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**HIGH-LEVEL NUCLEAR WASTE
TRANSPORT AND STORAGE
ASSESSMENT OF
POTENTIAL IMPACTS ON TOURISM
IN THE LAS VEGAS AREA**

December 1985

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La Jolla, California

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CHAPTER 1

INTRODUCTION

Yucca Mountain, approximately 100 miles northwest of Las Vegas, Nevada, is being considered as a candidate among the high-level radioactive waste repository sites to be evaluated by the Department of Energy (DOE) under the Nuclear Waste Policy Act of 1982 (NWPA, 1983). At public hearings in March 1983, and at other times since then, public officials have expressed the general concern that high-level radioactive waste transportation to and storage at Yucca Mountain could harm the local tourism industry.

This report has four objectives. The first is to identify possible sources of tourism impacts. The second is to review alternative methods for predicting how people responded to potential hazards. The third is to present a preliminary evaluation of whether a repository at Yucca Mountain would have a lasting effect on tourism in the Las Vegas area. The fourth is to make preliminary recommendations for further research.

To accomplish these objectives the following tasks were undertaken. Informal interviews were conducted with individuals familiar with the southern Nevada tourism industry. Literature on how people respond to perceived safety hazards was reviewed. The review focused on literature dealing with tourists as well as safety concerns associated with radioactive materials. Historical events where public safety concerns received broad media coverage were examined. Tourism-related data were collected and analyzed to determine if effects on tourist behavior were observable. Some of these events involved radioactive materials.

The literature review and empirical analyses presented in this report were undertaken, for the most part, between August and October 1983. They are not comprehensive. No primary data were gathered, nor were any formal surveys conducted. Additionally, because construction of a repository at Yucca Mountain, if that site is selected for a repository, is not scheduled to begin until 1993, engineering design and planned physical appearance of the repository are very preliminary. Therefore, specific design features or visual appearance were not addressed in the analyses. Finally, because actual transportation routes have not been designated, impacts on tourism generated specifically by transportation activities are not considered separately.

Chapter 2 briefly discusses possible means by which a repository could impact tourism in the Las Vegas area. Chapter 3 presents a review of previous research on alternative methods for predicting the response of people to potential hazards. A review of several published studies where these methods have been applied to facilities and activities associated with radioactive materials is included in Chapter 3. Chapter 4 contains five case studies of tourism impacts associated with past events that were perceived by the public to represent safety hazards. These perceptions of safety hazards were evidenced by news media coverage. These case studies were conducted specifically for this report. Conclusions of this preliminary analysis regarding the potential impact on tourism in the Las Vegas area of a repository at Yucca Mountain are in Chapter 5. Recommendations for further research are contained in Chapter 6.

CHAPTER 2

POSSIBLE SOURCES OF AN IMPACT

Las Vegas, Nevada, has been attractive to tourists for decades because of its unique combination of gaming and entertainment facilities, favorable climate, convention facilities, proximity to Boulder Dam and Lake Mead, and other appealing resort features. As part of this study, informal discussions were held with individuals familiar with the Nevada gaming and tourism industry to learn of possible means by which the Yucca Mountain repository project could affect Las Vegas tourism. In general, these observers indicated that the attractiveness of Las Vegas to tourists may be attributed to the image Las Vegas presents. These discussions did not involve a detailed presentation of the characteristics of the Yucca Mountain high-level radioactive waste repository project. They did, however, reveal varying viewpoints about how the repository project might affect tourism. Location of a repository at Yucca Mountain could have both negative and positive effects on tourism in the Las Vegas area. This could occur by means described below.

2.1 POSSIBLE SOURCES OF NEGATIVE EFFECTS ON TOURISM

Locating a high-level radioactive waste repository at Yucca Mountain could negatively affect tourism in several ways:

- o Reduced safety Prospective visitors could perceive repository-related activities to be unsafe. This could reduce the likelihood of their choosing the Las Vegas area as a convention site or vacation destination.
- o Reduced image or aesthetic appeal Locating a repository at Yucca Mountain could damage the image or aesthetic appeal of the Las Vegas area. This could result from physical features of a repository (about 100 miles northwest of Las Vegas) or its associated transportation network (whose actual routes are presently unknown). Damage to the Las Vegas image could also be the result of events related to the repository, such as a highly visible debate in the national news media.
- o Increased visibility of the Nevada Test Site Any adverse effects of a repository could be compounded by heightened visibility, not only of the repository, but also of any activities conducted at the Nevada Test Site (NTS) that might be perceived as unsafe or aesthetically unappealing. The effects on tourism could be two-fold. First, the behavior of potential tourists who are already aware of the nuclear weapons testing activities at the NTS could be affected by the additional Yucca Mountain repository activities. Second, the behavior of potential tourists who are unaware of ongoing activities at the NTS could be affected by both the incremental repository activities and the new or renewed perception of other NTS activities.

2.2 POSSIBLE SOURCES OF POSITIVE EFFECTS OF TOURISM

- o Tourist attraction It is possible that visitors and potential visitors to Las Vegas are already aware of or are indifferent toward nuclear weapons testing activities at the NTS. As a result of the awareness, it is possible that additional information about testing and repository-related activities would have a neutral or positive effect on tourism. For example, increases in tourism could occur if the repository were to become a tourist attraction (e.g., if people became curious about the repository and other activities at the NTS).
- o Technical exposure If the Yucca Mountain site were developed as the first U.S. geologic repository, it will involve first-of-a-kind technology of international interest. This would generate a great deal of national and international exposure for the Las Vegas area, and would draw visitors from the technical community around the country. These visitors would have a small but positive impact on tourism.

CHAPTER 3

REVIEW OF PREVIOUS RESEARCH

3.1 INTRODUCTION

This chapter presents a review of the literature on how people respond to perceived safety hazards. There were two objectives of the review. The first was to identify and describe methods of predicting how people respond to potential safety hazards. The second was to examine applications of these methods to events where the actual or potential presence of radioactive materials may have led to the perception of a safety hazard. The review focuses on theory and evidence concerning the effects of existing and proposed nuclear facilities on tourism and recreation. It is not comprehensive; however, the references cited in this chapter are representative of recent writings on this topic.

Section 3.2 describes some methods for predicting how people respond to potential safety hazards, including the use of models, surveys, and studies of past behavior. Section 3.3 reviews published studies in which researchers have examined changes in actual or potential tourism behavior in response to concerns about the safety of nuclear facilities. Finally, Section 3.4 summarizes the chapter and discusses the applicability of these published studies to the potential development and operation of a high-level radioactive waste repository at Yucca Mountain.

3.2 METHODS FOR PREDICTING HOW PEOPLE RESPOND TO POTENTIAL HAZARDS

Many questions that pertain to the consequences of people's responses to safety hazards can be addressed by economic methods. Simple economic models predict how individuals will make choices in a greatly oversimplified world with no uncertainty. Specifically, people are said to behave in an optimizing manner; they attempt to make decisions that are best in terms of their tastes and preferences, and within the limits of their income. Economists often find it useful to think of this optimization process as the maximization of utility, where utility is a hypothetical magnitude serving as an index for people's preferences (Hirshleifer, 1976).

People are willing, in some circumstances, to pay to avoid or reduce uncertainty. We say that they are "risk averse." For example, the purchase of hazard insurance generally demonstrates an individual's aversion to risk. Simple economic models can be expanded to take uncertainty into account by allowing for such risk averse behavior.

Uncertainty can be incorporated into models of how people make choices by explicitly accounting for the probabilities associated with uncertain events. The expected utility maximization model does this (e.g., von Neumann and Morgenstern, 1944). The model can be used to directly estimate the economic effect of potential safety hazards. Using the concept of mathematical expectation (in this case, multiplying the utility assigned to an event by its respective probability) the expected utility maximization model predicts how individuals will choose to behave, in light of their beliefs about the possible outcomes and the associated probabilities of occurrence. One difficulty in

applying this model is that the researcher must know what probabilities individuals attach to different possible outcomes--both favorable and unfavorable. This information could come from experts. However, some researchers claim that the type of information that experts use to quantify uncertainty is not sufficient to predict behavior. For example, a survey by Slovic et al. (1979) shows that experts and nonexperts tend to rank the riskiness of various activities differently.

Moreover, survey evidence indicates that members of different social groups have different perceptions of risk, such as the relative "risk of dying" from various activities and technologies (Slovic et al., 1979) and the "health and safety risks" of various industrial facilities (Lindell and Earle, 1983). Such evidence has led some researchers² to conclude that evaluation of people's perceptions and reactions regarding risk needs to consider their social context.

In general, experimental evidence and survey findings have raised questions about the applicability of the expected utility maximization model (e.g., Schoemaker, 1982; Kahneman and Tversky, 1979; Tversky, 1969). In response, some alternative models have been proposed. In contrast to the expected utility maximization model, these models emphasize peoples' inability to choose in a fully informed and consistent manner. Due to limited memory, limited computational ability, or other information processing constraints (e.g., Simon, 1957), people may rely on simple rules of thumb, known as heuristics, to make decisions.

One heuristic, known as the "availability" heuristic, has been used frequently to explain how people behave in the presence of a perceived hazard. The heuristic predicts that dramatizing or sensationalizing an outcome will lead people to overestimate the chance of its occurrence (Slovic et al., 1979; see also Tversky and Kahneman, 1974). Kunreuther (1976) has studied the decisions that people make whether or not to insure their property against flood and earthquake damage. He reports that the recency of a flood or earthquake in the geographic area does a better job of explaining their decisions than do actuarial reports of the probability of a flood (and resulting loss). Similarly, extensive media coverage could affect behavior. Media coverage of past events could distort people's estimates of their future chance of occurrence by making them more imaginable (e.g., Combs and Slovic, 1979). Lichtenstein et al. (1978) report that people's estimates of the chance of dying from different causes increase with the media's attention to the cause of death. For example, people tend to greatly overestimate the chance of dying in a motor vehicle accident and underestimate the chance of dying from heart disease.

Other heuristics describe different judgmental biases which may lead to behavior different from behavior that the expected utility maximization model would predict. The "representativeness" heuristic claims that individuals attempt to establish whether a given event is of a certain type by comparing how representative its characteristics are of those of a given category. This evaluation may be biased if other pertinent information (not related to the characteristics of a category) is ignored. The "anchoring" heuristic states that people tend to estimate the likelihood of events and the value of outcomes by starting at a preset initial point and making incremental adjustments. Because the adjustments are often insufficient, the result is biased or "anchored" toward the initial value (Tversky and Kahneman, 1974). While

heuristics appear useful, they do not presently provide us with a model which, taken alone, can predict the behavior people will exhibit.

In addition to formal models, researchers have used more direct means of estimating behavioral responses to situations that may be perceived as hazardous. Perhaps the most direct approach, is to ask people by means of surveys, how they would respond to such situations. Using survey findings, the researcher estimates what fraction of the population would change its behavior. Survey research can be a relatively fast and inexpensive method of gauging potential economic responses to future events. However, even well-designed surveys have weaknesses. For example, surveys ask people to predict their own future behavior, but respondents rarely have the information in responding to a survey question that they would have when making the corresponding real-world decision.

Some of the most important weaknesses of the survey method result from the hypothetical nature of the survey questions. An alternative approach would be to draw inferences about people's future behavior by observing how they have responded to similar situations in the past. This approach requires that the researcher analyze historical time-series data on economic variables. Using these data, the researcher estimates the potential economic effect of a perceived hazard. The advantage of this approach is that it permits the researcher to use information about people's real-world decisions as a basis for predicting their behavior. The primary weakness of this method is that it is often difficult to identify analogous past events. However, analysis of a potential hazard using models--such as the expected utility maximization model and heuristics--may help to identify what characteristics of the potential hazard would most greatly affect future behavior.

3.3 STUDIES OF TOURISM AND NUCLEAR FACILITIES

Past studies of tourism and recreation that have been conducted by other researchers have applied some of the methods identified in Section 3.2. Of particular interest here, some of those published studies have investigated the effects of activities involving radioactive materials. Such activities have included the siting of nuclear power plants, nuclear weapons testing at the Nevada Test Site (NTS), and the Three Mile Island (TMI) incident. Methods have included the use of surveys and the analysis of historical time-series data. This section reports the findings of those researchers. The following discussion, though purely descriptive, reveals some of the strengths and weaknesses of these methods in past applications.

3.3.1 Proposed floating nuclear power plants

In 1972, Public Service Electric and Gas company of New Jersey contracted with Offshore Power Systems to buy two floating nuclear power plants (FNPs) to be located less than 3 miles off the New Jersey coast, near the boundary between Atlantic and Ocean counties. In July 1973, the Atomic Energy Commission docketed an Offshore Power Systems application for a permit to build these and other FNPs. Intervenors in prehearing conferences on the Offshore Power Systems application contended that "fear of nuclear accidents will reduce the appeal of the area for recreational uses and have a detrimental effect on the region's tourist-based economy" (OTA, 1976). In 1977, Baker et al. prepared a

report for the Nuclear Regulatory Commission that evaluated the potential impacts on tourism and beach visitation of locating a floating nuclear power plant off the coast of a beach community. One part of the Baker et al. study consisted of interviews with a sample of beach-goers at two beaches in Florida, one beach in Massachusetts, and one beach in New Jersey. The purpose of the surveys was to find out if beach-goers would continue to return to those beaches if an FNP were sited "3 miles directly offshore" (for the Florida and Massachusetts sites) or in a proposed location (which, for the New Jersey site, was between 5 and 22 miles offshore from the beach area where the interview was conducted).

West and Baker summarized the findings of the Baker et al. study in a 1983 article. They found that 22.8 to 26.5 percent of those interviewed at the Massachusetts and Florida beaches said they would not return if an FNP were located directly offshore. The number of people who indicated they would not return to the beach "decreased sharply," as distance from the FNP increased. Results were comparable for the New Jersey beach. Approximately 5 percent of the interviewees at the Florida and Massachusetts beaches said they still intended to avoid the beach if an FNP were sited as far as 50 miles away. West and Baker determined that the survey finding should be reduced such that only 5 to 10 percent of all potential beach-goers would likely avoid the beach, at the point closest to the hypothetical FNP. They referred to these percentages as "avoidance factors."

Recognizing that the magnitude of this adjustment was somewhat arbitrary, West and Baker (1983) gave the following reasons for using an estimate to predict future behavior, that was substantially lower than the survey findings:

1. The direct wording of the question probably increases the likelihood of pro-avoidance responses...
2. The initial intentions to avoid are based on emotional responses that are likely to dissipate over time in the absence of further information. Later behavior is likely to show less change than is implied by the intention measure...
3. ...individuals routinely take a wide variety of risks because they underestimate the likelihood and consequences of risk with which they have not had negative experiences. In addition, individuals often believe the benefits of a given behavior exceed its associated risks.
4. The instability of the intention-to-avoid figures is highlighted by the 40.3 to 50 percent reduction in this figure when respondents learned of NRC safety certification...
5. The intention to avoid questions did not force respondents to consider the costs that are involved in selecting an alternative beach. The information integration tasks forced the subjects to give additional thought to their responses and to make the necessary trade-offs. The results of these tasks showed that proximity to a floating

nuclear plant was far less important than other beach attributes such as proximity to one's home, cleanliness, quality of facilities, and crowding... Finally, there appears to be a strong bias to return to a beach when the initial visit is favorable... Although several instances of aesthetic disruption (e.g. dredging) were noted during the present study, they had little impact on respondents' future plans to visit their favorite beach.

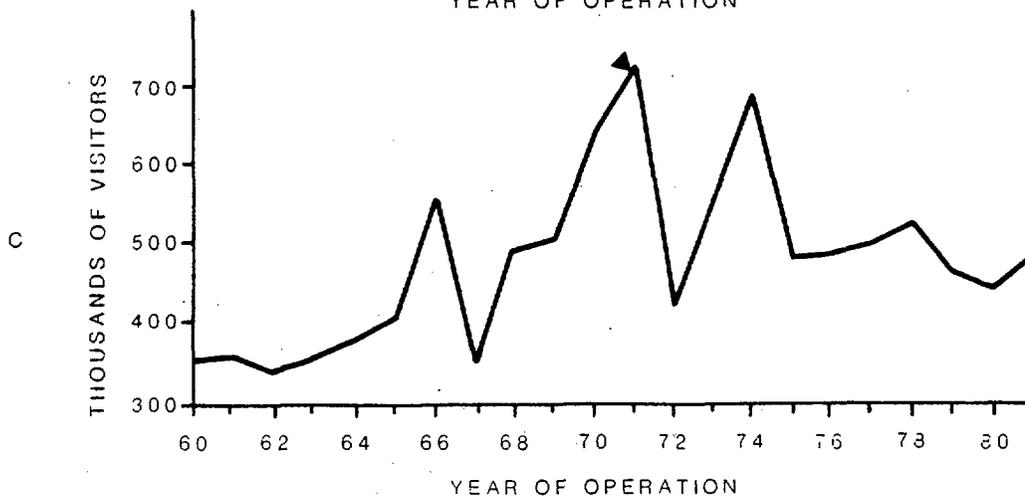
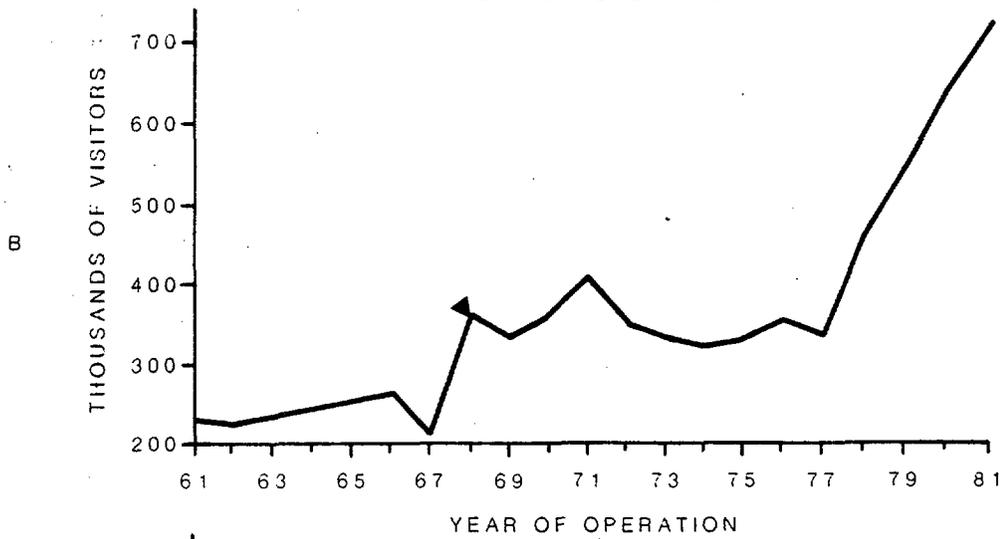
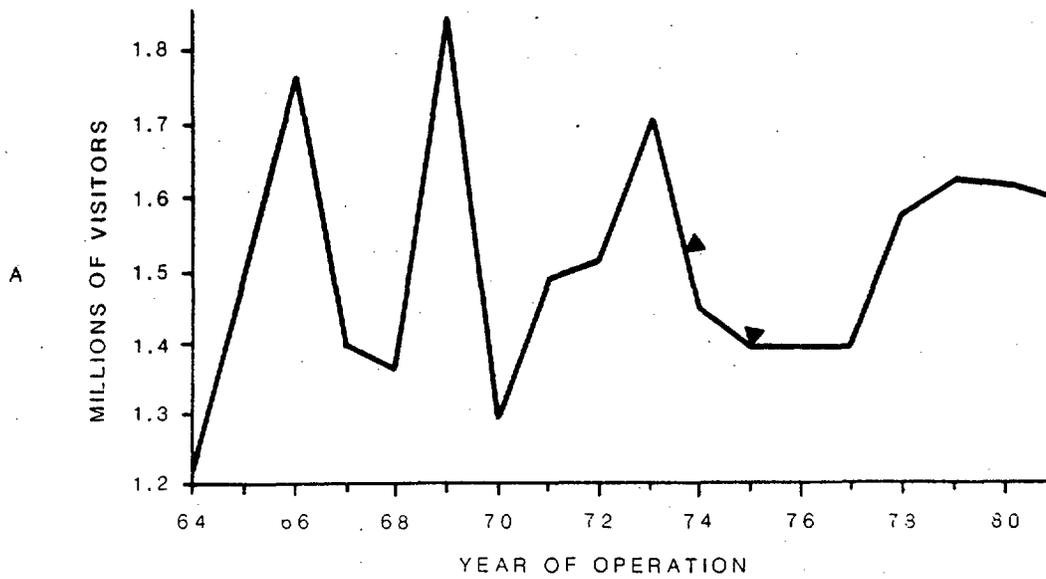
6. The direct avoidance questions and the information integration tasks all indicated that intentions to avoid decrease sharply as the distance to the nuclear plant increases...
7. [The] study of the ... analogous situations revealed no major impacts of existing coastal nuclear plants. Neither the park attendance data nor the interviews with special interests indicated a reduction in tourism due to the plants, and fewer than 5 percent of the beach visitors were aware of anyone having been deterred from visiting the beach by a nearby plant.

Bykoski et al. (n.d.) conducted a study to quantify the potential economic impact of siting an FNP. Part of their study included an analysis of the same beaches studied by Baker et al. (1977). The avoidance factors derived by Baker et al. were adjusted to account for the fact that some beach-goers would not avoid the beach altogether, but would move to an area of the beach farther away from the FNP. The net avoidance factors calculated under these assumptions ranged from 2.0 to 3.7 percent. These net avoidance factors were used to calculate the change in total visitor days, and a multiplier analysis was conducted to determine the net impact (considering both positive and negative impacts) of siting an FNP on earnings in nine major industrial sectors.

In each of the four areas examined, the major industrial sector experiencing the largest increase in earnings was the transportation, communications, and public utilities sector. The services sector was the most negatively impacted. Positive impacts on earnings in the former sector were due to increases in the plant operating payroll; negative impacts on earnings in the services sector were a function of the estimated reduction in tourist expenditures. All changes (both positive and negative) in individual sector earnings were found to be less than 1 percent. The net impact on all sectors therefore, depended on the magnitude of the nine individual sector changes. The net impact (either positive or negative) on total earnings in each area, resulting from the hypothetical siting of an FNP was also estimated to be less than 1 percent.

3.3.2 Beach tourism near land-based nuclear power plants

In their study of FNPs, West and Baker (1983) also looked at situations analogous to an FNP: operating land-based nuclear power plant sites that were in the vicinity of and visible from beaches with commercial tourism activity. As indicators of tourism, they examined attendance at beach front state parks near three sites, and interviewed operators of two motels near the fourth. Attendance data for the three beach state parks, are shown in Figure 3.2-1, as adapted from West and Baker. Exact dates of commercial operation of the



▼ DENOTES BEGINNING OF COMMERCIAL OPERATION OF NEARBY LAND-BASED NUCLEAR POWER PLANT (NUS CORPORATION, JANUARY 1981)

Figure 3.2-1. Attendance at (A) Illinois Beach State Park, Illinois, (B) San Clemente State Park, California, and (C) Rocky Neck State Park, Connecticut, before and after nearby nuclear power plant operation (adapted from West and Baker, 1983). The arrowhead denotes the beginning of commercial operation of nearby land-based nuclear power plant (NUS Corporation, 1981).

nuclear reactors were taken from NUS Corporation, 1981; the dates are indicated on Figure 3.2-1 by the arrowhead symbol. Additionally, beach visitors at each state park were interviewed by West and Baker to determine their awareness of the existence of the plant, as well as actual beach avoidance attributed to the plant.

At Illinois Beach State Park, near the Zion nuclear power plant, about 40 miles north of Chicago, Illinois, a drop in attendance occurred after the start-up of both the first reactor in October 1973 and the second unit in November 1974. Attendance returned to near previous levels in 1978. However, prior to the start-up of the Zion reactors, there also were large fluctuations in beach attendance. In light of the pre-Zion fluctuations, the post-Zion drop in attendance was not unusual and may be attributable to factors other than the power plant. West and Baker reported that beach management personnel generally attributed the post-Zion attendance decreases to weather variations, the opening of adjacent recreation areas, and an encephalitis scare in 1975. In interviews with 56 beach-goers, West and Baker found none who claimed to avoid the beach because of the nuclear power plant, but 9 percent said they knew people who avoided the area for that reason. Thirty percent were unaware of the presence of the nuclear plant.

The San Onofre plant, near San Clemente State Park, California, began commercial operation in January 1968. Attendance decreased slightly the following year, then increased through 1971. Attendance then declined for 2 years following the opening of another park nearby, but increased in all but one of the years between 1974 and 1981. West and Baker reported that none of the 15 beach-goers interviewed knew of anyone who avoided the beach because of the nuclear facility. Representatives of the California Department of Parks and Recreation and the San Diego Regional Commission reported that there were "no adverse effects of the plant on beach visitation" (West and Baker, 1983).

At Rocky Neck State Park attendance declined following start of the Millstone nuclear power plant in 1970. The plant, located in Waterford, Connecticut, is about 5 miles from the state park. Since then park attendance has both increased and decreased, but has remained slightly lower than pre-Millstone figures. West and Baker reported that of the 56 beach-goers interviewed, none knew anyone who avoided the beach because of Millstone, and 36 percent were unaware either of the existence of the plant or that it was only 5 miles away. The plant, however, is not visible from Rocky Neck State Park. Officials at the park did not attribute changes in park attendance to the operation of the power plant.

No state parks were located near the St. Lucie power plant, about 12 miles southeast of Fort Pierce, Florida, thus precluding examination of attendance data. However, operators of two motels in the vicinity did not report "any decrease in business attributable to the plant" (West and Baker 1983). Interviews were conducted with 104 people at nearby public beaches. The plant is visible from some locations on those beaches. Of those surveyed, 5 percent reported knowing people who avoided the beaches because of the power plant, and 7 percent reported increased reluctance to use beaches close to the plant. However, 13 percent reported that the plant attracted them to the beach because of "the perceived improvement in fishing and surfing" (West and Baker, 1983).

Another method used by researchers to identify the effects of siting nuclear power plants involved interviewing government officials and business representatives from 10 counties with both operating nuclear power plants and local water-oriented recreational facilities. These areas included: Brunswick, North Carolina; Berrien, Michigan; Middlesex, Connecticut; Westchester, New York; Lincoln, Maine; New London, Connecticut; St. Lucie, Florida; San Diego, California; Dauphin, Pennsylvania; and Lake, Illinois. Five to thirteen officials were interviewed at each location. The interviews were designed to obtain information on recreation and tourism activity near each power plant; "draw out information which might indicate impacts, positive or negative, of the plant on tourism and recreation"; and elicit respondents' personal opinions concerning plant impacts. Only one of the interviewees reported that the presence of the nuclear facility had any adverse effect on tourism (Bykoski et al., n.d.).

3.3.3 Other nuclear power plant studies

As part of a postsiting study of operating nuclear power plants, Purdy et al. (1977) examined the social, economic, and political impacts of the Pilgrim Nuclear Power Station located in Plymouth, Massachusetts. Nutant et al. (1977) conducted a study to determine the impacts of land-based nuclear power plants on resort oriented coastal communities.

Plymouth, Massachusetts, is on Cape Cod Bay, 35 miles south of Boston. The Pilgrim nuclear plant was the "subject of substantial controversy and publicity" (Nutant et al., 1977). Plymouth has relied for many years upon seasonal activities, such as cranberry production and tourism, for a major share of its income and employment (Purdy et al., 1977). After slow growth in the 1950s and 1960s, Plymouth underwent rapid growth beginning in 1968, when construction of the plant began. Purdy et al. (1977) state, "The growth which took place in Plymouth appears to have been a response to a variety of factors, only one of which was Boston Edison's siting of Pilgrim I."

In a similar analysis of historical data, Nutant et al. (1977) studied tourism effects associated with the Oyster Creek Nuclear Generating Station in Ocean County, New Jersey, about 35 miles north of Atlantic City. The area has substantial tourism activity, including saltwater fishing, boating, and water-skiing, and draws visitors from New Jersey and surrounding states. Like Pilgrim, Oyster Creek was controversial and received considerable publicity in the regional press. The power plant began operation in 1969. Ocean County's population grew by 42 percent, mostly through immigration, between 1970 and 1975. Nutant et al. interpreted this growth to mean that the Oyster Creek power plant had no adverse impact on the resort economy of nearby communities.

Qualitative assessments of coastal resort communities in proximity to three other operating nuclear plants (Turkey Point, near Miami, Florida; Maine Yankee, near Booth Bay, Maine; and San Onofre, near San Clemente, California) also revealed no indication that the "economy, particularly the tourist economy, of nearby communities was adversely affected" (Nutant et al., 1977).

3.3.4 Nuclear weapons testing at the Nevada Test Site

Nutant et al. (1977) also investigated the effects on tourism in Las Vegas of the nuclear weapons testing program at Yucca Flats, located on the Nevada Test

Site. They used gross gaming revenues (in constant dollars), resort employment, convention attendance, travel volume, and the number of hotel and motel rooms occupied from 1954 to 1974 as measures of tourist activity. All these measures showed "substantial and sustained growth," with the exception of auto traffic during the 1973 Arab oil embargo. Nutant et al. concluded that on the basis of the data examined and "discussions with representatives of the Las Vegas resort industry and the Nevada Test Site operations, there is no evidence to suggest that the presence of nuclear weapons testing operations has had any adverse impact on the resort economy of Las Vegas."

3.3.5 The Three Mile Island incident

In 1979, what may be the most serious operating incident involving a commercial U.S. nuclear power plant occurred at Three Mile Island (TMI) in Pennsylvania. The incident involved the release of radiation and raised public concerns about the safety of that plant and nuclear power in general (see Section 4.2 for a more detailed discussion). While there were no injuries, deaths, or physical damage to property (other than the reactor), there could have been some effects on tourism. Local businesses could have suffered from a decline in the number of visitors immediately after the incident. A similar but more lasting effect could have resulted if the incident and associated media coverage reduced the attractiveness of the area as a place to visit. Several studies have been published which investigate these possible effects.

The Commonwealth of Pennsylvania (ca. 1980) released its final report analyzing the affects on the local economy, including tourism, about a year after the incident. Ten major lodging and convention businesses reported that their sales had declined by about \$2.0 million in the weeks following the incident, which was a decline of \$762 per employee. By extrapolating to all 244 lodging and convention establishments in the 6-county area, the report estimated that area sales related to tourism had declined by approximately \$5.0 million. Economic activity related to tourism was lower in the summer following the incident, but the report expresses uncertainty about the cause. That summer, national economic growth was slowing and there was a gasoline shortage. A local polio scare that occurred within two months after the incident may also have contributed to the decline.

The Commonwealth of Pennsylvania report also discussed a telephone survey of potential tourists, conducted to learn how they might respond to the incident. Potential tourists from eastern Pennsylvania, Baltimore, Cleveland, Long Island, northern New Jersey, and the Philadelphia/Wilmington areas were asked, in late April 1979, whether they intended to travel to Pennsylvania during what was then the coming summer of 1979. About 6 percent said they would avoid travelling to the Harrisburg area, which is in the immediate vicinity of Three Mile Island. Two percent said they would avoid the state entirely.

Both the Commonwealth of Pennsylvania report and studies published later (Trunk and Trunk, 1983; Flynn, 1984) state that the incident had some favorable effects on tourism. Though some potential visitors were driven away, others were drawn by the incident. These included media representatives, technicians, and government personnel. The TMI visitor's center attracted more visitors in the 2 years following the incident than in the 9 years prior.

To evaluate whether the incident would have a lasting effect on tourism, the Commonwealth of Pennsylvania asked the opinions of local businessmen in early June 1980. They reported that tourism in the TMI area had "either approached or attained" pre-TMI levels. This led to the conclusion that there had been no lasting effect 1 year after the incident.

Two other studies have sought evidence of an economic effect of the perception of hazard related to the TMI incident by analyzing data on the prices of real estate in the area. Property values reflect not just the value of real estate in the present, but in the future. If the TMI incident increased the perceived risk of living within the proximity of the plant, this would be reflected in a fall in local property values and/or appreciation rates after the incident. Both Nelson (1981) and Gamble and Downing (1982) conducted econometric analyses to test whether the incident had a discernible impact on local real estate selling prices. Nelson reported that neither selling prices nor appreciation rates were adversely affected. Gamble and Downing also found that the incident had no discernible effect on property values.

3.4 SUMMARY

The preceding discussion has identified alternative methods of predicting how people respond to potential hazards and reviewed applications of some of these methods. Some of the applications involved the use of surveys to learn how people think they would respond to a hypothetical future event. This approach was used by Baker et al. (1977) and West and Baker (1983) in their studies of floating nuclear power plants. It was also used to evaluate visitor response to the Three Mile Island (TMI) incident (Commonwealth of Pennsylvania, ca. 1980). These studies reveal that some people consider nuclear power plants and associated incidents to be hazardous or otherwise aesthetically displeasing.

However, as predictors of future behavior, the survey results overstate people's tendencies to avoid perceived hazards. The decision of West and Baker (1983) to adjust their survey finding downward before using it to predict behavior illustrates an important weakness of this application of survey research methods. People are apparently unable, until confronted with an actual situation, to consider all the relevant costs associated with various options. Thus, they tend to overstate the lengths to which they would go to avoid the potentially adverse condition that is the subject of the interview. The extent of the bias, which must be estimated if the survey method is to be used to predict future behavior, appears uncertain. This calls into question the usefulness of surveys to learn whether locating a repository at Yucca Mountain would cause an economic effect.

Other studies (Nutant, et al. 1977; West and Baker 1983) employed time-series data. The most important finding of these studies is that tourism and recreational activities occur and grow in the presence of activities and incidents involving radioactive materials. The studies revealed no clear link between beach attendance and the siting of a nuclear power plant nearby. Studies of the TMI incident, including those sponsored by the Commonwealth of Pennsylvania, failed to detect any lasting effects of what may be the most highly publicized nuclear operating incident in U.S. history. Tourism in the Las Vegas area has continued to grow in the presence of nuclear weapons testing at the Nevada Test Site for the last three decades.

However, the time-series studies reviewed here have some important weaknesses. A few of the reports acknowledge that unrelated events could have caused reported changes in tourism and recreation activity, but none explicitly correct for this possibility. The possibility of such confounding events makes it particularly difficult to discern the short-lived effects of the project or incident in question.

Use of evidence from these studies could lead to an underestimate of the effect of a Yucca Mountain repository on Las Vegas tourism. First, some of the nuclear power plants studied were constructed before 1979, when the TMI incident occurred. The TMI incident focused the public's attention on the potential dangers of nuclear power and may have changed their responses to projects involving the use of radioactive materials. Second, the level of media attention in some of these cases may have been slight. With the exception of Nutant et al. (1977), the studies reviewed did not report the extent and content of media coverage. Consequently, beach visitors and tourists may not have known how close they were to the nuclear power plant or the weapons testing activity. Further, media attention per se may affect the public's response to the project. This possibility clearly applies to the Yucca Mountain project.

CHAPTER 4

CASE STUDY ANALYSIS

4.1 INTRODUCTION

As discussed in Chapter 3, past researchers have used several methods to evaluate the effects of activities and incidents involving radioactive materials on tourism and recreation. One method was to investigate the effects of past events to learn about the potential effects of future events. To the extent that the past and future events have common characteristics, this is a useful approach.

In evaluating the potential effects of the Yucca Mountain project on tourism and recreation, three project characteristics are important. First, Yucca Mountain is located outside the Las Vegas tourism and recreation areas. Second, the repository is likely to raise concerns about public safety because radioactive materials are involved. Third, it would initially receive extensive media coverage. This chapter presents five case studies of past events that have some of these characteristics. Each case study presented below was prepared specifically for this report.

4.1.1 Case selection

Five events were selected for further development as case studies after screening many situations that were perceived to represent safety hazards, as evidenced by broad media coverage. Table 4.1-1 presents a partial list of the initial set of situations. Nuclear reactor locations and hazardous waste sites on the U.S. Environmental Protection Agency's Superfund cleanup list were also considered. Although some situations were eliminated as offering too few characteristics of interest, the dominant reason for elimination was the absence of adequate tourism time-series data, both before and after the event, and/or by the unavailability of such data during the data collection efforts for this study. A more extensive study would certainly yield additional empirical data.

Five situations were selected for development as case studies. The first case study involved the March 1979 incident at the Three Mile Island (TMI) nuclear power plant in Harrisburg, Pennsylvania. It was chosen because it occurred in an area that has significant tourism and convention activity, received widespread and intensive publicity, and involved a nuclear facility.

The second case study involved a potential volcanic hazard in a popular recreation area: Mammoth Lakes, in the California Sierra Nevada. This occurred in the spring and summer of 1982. This situation was selected because it represented a natural hazard and received widespread media attention.

The third case study involved the relocation of families in 1980 following exposure to toxic chemicals in the Love Canal area of Niagara Falls, New York. It was selected because Niagara Falls is a heavily visited tourism area and because leaks from the toxic waste site have been perceived as a long-term

Table 4.1-1. Las Vegas Tourism Study - Possible Analogous Situations

Place	Situation	Media Attention	Tourist Activities
Niagara Falls, NY	Love Canal - contamination of water, soil	Known for long time; media attention starting in 1978	Sightseeing
Harrisburg, PA	Three Mile Island cooling system failure	Heavy nationwide publicity March - Summer 1979	Sightseeing, theme park, conventions
Kitsap County, WA	Trident nuclear submarine base	Local	Recreation, conventions
Mammoth Lakes, CA	Volcano alert	Articles in California newspapers	Year round outdoor recreation activities
Atlanta, GA	Murders of Black children	Heavy nationwide publicity	Conventions
Times Beach, MO	Dioxin contamination	National attention in early 1983	None
Philadelphia, PA	Legionnaires' Disease outbreak	Nationwide publicity in August 1976	Conventions
Beatty, NV	Low-level nuclear waste disposal site	Slight	Recreation and sightseeing - Death Valley
West Valley, NY	Nuclear waste site	Slight	State park, skiing
Las Vegas, NV	Nuclear test site	Occasional	Gambling, entertainment, and outdoor recreation

Table 4.1-1. Las Vegas Tourism Study - Possible Analogous Situations. (continued)

Place	Situation	Media Attention	Tourist Activities
Sacramento, CA	Rancho Seco Nuclear Plant	Slight	Sacramento, Delta recreation
Hanford, WA	Low-level nuclear waste disposal	Slight	Recreation
S. Padre Island, TX	Hammerhead shark infestation	Local attention, June 1977	Recreation
Glacier National Park, MT	Grizzly bear attacks	Brief nationwide attention	Recreation
Las Vegas, NV	MGM Grand and Hilton hotel fires	Brief nationwide attention	Gambling, entertainment, and outdoor recreation
Duluth, MN	Taconite dumping (threatening drinking water)	Brief nationwide attention	Recreation

threat to health and safety. Also, the situation received considerable publicity for several years.

Fourth, the MGM Grand and Hilton hotel fires, which occurred in November 1980 and February 1981, respectively, were selected because they took place in the Las Vegas area and received wide media coverage. These incidents provided an opportunity to examine the effects on Las Vegas tourism of events perceived to be hazardous and related safety concerns.

The final case study concerned the effect on tourism of nuclear weapons testing at the Nevada Test Site (NTS) since 1951. The Yucca Mountain project could bring media attention to the NTS, which is adjacent to the Yucca Mountain site. This attention could heighten any effect--positive or negative--that the NTS has had on tourism.

4.2 THREE MILE ISLAND

4.2.1 Description of the event

The Three Mile Island (TMI) nuclear power plant, located on the Susquehanna River at Harrisburg, Pennsylvania, was the site of the worst operating incident in more than 20 years of U.S. commercial nuclear power generation. On March 28, 1979, a pump supplying water to TMI Unit 2's steam generator failed. A subsequent series of equipment malfunctions and human errors caused the core of the reactor to overheat, which resulted in the release of radioactive gases. Over the next few days, an advisory evacuation notice was issued to pregnant women and preschool children residing within a 5-mile radius of the plant. By April 6, 1979, officials at the plant indicated that the crisis had passed and the situation had stabilized.

4.2.2 Public perception

Review of news media data bases indicated that significant national news exposure accompanied the TMI incident. A media search of the NEXIS³ data base alone yielded some 216 newspaper articles over a 3-month period and numerous wire service releases. Most major newspapers in the United States carried articles discussing concerns about public safety near nuclear power plants.

Some newspaper accounts attributed changes in the local business climate to the incident. According to the press, businesses from outside Pennsylvania were reluctant to purchase goods such as milk, tractors, and shoes from Pennsylvania. Hotel and restaurant proprietors stated that their business had dropped markedly. A spokesman for the State Department of Commerce stated that millions of dollars of convention bookings had been cancelled (Seaberry, 1979).

A Washington Post article, published 2 months after the incident, reported that many businesses had "lost a mint" in the first week following the incident (Seaberry, 1979). However, this same press account quoted local officials as saying that "the state's second-largest industry, tourism, has rebounded," and noted that posters, T-shirts, buttons, and other souvenirs from TMI were in demand. In addition, in May 1979 the Marriott hotel chain began construction of a new 300-room hotel just 8 miles north of the TMI reactors. "The public's memories are short. They'll forget about [the accident]," a Marriott spokesman said. In contrast, the same publication told readers on June 8, 1979, that "if

you're worried about eating fish caught near the site of the Three Mile Island nuclear accident, breathe a sigh of relief. Tests of fish collected from the Susquehanna River following the nuclear reactor accident have proved there was no radioactive contamination" (Almy, 1979). This statement suggests that some people were still concerned about safety as many as 10 weeks after the incident.

News media accounts 7 months after the incident noted that, "Middletown has become a tourist mecca. Since July [three months earlier], about 25,000 visitors ... have come to gaze at the four huge cooling towers" (Begley and Lord, 1979). However, the same report notes that "the plant is still closed, and uneasy townsfolk wonder about the effect of the near catastrophe on their health."

In summary, review of press accounts over the 7 months following the incident indicates that the perception of a safety hazard persisted in the local area surrounding TMI, and was given high visibility in the national news media over the entire period.

4.2.3 Evidence of effects on tourism

Among the more important tourist attractions in the immediate vicinity of TMI are Harrisburg, the state capital and host to many conventions; and Hershey, Pennsylvania, the site of Hersheypark, a theme park located approximately 10 miles east of the power plant.

For purposes of this case study, data on convention attendance in the Harrisburg area and the number of visitors to "Hersheypark - Chocolate Town U.S.A." were used to measure changes in tourism levels. A major convention was cancelled following the incident (Commonwealth of Pennsylvania, ca. 1980). However, forecasts of convention bookings did not reflect a lasting effect. While 1978 convention attendance was 2 percent less than in 1977, the year of the accident, 1979, brought a 20 percent increase in attendance. The increase was not matched in 1980, when attendance rose only 2 percent above the previous year (Hair, 1983).

Hersheypark attendance fell following the incident. The analysis of Hersheypark attendance data between 1975 and 1982 indicated that attendance declined around the time of the incident, even after correcting for the number of days of rainfall and the level of national economic activity.⁴ This is consistent with the view that the TMI incident had a negative effect on tourism. However, a park official offered other explanations for the observed 1979 to 1982 decline in attendance: 1979 featured a polio scare and gasoline shortages; 1980 was "a super-heated season," people were looking for pools, not parks; 1981 had a bad economy; 1982 had a bad economy with much rain (Hair, 1983). This analysis relied on a small data set and did not correct for effects of the gasoline shortage or a polio scare. These conditions, and not the TMI incident, could explain the drop in park attendance. Other variables such as admission prices, or the cost and availability of substitute recreation activities were not analyzed. Results of this analysis are not conclusive.

4.3 MAMMOTH LAKES VOLCANIC ACTIVITY

4.3.1 Description of the event

On May 26, 1982, the U.S. Geological Survey (USGS) issued a "notice of potential volcanic hazard" for the area surrounding Mammoth Lakes (Kerr, 1982), located on the east slope of the Sierra Nevada in Mono County, California. This notice, the lowest of three warning levels defined by the USGS, stated that "the outbreak of volcanic activity is a possibility but by no means a certainty." Since 1978, the Long Valley-Mono Lake area, which includes the towns of Mammoth Lakes, June Lakes, Lee Vining, and Bridgeport, had been shaken by an unusual sequence of earthquakes accompanied by spasmodic tremors. Volcanologists generally consider spasmodic tremors to be the result of rock fracturing associated with the flow of magma or magmatic gases which can precede the onset of volcanic eruptions (Kerr, 1982).

4.3.2 Public perception

Examination of the print-media data bases NEXIS and NewsBank⁵ indicated that the USGS notice did generate concern about public safety. This concern appears to have originated primarily in northern California. However, nearly 100 media articles yielded by the data base search included clippings from the Washington Post, New York Times, and Los Angeles Herald-Examiner, as well as wire service leads from the Associated Press, United Press International, and Reuters. The articles indicated that the perception of public safety hazards may not have been limited to the local area.

Media attention to the situation began when the U.S. Geological Survey issued the notice of potential volcanic hazard on May 26, 1982. Subsequent media accounts warned that "an eruption is imminent." An August 27, 1982, United Press International story began with the statement, "A volcano eruption in the Mammoth Lakes area of the high Sierra could wipe out lives, homes and utilities and have a devastating effect on the Los Angeles water supply, officials warn."

According to a San Jose newspaper, many Mammoth Lakes residents remained undaunted by the threat of an eruption. They scoffed at the volcano hazard in the way that other Californians do "the big quake." The local townspeople were not as concerned about the danger of eruption as they were the negative publicity that "has kept tourists away from Mammoth Lakes." Interviews with local officials referred to an "hysteria" created by the USGS announcement. A businesswoman asserted that "the media has basically destroyed us" (Bunting, 1982). Similar reports appeared in Sacramento and Los Angeles newspapers.

4.3.3 Evidence of effects on tourism

The communities in the Mammoth Lakes area are highly dependent on the year-round outdoor recreation opportunities that draw visitors to the surrounding Inyo National Forest.

Statements by businessmen to the press suggested that local tourism levels fell significantly in the summer of 1982 (Bunting, 1982). This case study sought quantitative evidence of an effect by reviewing two types of data on tourism: recreation visits to the Inyo National Forest and monthly revenues collected for Mono County's transient occupancy tax fund.

The area for which the volcano warning was issued is encompassed by the Mono Lake and Mammoth Ranger districts of the Inyo National Forest. Recreation use data on the Inyo National Forest (measured in thousands of recreation visitor days, MRVDs) for fiscal years 1980 to 1985 are displayed in Table 4.3-1. The figures shown represent all types of recreation activities (i.e., camping, fishing, skiing, hunting) occurring on the forest. Also shown is the percentage change in recreation use from one year to the next.

Recreation use on the forest increased by 26 percent between 1980 and 1985. All of the increased use was on the Mono Lake and Mammoth Ranger districts. In fiscal year 1980 these two districts accounted for about 64 percent of the forest's total recreation use. By fiscal year 1985 their share of the forest's recreation use had increased to about 80 percent.

The only year in which recreation use on the Inyo National Forest fell was fiscal year 1983. That year began on September 1, 1982, 4 months after the warning. However, if the warning caused the drop in tourism, its effect seems to have been short-lived. Recreation use of the Inyo National Forest grew considerably in the 2 years which followed.

Mono County maintains data on transient occupancy tax collections by local hotels (Table 4.3-2). The time between the receipt of taxes and the recording of those receipts into the tax system varies. When this lag is taken into account, the revenue data provide a general indication of how tax revenues vary over time.

An analysis of the tax revenue data did not find any significant effect of the warning issued in May, 1982. Tax revenues reported in the second half of 1982 were only about 1 percent lower than in 1981. Revenues reported in the two quarters ending with the first quarter of 1983 were about 21 percent higher than for the previous year. Revenues reported in the first half of 1983 were down about 1 percent from those of 1982.

In summary, analysis of the Inyo National Forest recreation data supports the view that the USGS warning briefly reduced tourism, while analysis of the county-wide tax data does not. These data do not represent the same geographic area, however, since tax data were not readily available for only the Mammoth Lakes area of the county. Additionally, these analyses did not correct for variation in weather conditions. A recreation specialist on the Inyo National Forest has indicated that lower visitor counts in fiscal year 1983 are "at least partially a reflection of the late, cold spring and a rather wet summer" (Warren, 1986). These conditions, and not the warning, may explain the drop in forest visitation.

4.4 LOVE CANAL CHEMICAL WASTE EMERGENCY

4.4.1 Description of the event

Between 1930 and 1953, Hooker Chemical and Plastics Corporation used the abandoned Love Canal to dispose of chemical wastes. The site was covered in 1954 and was sold to the Niagara Falls Board of Education and, later, to residential land developers. After several years of heavy rains, chemicals began seeping into basements and rising to the land surface in 1976. Residents

Table 4.3-1. Thousands of Recreation Visitor Days (MRVDs), Inyo National Forest, FY 1980 to 1985^{a,b}

Ranger District	FY	FY									
	<u>1980</u>	<u>1981</u>	Percent	<u>1982</u>	Percent	<u>1983</u>	Percent	<u>1984</u>	Percent	<u>1985</u>	Percent
	MRVDs	MRVDs	Change								
Mono Lake	982.8	1244.2	+26.6	1300.9	+4.6	1035.0	-20.4	1612.7	+55.8	1785.6	+10.7
Mammoth	1981.4	1762.6	-11.0	2055.8	+16.6	1728.3	-15.9	2439.8	+41.2	2818.5	+15.5
White Mountain	1230.1	1226.0	-0.3	1076.1	-12.2	997.9	-7.3	915.3	-8.3	910.2	-0.6
Mt. Whitney	402.9	403.7	+0.2	369.8	-8.4	266.6	-27.9	295.3	+10.8	275.8	-6.6

^a A Recreation Visitor Day (RVD) is defined as any combination of visitors and hours totalling 12 hours spent recreating on the forest (e.g., 1 person for 12 hours or 3 persons for 4 hours each). MRVDs = 1000 RVDs.

^b Data from Warren, 1986.

^c Percent change from previous year.

Table 4.3-2. Quarterly transient occupancy tax revenues,
Mono County, California, 1979 to 1983

Year	Quarterly	Revenue Collected (\$)
1979	3	134,320
	4	146,335
1980	1	159,882
	2	461,054
	3	196,539
	4	136,237
1981	1	171,024
	2	435,671
	3	222,442
	4	214,427
1982	1	216,050
	2	605,621
	3	235,851
	4	196,445
1983	1	324,212
	2	488,533

Source: County of Mono, Office of the Auditor-Controller (Ripley, 1983).

became concerned when a growing number of illnesses, birth defects, and cancers began to appear among the families living near the filled-in canal (Allan, 1978; MacClennan, 1978). On August 2, 1978, the New York State health commissioner declared a health emergency, stating that pregnant women living within a 16-acre residential tract in the La Salle area of Niagara Falls move at once. On May 21, 1980, President Carter declared a state of emergency at Love Canal and announced the temporary relocation of 2,500 residents from approximately 400 homes (Smith, 1982a).

After the completion of remedial cleanup work at the site and the release of a highly criticized report by the U.S. Environmental Protection Agency on the extent of current chemical contamination at Love Canal, it was still not known conclusively whether residents could safely return to their homes (Smith, 1982a; Smith, 1982b).

4.4.2 Public perception

Examination of news media data bases indicated that the discovery of a health hazard at Love Canal was accompanied by a significant level of nationwide news-media exposure. A review of the NEXIS and NewsBank data bases yielded about 600 articles on Love Canal, including 95 articles over a 4-month period from the Buffalo Evening News alone.

Media attention to the situation began immediately after the declaration of a health emergency by a New York State health commissioner on August 2, 1978. Safety concerns were evident in the news articles. In one interview, for example, a cancer researcher urged the relocation of many Love Canal families and urged that the state pay the costs (MacClennan, 1978). The same researcher warned of mutagenic chemicals, and stated that the rate of birth defects occurring in the area was 16 percent of all births. (The national average was 2 to 4 percent.) The newspaper accounts dealt primarily with the two major safety concerns of Love Canal residents: health and birth defects. Three months after the health emergency was declared, media coverage began to shift from the hazard itself, toward identifying who was responsible for it.

4.4.3 Evidence of effects on tourism

Tourism is an important component of the local economy near Love Canal. Niagara Falls, New York, of which Love Canal is a suburb, is known worldwide for its waterfalls and vacation resorts.

This case study analyzed bridge-crossing data in an attempt to learn whether the official declaration that the Love Canal area was unsafe had an effect on tourism. The Niagara Falls Bridge Commission keeps detailed records of bridge crossings for each of the four toll bridges in the immediate area of the falls. The Rainbow Bridge carries the most tourist traffic, although local residential and commuter traffic also cross the bridge, which is located approximately 10 miles from the Love Canal site. Through traffic is more likely to use one of the other bridges because of easier access to major highways.

Our analysis of the Rainbow Bridge crossing data revealed no statistically significant change in bridge crossings after the 1978 Love Canal declaration. However, this is a very weak result. During the study we learned that much of the variation in bridge crossings may be accounted for by changes in the relative prices of U.S. and Canadian goods associated with changes in the exchange rate. The analysis did not correct for this factor. However, a local analyst contacted in preparing this case study reported that there was no perception of danger outside the immediate 16-acre residential area (Illum, 1983).

4.5 LAS VEGAS HOTEL FIRES

4.5.1 Description of the event

Las Vegas was the site of disastrous fires at the MGM Grand hotel on November 21, 1980, and at the Las Vegas Hilton hotel on February 10, 1981. The Hilton fire toll of 8 deaths and 242 injuries was much lower than that of the MGM fire, where 84 people were killed. Circumstances surrounding the causes of

the fire differed. The Hilton fire was blamed on arson, while the MGM blaze was caused by an electrical short. Nevertheless, there were striking similarities between the two incidents. In both cases, only a few of those who died suffered burns. Most of the deaths were due to asphyxiation resulting from smoke and toxic fumes. Fire alarm and safety systems operated inadequately or not at all (Secter et al., 1981).

4.5.2 Public perception

The MGM Grand and Las Vegas Hilton hotel fires generated extensive news and media attention. A search of the NEXIS and NewsBank news data bases found over 700 articles from newspapers, magazines, and wire services. Publications including the Los Angeles Times, San Diego Union, San Francisco Chronicle, New York Times, and Washington Post, carried articles discussing fires and safety concerns about the two hotels.

Public perception of the two fires, as reflected in the news media, centered on the lack of proper safety and alarm equipment in the two hotels and on the presence of synthetics and plastics which released toxic fumes. "Most of the postmortems in Las Vegas ... have focused on the refusal of MGM managers to upgrade their fire safety system merely because they were not legally required to do so. In Las Vegas and Clark County, as in many areas nationwide, new, tougher safety codes have not been applied retroactively to existing buildings" (Sawyer, 1980).

Following the fires, many other hotel-casinos became concerned about these issues. In addition to the safety of the Las Vegas Hilton and MGM Grand hotels, media accounts discussed concerns of the entire hotel industry about hotel safety (Schaffer and Nunes, 1980). In response, many other Las Vegas hotel-casinos began to upgrade their safety systems (Sawyer, 1980).

4.5.3 Evidence of effects on tourism

Gaming, entertainment, and convention facilities are a major component of the Las Vegas image. Additionally, nearby Hoover Dam and Lake Mead National Recreation Area are major tourist attractions.

Two types of evidence of effects of the MGM Grand hotel fire on tourism levels were reviewed for this case study. The first consisted of comments in the financial press during the months following the fire that concerned the potential for effects on hotel-casino revenues. The second included data on the performance of hotel-casino stock prices before and after the hotel fire. Both types of evidence reflect expectations of investors about the effects of the hotel fire on future revenues of hotel-casinos in Las Vegas and elsewhere. However, evidence of changes in stock prices differs from public perception evidence gathered from statements in the press. The former reflects the way that changes in public perception translate into changes in investment behavior (as expressed in stock prices), rather than just the changes in perception themselves. Also, like property values, stock prices reflect the anticipation of future impacts.

A review of comments by financial market analysts in The Value Line Investment Survey (1980) reinforces the view that the effects of the MGM Grand fire were not limited to that hotel: "Another hotel fire, in Westchester County, New

York, a couple of weeks ago, nearly assures that the question of fire safety will have economic repercussions throughout this industry." The Value Line analysis suggested that since most hotels were built prior to the strengthening of fire codes in the early to mid-1970s, retrofitting the fire detection and sprinkler systems "will undoubtedly be an expensive retrofit." Such retrofits were said to be likely to reduce available rooms, while improvements were being made.

Reporting that, "Gaming in Nevada felt the pinch of a recession for the first time this year. The major fire at the MGM Grand in Las Vegas won't help attract new business, either...." Value line suggested that changes in customer attitudes were expected to translate into changes in future sales. However, these expectations were not noticeably reflected in the behavior of stock prices for a sample of corporations associated with the hotel-casino business.

During the days immediately before and after the MGM Grand hotel fire (November 20 to 23, 1980) the stock prices of seven corporations, other than MGM Grand Hotels, Inc., with substantial Las Vegas hotel-casino holdings rose an average of 1.7 percent, with a standard error of 3.4. These figures represent a statistically insignificant increase in value with respect to the market, which fell 0.7 percent, as measured by the New York Stock Exchange Composite Indicator. In contrast, the price of MGM Grand Hotels, Inc.'s stock dropped 35 percent. Based on this small sample, it appears that investor expectations that the fire would result in sizable lost revenues were limited to the MGM Grand. However, the fire could have meant financial gains to other hotels in Las Vegas because of their physical ability to absorb some of the MGM Grand's lost business.

These results suggest that customer concerns about safety that were reflected in the news media, had no lasting effect on Las Vegas tourism. If this is true, an analysis of gaming revenues, or other measures of the level of tourism-related business activity, should also reveal no significant decline in tourism levels following the fire (after other market factors and reduced Las Vegas hotel room capacity are taken into account). Such an analysis is beyond the scope of this case study.

4.6 NUCLEAR WEAPONS TESTING ACTIVITY - NEVADA TEST SITE

4.6.1 Description of the event

The Nevada Test Site (NTS) located in Nye County has been the site of nuclear weapons testing since 1951 (with the exceptions of 1959 and 1960). Until July 1962, both atmospheric and underground nuclear tests were conducted at the NTS (DOE/NVO, 1983). Atmospheric tests typically produced radioactivity detectable off the NTS. On August 5, 1963, the United States and the Soviet Union signed the Limited Test Ban Treaty, which effectively banned testing of nuclear weapons in the atmosphere. Since then all testing has been underground. Between 14 and 19 announced tests per year were conducted between 1981 and 1985. Tests of limited yield and no potential for off site damage are not generally announced.

4.6.2 Public perception

Discussions with the U.S. Department of Energy (DOE) and local planners indicate that concerns about the effects of the NTS on the tourism industry may have been expressed as early as the 1960s. Alternatively, it has been suggested that the visibility of the atmospheric tests from Las Vegas was an attraction to tourists (Melancon, 1983). The test events probably have been perceived differently over the years as public attitudes and information have changed. However, an investigation of public perceptions⁶ of the test events (e.g., as reflected in the news media) which might provide a stronger foundation for additional research on this topic was not conducted as part of this case study.

Public perceptions of the weapons tests depend on the amount and type of information available at the times of the tests, as well as the public's interpretation of that information. The DOE publishes information about all announced weapons tests, including event names, dates, purposes, (e.g., weapons related), types (e.g., tunnel), and yield ranges (e.g., less than 20 kilotons). However, few test events are announced in advance and some are not announced at all. Information about virtually all announced nuclear weapons tests is reported by the news media. While atmospheric tests were visible from Las Vegas, underground tests may not be noticeable to the Las Vegas visitor (Melancon, 1983).

4.6.3 Evidence of an effect on tourism

For a brief description of tourism attractions in the Las Vegas area, see Section 4.5.3.

Building and operating a high-level radioactive waste repository at Yucca Mountain could affect tourism by calling attention to nuclear testing activities. This presumes that heightened visibility of these activities would reduce tourism. This analysis for this case study used the number and size of weapons tests to indicate how tourism levels (as indicated by gaming revenues) may have varied over time.

An econometric analysis⁷ was conducted to examine the relationship among annual Clark County gaming revenues, California and United States economic activity, and NTS nuclear weapons test data. This very preliminary analysis indicates a statistically insignificant but negative relationship between test activity and tourism. The public declaration by President Eisenhower of a nuclear test moratorium in 1958 appears to have had no effect. Moreover, gaming revenues appear insensitive to the size of the tests and whether they were above ground or below ground.

CHAPTER 5

POTENTIAL IMPACT OF A YUCCA MOUNTAIN REPOSITORY

It is possible that the location of a repository at Yucca Mountain could affect tourism in the Las Vegas area. There are several ways this could happen. Tourists could avoid the area due to concerns about the safety of the repository project; they could avoid the area in response to adverse media coverage of the project. Of course, media coverage could arise from concerns about safety.

A Yucca Mountain repository would have some characteristics in common with the published studies discussed in Chapter 3 and the case studies presented in Chapter 4 of this report. The repository would be associated with radioactive materials. At least initially, this could generate widespread debate about public safety and this debate would likely receive extensive media coverage. Because of these similarities, it is reasonable to turn to the published studies in Chapter 3 and the case studies described in Chapter 4 for preliminary evidence concerning the nature of a Yucca Mountain repository's potential effect on tourism.

There was mixed evidence about the short-term effect on tourism and recreation of projects involving radioactive materials, and incidents in which safety concerns have received widespread media attention. Tourism or recreation levels rose at the time of some of the projects or incidents, but fell in the case of others. Factors other than the project or incident in question could have accounted for the changes observed in all of the indicators of tourism. More rigorous analyses would be necessary to distinguish whether these changes in tourism and recreation could be explained by these confounding factors, such as variation in weather conditions.

It does not appear that media coverage of safety concerns about a Yucca Mountain repository would, by itself, generate a discernible lasting effect on tourism in the Las Vegas area. The review of evidence surrounding both the Las Vegas hotel fires and the Three Mile Island (TMI) incident failed to uncover evidence that either incident produced a sustained decline in economic activity, including tourism. After the 1980 MGM Grand hotel fire, the average price of common stock in several Las Vegas hotel-casinos did not change relative to the market, while the price of stock in the corporation owning the fire-damaged hotel fell markedly. After the TMI incident, two independent studies were unable to discern any effect of that incident on local property values. Both the Las Vegas fires and the TMI incident involved the physical presence of hazard--in the form of fire damage or the release of radiation--in addition to widespread media coverage and the expression of concern about public safety. If adverse media coverage alone affects tourism, then we would expect adverse media coverage, accompanied by the well-documented presence of hazards, to reduce tourism levels. Neither of the two studies described above revealed evidence of such an effect. This suggests that adverse media coverage alone does not affect tourism.

These results are based on preliminary evidence. More extensive investigation of some of this evidence is recommended, as described in Chapter 6. At this point, two particular limitations of the analysis are noted. First, this

report has reviewed cases involving accidents to determine the effect on tourism of associated expressions of concern about public safety and media coverage. However, no attempt has been made to analyze the effects of a hypothetical accident involving a repository. Instead, the analysis presented in this report concerns the effects on tourism of a repository operating without incident.

Second, this analysis lacks specific information about both the design and physical appearance of the potential Yucca Mountain repository and the perceived riskiness of the repository. This analysis does not take into account information about transportation routes or the appearance of the transportation activity to visitors; nor does it explicitly account for either expert or nonexpert judgments of the riskiness of the project. Results of this preliminary analysis should be reevaluated as such information becomes available.

To summarize, the evidence presented in this report suggests that media coverage of a Yucca Mountain repository would not alone generate a lasting effect on Las Vegas tourism. Further, there is no systematic evidence to indicate that the presence of a repository would cause a short-term effect. The evidence concerning short-term effects varied among the situations reviewed.

CHAPTER 6

RECOMMENDATIONS FOR FURTHER RESEARCH

The preliminary literature review and analysis reported in Chapters 3 and 4 focused on exploration of alternative impact prediction methods and topics relevant to the Las Vegas area tourism impact issue. Further research is recommended on several of these topics: 1) the structure of the southern Nevada economy and its important tourism component; 2) time series analysis of Las Vegas area gaming revenues (or other appropriate indicators of tourism); 3) how the quality and type of information that potential visitors receive could affect tourism; 4) the usefulness of survey research in predicting behavior; and 5) alternative explanations for differences among reported perceptions of risk. Each of these topics are discussed in the following paragraphs.

Empirical analyses conducted for this report were based on very simple models of the tourism industry in southern Nevada. A more in-depth analysis of the structure of the southern Nevada economy, especially the hotel-casinos and convention activities, could reveal additional or alternative indicators of tourism that are better predictors of tourist behavior. Additionally, research should be undertaken to determine if analyses would be more meaningful for predicting potential impacts of a repository at Yucca Mountain, when conducted for separate market segments, rather than one homogeneous "tourist."

Based on the analyses undertaken for this report, the sources of historical data and experience on potential impacts of safety concerns relating to the Yucca Mountain repository project appear to be three southern Nevada situations: the nuclear weapons testing at the Nevada Test Site (NTS); the 1980 and 1981 Las Vegas hotel fires; and the existing low-level radioactive waste disposal site located near Beatty, Nevada⁸. Further time series analyses should be conducted to explore the historical impacts of these three situations on gaming revenues, or other appropriate indicators of local area tourism. Additionally, changes in the selected indicators in the local area should be compared to similar indicators at regional and national levels, to determine if such changes were widespread. Finally, the simple econometric analysis conducted for the NTS case study should be expanded to explore other variables that may be appropriate for inclusion in the analysis. Additional variables such as the price of hotel rooms in Las Vegas, the availability of gaming in alternative U.S. locations (such as Reno and Atlantic City), and alternative measures of general economic activity may strengthen the model.

Media coverage can be influential when it is positive, as well as when it is adverse. After the Three Mile Island (TMI) incident, the Commonwealth of Pennsylvania undertook a television and print "media campaign" to reinforce the image of Pennsylvania as an "ideal place for groups to meet and families to visit." Since the first phase was carried out from April to June 1980, its effectiveness had not been evaluated by the time the Commonwealth prepared its final report on the TMI incident. Information on the effectiveness of this type of media coverage would be useful. It should be also determined if similar mitigative efforts were undertaken after the Las Vegas hotel fires, and if so, their effectiveness should be analyzed.

West and Baker (1983) observed that when informed of the Nuclear Regulatory Commission (NRC) safety certification procedures for the proposed floating nuclear power plants, there was a significant reduction in the number of beach-goers indicating they would avoid the beach. Analyses of the effects of similar information in cases where safety concerns were expressed could be useful in determining the types of information regarding repository safety, as well as repository design and appearance, that would be appropriate for the proposed repository at Yucca Mountain.

Initial survey results reported by West and Baker (1983) indicated that approximately 25 percent of the beach-goers interviewed would avoid that beach if a floating nuclear power plant were sited directly offshore. In contrast, results of a survey of residents of Pennsylvania and its neighboring northeastern states, reported by the Commonwealth of Pennsylvania (ca. 1980), indicated that 6 percent would avoid the Harrisburg area in their planned summer of 1979 travels. The survey instruments were not examined, making direct comparison of the two percentages inappropriate. However, the range of stated tourist avoidance behavior is noteworthy, as is the magnitude (about 50 percent) of West and Baker's downward adjustment prior to using their survey results to predict tourist behavior.

It would be informative if predictions of behavior based on such survey results could be calibrated. One method of calibration would be to examine cases where such survey-based predictions of behavior have been made, and compare these with evidence of actual behavior. Another way would be to repeat a survey, such as the TMI survey. If the percent of potential tourists not wishing to visit Harrisburg was still close to 6 percent today, that percent is likely to be the result of factors other than the TMI incident.

Finally, given the preliminary nature of the literature review presented in Section 3.2, a more in-depth review of the literature on risk perception may be useful, especially that dealing with explanations of why reported perceptions of risk appear to differ among groups.

NOTES

¹ The relevance of views expressed about the linkages between tourism and repository siting may be limited by a lack of understanding of the repository project. However, the level and accuracy of available information about the repository may, in itself, be important in determining its effect on tourism. Thus, discussions with less-than-perfectly informed observers seem both appropriate and informative at this preliminary stage of analysis.

² Otway and Thomas (1982) distinguish between the generation of probabilistic data by experts and the interpretation and meaning that people attach to the data. These authors emphasize that people "see the world differently" and that risk perception and responses depend upon a variety of factors, including information; social experiences; values and world views; interest group activity; the legitimacy of institutions; and the political process. Covello (1983) has recommended the adoption of an organizational or structural perspective which assumes that "risk perceptions are substantially influenced by group norms and expectations and by the social and organizational location of the individual". Researchers such as Douglas (Douglas, 1982; Douglas and Wildavsky, 1983), Thompson (Thomson, 1983) and Rayner (Rayner 1984; Gross and Rayner, 1985) explicitly recognize the existence of different groups based on differences in culture (i.e., differences in values and ideas). According to these authors, risks that are compatible with the norms of different types of organization will be filtered out, while those that threaten existing values will be magnified.

³ NEXIS is a computerized library of public affairs and business information maintained by Mead Data Central, Inc. of Dayton, Ohio. The online data base consists of 142 files grouped according to the following categories: newspapers, magazines, wire services, newsletters, business, finance, government, news, and trade/technology. Some files, such as the one containing articles from Newsweek, are in more than one group. All of the files contain selected full-text articles, while some, such as the one corresponding to the New York Times, contain entire publications. The user can search the entire library at once, or can specify individual files or groups. NEXIS currently contains about 8 million articles, and about 40,000 new articles are added per week.

⁴ Using a dummy variable to represent the period following the TMI accident (1979-1982), the statistical relationships among park attendance, gross national product, days of rain per season, and the accident may be described by the regression equation:

$$\text{Log (PARK)} = 2.49 + 1.64 \text{ Log (GNP)} - 0.0014 \text{ RAIN} - 0.15 \text{ D}$$

(2.45) (0.403) (1.97)

$$R^2 = 0.67$$

where

PARK = annual Hersheypark attendance
GNP = Gross National Product in 1972 dollars
RAIN = number of days of rainfall each park season
D = 1 for 1979-82 and 0 for 1975-79

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