Introduction

The U.S. Department of Energy’s (DOE) Yucca Mountain Draft Environmental Impact Statement (EIS) contains no analysis of the impacts the Yucca Mountain high-level radioactive waste repository (HLRW) program will have on the State of Nevada’s principal economic sector and on other areas of the Nevada socioeconomic context vulnerable to stigma effects of the Proposed Action. Nevada is unique among all of the states in its heavy reliance on tourism for its economic well-being. A repository at Yucca Mountain, just 100 miles from Las Vegas, and the transportation of spent nuclear fuel and high-level radioactive waste (HLW) to such a facility have the potential to significantly and negatively impact the State’s economy. This Appendix is provided to demonstrate the substantial body of research and information available for conducting a credible Socioeconomic Impact Assessment (SIA) that fully addresses the potential effects of the Yucca Mountain project, including the most important and potentially most damaging economic stigma impacts.

Impacts associated with stigma attached to nuclear and/or hazardous facilities and activities are not psychological effects. They are real, definitive, quantifiable impacts that are directly manifested in economic indicators such as reduced property values, reductions in tourism and conventions, suppressed economic development, and reduced business investment. A substantial body of information and research exists, some of it generated through DOE and DOE-sponsored research, that can and should be used in any assessment of impacts related to the federal HLRW program.

The attached bibliography provides references for the basic social science literature that should be consulted and utilized in preparing an EIS. These references are shown in three categories: 1) Background and socioeconomic responses to managing and siting high-level radioactive waste facilities; 2) Basic literature on perceptions of risk from HLRW materials, programs, and projects, the conceptual framework of the social amplification of risk, and technological stigma including the special stigma associated with nuclear facilities and radioactive conditions; and 3) An annotated bibliography of reports and data produced by the State of Nevada’s socioeconomic studies of Yucca Mountain. Most of the Nevada materials are publicly available and have been provided to DOE over the years.
Understanding Public Responses to High-Level Radioactive Waste

Public responses to facilities and programs designed to store or dispose of 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. The details of 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 impacts from the proposed repository at Yucca Mountain.

Over the past two decades, social scientists have developed the theories, methods, data, and analytic capabilities to describe, understand, and project the range of potential socioeconomic impacts. These developments have been presented to DOE’s Office of Civilian Radioactive Waste Management (OCRWM) in many ways and on numerous occasions. Reports have been submitted to DOE. Papers have been presented at conferences attended by DOE personnel and their contractors. Testimony has been presented in venues attended by, and in some cases even organized by, DOE. Major publishers have issued books on these subjects, and peer-reviewed articles have appeared in leading journals and magazines. The 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 to DOE and contractor personnel assigned duties of impact assessment, even to those with only rudimentary social science backgrounds.

The Nuclear Waste Policy Act of 1982 (NWPA)

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

Several provisions 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 important process issues in site selection. DOE was required to report to affected stakeholders (state governments, Indian tribes, public, etc.) on all activities. The selection process was to be based upon technical criteria, and this was to be subject to outside scrutiny and review. DOE was directed to consult and cooperate with affected states and tribes before making key decisions. Participation by the affected states and tribes to oversee the repository program and conduct socioeconomic 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 (EPA) the duty to set radiation exposure standards and gave the U.S. Nuclear Regulatory Commission (NRC) the authority to permit and license construction and operation of a repository facility. The provisions for fairness and public safety were designed to make the eventual choice of a site acceptable to those directly affected. 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 OCRWM and the Site Selection Process, 1983-1987

Key issues, concerns, and problems that produce social and economic impacts and limit public acceptance and support were clarified during the early years of the OCRWM 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 process 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 HLRW facilities. Tennessee argued that a Monitored Retrievable Storage (MRS) 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-round 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).

This early history of public responses throughout the nation in response 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 HLRW programs. In terms of socioeconomic impacts, it became clear during this period that HLRW 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.

As one of several sites being considered, the State of Nevada outlined the requirements for socioeconomic assessment of the proposed facility site at Yucca Mountain in 1985 and issued a Request for Proposals (RFP) to conduct research and provide needed reports. This RFP required work to assess 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. The RFP also specified new basic research to address “special effects” that were so obviously important determinants of public responses to HLRW facilities and the economic and related impacts stemming from such responses.

The purpose of Nevada research on special effects was to devise methods for characterizing and estimating the potential for this unique class of impacts. A contractor was selected and the study team began work in March 1986. Mountain West Research, Inc. of Phoenix, Arizona headed the study team. This firm had extensive experience in socioeconomic impact assessment of energy facilities in the west and included researchers with experience in developing methods for the Nuclear Regulatory Commission, the Bureau of Land Management, and other agencies, as well as doing EIS work for federal, state, and industry clients. The effort also involved Planning Information Corporation of Denver, Colorado whose principals specialized in regional economics, fiscal, and transportation studies. Other team members included participants from Decision Research and the University of Oregon, the University of Nevada, Reno, the University of Nevada, Las Vegas, Clark University, Arizona State University, The Wharton School at the University of Pennsylvania, and Utah State University. Provisions were made to include other individuals...
and groups to address specific problems and to provide technical and professional assistance when needed.

To provide an objective review, the State established a Technical Review Committee (TRC) made up of distinguished social science researchers and professionals. At periodic meetings, State, county, and local representatives, together with the TRC, examined research plans and issues, provided rigorous peer review of study results, and gave the study team guidance. These reviewers supported state-of-the-art efforts to address the standard effects including economic, demographic, public service, fiscal, social, and cultural impacts that would be expected from a major project of this size, cost, and timeline. They also encouraged a research program to investigate and describe the unique, highly significant “special” socioeconomic impacts.

The effort to understand special effects focused on the characteristics of the Nevada economy, especially tourism, gaming, conventions, recreation, outside business investments, and the immigration of workers and retired people. The purpose was to develop methods to evaluate the potential effects of the HLRW repository within the Nevada socioeconomic context.

The Historical Case for Assessing Impacts to Nevada’s Principal Economic Sector

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 will be conducted” (emphasis added).¹

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 HLRW 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. The Nuclear Waste Policy Amendments Act of 1987 directed DOE to report to Congress on potential socioeconomic impacts that could be occur as a result of locating a repository at the Yucca Mountain site. 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 in Nevada 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.

Following the publication of the Section 175 Report, a June 1992 policy directive was issued by DOE headquarters to OCRWM Associate Directors and Office Directors.

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2 Ibid., p. 5-111, p. 6-87, p. C.7-6.
3 Public Law 97-425 [42 U.S.C. 10174(a)]
5 Ibid, page 64.
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 will guide the conduct of all OCRWM socioeconomic activities. Project-level socioeconomic plans for all OCRWM components will be prepared in accordance with the guidance provided in this document, and will 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 EIS:

- 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 (page 2)7

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

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6 Memorandum from Jerome Saltzman, Director, OCRWM Office of External Relations, dated June 3, 1992.

7 The terms “standard” impacts and “special” impacts are terms of art in socioeconomic assessment. The former refers to the impacts of the range of specific economic indicators used routinely in such assessments. The later refers specifically to those impacts that occur as a direct result of the nuclear or hazardous nature of the project and are synonymous with “stigma” impacts. In practice, “standard” and “special” effects are interrelated. Stigma effects of the project will be manifested as "standard" economic, fiscal, and impacts that can be characterized in the same units of measure as standard effects.
identifying potential stigma impacts associated with the high-level radioactive waste program 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 is not included in the socioeconomic analyses contained in the draft EIS. An excellent example of this research is the work done by the University of New Mexico under contract with DOE. Of particular interest is a study by Drs. Gawande and Jenkins-Smith 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

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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).”

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. In 1991, 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 will affect the location decisions of small businesses.”

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 to result in significant impacts to Nevada. 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. And, 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.

The fact that no assessment of “special” impacts to Nevada’s uniquely vulnerable tourism-dependent economy was conducted in the draft EIS, despite DOE’s prior knowledge of the potential for and legitimacy of such impacts, renders the socioeconomic impacts assessment in the draft document both legally and substantively deficient.

The following sections describe in some detail the research approaches, information, and findings that were available to DOE and should have been used in conducting the impact assessment contained in the Draft EIS.

**Perceptions of Risk and Trust**

Understanding how the public constructs its attitudes, opinions, and behaviors toward high-level radioactive wastes utilizes research on perceptions of risks and research on public trust of the program and the project managers. These efforts examine how members of the public view the risks from radioactive materials, from the science and technologies applied to HLRW disposal, and from the performance capabilities of the managers. The process by which perceptions influence the construction of attitudes and opinions underlies subsequent behaviors (see Kraus, 1995, for a review of the literature on attitudes and behaviors).

Research on perceptions of risk from technological hazards, including various nuclear technologies, advanced significantly in the 1970s and 1980s. The article in *Science* by Slovic (1987) serves as the basic statement of the findings from those years and as the starting point for subsequent work to understand the social dynamics of public response to HLRW. A subsequent 1991 article in *Science* by Slovic, et al. focused specifically on HLRW and demonstrated how data collection and analysis could address some of the public’s key questions about the Yucca Mountain project. Other areas of inquiry, as discussed in the following sections, addressed broader social factors (such as the role played by the media and the influence of expanded public awareness) that create conditions of stigma.

Two factors, waste materials and trust in waste managers, are often separated in formal assessments and evaluations. However, the public views both these factors as significant sources of risk. The safeguards provided by engineering and other techniques for containing the radiation from HLRW are routinely subjected to risk assessments and various levels of testing. The contributions of program and project management to risks from
HLRW are seldom afforded any similar level of scrutiny. This appears to be the case because the proposed management itself defines and performs the required risk assessments. The existing regulatory evaluation of management schemes seldom goes beyond acquiescence to assurances that new levels of performance will be achieved on a consistent basis in the future. Nonetheless, the history of DOE (and its predecessor agencies) provides extensive evidence that shortcomings and failures in management of facilities and materials are major, perhaps dominant, sources of radiation exposure. Public opinion on this matter is expressed in terms of trust or distrust of radiation waste management agencies, since this is the terminology provided. Thus, studies of public risk perceptions and trust-distrust must be examined to understand public responses to HLRW. Understanding the full range of public responses is, in turn, necessary to evaluate potential socioeconomic impacts from a repository program.

Risk Perception and the Social Amplification of Risk

The public’s knowledge of hazards and risks is based on information from many sources. At a basic level, personal experiences and interpersonal communications are involved. In the contemporary world, however, the speed and influence of the news media plays a dominant role. News of risk events is transmitted quickly and widely to a receptive public. These messages contain information about conditions that create the hazards and, in the case of technological dangers, there is both implied and specific identification of the responsible parties. Taken together, a hazard with inherent danger (e.g., radioactivity) and reports of mismanagement create serious public concern. The taxonomy used to explain the complex social processes that tie together these causal relationships was developed by Kasperson, et al. (1988) in "The Social Amplification of Risk: A Conceptual Framework." In the following decade this framework became an essential conceptual tool for social scientists who study issues of public responses to technological hazards. More than thirty peer-reviewed articles have directly dealt with this framework, and it has been widely accepted by and cited in the social science literature.

Development of the Social Amplification of Risk (SAR) framework addressed a full range of public responses - from those relating to major accidents to those cases where some relatively minor risks or risk events, as assessed by technical experts, elicit strong public responses and produce substantial social and economic impacts. The main thesis of the SAR research is that hazards interact with psychological, social, economic, institutional, and cultural processes in ways that amplify or attenuate public responses, with consequent economic effects (Kasperson, et al., 1988). This research found, among other things, that a key determinant of amplification is public belief that an event is caused by managerial
incompetence and that it is a signal of increased future risk (Burns, et al., 1993). Concern about dangers from hazardous materials, especially when associated with evidence of poor organizational control, leads to the stigmatization of places, products, and even whole technologies (Gregory, et al., 1995). The history of America's nuclear facilities provides ample evidence of stigmatization associated with the nation's nuclear technologies (Flynn, 1999).

Specific examples of stigma responses are found in public responses to the transport of nuclear wastes with associated impacts on property values. Adverse impacts on property located near nuclear facilities were found in the case of the weapons plant at Rocky Flats, Colorado (Flynn, et al., 1998). The public response to potential danger from radioactivity is characterized by strongly negative images and negative affective evaluations.

Tourist and Visitor Studies

In their work on images of place and of a high-level radioactive waste facility, Slovic and his colleagues provided a research design and outlined a set of related propositions to examine possible connections between images and stigma. The research was designed to test 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 will, 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 demonstrate a mechanism whereby the HLRW repository could adversely affect tourism, migration, and business development in Nevada. This demonstration is based upon established patterns people use to evaluate and characterize information about places as a prelude to making behavioral decisions. As such, the results from these studies do not rely 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, AZ 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 show that the affective quality of the respondent's original image ratings were clearly related to the probability that person would subsequently vacation at places with the highest positive image ratings with the relationship being stronger for states than for cities.

A class of socioeconomic impacts of a HLRW facility at Yucca Mountain, therefore, will depend upon the nature of the repository images (positive or negative) as held by key economic actors (i.e., potential visitors, investors, and immigrants), as well as the degree of association of these images with Nevada or Las Vegas. Both these conditions are subject to change and development over time. The existing images of a high-level radioactive waste repository have been collected from thousands of survey respondents. These data provide a baseline for answering the first part of the question about the nature of repository images. At present, it is known with a high degree of certainty that repository images are overwhelmingly negative.

Four surveys that interviewed 3,334 respondents 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, and 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.

The results of these image-based studies support and extend other methods of eliciting responses to HLRW programs and projects. Respondents in surveys were asked direct questions about whether a repository would reduce the desirability of a community located within 100 miles of the site. The activities measured were the attraction of the community as a place to attend a convention, vacation, raise a family, retire, or locate a new
business. In a national survey, between 41% (attend a convention) and 73% (raise a family) said a repository would reduce the desirability of the area.

Convention Impact Studies

Easterling and Kunreuther (1993) undertook a study of potential impacts to the Las Vegas convention industry from association with a repository at Yucca Mountain. They defined the industry at risk in two ways: the transfer of conventions from Las Vegas to other cities, and the decrease in the number of people who would attend meetings still held in Las Vegas. These possibilities were examined by studying 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 research scenarios used in these studies included a variety of conditions that were defined within the social amplification of risk framework. That is, events as they might be treated in the news media, both amplified and attenuated, were evaluated by respondent-planners. Even the least adverse scenarios (a benign ten-year history of repository operation with dampened media attention) prompted 13 percent to 35 percent of the planners to say they would hold meetings somewhere else if a repository were located in the area. For the more dramatic scenarios (multiple mishap events with amplified media attention), 47 percent to 80 percent of the planners said they would go elsewhere.

Interviews with convention attendees were conducted with respondents who belonged to organizations that had held at least one meeting in Las Vegas during the preceding four years (1986-1989). This study found that images of places predicted attendance at the cities covered during the four years under review. The location of a HLRW repository near a convention city was compared to other conditions and resulted in the most negative evaluations, with 23 percent of the respondents reporting they "probably" or "definitely" would not attend.

Economic Development

Studies of economic development issues were conducted by Mountain West Research and its subcontractor Growth Strategy Organization to provide a baseline for potential economic impacts and to examine the role of stigma effects among business decision-makers (Mountain West Research, 1989). This research demonstrated that Las Vegas has significant strengths in competing for business development. These advantages
have been widely recognized since the early 1980s. Its location in the rapidly growing southwest is augmented by excellent surface and air transportation to the region. There is an abundance of land, cheap electric energy, excellent telecommunications, good climate, low taxes, and excellent recreational and entertainment opportunities. There are limitations in education, lack of a critical mass in manufacturing, and limitations on transportation to national markets to the east. Overall, the economic development potential for the Las Vegas area was judged to be excellent.

In the 1988 national survey of randomly selected citizens, two-thirds of the respondents felt that Las Vegas would be a desirable location for a new business, but this dropped to only 20 percent when respondents were aware of the repository possibility. In that case, 77 percent rated Las Vegas as an undesirable business location. The Mountain West study team followed up on these public responses by conducting a survey focusing on corporate decision-makers with expertise in business development and business site evaluation.

A survey of corporate decision-makers was conducted with a sample selected from *Who's Who in Corporate Real Estate*, published by the National Association of Corporate Real Estate Executives (NACORE). Five hundred and sixty-nine business people were contacted; 400 interviews were completed. Respondents were interviewed about four cities: Phoenix, Las Vegas, Denver, and Albuquerque. The interviews utilized the methods of image elicitation developed with public samples and also asked about the desirability of these cities as business locations in terms of five factors: work force availability, image of the city, availability and cost of space, quality of life, and accessibility to markets. Finally, the respondents were asked about a series of LULU's (locally unwanted land uses). These inquiries included proximity to a sanitary landfill, chemical manufacturing plant, oil refinery, and highways used for radioactive waste and nuclear materials transport. Additional questions asked about environmental conditions of poor air quality, flood plain location, and earthquake hazards.

These image responses, like those the public provided for vacation choices, produced a strong correlation between the image scores and the ranking of the cities as places to do business. In responding to the LULU conditions, 52 percent said a site next to a highway leading to an underground facility for disposing of radioactive wastes would be very influential (negatively so) in a location decision. This level of influence was greater than location on a highway leading to a "nuclear weapons testing site" (38 percent) or a "nuclear power plant" (26 percent). The siting of an underground radioactive waste storage facility at Yucca Mountain was found to affect the opinion of these decision-makers in terms of the physical security of their employees, their perception of the environment, and the area's
public image. Concerns were greatest for the location of administrative offices, business and professional services, and firms that serve the tourism/hospitality industry, an area of crucial importance to the Nevada economy.

The potential impacts from HLRW stigmatization of Nevada and/or Las Vegas could be very large, especially if the entertainment and visitor sectors were involved. The State of Nevada research estimated that a one percent decline in visitor spending from the 17 million visitors that came to the Las Vegas area in 1988 would reduce visitor spending by almost $100 million, lead to a drop in employment of about 7,000 jobs, and cut public revenues by $7,000,000 (Mountain West, Interim Report, 1989, pp. 4-26 to 4-28). As visitors and tourists in the year 2000 number around 30 million, potential impacts of a one-percent downturn would be even larger and more dramatic. Given the power of messages forwarded to the public through the social amplification of risk process, a significant decline in visitation trips to Las Vegas resulting from a spent fuel or HLW incident or accident should be expected.

The history of public responses to technological stigma supports a conclusion that sudden and serious economic impacts can result from accidents, incidents, or reports of mismanagement. Major accidents are obviously capable of provoking costly impacts. It is also true that seemingly minor events can produce major economic impacts. This phenomenon was addressed in the work on the social amplification of risk initiated with the conceptual framework article by Kasperson and his colleagues (1988). In the more than ten years since the publication of that article, dozens of studies have demonstrated the validity of the observation that widespread dissemination of news about potentially dangerous events through the news media, and now including the internet, is central to this stigma impact process.

Potential losses from hosting HLRW facilities as a result of economic stigmatization have been intuitively recognized by states and communities for many years. This widespread recognition was verified through the social science research outlined in this appendix. The mechanisms and the potential for serious social and economic impacts have been demonstrated. The implication for the Yucca Mountain Draft EIS is that these impacts must be considered if the final EIS is meet its mandated purposes.

The Overall Conclusion of the Nevada Research

The State’s research has demonstrated that the Yucca Mountain repository program will result in significant socioeconomic impacts at all levels within the state, from the local
communities to the state government. The research has developed a convincing body of evidence that indicates the greatest potential socioeconomic threat from the proposed repository stems from what has been termed the "special effects" of the project. These are impacts related to intense negative perceptions and stigma associated by the public with a high-level radioactive waste repository, combined with the unique vulnerability of Nevada’s economy to changes in its public image. Because of the high profile nature of the high-level nuclear waste disposal program, the potential exists for Nevada to become associated with these negative perceptions to the detriment of its ability to attract tourists, conventions, migrants, and diversified new industry to the state. This would be especially troublesome in the event of a nuclear waste accident in or near Las Vegas that might stigmatize the area and cause visitors to stay away in significant numbers. The work to date demonstrates clearly that Nevada is uniquely vulnerable to such stigmatizing effects because of its tourism-dependent economy and State revenue structure.

Summary: The Scope of Stigma Effects

The studies summarized in this appendix provide a guide to understanding nuclear stigma. The Social Amplification of Risk defines the conceptual framework, while the image studies provide a means to estimate potential impacts and monitor ongoing events. A report from Planning Information Corporation (1995) to the Clark County Nuclear Waste Division provides the theoretical and applied interface with existing economic-demographic modeling, such as the REMI model available to DOE personnel and contractors.

The importance of considering the economic impacts of technological stigma can be gauged by the important role they play in a wide range of economic activities. This includes economic development, investments in existing properties, potential declines in property values (relative to healthy economic conditions), increased unemployment with downturns in the Nevada visitor economy, and resulting negative impacts on public sector revenues leading to reduced public services (public safety, schools, transportation, public health, etc.). It is also highly probable that these stigma effects underlie social and political impacts at several levels of society. These same effects play an important but largely unexamined role in the history of tensions between communities, counties, the State of Nevada, and key entities of the federal government. One example of this is the introduction of potential economic stigma effects into adjudicatory proceedings between the State and DOE, as was the case in the recent water permit hearings before the State Water Engineer. Another area where stigma effects can clearly be seen is in the responses of states and communities along proposed transportation corridors. The conflict between the Mescalero Apaches in New Mexico and the State of New Mexico on the issue of a possible monitored retrievable storage
facility on the Indian reservation was largely based upon stigma concerns. Stigma impacts were also the basis for claims and court-awarded damages against the City of Santa Fe in regard to the transportation of transuranic wastes to DOE’s Waste Isolation Pilot Plant facility in southern New Mexico.

The development of the methods to examine perceptions of risk, the Social Amplification of Risk framework, and the concept of Technological Stigma provide the means for understanding the long and difficult history of the nation's attempt to locate and develop radioactive waste facilities. This, in turn, allows researchers the means to evaluate the full range of potential socioeconomic impacts that a repository imposes on a host state and its communities and that spent fuel and HLW waste transportation imposes on states and communities along shipping routes. Research in these areas has been ongoing for a quarter of a century, and the methods and findings are well established in the peer-reviewed social science literature. A full and honest examination of the potential socioeconomic impacts resulting from stigma effects and public aversion to places associated with HLRW is possible, given the substantial social science resources now available. Such an examination is clearly called for to meet the standards of impact assessment mandated by federal law and regulation.
REFERENCES

References A:


References B:


References C:

Reports and Data from the Nevada Socioeconomic Studies - Summaries attached to this Appendix.