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**INTERIM STATEMENT**  
**OF THE**  
**TECHNICAL REVIEW COMMITTEE**  
**ON THE**  
**YUCCA MOUNTAIN SOCIOECONOMIC**  
**PROJECT**

**JANUARY 1990**

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Institute of Behavioral Science

Campus Box 482  
Boulder, Colorado 80309-0482  
(303) 492-6311

This statement by an independent review committee offers comments on the quality and possible national significance of studies undertaken by the State of Nevada on socioeconomic aspects of the proposed Yucca Mountain repository for high-level nuclear waste. The Committee believes that the studies deserve careful appraisal by officials responsible for the nuclear waste disposal program and by other concerned people in Nevada and wherever nuclear waste is stored or likely to be transported in the United States.



Gilbert F. White  
Chair, Technical Review Committee

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Interim Statement of the Technical Review Committee  
on the  
Yucca Mountain Socioeconomic Project

Introduction and Overview

The present uncertain state of knowledge about the likely impacts of constructing a national repository for high level nuclear waste makes it timely to comment on the status of current studies by the State of Nevada on the socioeconomic dimensions of the repository effort and the implications for national and state policy. In light of the 10,000 year time horizon, the hazardous nature of the material to be stored, and the intrinsic uncertainties associated with a project of such unprecedented scope, it will be important to the nation for all parties involved in nuclear waste program planning to study carefully the insights gained from socioeconomic as well as environmental impact studies. These studies, whether carried out by the facility developer or by other national or state entities, can contribute to the development of public trust as well as to the identification of impacts and the measures needed to address them.

From the evidence now available, it appears that the designation of Yucca Mountain as the site for a repository has already had significant socioeconomic impacts on Nevada, and that, depending upon numerous decisions not yet made by federal, state, and local agencies as well as public reactions to future events, the development of the repository could have a profound effect upon the economy and quality of life of people of the region. This conclusion arises in part from observation of the effects on the political and social fabric of Nevada over the fourteen years since investigations commenced at Yucca Mountain, and in part from emerging findings related to public perceptions of the risks of waste transportation, storage, and disposal. In addition to the effects on Nevada, the consequences may also be large for other parts of the nation. With no alternatives to Yucca Mountain under study, communities across the nation may increasingly be concerned with the prospects for transport of waste through their areas, or with the possibility that they may be obliged to store mounting volumes of high-level waste locally in temporary facilities for an indefinite period.

Role of the Technical Review Committee in the Yucca Mountain Socioeconomic Project

The Nuclear Waste Policy Act of 1982 and its 1987 Amendments give the State of Nevada authority to conduct independent assessments of the socioeconomic impacts of the repository project at Yucca Mountain. These assessments are distinct from socioeconomic studies required of the Department of Energy (DOE)

as part of its responsibility for evaluating the site. In April 1986, the State hired Mountain West Research to carry out its studies, and created the Technical Review Committee (TRC) to provide independent review and comment on the scope, methodology and findings of these studies. In June 1989, Mountain West presented to the Nevada Nuclear Waste Project Office (NWPO) its "Interim Report on the State of Nevada Socioeconomic Studies."

The TRC has met regularly since 1986 to examine work in progress and to provide comments, criticisms, and suggestions to the NWPO and Mountain West. The TRC would like to stress the independent nature of its review. It understands itself to be responsible for appraising the technical validity of the studies, their usefulness to policy planners, and their contribution to scientific knowledge. The TRC commends the NWPO for seeking such outside review, and believes that its comments have been seriously considered by the NWPO and Mountain West and largely incorporated in the studies. The TRC is, however, an advisory committee; the NWPO and Mountain West are responsible for the study efforts and their findings.

This statement by the TRC is intended to provide to interested parties the perspective of an independent body concerning the quality and significance of the socioeconomic studies conducted to date. The TRC's comments and views are provided below in four categories:

- (1) the sources of uncertainty that surround estimates of socioeconomic impacts from this unprecedented project,
- (2) the validity of the methods employed and findings reached to date,
- (3) the components of the current situation that will make it difficult to reach sound conclusions, and
- (4) the steps that appear essential to arriving at reasonable, accurate, and reliable findings from the studies now underway or projected.

#### Sources of Uncertainty

Uncertainty is inherent in any attempt to estimate the impacts of a unique project of the magnitude, complexity and time horizon of the proposed Yucca Mountain repository. Given the potential for human error, the novelty of some aspects of the technology, and an extended time horizon that is twice as long as recorded human history, it is inevitable that the actual impacts -- physical, biological, social, psychological, and economic -- will differ from the best of impact projections. It is important to understand that much of the uncertainty cannot be reduced to probability estimates.

Estimates of probability, if they are sound, must be based upon experience. When experience is lacking, grounds for calculating probabilities are deficient and uncertainty is compounded.

Even for the foreseeable future, there are at least three categories of uncertainty that can significantly alter socioeconomic impacts. First, there are uncertainties that flow from the simple condition of indecision. For instance, DOE plans for transporting nuclear waste from storage sites to the repository remain unformulated: we do not know at this time whether waste shipments will be made by truck or rail, over which routes, with what frequency or safeguards, and when they will begin. In the face of these uncertainties, it is difficult, if not impossible, for the state of Nevada, corridor states or the Department of Energy to make realistic projections of risks and their probabilities, to prepare to respond to public perceptions and actions, or to develop specific mitigation policies.

Second, the policies to be followed by state and local governments and the future behavior of individuals in response to the project are largely unknown, and they could have a powerful influence on impacts. The nature of the materials to be stored, the apprehension of the public concerning such materials, and phenomena involving the social amplification of risks, all combine to create uncertainty regarding human and institutional responses to the repository.

Third, there will continue to be external perturbations and surprises that may cause the repository development to differ from anything that can be foreseen at this time. Unforeseen events occurring throughout the 10,000 year life of the repository will continue to surround future repository development, operation and storage with irreducible uncertainty. The most sophisticated projections will not be predictions, and are virtually certain to require modification in response to events over the course of time.

The nuclear waste repository is an unprecedented undertaking for humanity, and the extreme uncertainty that surrounds its impacts should not be minimized. The state's studies have made a strong case for the importance of assessing uncertainty, and the TRC believes it would be imprudent to ignore the effects of uncertainty in any studies carried out by the state, the Department of Energy, or other public and private agencies. Careful studies with appropriate caveats, like those undertaken by Nevada, can provide insights concerning the range of future impacts and management options, and can be helpful in informing the near-term choices and decisions that face the state and nation. The state is to be commended for developing a set of studies that begin to deal systematically with the irreducible uncertainties of the project.

### Validity of Methods Employed and Findings to Date

In the opinion of the TRC, the Executive Summary of the Interim Report is an accurate, carefully stated, and appropriately qualified summary of the major issues uncovered by the study and the findings reached to date. The TRC considers the most significant observations in the Executive Summary to be:

- Disposal of high level nuclear waste presents society with one of its most complex social and technological challenges.
- Wide-spread public concerns over the hazards of radioactive waste disposal create a special context for Nevadans, one which generates discussion, debate and conflict.
- The nature of future events and the types and magnitudes of the consequences will depend heavily upon future conditions that cannot be fully anticipated.
- The greatest potential socioeconomic difficulty of the proposed repository stems from the intense negative imagery associated by the public with a high-level radioactive waste repository, combined with the vulnerability of the Nevada economy to changes in its public image. Because of the high profile nature of the whole nuclear waste disposal program, the potential exists for Nevada to become associated with this negative imagery to the detriment of its attempts to attract tourists, conventions, migrants, and new industry to the state.
- The results of the many different research efforts indicate that the state and local governments must work under the assumption that the high level radioactive waste repository proposed at Yucca Mountain has the potential to result in significant negative impacts for the state's economic base, revenues, public services, and community life. Such impacts could more than offset any expected benefits to be derived from employment and income generated by the project.

Regarding the last two findings given above, the TRC believes that the research conducted to date indicates that risk-induced behavioral effects, called "special effects," may result in significant negative socioeconomic impacts much larger than any positive impacts resulting from "standard effects" of the repository project. Although it is also plausible that the special effects may turn out to be small in their overall impact and/or temporary in their duration, the TRC believes that the State cannot afford to ignore the potential consequences for its economy and society of these special effects. The magnitude of impacts will depend in part on the accidents and events that occur, on the

treatment of such events by the media, and on the management policies of the federal, state and local governments.

Although negative imagery from public perceptions of risk could potentially cause socioeconomic difficulties of significant magnitude, as suggested in the findings above, the physical effects of potential accidents should not be minimized in estimations of impacts. While the physical effects of the most serious credible accidents involving spent nuclear fuel transported to and stored at a repository would not be as severe as the most serious accidents that might befall an operating nuclear power plant, a major accident could have severe repercussions upon the society and economy of the state.

The body of the Interim Report presents the current stage of development of several innovative approaches to understanding the consequences of a project for which there are no direct parallels. Separating the studies into analysis of standard impacts, which are treated in conventional studies of all major projects, and the analysis of special effects, associated with the risk aspects of a repository is an important contribution of the current effort. By segmenting the investigations into these categories, competent researchers have been able to pursue important avenues of inquiry on the factors influencing public perceptions of the risk associated with the repository, about which little was previously known. The study has demonstrated the importance of considering potential risk-induced consequences of repository development. It has also shown that the political climate within which repository siting decisions have been made can affect public perceptions of risk and is directly relevant to the assessment of the socioeconomic impacts.

In terms of methods, the analysis of standard effects represents the state of the art. Considerable effort has been expended to develop tools and to obtain data bases to evaluate standard economic/demographic impacts. Data collection and calibration of models have been completed in a rigorous, unbiased, and scientifically defensible manner. One particularly important finding is that the repository will result in negative fiscal balances to state and local governments. Because of the tax structure in Nevada, growth from any project that does not generate a commensurate increase in gaming or tourism tax revenues will have this result.

There are, of course, significant uncertainties associated with the results of the analysis of standard effects. Most of the uncertainties involve the adequacy of the project description and the validity of the projections of baseline conditions over time, particularly with regard to rapid growth rates currently being experienced in Clark County. Although these uncertainties are not atypical of analysis of standard impacts employed in other major studies, the much longer than normal time frame under analysis in



this study increases the potential for uncertainty. The findings on standard effects point to significantly increased demands on state and local government facilities and services. If there is a deficiency in the analysis of standard economic/demographic impacts, it results from the lack of a complete base of reliable information on the project, including descriptions of the nuclear waste transportation network and the management system that will be employed by DOE to construct and operate the repository.

Many changes in design and operational concepts will result from discoveries during site characterization, additions to regulatory requirements, and changes in technology in the future. Project uncertainties and problems may contribute to schedule delays, construction layoffs while problems are investigated and solved, or delays in the commencement of operations once construction is completed. Recent examples of such delays have occurred for both the Yucca Mountain Project and the Waste Isolation Pilot Project in New Mexico. Socioeconomic impact assessments cannot be expected to predict reversals and delays in a project. Such problems, however, can create serious dislocations in the affected communities, causing impacts much more severe than originally predicted. The sudden termination of the Exxon Colony Oil Shale project in Colorado, which was abandoned by its developers when the oil market shifted, provides a good example of how radical changes in projects can overwhelm impact assessments and mitigation efforts. At best, a socioeconomic study might provide a warning of the potential for drastic changes when an unstable environment internal or external to the project is foreseen, as with the repository project. Good impact assessments can also analyze the impacts of specific events, such as cancellation of the project, that are usually not considered by developers.

The standard social/cultural analyses have employed advanced research methods consisting of field interviews, survey research, and ethnographic investigations. These efforts have resulted in important findings including differences in perceptions about the repository across communities in rural areas of southern Nevada. The western part of the study area is less opposed to the repository than the eastern part, and the rural communities are less opposed than the urban area. Rural communities in the eastern part, which experienced downwind effects of atomic testing, have exhibited stronger opposition to the repository than communities in the west where employment at the Nevada Test Site has been an influential factor. The studies have shown that, even before any physical development at the site, very powerful political-social effects have been spawned by the differences of opinion on the project, as with the temporary creation of a new county surrounding Yucca Mountain that generated intense intra-state conflict. The studies have employed ethnographic approaches to assessing impacts of the repository on Native Americans as well as on the rural and urban populations in the affected region. The studies are an

effort to identify and analyze likely impacts on social structure as well as issues of concern to the citizens of Nevada. As the studies have shown, "there is potential for conflict, a decrease in community satisfaction, and divisive political issues in response to the repository program."

The "special effects" analyses have been innovative. Some of the researchers in the country have been involved in the studies of risk perception, risk management, and risk assessment. Through continuous refinement, the methods have reached a stage of development such that the preliminary results can, given the careful caveats and qualifiers stated in the reports, be accepted with reasonable confidence. In particular, the possibility can no longer be ignored that the intense negative imagery surrounding the repository may cause significant impacts on Nevada's economy and social life.

The methods of investigating special effects consist of essentially three approaches: survey research, imagery analysis, and analogous case studies. Survey research has been applied extensively, especially early in the study effort. However, important questions exist about the reliability of "hypothetical perception" research (e.g., survey research that asks "what would you do if ..." questions) as a predictor of future human behavior, especially with unfamiliar situations. The study team has directed more of its recent efforts to imagery analysis as a way of examining how future behavior might be affected by risk perceptions. This approach builds on the well-established connection between people's images of a product and their behavior as consumers in traditional advertising research. The use of imagery analysis in the Nevada study, correlating people's ratings of their perceptions about places and situations with their past and future actions, provides what may be a more reliable indicator of people's future intentions than "hypothetical" survey research. The purpose of the imagery analysis has been to examine how perceptions about the repository might affect tourism, migration, convention bookings, and industrial location decisions in Nevada. Although more work is needed, this approach helps to resolve the methodological concerns about having people respond to hypothetical questions about their prospective behavior.

Recognizing that no other situation is directly comparable to the Yucca Mountain project, the detailed study of a number of analogous cases by the research team supports the finding that risk-induced behavior could result in significant negative impacts. Substantial evidence points to the existence of risk-induced behavioral effects and indicates that negative imagery associated with a waste repository could become associated with Nevada and Las Vegas. However, it is also possible that the effects could be small or of temporary duration, depending on the nature of events and of government and media responses to them. Additional studies, especially of analogous cases in which actual behavior could be

observed, should be undertaken to refine our understanding of the likelihood and extent of risk-induced effects.

### Constraints in the Current Situation

A number of issues surrounding the current and future evolution of the nuclear waste program are likely to make it difficult to reach sound conclusions from socioeconomic studies of this unique project. Some of these issues are: (1) the relationship of the socioeconomic studies to the unfinished studies on physical and biological impacts, (2) the lack of comprehensive studies of the effects of transport of waste to Yucca Mountain from sites outside of Nevada, (3) the ways in which the continually accumulating storage of high-level waste at presently dispersed sites might influence decisions about research and development at Yucca Mountain, (4) the possibility that further technological research may alter radically the prevailing assumption as to opportunities to treat, reprocess, and store high-level waste, and (5) the circumstances in which the allocations of funds for studies have been and are being made by the Congress and the Department of Energy.

The repository project is now in the very beginning of the characterization stage. Several years, and perhaps many years, of detailed characterization of the site underground will be required for a license application, and several years of review of the license application by the Nuclear Regulatory Commission (NRC) will be required before a decision is made about whether or not to construct the facility. Major uncertainty exists at this time concerning the results of the geological, hydrological, and other physical and biological studies at the Yucca Mountain site. These uncertainties are a frequent focus of media attention.

Significant uncertainties also exist regarding the future interpretation of regulations developed by the NRC to protect human health and the environment for the next 10,000 years. Additional engineering safeguards may be required and further technological research may alter radically the current design for engineered barriers and waste preparation. Because all these uncertainties concerning site characterization and licensing are greater than originally anticipated, DOE recently postponed its projected opening date from 2003 to 2010. It is also quite possible that, after several years of investigation, the Yucca Mountain site will be found to be unsuitable for geologic isolation, requiring the site to be abandoned.

The transport mode, routes, and number of shipments are also uncertain. The role of above-ground, monitored, engineered storage as a part of, or as an alternative to, the geologic repository has not been determined. Because of the delays in the repository, the debate over the location of temporary storage, either at reactors

or at a central facility, may have a significant effect on research and development activities at Yucca Mountain. Moreover, further technological research and changes in resource economics and environmental policy may in time significantly alter assumptions about storage, treatment, and reprocessing of high-level waste. Because of all these significant uncertainties associated with the physical system, magnified by the volatility of the political system which has already changed the direction of the repository program several times over the past two decades, it will be very difficult to reach reliable projections about socioeconomic impacts beyond the near-term horizon. Nevertheless, making wise decisions will require our best efforts at understanding the range of possible impacts.

Congress recently decided to reduce funding for completion of Nevada's socioeconomic and transportation assessments. The practical result of this action is a drastic reduction in the resources available to complete the final year of the study. While much has been learned to date, the reduction in effort will make it difficult to reach reliable conclusions in a number of areas.

One area in which this difficulty is clearly evident is transportation impact assessment. There is a consensus on the TRC that DOE's transportation plans are so ill-defined with regard to choice of mode, routes and containment systems that a meaningful and convincing transportation impact assessment has yet to be conducted -- by DOE or anyone else. The transportation issues are nevertheless of great concern to citizens and local governments in Nevada and in the corridor states. To deal with these concerns, the State has embarked upon a program to put in place the resources, in the form of professional staff, databases, and analytical models, to review future DOE transportation studies and plans and to perform credible independent analyses. This work is just now reaching the stage where some meaningful preliminary transportation impact assessments can be made. The uncertain funding outlook threatens to abort these efforts before useful results can be generated. The TRC finds these efforts to be important and worthy of continued support.

Because of the funding reductions, the plans to complete the gathering and updating of economic, demographic, community services, and fiscal information necessary for the county and subcounty level impact projections have been virtually halted for FY 1990. Analysis of social-cultural and Native American databases has been scaled back significantly, the ongoing effort to chronicle events in communities has been deferred indefinitely, and the important work on risk-induced behavior has had to be reprogrammed and stretched out over a longer time frame. The major task of designing and implementing monitoring systems to maintain databases and to monitor impacts has had to be postponed.

The TRC believes that the repository program is of such unprecedented scope and longevity and is so fraught with uncertainties that it is imperative to have a well-structured monitoring program in place at the very start of the project to collect the baseline economic data needed to track the project's impacts and to chronicle social and cultural developments in affected communities. Many of the Nevada studies are designed to provide the requisite baseline data. Curtailing the studies severely compromises this objective. Further, the lack of a sound monitoring program will make it very difficult to measure the actual impacts of the project as they occur and to recalibrate the State's analytical tools to project more accurately the impacts in later years.

#### Essential Steps for Reaching Reliable Findings

The research carried out to date is very promising. The reduction in funding for the final year, however, has required hard choices concerning priorities. The value of the body of findings and information that was expected from the study in 1990 will be lessened because of the deferral of the monitoring effort and other studies, and the constraints on the transportation assessments. Among the investigations that appear essential for testing some of the significant preliminary findings and reaching reasonable final conclusions are:

1. performing additional surveys and analysis to examine linkages between images and actual behavior at the national and local level,
2. continuing development of data on current conditions in Nevada that are needed to make projections relative to population-driven effects of the repository, especially in regard to the very rapid growth rates in Clark County.
3. performing additional analysis on analogous case studies, which in a qualitative way provide an extraordinarily rich source of information of how human beings react to risk and their perceptions of risk,
4. performing additional analysis of surveys of risk perceptions in rural and urban areas, and
5. developing a sound monitoring program, including the chronicling of events as they occur.

Regarding the fourth item, the preliminary report of the Nevada urban risk surveys shows data that are extremely rich, complex, and challenging. For example, an early picture that

emerges is of people satisfied with their lives and communities; despite some wariness of the repository and being very negative about it if asked directly, they give it very low salience among the problems with which they are concerned; they are fatalistic about its coming into being, and very distrustful of authorities, especially federal authorities involved in dealing with it and/or the problems that may arise from it. There are many seeming paradoxes and compelling questions raised by these initial results that deserve further analysis if the research is to provide an understanding of baseline conditions and a basis for speculating intelligently about future special effects. The data on experiences with and reactions to the Nevada Nuclear Test Site might be useful in this endeavor, although the Test Site is not an analogous facility to a repository and the socio-political circumstances surrounding the repository are different from those that surround the Test Site.

The TRC hopes that the monitoring effort will be restarted since it is much easier to collect the data through a monitoring program than to attempt to reconstruct data for past years. The planned monitoring system would have provided data at a fraction of the cost it will require to collect the data at some time in the future.

The TRC expects that, if the State of Nevada is provided adequate funding to complete the ongoing work program, the study effort can produce a balanced, insightful, and incisive analysis of the socioeconomic impacts that might be expected to result from this unprecedented national undertaking. The uncertainties about future impacts will be enormous, but the importance to Nevada and the nation of safely managing the risks and fairly mitigating the negative impacts requires our best attempt at understanding the range of future possibilities.

## TECHNICAL REVIEW COMMITTEE

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