might be impacted" (p. 19) if DOE locates an intermodal facility in Caliente.

- All Lincoln County highway routes that might be designated for high-level waste shipment "are two-lane with minimal availability of pullout areas, rest stops, or service facilities" (p. 9). Portions of US-93 and SR-375 have high crash rates (p. 49).

- Approximately 100 miles of possible rail route in Lincoln County is in "rugged terrain … that results in 40% of the track alignment being curved … (and requires) 44 bridges and cuts through 14 tunnels" (p. 52).

- Local emergency response providers include 4 local fire departments, 2 ambulance associations, 2 medical centers (in Caliente and Alamo), and the County's Sheriff Department. However, "much of the equipment currently in service is outdated and unreliable" (p. 34). Emergency response providers also include the Union Pacific

Railroad, the Nevada Highway Patrol, and the U.S. Bureau of Land Management. However, "based upon current facility locations, additional state and/or federal support may not arrive for 3 to 4 hours" (p. 35).

- "Many of the communities in Lincoln County, particularly Alamo and Panaca, experience reduced water pressure during the summer months, with insufficient flow for fire fighting" (p. 36).

Impacts of the Yucca Mountain Project

The Report describes three scenarios to "illustrate the types of events and consequences of possible DOE action" (p. 12) in Lincoln County:

- One scenario involves a collision of a legal-weight truck shipment of spent nuclear fuel with a gasoline tanker truck approximately 6 miles west of Caliente on US-93. The accident occurs in late June, the height of the local tourist season (p. 12). "The two drivers of the spent fuel truck and the driver of the tanker are killed" (p. 13). The resulting fire damages shipping cask seals, allowing small amounts of radiation to escape. "Wind patterns carry the radionuclides toward the City of Caliente" (p. 12), where residents are told to stay indoors. Highway 93 is closed "for many days." Intensive media reporting results in mass cancellations of hotel-motel reservations, and "visitation to Lincoln County during the following four weeks is off by an estimated 30 to 40 percent" (p. 13).

- A second scenario involves a collision of "a westbound train carrying spent fuel shipments to the intermodal facility (with) "an eastbound train carrying a flammable, explosive chemical … parked on a siding approximately 5 miles east of … Caliente" (p. 14). The resulting fire "burns out of control for three hours, causing the seals on the casks to fail" (p. 14), releasing radiation and initiating evacuation of Caliente, Panaca, Pioche, and "the five state parks that are within thirty miles of the accident" (p. 14). "The UP mainline is closed for several days" (p. 14). Intensive media coverage results in mass cancellations of hotel-motel reservations, and visitation to Lincoln County "is substantially less than normal for the summer months, resulting in lost revenue for local merchants, (and) reduced tax revenue for … local governments." (p. 15).

- A third scenario involves "A volcanic eruption … beneath the Yucca Mountain repository site (in which) the containment capability of one or more waste canisters is compromised, resulting in radionuclides being transported in the ash plume" (p. 14) and settling in downwind communities, including Alamo, Hiko, Caliente, Panaca, and Pioche. "Most Lincoln County residents evacuate north to White Pine and Elko counties, which are "quickly overwhelmed with the need to provide emergency shelter and assistance" (p. 14).

Aside from the worst case scenarios, the Report finds that "Lincoln County can expect a broad range of impacts, including negative impacts on community cohesion,

population driven effects, emergency management, highway accident risk, and impacts from stigma that may reduce the desirability of Lincoln County as a place to live and as a destination for tourists" (p. ES 2). At the same time, it states that "the lack of specific transportation plans and policy for Yucca Mountain, …the magnitude of uncertainty associated with DOE's analysis of risk, and the unique nature of the repository system make any definitive statement about the safety of the system and (its) impacts impossible" (p. ES 4). The Report then describes impacts in the following categories:

- Air Quality: Unmitigated reductions make business attraction more difficult.
- Hydrology: Proposed facilities/routes close to perennial streams and resources.
- Noise: Construction and operations noise vs. current and EPA recognized levels.
- Viewshed: Possible effects at Rainbow Canyon and Kershaw-Ryan State Park.
- Radiation Exposure: Especially if rail shipments stalled due to congestion at the Intermodal Facility (IMF).
- Community Cohesion: Disagreements stimulate internal community conflict.
- Political Divisiveness: Polarization. High levels of emotion, divergent opinion.
- Employment: Jobs in IMF construction and operation, also NTS and YMP.
- Income: Re: IMF operations … from $2.6 increasing to $11.7 million.
- Population: 110-130 new residents re: IMF, plus others re: NTS and YMP.
- Emergency Management: Need for vehicles, staff, training, and communications.
- Emergency Medical: Need for staff training and equipment.
- Schools: 24 students, at $8044 operations and $10,630 capital per student.
- Streets: Annual maintenance costs would increase.
- Wastewater: IMF location at or adjacent to current treatment facility.
- Municipal Water: Demands of involuntary activity on existing resources.
- Local Oversight: Joint Committee meeting time; prospective PETT requests.
- Local Gov. Finance. Local revenues do not cover costs; intergov. revenue precarious.
- Land Use: Rail construction and operation would disturb livestock and wildlife.
- Highway Transportation Risk: 4 crashes involving loaded/empty heavy-haul trucks.
- Rail Transportation Risk: 4 derailments expected in Lincoln County over 24 years.
- Public Perception & Stigma: Possible out-migration, business closures, etc.
- Tourism: State Parks and wildlife areas near IMF and transportation routes.
- Economic Development: Increased difficulty to attract desired development.
- Property Values: Some factors may increase; others could reduce.

4.1.4 White Pine County, Nevada

The perspective of White Pine County is presented in its November 2001 "White Pine County Impact Report" (Appendix VII).

Project Description

The Report notes that "DOE did not include (the US-93/6 route for legal-weight truck shipment of HLW) as an analyzed alternative in the DEIS" (p. 10), but that this route "has been designated by the Nevada Department of Transportation as an

'alternative route' permissible for interstate trucking, including all classes of hazardous materials except route-controlled high-level waste shipments" (p. 9). Should a repository be sited at Yucca Mountain, the State would face "the necessity to protect the State's gaming-based tourist economy" (p. 3). Under these circumstances, "it is possible, if not likely, that the Governor of Nevada would designate US-93/6 through White Pine County as Nevada's preferred route for spent nuclear fuel shipments (as the State has done for LLW shipments)" (p. 10).

Based on these assumptions, the Report estimates that high-level waste shipments through White Pine County could number 55,000, and an additional 19,000 spent fuel shipments could be routed through the county if a private storage facility is developed at Skull Valley, Utah. These high-level waste shipments are in addition to about 12,000 expected shipments of low-level wastes for disposal at the Nevada Test Site (p. 42).

The specific White Pine highway segments are "US Highway 93 south to Ely from the Elko County line (approximately 64 miles, and) … US Highway 6 from Ely south to the border with Nye County (approximately 39 miles)" (p. 42-43).

Local Vulnerabilities

The Report refers to several special vulnerabilities in White Pine County:

- "The US-93/6 corridor route through Elko, White Pine, and Nye Counties is two-lane with minimal availability of pullout areas, rest stops, or service facilities. There are no safe haven areas…. Road conditions in the winter normally include snow and ice, particularly in the mountain passes" (p. 9).

- US-6 south of Ely "is characterized as mostly mountainous, where grades can reach 7 percent in the vicinity of Murry Summit, … (and where) severe winter storms can result in highway closures" (p. 43).

- "Approximately half of the population of White Pine County lives in the US Highway 93 corridor (21 miles) between McGill and Ely, within (a) .5 mile exposure zone" (p. 23). In particular, the McGill/Ely Corridor has a "high concentration of residences, businesses, and schools in very close proximity to US-93/6" (p. 10). In this section, the density and land uses "are similar to (those) of the potential route for high-level nuclear waste near Las Vegas, (and) the distances between commercial and residential uses and the actual roadway may be less than (those) in the Las Vegas corridor" (p. 10).

- In addition, many of the motels and schools in the Ely area are located adjacent to the highway or within the .5 mile exposure zone (p. 23). DOE's "DEIS analysis of radiological risks … and estimates of the consequences of maximum reasonably foreseeable accidents did not explicitly address local, difficult-to-evacuate populations such as those in prisons, hospitals, nursing homes, or schools" (p. 24).

- "Ely, the principle city and county seat (of White Pine County), serves a large geographic area including local and transient populations with essential services … The nearest alternative availability of these types of services is often two hundred miles distant" (p. 6). Thus, "Ely is a gathering place for transient(s) and locals, well isolated from other population centers (p. 9). Truck drivers would need to rest, refuel their vehicles, and have meals as they travel along the route through Nevada. Unless DOE designates otherwise, some … may choose Ely as the best location for these functions" (p. 23).

- For emergency response, "White Pine County and the City of Ely rely on volunteer and professional fire fighters, and emergency medical technicians (who) are not adequately trained in the event of a radiological accident." Furthermore, "Incompatible radio and communication equipment between emergency response agencies hinders optimal communication" (p. 37).

- "White Pine County is characterized by an abundance of outdoor recreation activities" (p. 46), which include two state parks (Cave Lake and Ward Charcoal) and the Great Basin National Park. As a result, "tourism has begun to emerge as a significant component of the White Pine economy" (p. 8), and "the County is seeing more and more residents of Clark county elect to purchase second homes in the Ely area" (p. 9).

- Two local vulnerabilities involve linkages with the Las Vegas Valley metro area: a) "Local government finances in Nevada involve distribution to rural areas of tax revenues derived in the State's metropolitan areas. Any stigma-induced downturn in the economy of the Las Vegas metropolitan area could have direct consequences upon the fiscal health of White Pine County" (p. 13). "The Las Vegas Valley Water District has filed for groundwater rights in White Pine County. Degradation of southern Nevada water supplies (due to the YMP) could increase demand by Las Vegas for White Pine County water" (p. 13).

Impacts of the Yucca Mountain Project

The Report describes three scenarios to "reflect what might be considered 'worst case' situations and outcomes" (p. 16):

- One scenario involves a collision of a spent fuel shipment with a gasoline tanker truck approximately ½ mile south of Ely on US-6. The accident occurs in late June, the height of the local tourist season (p. 16). The resulting fire damages shipping cask seals, allowing small amounts of radiation to escape. The Murry Canyon area of Ely is evacuated. Intensive media reporting results in mass cancellations of hotel-motel reservations, and "a sixty percent reduction in direct visitor spending for a period of four weeks (p. 17). In addition to tourism impacts, demand for real estate in the area (particularly from second home buyers) declines dramatically" (p. 18).

- A second scenario involves a collision of a spent fuel shipment with "a double trailer tanker containing 10,000 gallons of gasoline heading down Murry Canyon on US-6 at 55-mph in a light winter snowstorm …The vehicles interlock and … careen off the highway and smash forty feet vertically into Murry Canyon (p. 19). A 30-mph wind blowing down Murry Canyon increases the temperature of the fire, and the intensive heat and smoke impedes local emergency response. Since weather "has forced closure of the small county airport" (p. 20), the DOE radiological response team and the nearest large-scale petroleum fire fighting capabilities (at Nellis AFB) are at least 4 hours away. "Most of Ely is sufficiently contaminated to preclude reoccupation anytime in the near future (p. 20). Worse yet, radionuclides have been found in Murry Spring, which was up to now Ely's water supply source" (p. 21).

- A third scenario involves "A volcanic eruption … beneath the Yucca Mountain repository site (in which) the containment capability of one or more waste canisters is compromised, resulting in radionuclides being transported in the ash plume" (p. 18) and settling in downwind communities, including Ely and McGill. This adds to the effects of DOE's weapons testing program (p. 22).

Aside from the worst case scenarios, the Report anticipates the following types of impacts:

- A comparison of "transportation risks in the County with nationwide risk studies conducted by DOE indicates that incident-free risks in White Pine County (are) slightly greater for rural segments than those for the nation as a whole, but lower for suburban and urban segments" (p. 23).

- "A severe accident which results in the breach of a containment cask finds the risk substantially greater than the risks outlined in DOE's DEIS" (p. 24).

- Stigma effects could cause out-migration, reduced property values, and reduced second home development (p. 25). Conversely, DOE could locate ancillary functions or manufacturing facilities in White Pine County, "generating a positive employment effect" (p. 25).

- Effective evacuation plans would be needed for the City of Ely, the White Pine County School District, the W.B. Ririe Hospital, and the Ely Maximum Security Prison (p. 34-35).

- "Emergency medical systems … would need to be enhanced in order to handle additional incidents … without compromising service to the existing resident population" (p. 37).

- An indirect impact is "the heightened costs of encouraging economic development in view of possible negative public perceptions of the region due to its location on a designated highway route for the transport of high-level nuclear waste."

- "Current residents may view the area as less attractive, and this may ultimately lead to an out-migration of residents….potential retiree in-migrants may chose to locate elsewhere if they view White Pine County as having lesser appeal or quality of life" (p. 44).

The Report reviews studies of property value effects at other DOE sites, Superfund sites, and "a nuclear transportation route in South Carolina" (p. 50-51). It then notes that the 1997 Interim Nuclear Waste Storage Bill (H.R. 1270) "was amended to require compensation for land owners if transport of the waste could be shown to have devalued their properties by at least 20%" (p. 52). Applied to property values in the City of Ely, the Report estimates the uncompensated reduction in property value at $8.4 million (p. 53).

4.1.5 Eureka County, Nevada

The Eureka County assessment is presented in its August 2001 "Impact Assessment Report on Proposed Shipments of Spent Nuclear Fuel and High-Level Radioactive Waste through Eureka County, Nevada" (Appendix VII).

Project Description

The Report addresses the possibility that the Carlin rail route (one of DOE's five options for rail transport in Nevada) would be developed and used for transport of high-level waste and other materials to the Yucca Mountain site. In addition, the report assumes that "since all scenarios involve some transport by legal-weight truck, (and) since no specific alternative route has yet been designated … weather or other operational variables could force the use of … I-80, US-50, and SR-278 in Eureka County (to) be used periodically or regularly to transport SNF or HLW to Yucca Mountain" (p. 3).

The Carlin rail corridor would depart from the Union Pacific/Southern Pacific (UP/SP) rail tracks at Beowawe and extend south through the Crescent Valley and into Lander County. Of the 317-mile route, 18.25 miles would be in Eureka County. Terminal facilities (wye turnouts; interchange, turning, and emergency materials storage tracks; a crew station and office; a locomotive service facility; and an emergency station and garage) would be located at Beowawe. Other facilities that might be located at Beowawe include "an operations center; maintenance headquarters; (vehicle) maintenance facility; dormitory; fueling station; and rail car repair shop" (p. 8).

The assessment assumes that the Carlin corridor would have a 1300-foot federally-owned and fenced right-of-way, within which the disturbed area would be 200 feet. It further assumes that the Eureka County segment would include a grade-separated crossing of County Road M-115, just east of the Town of Crescent Valley, and one signaled at-grade crossing at an unspecified location (p. 8).

Construction of the Carlin branch line might require a workforce of about 500, divided into 50-person roadbed and bridge construction crews (p. 14). Construction

materials would include "10 million gallons of diesel fuel, 210,000 gallons of gasoline, 79,000 tons of steel, and 440,000 tons of concrete" (p. 13), most of which would be delivered via Beowawe. Also required would be 660 acre-feet of water drawn (under temporary permits from the State of Nevada) from 67 wells along the corridor route (p. 12).

Operations of the Carlin branch rail line might require about 50 contract operator employees, who would be based in Elko or the Town of Crescent Valley (p. 14). Though owned by DOE, use of the line could be shared with mine operators, general freight operators, and the NTS (e.g., for LLW shipments) (p. 15).

Local Vulnerabilities

The special vulnerabilities of Eureka County to the prospective transportation program include:

- An existing bulk propane facility at Beowawe and a proposed ethanol production plant at Dunphy could exacerbate the effects of an accident in the vicinity (p. 2).

- The Humboldt River (the major water system of north central Nevada, and the route for I-80 and the UP/SP railroad) could be damaged by accidents involving releases from shipments of HLW, LLW, or other materials.

- The Carlin route would cross the 100-year flood plain in the Crescent Valley. The generally shallow water table in the valley could exacerbate the effects of borrow pits or complicate the provision of underpasses for livestock or equipment. (p. 3).

- Private land within the Carlin corridor, which comprises up to 59% of the Eureka segment, would be converted to public (federal) use, thus removing it from the local tax roles (p. 3).

- Two grazing allotments in the Crescent Valley would be affected by the Carlin rail corridor with effects dependent on the specific route and the fencing (p. 3).

- The value of private property along the corridor and tourist visitation to Eureka County could be damaged by incident-free transport of HLW and severely damaged by an accident (p. 3).

- The historic way of life in the West, as it is practiced in Eureka County, could be affected by rail corridor construction and operations (p. 3).

- The soils in the (Crescent) Valley are fragile and easily disturbed, difficult to revegetate, and vulnerable to invasion by noxious weeds (p. 2).

Impacts of the Yucca Mountain Project

After stating that a complete assessment of impacts "is not possible until the DOE provides more detailed information on construction and operations" (p. 52), the Report elaborates on the types of impacts on the natural and human environment anticipated as a result of rail or truck transportation of HLW, under accident-free and accident conditions. Accidents are differentiated between those in which a cask "hits the ground" without radioactive release, and "severe accidents" involving the release of radioactivity.

Impacts to the natural environment (Part 4A, p. 52-59) include those to:

- Hydrology and water resources (e.g., the 100-year flood plain in Crescent Valley)
- Air resources (e.g., vehicle emissions)
- Vegetation and soils (e.g., 1.6 million cubic yards of fill material, in excess of cut.)
- Wildlife and fish (e.g., fencing effects on movement of pronghorn antelope)
- Range resources (e.g., destruction of forage and invasion by noxious weeds)
- Scenic resources (e.g., views of and views from the historic Maiden's Grave)

Impacts to the human environment (Part 4B, p. 60-73) include those to:

- Cultural resources (e.g., archeological sites, sacred springs, and burial sites)
- Population and demographics (e.g., the families of direct employees)
- Land ownership (e.g., conversion of private land to public use)
- Economy (e.g., direct jobs during construction and operations)
- Housing (e.g., housing in communities and at work camps)
- Mining and minerals (e.g., potentially lower transportation costs)
- Infrastructure (e.g., disposal of liquid and solid construction wastes)
- Public finance (e.g., the costs for emergency management and response)
- Outdoor recreation (e.g., limitations of public access, decreases in visitation)
- Public health & safety (e.g., radiation and related impacts on workers and public)
- Noise, land use, and the quality of life (e.g., noise during construction and operation)

4.1.6 Lander County, Nevada

The perspective of Lander County is presented in its August 2001 "Lander County Impact Report" (Appendix VII).

Project Description

The Report "considers direct, indirect, and risk induced impacts … primarily related to transportation" (p. 4) elements of the Yucca Mountain Project. Among the transportation options being considered "… is a rail access spur through north central Nevada, (in particular,) a rail alignment that leaves the Union Pacific mainline at Beowawe … and heads south past Crescent Valley into eastern Lander County. The proposed rail spur could carry as many as 19,000 … shipments of spent nuclear fuel and

high-level nuclear waste to a (Yucca Mountain) repository over a period of 24 to 38 years" (p. 4, 6).

Since the Lander County community of Battle Mountain is located on the UP mainline, eastbound rail shipments to Beowawe would pass to the north of town, and the more numerous westbound shipments would be diverted 30 miles east of Battle Mountain. "As a result, rail operations would not directly affect the Town of Battle Mountain" (p. 9).

"From the connection at Beowawe, the proposed rail route travels southwesterly following the alignment of Coyote Creek and State Highway 306" (p. 11), and continues through Dry Canyon, Grass Valley, and Rye Patch Canyon to the Nye County line near the head of the Big Smoky Valley (p. 11).

The Report observes that a rail spur might also be used for LLW shipments to the NTS. "It is possible that some LLW shipments may travel by rail, if a spur were constructed through northern Nevada" (p. 5).

Though the focus is on rail shipments, the Report notes that I-80 in northern Lander County could be used for legal-weight truck shipments of HLW. This could occur due to shipments east on I-80 to a private spent fuel storage facility in Skull Valley, Utah or to an intermodal transfer station (not proposed by DOE) at Beowawe. Legal-weight truck shipments could also occur due to shipments west on I-80 to a State-designated highway route (e.g., US-95) for HLW shipments (p. 8).

Local Vulnerabilities

The Report refers to several local vulnerabilities to HLW transportation impacts:

- "The Union Pacific railroad parallels (the Humboldt River) nearly the entire length of the route…Speeds along the track can reach 70 miles per hour in certain areas. An accident or derailment … in this area has the potential to contaminate surface water resources in the Humboldt River Basin (p. 12). Along many areas of the Humboldt River Basin, there is direct interaction between surface and ground waters. Surface water contamination can directly intercept groundwater leading to a direct contamination of the groundwater reservoir (p. 13). Surface water is not currently used for human consumption. However, it is a major component of groundwater recharge that is ultimately available for domestic wells and municipal and industrial water supplies" (p. 12-13).

- "Irrigation diversions occur off the Humboldt, (supporting) surrounding … pastures utilized by grazing livestock" (p. 12).

- Along the Coyote Creek and State Highway 306 sections, "There is bottomland to the east of the route, and there is mining activity in the area, with several mine access roads crisscrossing the valley" (p. 11).

- "Road crossings in Lander County, particularly those in Battle Mountain, are heavily traversed by trucks hauling materials of a toxic and explosive nature. Additionally, there are several at-grade crossings along the rail routes in northern Lander County that have limited safety and warning devices" (p. 9).

- "Current mining operations at Cortez are expected to continue beyond 2010. The proposed rail route would pass directly through the pipeline and south pipeline project area…. A development of a rail line could cause serious conflicts, particularly with respect to the value of mineral rights in the Pipeline and Cortez Mining areas" (p. 21).

- "During nearly the entire length through Grass Valley, the proposed rail spur either crosses or follows principle surface water drainages, (which are) the primary sources of recharge for groundwater in Grass Valley" (p. 16).

- The Lander County town of Austin is located "about 10 miles west of the proposed rail line through the Big Smoky Valley," and the communities of "Kingston and Gilman Springs are located in the Big Smoky valley approximately 3 miles from the proposed rail route" (p. 3).

Impacts of the Yucca Mountain Project

The impacts identified in the Report are associated with the resource and stigma effects of a prolonged high-level waste shipment campaign:

- "The effect of (railroad) construction and operation … on livestock grazing depends primarily on whether or not the right-of-way is fenced and where the fence (is) located… (Regarding unfenced rights-of-way,) we would assign an arbitrary 0.1% reduction in AUMs (Animal Unit Months) to reflect the effect on (livestock) management…. (Regarding fenced rights-of-way,) we would assume an arbitrary 0.5% minimum reduction of AUMs" (p. 24-25). The allotments potentially affected include the Carico Lake, Grass Valley, Simpson Park, Kingston, and Potts Allotments (p. 25-31), and several US Bureau of Land Management wild horse herd management areas within these areas (p. 32).

- The Report estimates the consequences of a stigma-related reduction in "overnight travelers staying in … motels in Battle Mountain and Austin, and recreation users in areas near the proposed Crescent Valley rail spur" (p. 34). Assuming a "10 percent decline in visitor volume annually over the course of (a 38-year) shipment campaign through Lander County" (p. 35), the Report estimates losses of $306 million in economic activity and $12 million in state/local tax revenues (p. 36).

- The Report estimates "total property value along the transportation corridors (at) just over $150 million" (p. 40). Stigma-related losses over a 38-year rail shipment campaign (no accidents) are estimated at $10-$21 million in property value and $2-$4 million in property tax revenues. Should an accident with no radiation release occur,

the losses over a 38-year rail shipment campaign are estimated at $34-$48 million in property value and $7-$10 million in property tax revenues (p. 41).

- The cost to upgrade and maintain local emergency response capabilities over a 38-year rail shipment campaign is estimated at $31 million (p. 45).

- Assuming that additional state government expenditures in response to the Yucca Mountain Project result in reductions of state services to local governments, the Report estimates the Lander County portion of the "lost benefit" at $3.5 to $5.0 million (p. 45).

- Assuming HLW shipments are also routed through the Las Vegas Valley, the Report estimates that the "cumulative losses (of state-distributed local revenues) to Lander County residents over the course of the shipping campaign could range from "$10.9 to $21.3 million" (p. 46).

The Report concludes that economic benefits of the proposed rail spur are uncertain and potentially contentious. "Unlike the 1880s, when the railroad so thoroughly complimented the development of lands for mining and associated uses, the proposed rail spur to Yucca Mountain has only speculative secondary benefits that may or may not be achieved" (p. 53)

4.1.7 Churchill County, Nevada

The Churchill County assessment is presented in its August 2001 "Churchill County Impact Report" (Appendix VII).

Project Description

The Report assumes that "use of rail through Churchill County (the Mina route) is not considered a viable transportation option (for shipments of high-level waste to Yucca Mountain) at this time" (p. 5). However, "states have the ability to select alternative highway routes that could place waste shipments to Yucca Mountain on a host of alternative routes other than U.S. Department of Transportation preferred transportation routes" (i.e., the interstate highway system) (p. 1). "The central theme of the WIPP transportation program (for shipments of transuranic wastes to Carlsbad, New Mexico) is the avoidance of major metropolitan areas,"…and the DOE program for shipment of low-level wastes for disposal at NTS has diverted shipments to a variety of routes through rural Nevada "in order to avoid the Las Vegas Valley…. (These) low-level waste routes are being treated as a precursor for high-level waste shipments to Yucca Mountain. If and when Yucca Mountain shipments begin, the State of Nevada would probably designate alternative routes similar to those now being used by the LLW program" (p. 6).

The Report estimates that, under these assumptions, shipments of SNF from four commercial sites in northern California, Oregon, and Washington, as well as shipments of HLW from Hanford and the Idaho National Engineering and Environmental

Laboratory (INEEL) could travel along US-50A and/or US-95 through Churchill County. Under DOE's "mostly truck" scenario, the number of shipments could range from 5,450 (11% of the Proposed Action total) to 19,193 (20% of DOE's "module 1&2" total) (p. 8).

The Report notes that an interim storage facility in Skull Valley, Utah could reduce the number of spent fuel shipments on US-50A/US-95, while increasing the number of eastbound shipments on the I-80 or the UP railroad routes, which cross the northwest corner of Churchill County (p. 10).

Local Vulnerabilities

The Report identifies several local vulnerabilities to YMP impacts:

- "Just over 90 percent of the Churchill County population is located in the Fallon urban area" (p. 1), where US-95 (extending south from I-80) and US-50A (extending east from I-80) intersect. The corridor population (within one mile on each side of the highway centerline) is estimated at 19,014, and is projected to increase to 23,650 by 2010 (p. 13).

- Fallon has approximately 350 motel rooms and 100 RV spaces, all located within the corridor (p. 36). Considering occupancy, these add about 550 persons to the resident population.

- Commercial and residential development within the corridor encroaches on the highway, "in some cases at a distance of less than 30 feet, and sometimes less than 15 feet (p. 16), much closer than default assumed distances for the RADTRAN analysis used in the Yucca Mountain DEIS" (p. 18).

- In addition, the Report inventories 23 public facilities (schools, hospitals, community centers, parks, libraries, etc.), most of which "are located within one-quarter mile of the highway corridor" (p. 18).

- The intersections of the major highways in the center of Fallon are "a physically confined and busy center of urban commerce" (p. 23), where the lane widths and turning radii are "not adequate to handle … tractor-trailer vehicle types" (p. 23).

- Both US-50A and US-95 have high accident locations near the in-town intersections, and "significant portions of (both roads) project to be operating at a level of service D or F soon after waste shipments begin" (p. 24).

- The valley of the Carson River, which flows just north of the City of Fallon, is "one of the primary agricultural regions in the state" (p. 1).

- The Fallon Naval Air Station, located southeast of the city, "is the primary training facility for the U.S. Navy's Advanced Fighter Weapons School" (p. 1).

Impacts of the Yucca Mountain Project

The socioeconomic impacts identified in the Report are associated with the stigma effects of a prolonged high-level waste shipment campaign:

- A potential 10% decline in annual visitor volume could cause losses of $726 million in economic activity and $30 million in state/local taxes over the course of a 38-year shipment campaign (p. 38).

- Applying the findings of a Clark County survey of real estate appraisers and lenders to Churchill County property within 3 miles of US-95 and US-50, the Report estimates that the property value diminution could range from $29-$186 million over a 38-year accident-free shipment campaign, while a no-release accident scenario could cause diminution of $81-$430 million. The associated property tax losses are estimated at about 21% of the property value diminution (p. 44).

- The costs of upgrading and maintaining the County's emergency management and response capability is estimated at $30 million over a 38-year shipment campaign (p. 48).

- Assuming that additional costs of the YMP to state government agencies (as estimated in a 1998 report[3] and projected forward as recurring costs) would correspondingly reduce state services to local governments, the Report estimates a loss of $47-$92 million in state government services over a 38-year shipment campaign (p. 49).

- Assuming that nuclear waste shipments would also be routed through Clark County and cause stigma effects to its substantial state-distributed tax revenues, the Report estimates that Churchill County's share of the losses would total $85 million over a 38-year shipment campaign (p. 50-54).

4.1.8 Mineral County, Nevada

The Mineral County assessment is presented in its July 2001 "Mineral County Impact Report: A Preliminary Assessment of the Proposed Yucca Mountain Project and the Transportation and Socioeconomic Impacts to Mineral County" (Appendix VII).

Project Description

The Report states that, while "use of rail (the Mina route) through Mineral County is not considered a viable transportation option at this time… The (legal-weight truck) routes used for LLW shipments could become (the routes used for) high-level waste/spent nuclear fuel shipments to Yucca Mountain" (p. 4). This judgment is based on the observations that "the central theme of the WIPP transportation program is the

[3] "The Fiscal Effects of Proposed Transportation of Spent Nuclear Fuel on Nevada State Agencies" NV-NWPO, 1998.

avoidance of major metropolitan areas" (p. 4), that the recent rerouting of LLW shipments to NTS has made I-80 and US-95 the principle routes for such shipments from the northwest, and that "the State of Nevada would probably designate alternative routes (for legal-weight truck shipments of high-level wastes) similar to those now being used by the LLW program" (p. 6).

The Report estimates that, under these assumptions, shipments of SNF from four commercial sites in northern California, Oregon, and Washington, as well as shipments of HLW from Hanford and INEEL could travel along US-95 through Mineral County. Under DOE's "mostly truck" scenario, the number of shipments could range from 5,450 (11% of the Proposed Action total) to 19,193 (20% of DOE's "module 1&2" total). The Report notes that the number of shipments through Mineral County would be reduced if portions of the SNF from the above sites were stored on an interim basis at Skull Valley, Utah.

Local Vulnerabilities

The Report identifies several local vulnerabilities to YMP impacts:

- "Total population in the 1-mile corridor area (.5 miles on each side of the US-95 centerline) is estimated to be approximately 4,287" (p. 9), and is projected to increase to 5,228 by 2010. "Within the … Hawthorne area, (current) population density reaches 4,778 persons per square mile… values similar to the suburban population densities used by RADTRAN" (the model used to estimate doses from transportation of radioactive materials) (p. 16).

- The Report counts 276 motel rooms in Hawthorne and estimates that the average occupancy of motels and RV parks increases the corridor population by about 500 persons (p. 10).

- Much of the residential and commercial development in the Town of Hawthorne encroaches within 15-30 feet of US-95, increasing the potential exposure from incident-free radioactive waste shipments (p. 10).

- The Hawthorne Army Ammunition Depot (HWAAD: a 147,000-acre government-owned contractor facility between Hawthorne and Walker Lake), "stores (and produces, assembles, and tests) approximately 300,000 to 400,000 tons of primarily conventional munitions. An accident involving HWAAD activities with a truck hauling radioactive waste to Yucca Mountain could potentially have severe consequences for the Hawthorne area" (p. 21).

- The Report inventories 24 public facilities (schools, libraries, parks, hospitals, etc.) in Mineral County, finding that 21 are located within .5 mile of US-95 (p. 12).

- Though standard applications of RADTRAN would assume that the Mineral County segments of US-95 are rural areas, the Report's assessment of traffic volumes and

speeds suggests that portions of the corridor, such as the Hawthorne area, are suburban or urban in character (p. 17).

Impacts of the Yucca Mountain Project

The Report links nuclear waste transport to several types of socioeconomic and fiscal impacts:

- The Report estimates that the use of US-95 for shipments of highly radioactive wastes could reduce travelers and special event visitors to Mineral County by 10% over the 23-38 year shipment campaign. The impact on the local economy is estimated at $390-$900 million; the impact on state and local taxes is estimated at $15-$39 million (p. 24).

- The Report applies the findings of a survey of Clark County real estate appraisers and lenders[4] to property within 3 miles of US-95 in Mineral County, estimating that a no-accident scenario could result in property value losses of $6-$62 million and property tax losses of $2-$13 million over a 38-year shipment campaign. A no-release accident scenario could double or triple these figures (p. 29).

- The Report estimates the cost to improve and maintain local emergency response capability over a 38-year shipment campaign at $28 million (p. 30-33). In addition to equipment and staffing in the local emergency management, sheriff, and fire departments, the estimate includes lost wages and travel reimbursement for annual training for volunteer responders (awareness, operations, and technician level), and hospital, radiology, and other personnel.

- Assuming that transportation-related costs to Nevada state agencies would require cut-backs of current state services to local communities, the Report estimates that Mineral County would lose $3.5-$5 million in current state government programs (p. 33).

- Assuming that repository-related transportation would also affect Clark County and its visitor-gaming economy, the Report estimates that the loss to Mineral County in state-distributed revenues could be $11-$21 million over a 38-year shipment campaign (p. 34).

[4] "Clark County Results and Key Informant Surveys: Beliefs, Opinions, and Perceptions about Property Value Impacts from the Shipment of High-Level Nuclear Waste through Clark County, Nevada," Urban Environmental Research, LLC (Feb. 2000).

4.1.9 Esmeralda County, Nevada

The Esmeralda County impact report is contained in Appendix VII.

Project Description

The Report assumes that "Due the precedent set by the (DOE) low-level waste transportation campaign, and the political clout of southern Nevada, all highway shipments of high-level waste (to Yucca Mountain) would be routed through rural communities in Nevada" (p. 4).

The Report also considers potential rail transport along the Carlin or Caliente routes. Depending on the alignment chosen, the route could pass 10 miles east of Goldfield, along the western edge of the Nellis Air Force Range, or about 5 miles west of Goldfield, closely following an abandoned north-south rail corridor through Esmeralda County.

Local Vulnerabilities

The Report refers to several special local vulnerabilities to impacts from the YMP:

- Over 98% of Esmeralda County's land area (3570 sq. mi.) is controlled and managed by the federal government. The recent decline in the mining industry, combined with the population-based distribution federal Payments-in-Lieu-of-Taxes, results in a very meager local revenue base (p. 7, 14).

- The mining industry in Esmeralda County, which has a long history of "boom and bust" cycles, "is currently in the midst of a lengthy 'bust'" (p. 8), which has severely affected the county's economic and revenue base.

- The county's tourism and recreation activity is centered in Goldfield, a national historic site, with the historic Goldfield Hotel (p. 7). US-95, with its well-known 90-degree 'critical curve,' "bisects Goldfield and provides the right-of-way for the community's major water and sewer lines" (p. 23).

- Due to its economic decline, Esmeralda County has a significant indigent and senior population. "A large percentage of county resources are dedicated to assisted living and senior care programs" (p. 12).

- "Esmeralda County's emergency responders are all volunteers. They are not equipped, trained, or willing to take on the additional responsibility of responding to high-level waste emergencies" (p. 16).

Impacts of the Yucca Mountain Project

The Report states "the County does not feel that attempting to identify each potential impact and address it individually is feasible or realistic" (p. 3). Even so, it identifies several potential health-related, social, and financial impacts on the County and its residents.

- The Report states, "perhaps the most important and ignored impacts to rural counties in Nevada are those having to do with cultural cohesion…. The costs to the community due to the highly emotional conflicts associated with the (YMP) issue, the time invested by community leadership, and the breakdown in community cohesion are very real, already present, and impossible to quantify" (p. 8).

- The Report points to "possible impacts on future economic activity, including current restoration efforts on historic buildings, improvements to build community capacity, and efforts to make mining in the county more economically feasible" (p. 9). On the other hand, if the Carlin or Caliente rail line were constructed in the County, exploitation of (the County's mineral resources), which are not "presently economically feasible to ship … by truck" (p. 19), could become feasible and may benefit the local economy.

A transportation accident in Goldfield could cause loss of life, overwhelm the County's emergency response capacity, and cause a decline in tourism, an exodus of population, and declines in property value and tax revenue (p. 10).

4.1.10 Inyo County, California

Inyo County has not prepared an assessment of the impacts of the Yucca Mountain Project. However, like other affected units of government, Inyo County prepared comments on various DOE assessments, including:

1. The Draft Environmental Impact Statement (Jan. 24, 2000)
2. The Supplement to the Draft Environmental Impact Statement (June 19, 2001)
3. The Yucca Mountain Preliminary Site Suitability Evaluation (Sept. 18, 2001)

A few quotes from these response documents indicate Inyo County concerns:

- The border of Inyo County "lies just 17 miles from the Yucca Mountain site." Inyo County "would receive via groundwater radioactive materials leaking from Yucca Mountain" (#3, p. 3).

- "The EPA's radiation protection standards allow for the destruction of those aquifers that provide sustenance for humans and Federally-protected natural habitat in both the Amargosa Valley and Death Valley National Park" (#3, p. 4).

- "The DEIS lacks mitigation measures adequate to address the contamination of the regional aquifer and associated demise of the economy of the Amargosa Valley, the communities of Death Valley Junction, Shoshone, and Tecopa and the destruction of surface and groundwater sources crucial to Death Valley National Park" (#1, cover letter, p. 2).

- "The 1996 (Inyo and Esmeralda County) study of the Lower Carbonate Aquifer suggests a significant degree of hydrologic connectivity between the Lower Carbonate Aquifer lying beneath the proposed repository and surface manifestations of the same formation within Death Valley National Park" (#1, p. 8).

- "Given that Low-Level Nuclear Waste is currently being transported on State Route 127 through Inyo and San Bernadino counties, …a precedent is now being set for expanded use of the route for high-level waste and spent fuel" (#1, p. 5).

- "Currently, the State Route 127 towns of Tecopa, Shoshone, and Death Valley Junction are served by a single Volunteer Fire Protection District that is without adequate funding. In case of a serious toxic or radiological release in Inyo County, specialist response teams must be brought in from either San Bernadino or Bakersfield, a process which takes a minimum of three to four hours" (#1, p. 6).

- "Due to the lack of information in the DEIS on the relative risks posed by the possible range of rail-truck transportation scenarios, it is impossible at this time to determine whether a rail or truck-focused transportation campaign would best serve the need to mitigate the risks associated with the proposed repository. Inyo County does, however, have a preference for development and use of the Chalk Mountain Route for waste shipments originating east of California" (#1, p. 7).

- "Inyo County, with its tourism-based economy revolving around the use of Death Valley National Park, is particularly vulnerable to the economic impacts of stigma. The same holds true for risks associated with possible contamination of the regional aquifer serving commercial uses in Death Valley" (#1, p. 12).

4.2 Impacts To Native American Communities

The proposed site of the Yucca Mountain high-level nuclear waste repository is astride a very old border between the Western Shoshone (Newe) and the Southern Paiute (Nuwuvi), two large Native American entities whose aboriginal territories once covered much of what now are central and southern Nevada as well as adjacent southern Utah and southern California (see Appendix VIII for details). Within these entities in the immediate area are several federally recognized tribes and their reservation communities (Yomba Shoshone Tribe, Duckwater Shoshone Tribe, Timbisha Shoshone Tribe, Las Vegas Paiute Tribe, Moapa Band of Paiute Indians), as well as other urban and rural Native American residents and organizations (people in Pahrump, Beatty, Tonopah, Caliente, Las Vegas, and the Western Shoshone National Council, etc.).

Given the potential impacts of the transportation of nuclear waste to this proposed facility, an even broader area of concern encompassing many more Native American tribes and communities (e.g., Battle Mountain, Elko, Wells, South Fork, Ely, etc.) needs to be considered, which to date DOE has failed to do. DOE has dealt thus far only with the immediate site at Yucca Mountain and only with cultural resources at that site (see Stoffle, Halmo, Olmstead, and Evans, 1990). There has been no attempt to assess the broader socioeconomic or health impacts, or any of the special impacts that flow from the abrogation of treaty rights and the deep cultural attitudes of stewardship and custodianship that these groups feel toward their reserved lands and their larger aboriginal holdings. Furthermore, given that most tribes and other entities do not have either the in-house technical expertise or financial resources to conduct their own oversight and independent evaluations of potential impacts, they have had very little opportunity to voice their concerns and get directly involved in the decision making process on this highly significant project.

Indian tribes have unique standing under various environmental and cultural protection acts (National Environmental Policy Act, National Historic Preservation Act, American Indian Religious Freedom Act, etc.). The Nuclear Waste Policy Act officially recognized their status when it wrote into the legislation special provisions for consultation with tribes equivalent to that of states. The Act also defined the additional status of "affected Indian tribe(s)" as flowing from construction of a repository (or MRS) on reservation lands, or on lands covered by a ratified treaty. Although Yucca Mountain is not located on a reservation, tribes would argue that it is within lands covered by the Treaty of Ruby Valley of 1863, a ratified treaty (18 Stat. 689-92; see Western Shoshone Claims Issues, below). DOE has recognized "affected counties" and supplied them with monies for preparatory studies. But thus far, the status of "affected Indian tribe(s)" has not been awarded, although at least one tribe formally applied and was rejected. The Timbisha Shoshone Tribe has recently applied for affected Indian tribe status. That application is pending. Tribal assertions of broader existing tribal rights and interests have been ignored.

Native American Socioeconomic and Health Issues

Native American populations, especially reservation populations, in the immediate vicinity of Yucca Mountain and at a greater distance, are poorly positioned to withstand any economic difficulties that might arise from the siting of this repository. They are, for the most part, economically disadvantaged when compared to their urban and rural neighbors. In 1990, of the 550 (900 + enrolled) persons residing on the four reservations in Nye and Clark counties (+ Timbisha, CA), average incomes were one-third to one-half lower than those of their non-Indian neighbors [Nye County, 1990: reservation incomes, $18,646; county as a whole, $34,196. Clark County, 1990: reservation incomes, $20,000; county as a whole $35,172 (see Table 7.2 in Fowler 1995:109)]. Unemployment rates were also much higher, with Nye County reservations (Yomba, Duckwater) showing on average 26% unemployment (as compared to 7% for Indians in the county and 5.4% for the county as a whole); and Clark County at 14.7% for the Las Vegas and Moapa reservations (9.7 for Indians in the county and 6.7 for the county as a whole). These profiles are likely quite applicable to other rural and urban reservation situations in the State. Although comparable figures are not yet available for the 2000 U.S. census, it is doubtful that the figures have changed appreciably. Only the Las Vegas Paiute Tribe, which, since 1990, has been involved in a vigorous economic development strategy, is predicted to show much improvement. However, given that this success is based on tourism, they are now vulnerable to the same factors that can affect an economic downturn for the entire Las Vegas Valley, such as the stigma of a nearby repository and the negative economic effects of the HLW shipping campaign.

Native American communities and individuals are also poorly positioned to profit from potential employment that might come from jobs generated by the repository, unless these jobs are largely for unskilled workers. Roughly 2% of individuals on reservations have any college education. The figures for urban Las Vegas are better (30%), but many of these individuals are already employed. Reservation and urban populations alike see high-risk health factors as particularly disturbing. Reservation residents feel particularly vulnerable to past and future contamination of the land, water, and plant and animal resources because their present subsistence strategies involve all of these (cattle, hunting, gathering). They have participated, and continue to participate, in studies by the Childhood Cancer Research Institute, the Native American Radiation Health Network, the Citizen Alert Native American Program, and others involved in assessing past and potential dangers from radiation, out of deep-seated fear that they are already contaminated. They continue to be part of anti-nuclear protest demonstrations on the local, national, and international levels, and the Western Shoshone National Council has declared their lands a Nuclear Free Zone. They have very low levels of trust in government to build and run this project safely and see threats to personal and family health, water contamination, general damage to lands, air, and traditional teachings, and a worsening of their economic well-being as the outcome of construction and operation of the site (see Appendix VII for details).

Transportation Issues

Native Americans are very vulnerable populations when transportation of nuclear waste to the proposed repository is considered. All of the communities listed are on existing or proposed transportation corridors: 1) the Moapa Reservation is transected by I-15 and also by a main north-south rail line from Utah; 2) the Las Vegas Colony is on the edge of I-15 and astride the same railroad tracks - and close to a major downtown Las Vegas switching yard. Their Snow Mountain lands are cut by U.S. 95 between Las Vegas and Yucca Mountain and by one of the potential rail lines; 3) the Duckwater Reservation is very close to U.S. 6, as is the Ely Colony, and to several of the proposed rail spurs that access the NTS from the east; 4) the Timbisha Shoshone Tribe has lands at Scotty's Junction on U.S. 95 and on the proposed Carlin/Caliente/Bonnie Claire rail line; 5) Wells, Elko, Winnemucca, Battle Mountain, and Lovelock are on I-80 to the north and existing rail lines; and 6) Yomba is close to a proposed rail spur from the north. Only Duckwater has any personnel with EMT training, and they are not prepared for nuclear disasters.

The State of Nevada has defined transportation-affected Native American lands and resources to included the following:

(1) reservations crossed by potential shipping routes;

(2) off-reservation ceded lands, where Tribes retain treaty rights or other legally-recognized user rights, crossed by potential shipping routes;

(3) reservation lands and off-reservation lands within transportation emergency evacuation zones along potential shipping routes;

(4) reservation and off-reservation lands that could be contaminated by air or water transport of radioactive materials released in a severe transportation accident or terrorist incident (generally within 50 miles down-wind, down-stream, or down-gradient of a potential shipping route);

(5) reservations whose highway access would be disrupted by a nuclear waste transportation emergency; and

(6) off-reservation lands along potential shipping routes where Tribal personnel would likely be involved in transportation emergency response.

The Yucca Mountain DEIS ignores the major concerns identified by potentially affected Indian Tribes in Nevada, the Western Shoshone National Council, and organizations such as the Nevada Indian Environmental Coalition and the Inter-Tribal Council of Nevada. These concerns include:

(1) Tribal authority to regulate shipments across reservations;

(2) emergency response planning and training for Tribal personnel;

(3) advance notification of shipments and shipment monitoring;

(4) protection of Native American religious and cultural sites, plants, and animals, both on and off reservations;

(5) cultural implications of potential radiological contamination of Indian lands and the cultural implications of cleanup activities involving non-tribal personnel; and

(6) adverse economic impacts of public perception of risk, especially adverse impacts on tribal tourism and recreation businesses.

DOE's proposal to construct a rail spur to Yucca Mountain creates special concerns about right-of-way acquisition implications for Western Shoshone land claims (Ruby Valley Treaty) and about protection of graves, religious sites, and other cultural resources within the potential rail corridors identified in the DEIS.

Moreover, DOE failed to provide financial assistance to facilitate independent technical review of the DEIS by potentially affected Indian Tribes in Nevada.

Western Shoshone Claims Issues

As noted above, the NWPA allows qualification as "affected Indian tribe" of any federally recognized tribe that has a ratified treaty covering lands being considered for a high-level nuclear waste repository. The Western Shoshone (several federally recognized tribes) have such a treaty, the Treaty of Ruby Valley of 1863, which did not cede lands. In 1985, the U.S. Supreme Court held that an award to the Western Shoshone people of monies by the Indian Claims Commission in 1979 constituted payment for their lands, regardless of the fact that the Western Shoshone people for more than 20 years have refused to accept these monies. But the decision was ambiguous enough to allow pursuit by the Western Shoshone National Council (an overarching governmental body that includes several constituent tribes) and several Shoshone individuals of other legal options. In 1999, the Yomba Shoshone Tribe entered a "Request for Urgent Action" to the United Nation's Committee for the Elimination of Racial Discrimination (CERD). The request asked CERD to direct the United States to halt all actions that do irreparable harm to the Western Shoshone and to enter into negotiations with the tribe to solve land rights issues. After hearing direct testimony in August 2001, the CERD expressed concern over the situation and recommended that the U.S. address the Western Shoshone's concerns. Thus, potential legal issues remain.

Summary of Native American Impacts

Most Native Americans in Nevada do not want the disturbance of cultural resources that they see as the inevitable outcome of the Yucca Mountain project. Mitigation of disturbed archaeological sites is seen as an unacceptable alternative. They would prefer that no disturbance take place at all.

Native American tribes in the immediate vicinity of the Yucca Mountain project area and along potential transportation routes are, for the most part, economically disadvantaged. Reservations and communities in Nye, Lincoln, Clark, and Inyo counties are rural and isolated and either lack a land base or have land bases too small to support their populations by ranching or other locally common means. A large number of people are unemployed, underemployed, poorly educated, and/or are living below the poverty level. Any negative statewide economic impacts associated with or caused by the repository or repository-related nuclear waste transportation would have a disproportionate impact on such communities because of these depressed baseline conditions.

Table 4.2.1 below summarizes, by area, the various impacts on Native American communities identified in studies undertaken by the State of Nevada between 1987 and 2001.

Table 4.2.1 Native American Impacts: Transportation

Area	Source	Data Base	Information	Major Results	Type/Range of Impacts
Moapa Paiute Reservation I-15, SPRR cross tribal land	Rusco 1989 NA0013	Interviews	attitudes to accident scenarios	order of concerns: tribal/personal health; tribal economy worse; cultural resources damaged;	severe in all accidents, also just presence
	Dufort 1995	extensive interviews	health assessments, general ethnography	infrastructure cannot cope; downwinder effects already perceived; worsening with repository	potentially severe; mental anguish; loss of quality of life
Las Vegas Paiute Colony/Snow Mountain Reservation; SPRR immediately adjacent; US 95 crosses lands	Fowler 1995 Fowler and Zabarte 2001	Interviews	attitudes to crossing tribal lands, accident scenarios	major health impacts perceived; major economic impacts, especially to Snow Mountain economics; drop in tourism	severe in all categories
Timbisha Shoshone Tribe US 95 crosses tribal lands	Fowler and Zabarte 2001	Interviews	attitudes to crossing tribal lands	severe; would not be able to develop property just obtained due to economic impacts; no housing because of health concerns	severe in all categories
Yomba Shoshone Reservation, Duckwater Shoshone Res., Ely, Elko, Timoak, Battle Mountain Res.	Fowler and Zabarte 2001	Interviews	alternative transportation routes in north and central areas would all impact tribal lands	health; lack of infrastructure for EMT response; economic impacts	severe for all groups

Table 4.2.1 Native American Impacts: Legal

Area	Source	Data Base	Information	Major Results	Type/Range of Impacts
Western Shoshone	Rusco, E. 1991 NA0022	Literature review	legal history of Western Shoshone Claims; State of Nevada hunting and fishing laws and Western Shoshone	ambiguity of claims decision; Supreme Court response; State response by allowing W. Shoshone to monitor hunting and fishing in	severe lack of trust in government; US and international law implications
	Fowler 1995 Fowler and Zabarte 2001	update of literature reviews	present standing of Claim	State continuing the battle over Western Shoshone Claim, including international tribunals	severe lack of trust in government continues; international law implications
Western Shoshone and Southern Paiute governments	Fowler and Zabarte 2001	interviews with tribal governments	lack of "affected tribe" status under NWPA	tribes have received no funding to plan, develop infrastructure for monitoring; considering health and economic consequences	severe; tribes cannot afford to be involved in the planning that is necessary

Table 4.2.1 Native American Impacts: Cultural

Area	Source	Data Base	Information	Results	Type/Range of Impacts
Las Vegas, Moapa, Panaca, Pahranagat Southern Paiute; Yomba, Duckwater Shoshone	Fowler, Rusco and Hamby 1988 NA003	literature review	location, subsistence, resources, settlements, sociopolitical, ceremony, ritual practices	baseline data	none involved
Southern Paiute, Shoshone tribes	Cultural Resources Consultants 1988; NA005	Archaeological site visits, Yucca Mountain	attitudes, interpretation of site	area of cultural and spiritual importance	sites would be destroyed, disturbed; must be mitigated; no real mitigation possible.
Southern Paiute Western Shoshone Tribes	Hamby and Rusco 1988 NA009	questionnaire on risk perception	perceptions of damage to land, water, cultural resources	scaled responses; much stronger than general population	severe; cannot be mitigated
Timbisha Shoshone	Hamby 1989 NA0015	intensive field studies	demographic, economic; cultural attitudes	high negative responses to project, transportation would damage environment and cultural resources	severe; cannot be mitigated
All Native American groups	Fowler (with Hamby and E and M. Rusco 1991 NA0021	summary statement	AIRFA, NHPA, cultural resources; cultural themes and values	project disastrous to cultural resources, values, quality of life	

Table 4.2.1 Native American Impacts: Economic

Area	Source	Data Base	Information	Results	Type/Range of Impacts
Las Vegas Colony, Snow Mountain Reservation	Fowler and Zabarte 2001 Cultural Resources Consultants 1988 NA004	Informal interviews socioeconomic surveys	economic on tribal golf courses, tribal smoke shops household composition; education levels; family composition	decline with fall in tourism, comparable to Las Vegas baseline data	Severe not part of study
Pahrump - Amargosa Valley	Fowler, Hamby and Rusco 1987 NA0001	survey, field studies	labor force statistics; education levels; income; tribal enterprises	baseline	fiscal impact to individuals, tribes
All Native Americans in study area	Fowler, Hamby and Rusco 1987 NA0001	literature review	economic characteristic sociopolitical features; settlement patterns	baseline	fiscal impact to tribes, individuals
Esmeralda Co., Lincoln Co. and Death Valley	Hamby 1988 NA0006	survey	demographics, household composition, education, labor force, income	baseline	not part of study
Western Shoshone, Southern Paiute	Hamby and Rusco 1988 NA0009	questionnaire, risk perception	employment opportunities lacking	negative on NTS testing to date; negative on improvement of employment opportunities with project	higher negative values than same survey with rural, urban non-Indian people
Duckwater Reservation	Hamby 1991 NA0024	field work	socioeconomic, demographic, income, education, health care	baseline	present services would be inadequate to cope with emergencies, quality of life issues
Las Vegas Tribe	Rusco, 1991 NA0023	field work	socioeconomic, demographic, income, education, health care	baseline	present services would be inadequate to cope with emergencies, quality of life issues
Yomba Reservation	Rusco, E. 1988 NA0008 Hamby 1991 NA0025	literature review field work	history, economy, socioeconomic, education, labor force, community services	baseline baseline	not part of study, conditions very poor; would worsen with project

Moapa Reservation	Rusco and Hamby 1988 NA0007	literature review, interviews, 1980 census	housing, health care, education levels, labor force, income,	baseline	economic conditions poor; would worsen with project
Moapa, Las Vegas, Yomba, Duckwater	Fowler 1995	1990 census, BIA work force reports	unemployment statistics; education levels, income levels	unemployment averages 12-28%; education levels on res. 1/3 of Indians in counties, which are well below average	conditions are improving slowly; reservation people, non-reservation unlikely to be advantaged in getting jobs because of ed. levels

Table 4.2.1 Native American Impacts: Health

Area	Source	Data Base	Information	Results	Type/Range of Impacts
Southern Paiute, Western Shoshone	Fowler, Hamby, Rusco and Rusco 1991	questionnaire	risk perceptions	personal and family health threats 7.7 on 10 pt. scale; contamination of food supply because of subsistence level	severe
Moapa	Dufort 1995	field work	health studies	characterizes present health status, delivery of health care; emergency preparedness	would be severe impacts in any type of accident; worsening of all health conditions
All areas	see all baseline documents	field work	health studies	gives baseline health care, delivery system for each community in study area	emergency preparedness very low; EMT required and aid to all communities

CHAPTER FIVE
SUMMARY AND CONCLUSIONS

"[A] nuclear waste repository should not be built until it can be shown, beyond the shadow of a doubt, that the facility can, in fact, do what its advocates claim - isolate radioactive materials from the biosphere for more than 10,000 years - and that construction of such a repository would be benign in its effects upon the people, the environment and the economy of the state or region within which it would be located. We owe nothing less to our state or to our nation."

In 1986, former Nevada Governor Grant Sawyer, first chairman of the Nevada Commission on Nuclear Projects, set forth these criteria as the benchmark by which DOE's proposal for a high-level nuclear waste repository at Yucca Mountain or anywhere else must be judged. Nevada's oversight and impact assessment efforts over the years have been guided and shaped by these simple, yet profound standards.

The findings from nearly two decades of intensive oversight and impact assessment research, as documented in this report, demonstrate convincingly that the effects of the Yucca Mountain project are not at all benign. In fact, the program has the potential to wreak economic and environmental devastation on the State of Nevada and on at least 43 other states, hundreds of major cities, and thousands of communities across the country through which SNF and HLW must travel en route to a Nevada facility.

A decision by the President to forge ahead with this transparently flawed project in the face of Nevada's strong, long-standing, consistent, ubiquitous, and scientifically based opposition would also have damaging consequences for the nature and shape of American federalism now and in the future, as the nation pursues solutions to other difficult problems involving hazardous facilities and controversial technologies.

What began in 1982 as a noble piece of federal legislation that promised to place science ahead of politics, and fairness, equity, and openness above congressional parochialism has degenerated into a technical and ethical quagmire, where facts are routinely twisted to serve predetermined ends and where "might makes right" has replaced "consultation, concurrence, and cooperation" as the guiding principle for the program. The shoddy and politically driven science, the heavy-handed federal approach, and the constant changing of the rules in response to "inconvenient" findings regarding site suitability have created an atmosphere of severe distrust, where the already significant impacts associated with the nuclear nature of the program are further exacerbated and amplified. The result is a massive suite of negative impacts, inextricably linked to the Yucca Mountain program, that are unprecedented in the history of federal government domestic projects.

Even the establishment and operation of the Nevada Test Site in the 1950s did not pose as great a threat to the State and the nation as Yucca Mountain does today because times were different; the severe (and, as it turned out, justified) aversion to things nuclear

had not developed; and the atmosphere of pervasive distrust and cynicism with respect to DOE [then known as the Atomic Energy Commission] did not exist.

The conclusions of this report, set forth below, present a compelling case that Yucca Mountain and its unprecedented nuclear waste shipping campaign would do irreparable harm to the State of Nevada and to the nation.

Impacts to the State of Nevada

Economic Impacts

(1) The most serious and possibly catastrophic economic risk for Nevada stemming directly from the Yucca Mountain project is the potential for stigma impacts on the tourist and visitor industry. Such impacts could produce significant losses to an economy dominated by visitor-based revenues. Dozens of studies spanning two decades show that populations important to Nevada's economic well-being are highly sensitive to the radioactive risks associated with a repository and spent fuel/HLW transportation. These project conditions threaten the attractiveness of the State as a place to visit, move to, or invest in.

(2) A radioactive waste accident or incident that causes Las Vegas to become even moderately associated with radioactive imagery would have major negative economic impacts for the area's visitor economy, in-migration, and economic development. Estimates of between 5 and 30 percent or larger reductions in key economic sectors are consistent with the empirical evidence gathered.

(3) Annual losses to the Las Vegas and Nevada economy could be expected to reach $39 billion or more in the event of a nuclear waste accident. Even without an accident, the Nevada economy stands to lose upwards of $5.5 billion annually as a result of the stigmatizing effects of the repository and HLW shipments through the State.

Property Value Impacts

(1) The transportation of SNF and HLW within the State of Nevada imposes significant risks to property values along nuclear waste shipping routes. In Clark County, real estate experts estimate losses to property would range from $5.6 billion to $8.8 billion in the event of a serious transportation accident. Even without a serious accident, property value losses would be as much as $1.6 billion along either of the two likely HLW shipping routes.

(2) Property value impacts would occur in other parts of the State as well. In Washoe County, residential property value losses along the I-80/Union Pacific railroad corridor are estimated between $1.9 and $2.2 billion in the event of a

HLW accident. In Elko County, potential losses along I-80 could reach $129 million or more. For the State as a whole, property value impacts along Yucca Mountain shipping routes can be expected to be in the tens of billions of dollars, given the nature of the required Yucca Mountain transportation system.

Impacts to State of Nevada and Local Public Safety Agencies

(1) The Yucca Mountain program would place an overwhelming fiscal burden on State of Nevada agencies as a result of HLW shipments within the State. Costs to agencies just to prepare for such shipments and for the first year of operations are estimated at over $657 million. Costs for dealing with the entire four decades of shipments have not been estimated, but could likely reach several billion dollars

(2) Local government public safety agencies would be especially hard hit by the Yucca Mountain shipping campaign. The startup cost to Clark County public safety agencies alone is projected to be almost $360 million (in 2007 dollars). Significant additional annual costs would be incurred in response to the continued operation of a repository and the transportation of HLW. These estimates do not include the fiscal impacts to southern Nevada hospitals that are not adequately prepared in terms of training, decontamination facilities, and necessary personnel and equipment.

(3) Startup costs to public safety agencies statewide could reach several billion dollars, given the extent and nature of the Yucca Mountain nuclear waste shipping campaign.

Impacts to Native American Communities

Because of their uniquely vulnerable circumstances, Native American communities in Nye, Clark, Lincoln, and Inyo counties could be disproportionately impacted by the Yucca Mountain project and the transportation of SNF and HLW to the facility. More than a decade of field research shows that a range of such impacts could occur, including negative consequences for economic well-being, public health, environmental health, and culture. Furthermore, any negative economic impact to Nevada's visitor economy would have a disproportionately damaging effect on Native American communities because of their socially and economically vulnerable conditions.

Impacts to Local Governments in Nevada

At least 13 of Nevada's counties will be directly impacted by the federal HLW program - by Yucca Mountain construction and operation activities, by the performance of the repository system over thousands of years, and/or by the massive and unprecedented SNF and HLW shipping campaign required to move waste through the State to the repository. The impacts involve public health, economic stability, community

development, public revenues, essential community services, and damage to the state's system of governance.

Significantly impacted localities include both of the State's major population centers, the Las Vegas metropolitan area and the Reno-Sparks metro area, as well as rural counties and communities throughout the State. Major impacts to local governments include:

(1) The site county—Nye County—would be uniquely affected by the Yucca Mountain Project. Not only is it at "the end of the funnel" for the massive waste shipping campaign, but the Yucca Mountain Project also threatens this growing county's efforts to develop and sustain a viable economic and revenue base in the aftermath of 40 years of nuclear weapons testing on DOE's adjacent Nevada Test Site.

(2) The magnitude of potential economic and fiscal impacts is greatest in Clark County, the state's major metropolitan area, located at the convergence point for default highway routes and on the corridor for one of the state's two mainline railroads. Over 80% of the state's dominant visitor-gaming industry is located in Clark County and concentrated in areas adjacent to prospective highway or rail shipment routes. The Las Vegas visitor-gaming industry is particularly vulnerable to stigma effects linked to the repository program and the nuclear waste transportation associated with it. The stigma impact could also negatively affect economic development, migration, and investment in southern Nevada.

(3) Clark County property value losses associated with the Yucca Mountain program could be as large $8.8 billion in the event of a serious accident involving a spent fuel shipment. Even without a serious accident, the stigma effects associated with radioactive waste shipments through Las Vegas could cause property values to decrease by $236-$463 million, with additional government service impacts (public safety related and otherwise) of several hundred million to over a billion dollars.

(4) Rural communities in central Nevada are particularly vulnerable to the effects of an unprecedented shipment campaign for the nation's highly radioactive wastes, the modes and routes for which are uncertain. Typically in these counties, the economies are fragile, the service systems (particularly emergency and medical response services) are very limited, the road systems are inadequate for such uses, and residential and community activity is clustered closely along the prospective nuclear waste routes.

(5) Even counties that are not "affected units of government" under the Nuclear Waste Policy Act would be negatively affected by the prospective shipment campaign. Of particular note are Washoe County, the state's second largest metro area and visitor-gaming center, and Elko County, the urban center of

northeastern Nevada. Both communities are astride an interstate highway and mainline railroad that could be used for high-level waste shipment. Washoe and Elko counties have estimated property value losses at $1.9-$2.2 billion and $109-$129 million, respectively. Other counties and cities along the routes of Interstate 80 and the Union Pacific mainline would experience comparable decreases in property values due to a Yucca Mountain shipping campaign.

(6) Nevada's state-local revenue structure includes critical sales tax and other revenues that are distributed among localities by formula. Thus, stigma-related damage to the state's metropolitan economies (particularly the visitor-gaming economy of Clark County) would have direct fiscal consequences for local governments across the state, many of which are already in fiscal stress. Visitor spending produces 19% of the taxes for local jurisdictions, currently about $1.3 billion per year. A 7% decline in visitor spending, projected for the no-accident scenarios, would reduce local government tax revenues by $91 million annually.

(7) Given the extreme differences among Nevada's local jurisdictions (in economic base, revenue resources, population and growth, federal land presence, political influence, etc.) and the highly differentiated consequences of the Yucca Mountain Project among the state's localities, the Yucca Mountain site characterization process has caused conflict among localities and in state/local relationships that has already had damaging impacts on the system of governance within the State. These impacts would be exacerbated if the Yucca Mountain project proceeds, with conflicts broadening along rural-urban and north-south lines.

(8) Development in rural Nevada counties, such as that taking place in southern Nye County, depends upon the attractiveness of the State and these communities. Nuclear waste images would diminish the appeal of Nevada's rural communities for business investment, retirement, and job in-migration.

Transportation Impacts of the Yucca Mountain Program

Of all impacts associated with the Yucca Mountain program, none are as far-reaching and pervasive as transportation. Tens of thousands of shipments of deadly SNF and HLW would impact Nevada and 43 other states, hundreds of cities, and thousands of communities, day after day, week after week, month after month for 38 years or more. Transportation would be the principal instigator of impacts ranging from losses in property values to depressed economic activity to escalating and unfunded preparedness and response costs to social disruption and even civil unrest. The release of radioactive materials following a severe accident or terrorist incident could precipitate a human health and economic catastrophe. Among the most important impacts for Nevada and the nation are the following:

(1) About 123 million Americans live in the 704 counties along potential highway routes to Yucca Mountain. About 106 million Americans live in counties along potential rail routes to Yucca Mountain.

(2) The "mostly truck" scenario would send 96,000 shipments through 44 states. The mostly rail scenario would send 19,800 rail shipments through 43 states, plus 3,700 truck shipments through 23 states, and up to 2,200 barge shipments through the ports and waterways of 13 states.

(3) Shipments to Yucca Mountain would traverse up to 58 Indian Reservations, including 14 Indian Reservations in Nevada.

(4) Truck shipments to Yucca Mountain could be a daily occurrence in major metropolitan areas like Atlanta, Nashville, Cleveland, and San Bernardino. Chicago could experience a truck shipment every 15 hours; St. Louis, Kansas City, and Denver, every 13 hours; Des Moines and Omaha, every 10 hours; and Salt Lake City, every 7 hours.

(5) Rail shipments to Yucca Mountain would be a daily occurrence in Nevada, Utah, Wyoming, Nebraska, Colorado, and Illinois. Every other day, rail shipments would cross Iowa, Missouri, Kansas, and Indiana. There would be at least one rail shipment per week through Alabama, Arizona, Georgia, Idaho, Kentucky, Ohio, New York, Pennsylvania, and South Carolina.

(6) Routine radiation from shipping casks poses a clear health threat to certain transportation workers. Safety inspectors, truck drivers, and rail crews could receive cumulative doses large enough to increase their risk of cancer death by 15 percent and their risk of other serious health effects, including genetic damage to future generations, by 50 percent or more. DOE proposes to control these exposures and risks by limiting work hours and doses.

(7) Routine radiation from shipping casks poses a potential health threat to certain members of the public. Service station attendants could receive 100-1,000 mrem doses per year. Motorists could receive 40 mrem during a traffic gridlock incident. Residents near certain routes in Nevada could receive 5-45 mrem per year from passing casks. Such exposures could increase the risk of certain health effects, such as mental retardation in unborn children.

(8) Routine radiation from passing casks would deliver small radiation doses to members of the public within one-half mile of highway and rail routes. Nationally, 7-11 million people reside within one-half mile of a truck or rail route. Even though these dose levels are well below the established thresholds for cancer and other health effects, research shows that the mere presence of sustained numbers of such shipments through communities can devalue – and has devalued – property by as much as 4.75 percent. Applied nationally, the economic impacts of such devaluation would be devastating.

(9) A successful terrorist attack on a truck cask involving the release of radioactive materials in an urban area could result in 6-165 latent cancer fatalities and $3.1-20.9 billion in cleanup costs. Incidents of greater severity are credible.

(10) In Nevada, 13 counties, including the State's major metropolitan areas, would be directly and significantly affected by Yucca Mountain-related nuclear waste transportation. At the end of the shipping 'funnel', Nevada communities would experience up to 96,000 shipments during a shipping campaign that would span four decades.

(11) The Las Vegas metropolitan area could receive more than 2,500 truck shipments per year, an average of one truck every four hours. Under the minimum impact scenario, Las Vegas would receive 620 shipments per year, an average of one truck or rail cask every 14 hours.

(12) In Nevada, research has shown that, in the event of an accident or incident resulting in the release of radiation, property value impacts throughout the State would be in the billions of dollars (see above). Such property value impacts would also likely occur in cities and communities throughout the country along nuclear waste shipping routes.

(13) A severe truck accident in Las Vegas involving the release of radioactive material could contaminate up to 4.3 square miles. Acute radiation exposures during the first 24 hours could result in 2.7 latent cancer fatalities. Decontamination would cost over $1.7 billion (exclusive of the costs of evacuations and economic disruption caused by the event). A decision not to clean up the contaminated area could result in between 200 and 1,300 cancer fatalities over 50 years. Accidents of greater severity could occur.

(14) A severe rail accident in Las Vegas (or elsewhere) involving the release of radioactive material could contaminate up to 40 square miles. Acute radiation exposures during the first 24 hours could result in 400 latent cancer fatalities. Decontamination would cost over $15.4 billion (exclusive of the costs of evacuations and economic disruption caused by the event). A decision not to clean up the contaminated area could result in between 6,000 and 41,000 cancer fatalities over 50 years. Accidents of greater severity could occur.

Yucca Mountain's Impact on the Federal Budget and the American Taxpayer

Because of the steadily escalating costs of the Yucca Mountain program, it is expected that the total life cycle cost of the project would leave the federal budget, and by extension the American taxpayer, with a major unfunded liability. Current estimates are that the Nuclear Waste Fund, which was originally intended to pay the largest share of

repository program costs, would generate, at most, $41 billion. This is an extremely optimistic estimate, given the uncertainties involved with the operational capabilities and lifetimes for existing nuclear power reactors and the highly uncertain future for any new nuclear plants.

Most current estimates by DOE and, independently, by the State of Nevada have place the total cost of the repository program between $54 (State) to $59 billion (DOE). However, given the continued escalation in program costs over the past five years (in 1998, DOE estimated the total life cycle system cost at just over $28 billion), the actual cost of the program would likely be considerably higher, with informal estimates now approaching as much as $75 billion.

The Yucca Mountain program would mean an overall deficit for the federal budget in the range of $18 to $35 billion or more. This shortfall would occur at a time when the government's ability to assess utility companies additional fees based on nuclear electricity generation (as is currently the case) would have greatly diminished, if not disappeared altogether. If continued, it is inevitable that Yucca Mountain would become a net drain on the federal budget and a fiscal liability of enormous proportions for future generations.

This situation is compounded by the fact that, in the event of a serious SNF or HLW transportation accident, neither Congress, DOE, nor any other federal entity has considered what the costs will be nor how to pay for the negative impacts on property values, damages to ongoing economic activities, foregone opportunity costs, or the exploitation of vulnerable individuals and communities who will be directly affected. These costs would be greater than the entire repository program costs by a factor of ten or more.

Overall Conclusion

The inescapable conclusion of the findings presented in the foregoing chapters is that the Yucca Mountain program and the unprecedented nuclear waste shipping campaign associated with it cannot be implemented without incurring major, unacceptable impacts and untenable costs, and without putting people, their communities, and the environment at substantial risk throughout the country. The fact that DOE has not assessed these risks and impacts and has ignored several decades of research concerning them is reason, of itself, for the President to reject any recommendation from the Secretary of Energy to proceed with the Yucca Mountain program.

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