

NEVADA NUCLEAR WASTE STORAGE INVESTIGATIONS PROJECT
SUMMARY OF ONGOING AND PLANNED SITE CHARACTERIZATION
ACTIVITIES FOR THE CANDIDATE SITE AT
YUCCA MOUNTAIN, NEVADA
May 1986 - April 1987

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NNWSI PROJECT
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1.0 Preface

The Nuclear Waste Project Act (NWSA) of 1982 requires that the Department of Energy (DOE) prepare and issue a Site Characterization Plan (SCP) to the Nuclear Regulatory Commission (NRC) and to affected States and Indian Tribes before sinking exploratory shafts (ES) at any candidate sites. While site characterization activities related to the exploratory shaft facility (ESF) will not be initiated until after the issuance of the SCP, some surface - based activities are ongoing or may be initiated before issuance of the SCP.

During the May 7-8, 1986, NRC DOE meeting on the level of detail for site characterization plans and study plans, the DOE agreed to prepare a letter report describing these ongoing and planned site characterization activities for the States and Indian tribes. Ongoing activities are defined as site characterization activities, as defined by NWSA, that were in progress at the time of Presidential Approval (May, 1986). Planned activities are defined as site characterization activities, as defined by NWSA, that have been started, or are planned to be started, after Presidential approval, but before the expected date of SCP issuance (April, 1987).

2.0 Introduction

According to the NWSA of 1982, site characterization refers to those research activities, whether in the field or in the laboratory, that are undertaken to establish the geologic condition and the range of parameters relevant to an evaluation of the suitability of a candidate site. Yucca Mountain became a candidate site on May 28, 1986, with the President's approval of the recommendation by the Secretary of the DOE. This recommendation was accompanied by a final Environmental Assessment pursuant to the NWSA.

Site characterization activities that take place in the field include mapping, geophysical surveys, borings, surface excavations, excavation of exploratory shafts, subsurface lateral excavations and borings, and in situ testing. Laboratory activities include measurement of thermal, mechanical, and hydrological rock properties; analysis of gas and water samples and fossil plant material; detailed mineralogic and petrologic analyses; and geochemical studies under conditions simulating the repository environment. Office activities include modeling and data reduction and analysis. Excavation of an exploratory shaft and in situ testing at the depths of waste emplacement are required by the NRC (10 CFR 60.10(b)), and were described in the DOE Mission Plan.

2.1 The Nevada Nuclear Waste Storage Investigations (NNWSI) Project Site Characterization Plan (SCP).

Site information gathered during the 1978 to 1984 time frame was used to prepare the EA and to evaluate the site against the DOE siting guidelines. Site investigations completed before Presidential approval (May 1986) but not reported in the EA will be described in the SCP, tentatively scheduled for issuance in April 1987.

Data Chapters 1 through 5 of the NNWSI Project SCP will establish the current understanding about the Yucca Mountain site with regard to Geology (Chapter 1), Geoengineering (Chapter 2), Hydrology (Chapter 3), Geochemistry (Chapter 4), and Meteorology and Climate (Chapter 5). Current conceptual designs for the repository and waste package are provided in Chapters 6 and 7, respectively. Results from ongoing studies and design activities available too late for incorporation into the SCP will be reported in the semiannual Progress Reports.

Chapter 8 of the SCP contains a description of plans for site characterization activities. Section 8.1 of the SCP describes the rationale for the planned site characterization program, while Section 8.2 discusses the technical and regulatory issues that are to be resolved during site characterization. Section 8.3 is the Plans section of the SCP and is structured on the basis of Issues and Information Needs, using the NNWSI Project Issues Hierarchy. Section 8.4 describes the plans for site preparation for the surface and subsurface excavations at the exploratory shaft location and a description of the exploratory shaft and underground test facilities. Section 8.5 reviews the milestones and decision points in the site characterization program up to submittal of the license application. Section 8.6 provides a description of the Quality Assurance Program for the Project, and Section 8.7 describes the plans for decontamination and decommissioning of the candidate site if the site is not selected for development as a repository. Enclosure 1 provides a working copy of the structure of Chapter 8.

Details of planned in situ testing in the Exploratory Shaft will be described in the SCP and in Study Plans, which will provide supporting material of the Yucca Mountain SCP.

2.2 The NNWSI Project Issues Hierarchy.

The Issues Hierarchy is the means by which the NNWSI Project has abstracted and organized the repository siting and licensing requirements into a hierarchical structure of Key Issues, Issues, and Information Needs. This hierarchical structure provides a means to distinguish broad questions of overall suitability (Key Issues) from more specific questions (Issues). Some questions in the regulations governing repositories deal with performance objectives or regulatory standards; other questions deal with favorability or standard operating practices and procedures. In addition, some questions in the regulations deal with postclosure time frames, while others only deal with the preclosure period. Key Issues are related to broad technical or institutional requirements pertaining to the performance of the site with respect to compliance with applicable regulations. Issues are subordinate to Key Issues. Collectively, the group

of Issues under a Key Issue indicates what questions must be resolved to satisfy the Key Issue. The Issues are also generally readily identifiable as elements of the regulations. Information Needs are subordinate to Issues and identify the specific information, data, and analyses needed to resolve the Issues.

Issues within each Key Issue in the NNWSI Project Issues Hierarchy are grouped into Characterization, Design, and Performance Issues. The separation of topics according to preclosure and postclosure time frames is automatic, because the Key Issues explicitly make the time frame distinction. Characterization Issues encompass the site characteristics, processes, and events that may affect repository design and performance. They include detailed information on the geologic, hydrologic, and other site characteristics. Design Issues address needs for information about the design of the geologic repository operations area and its associated surface facilities and underground facility. Performance Issues address the analyses necessary to assess the suitability of the Yucca Mountain site and its proposed repository facilities as a licensable repository system. Performance Issues encompass the requirements placed on the behavior of the repository system. Key Issue 3 is not included because it represents the environmental regulatory requirements and Information Needs, and covers monitoring and mitigation efforts. Key Issue 3 will be fully developed after the Environmental Impact Statement (EIS) scoping meetings and hearings are completed.

Information Needs were used as the basis for defining the field and laboratory investigations to be conducted during site characterization. Each Information Need described in Section 8.3 of the SCP will be presented according to a standard format:

1. A list of the data and parameters to be collected to satisfy the Information Need.
2. A discussion of the logic tying the data and parameters together.
3. A description of the studies and activities planned to collect the data and parameters for the Information Need.
4. A discussion of where the data and parameters will be used as input to other Information Needs.
5. A preliminary list of planned milestones and schedules for completion of the activities and studies.

2.3 Purpose

The purpose of this report is to summarize site characterization activities at the candidate site at Yucca Mountain, Nevada, for ongoing activities and the status of planned activities. This summary is provided in response to agreements between the DOE and the NRC resulting from the May 7-8, 1986 meeting. A more comprehensive discussion will follow in the SCP.

This summary concentrates on surface-based activities, which include all field activities defined by the NHPA as site characterization activities (e.g., drilling, drillhole testing and monitoring, trenching, mapping, and surveying at the Yucca Mountain site and surrounding region) that are not directly related to the ESF. Site Characterization activities related to the ES will not be initiated until after the SCP is issued. In addition, prototype testing which is not a part of site characterization, is not included in this summary. Geochemical and thermomechanical laboratory testing related to field activities are described, as well as meteorological studies. A brief technical rationale for each activity is provided, and activities are cross-referenced to the appropriate sections in the SCP.

This report is divided into two sections: ongoing site characterization activities and planned activities.

3.0 Ongoing Site Characterization Activities: Description and Rationale

Site investigation activities were initiated in 1978 when the NNWSI Project began to focus on tuff at Yucca Mountain as a potential repository host rock. The DOE identified Yucca Mountain as a potentially acceptable site in February 1983. Publication of the final EA for the Yucca Mountain site (May 1986) establishes that the site is suitable for site characterization. It is expected that some of the previously initiated activities will continue or be completed during the time between Presidential approval of the site recommendation, and issuance of the SCP. Examples of such activities include seismic monitoring, hydrologic monitoring, meteorologic monitoring, geodetic surveys, and laboratory analyses of degradable and irreplaceable samples. Office activities include modeling and data reduction and analysis of available data. Brief descriptions of each activity are given below.

3.1 Hydrologic Activities.

Various hydrologic activities have been initiated to establish the moisture conditions of the unsaturated zone, and to determine if recharge is episodic or steady-state. Saturated zone activities have been focused on determining the position of the water table, and on establishing the characteristics of fracture hydrology. The following specific activities, including the data reduction and analyses associated with field-data collection, are ongoing.

- 3.1.1 Seven holes have been drilled to monitor in situ moisture conditions in the unsaturated zone (Figures 1 and 2). These holes range from 400 to about 2,000 feet deep. One of these holes, USW UZ-1, has been fully instrumented and continuously monitors hydrologic properties of the unsaturated zone. Existing holes UZ-4, 5, 6, 6s, 7, and 13 will be instrumented and monitored. Gas samples are also obtained periodically from UZ-1. UZ-8, which was only partially drilled, will be re-entered, drilled to the planned total depth and instrumented. Re-entering any of these holes may be necessary to acquire additional information using geophysical logging tools and other instrumentation. This activity supports the studies identified in section 8.3.1.2.2 of the SCP.

- 3.1.2 Fourteen boreholes (Figures 1 and 2) were drilled into the saturated zone for the purpose of determining the elevation of the water table at various locations at the site. These boreholes range from about 1,600 to 2,000 feet deep. Water levels in the boreholes are monitored regularly to record fluctuations in water levels as a function of time. Water table levels from the fourteen water table holes were used to establish the hydraulic gradients used to estimate the saturated zone travel times presented in the EA. This activity supports the studies identified in sections 8.3.1.2.1 and 8.3.1.2.3 of the SCP.
- 3.1.3 Seventy-four neutron holes (depths from 50 to 200 feet) have been drilled in the vicinity of the site to monitor the infiltration of precipitation in various geologic settings. Because of the importance of flux estimates in the unsaturated zone, monitoring data on shallow infiltration is used to determine the upper bounds on flux through the repository horizon. The holes are logged periodically with thermal and epithermal neutron tools, and gamma-gamma tools. The locations of the neutron holes are shown in figures 1 and 2. This activity supports studies identified in section 8.3.1.2.3 of the SCP.
- 3.1.4 Nine streamflow gages have been installed in dry washes at and near Yucca Mountain to monitor the surface-water runoff that occurs during and after storms. Streamflow gages provide data to be used in predicting the frequency and magnitude of runoff resulting from heavy precipitation events, which are typical in desert environments. This activity supports studies in sections 8.3.1.5.1, 8.3.1.6.1, and 8.3.1.16.1 of the SCP.
- 3.1.5 Observations of debris-flow movements are being made at the time of occurrence in order to understand the mechanisms of flow and the climatic and other factors that cause them. This effort contributes to the understanding of the conditions under which paleoflood deposits occurred. This activity supports studies identified in sections 8.3.1.5.1 and 8.3.1.6.1 of the SCP.
- 3.1.6 Channel scour chains have been installed at three locations in the Yucca Mountain area to measure the amount of erosion, or scour, that occurs in washes during times of heavy runoff. Heavy runoff events expose successively deeper parts of the chain, thus giving a measure of the amount of sediment movement in the wash. This activity supports studies identified in sections 8.3.1.5.1 and 8.3.1.6.1 of the SCP.
- 3.1.7 Water-level and pressure measurements are being recorded continuously in the three UE-25c boreholes (Figure 2), located in Drill Hole Wash, using a continuously recording data logger to evaluate barometric, tidal, and other time-related effects on water levels. This information is used to provide better understanding of fracture porosity and other aquifer properties. Long-term, continuous recording is required in order to obtain an accurate correlation of the atmospheric pressure versus water-level data. This activity supports studies identified in section 8.3.1.2.3 of the SCP.

- 3.1.8 A mining company is drilling boreholes in the Amargosa Desert as part of its exploration programs. This commercial company have agreed to allow installation of tubing or piezometers in their holes for NNWSI Project data collection purposes. Some tubing and piezometers have been installed to measure water levels in areas adjacent to the Yucca Mountain site in order to provide data for regional hydrologic studies. Additional instruments will be installed if additional holes are made available to the Project. This activity supports studies identified in section 8.3.1.2.1 of the SCP.
- 3.1.9 Measurements of temperature, precipitation, and infiltration are being made at two recharge sites at Pahute Mesa and near Tonopah that are thought to be analogous to the Yucca Mountain site under pluvial climatic conditions. Temperature of the air and soil are continuously recorded on a data logger. Precipitation samples are collected from samplers and sent to the laboratory for stable isotope analysis. The measurements will aid the estimation of ground water recharge rates at the site under future pluvial conditions. This activity supports studies identified in section 8.3.1.5.1 and 8.3.1.5.2 of the SCP.
- 3.1.10 Laboratory testing of crushed tuff for hydrologic and other properties is being conducted for evaluation of sealing materials. Although this effort is necessary for work on sealing concepts, it has only an indirect tie to site characterization.
- 3.1.11 Laboratory measurements of hydrologic properties of existing core and cuttings and water and gas samples are being made to define in situ conditions. Relationships among various hydrologic properties in the unsaturated zone are being identified. This activity supports studies identified in section 8.3.1.2.2 of the SCP.

3.2. Geologic Activities.

The tectonic setting of the Yucca Mountain site is important to its overall suitability as a candidate site. Seismic data and geodetic measurements are both valuable in assessing tectonic setting of the site. The following geologic activities, including the data reduction and analyses associated with field-data collection, are currently ongoing.

- 3.2.1 Fifty-three seismometers (Figure 3) have been installed in the region around Yucca Mountain as part of a regional seismic network, extending in lines trending east-west from the west side of Death Valley to Caliente, and generally north-south from Tonopah to Lake Mead. The two lines intersect near Yucca Mountain. The seismometers are in continuous operation and data are recorded automatically. Data from the seismic network have been used to establish the earthquake catalog for the region (Rogers et al., 1976, 1983), which is essential for predicting the size and frequency of earthquakes that are possible during the pre-

and postclosure time periods. The ability to accurately locate earthquakes is also very important for establishing the activity of faults near the site. This activity supports studies identified in sections 8.3.1.8.2 and 8.3.1.17.3.

- 3.2.2 Ground motions are being measured to define aspects of the design basis for the proposed site for surface facilities near Yucca Mountain. Data from surface and downhole measurements will be used to revise approaches to predicting vibratory ground motion for surface and underground facilities. Motions from underground nuclear explosions (UNEs) are analyzed to develop the relationship between earthquakes and UNEs and for prediction of potential ground motion during repository operation. This activity supports studies identified in sections 8.3.1.8.2 and 8.3.1.17.2 of the SCP.
- 3.2.3 Without accurate benchmarks that are routinely surveyed, it is impossible to establish local rates of vertical or horizontal tectonic movement. Therefore, geodetic survey benchmarks have been permanently installed in and around the Yucca Mountain site in order to monitor present-day tectonic adjustments in the Yucca Mountain area. A 43-mile level line extends from Crater Flat on the west to Rock Valley on the east. A quadrilateral network has been installed across several faults in the immediate vicinity of Yucca Mountain. Biannual resurveys are conducted. These activities support studies identified in sections 8.3.1.8.2 and 8.3.1.17.2 of the SCP.
- 3.2.4 Determination of soil characteristics for purposes of soil modeling are made on a seasonal basis. These include dust-trap sampling, determining field capacity of soils, and periodic measurements of carbon dioxide and soil gases. The soil modeling is part of the overall climate modeling effort that addresses the effects changing climate may have on the hydrologic characteristics of the site. This activity supports studies identified in section 8.3.1.5.1 of the SCP.
- 3.2.5 Several trenches (Figure 4) have been excavated as part of the geologic, tectonic, and paleoclimatic studies. These trenches are sampled and mapped on an ongoing basis. Occasionally, it may be necessary to deepen or lengthen existing trenches to collect additional data and to prevent degradation of the trenches. These activities support studies described in sections 8.3.1.5.1, 8.3.1.8.2, and 8.3.1.17.2 of the SCP.
- 3.2.6 Geologic mapping is continuing in the vicinity of Yucca Mountain as part of the geologic, tectonic and igneous activity studies. This activity includes the collection of samples to provide dates which help to define rates of tectonic and igneous processes. This activity supports studies identified in sections 8.3.1.8.1, 8.3.1.8.2, 8.3.1.17.1 and 8.3.1.17.2 of the SCP.

3.3 Meteorological Activities.

A meteorological monitoring network has been established at the Yucca Mountain site and has been collecting data since December 1985 (Figure 5). Meteorological data is collected at five towers: four are 10 meters high,

and one is 60 meters high. The four 10-meter towers continuously measure and record wind speed, wind direction, sigma theta (standard deviation of wind direction for determining atmospheric stability), relative humidity, and temperature. The fifth tower is instrumented at both the 10-meter and 60-meter levels. The data collected at this tower include the data stated above, plus sigma phi (standard deviation of vertical wind speed), net solar and terrestrial radiation, and precipitation.

These meteorological monitoring activities have begun to provide site-specific data for use in repository design studies, and eventually in the radiological safety assessments required by the NRC (10 CFR Part 60). These activities support studies identified in sections 8.3.1.2, 8.3.1.5.1 and 8.3.1.12 of the SCP.

3.4 Geomechanical Activities.

Laboratory testing, data reduction, and data analysis is ongoing for both thermal and mechanical properties. The next phase of planned testing for thermal properties is the determination of heat capacity of samples of the Topopah Spring Member of the Paintbrush Formation. These measurements are required for predicting the behavior of the host rock under the heat load generated by the waste emplaced in the repository. The next phase of planned mechanical measurements includes low-strain-rate testing, which will help determine the proper constitutive relationships for long-term conditions of the repository, and tensile strength testing, which is relevant to certain repository design analyses.

The NNWSI Project is conducting experiments in the G-Tunnel Underground Facility on Rainier Mesa. Although these experiments are not a part of site characterization, they are ongoing field activities that will guide the planning of the ESF and experiments. Therefore, a short description is provided. A principal ongoing effort in G-Tunnel is a mining evaluation experiment. Instrumented boreholes were used to determine mining-induced rock responses, and to develop improved techniques for controlled blasting in welded tuff. In situ stress and the modulus of deformation for welded tuff are also being determined at the G-Tunnel Facility. A thin slot is cut in the tuff and a flatjack is used to pressurize the side walls, moving them back to their original unrelaxed positions. Measurements obtained through these experiments provide useful experience in preparation for similar activities in the welded tuffs at Yucca Mountain.

These activities support thermomechanical studies and testing to establish repository design constraints and considerations described in section 8.3.1.15 of the SCP. These studies are important for establishing the stability of emplacement holes and drifts, particularly with regard to the requirements for retrievability.

Activities related to measurements of rock properties to be used in predictions of long-term behavior of the potential host rock under the heat load generated by the repository support studies described in section 8.3.1.14 of the SCP. These measurements are important for predicting long term rock mass response and fluid migration due to temperature effects and for establishing whether emplacement holes are likely to remain stable during the retrieval period.

3.5 Geochemical Activities.

Geochemistry of the rocks and water in contact with emplaced waste must be established in order to predict possible interactions for use in determining the lifetime of waste containers, and for predicting radionuclide transport if releases occur. The following activities, and the data reduction and analysis associated with them, are ongoing.

3.5.1 Near-Field Activities. Two types of laboratory activities are being conducted to characterize the expected time- and temperature- dependent conditions in the hydrologic environment immediately adjacent to the waste packages. These investigations are short-term hydrothermal rock-water interaction experiments between samples from the Topopah Spring Member and water from Well J-13, and experiments to determine the rates and mechanisms of dehydration and rehydration of repository near-field rock in response to the expected thermal field generated by the emplaced waste. In addition, experiments are being conducted to measure the rate at which radionuclides released during waste-form tests are picked up by rock wafers and transported through the wafers. These activities support geochemistry studies for characterizing the very near-field waste package emplacement environment identified in section 8.3.4.2 of the SCP. These studies are important for predicting the performance of the metal container, and for establishing expected release rates.

3.5.2 Far-Field Activities.

There are seven laboratory studies being conducted to better characterize geochemical conditions in the far-field. These include dynamic transport, mineralogy/petrology, sorption, natural isotope, ground-water chemistry, solubility, and hydrothermal studies. The first five studies listed involve experimental work using natural samples previously collected from the Yucca Mountain site. The following sections provide a discussion of each of these five studies.

3.5.2.1 Dynamic Transport Experiments.

The objective of the dynamic transport experiments is to determine the rate of movement of radionuclides along potential flow paths from the repository to the accessible environment. Factors under study which may potentially affect rates of movement include diffusion, dispersion, anion exclusion, sorption kinetics, and colloid movement in the flow geometries and hydrologic conditions that are expected to exist at Yucca Mountain. Ongoing transport studies include column experiments using crushed Yucca Mountain tuff, unsaturated solid tuff core, and fractured core. These column studies will provide experimentally determined hydrologic, physical, and chemical parameters needed to determine the rates of movement of various chemical species and aid in the prediction of radionuclide transport. In addition, diffusion experiments are being conducted using tuff wafers and rock beakers made from Yucca Mountain tuff. These experiments support studies described in section 8.3.1.3 of the SCP.

3.5.2.2 Mineralogy-Petrology Activities.

The objectives of the mineralogy-petrology activities are to describe the host rock mineralogy and petrology by establishing the mineralogic and petrographic stratigraphy including the mineralogic variability, and to provide descriptions of rock and fracture-fill petrology and mineralogy along potential transport pathways to the accessible environment. Ongoing activities include (1) studies of the potential for mineral alteration; (2) characterization of the fracture mineralogy using electron microscopy, x-ray diffraction, and radiometric dating on rock samples from cores, outcrops, and trenches; (3) mineral stability studies on clay, zeolites, and glasses that are important to the natural retardation system; and (4) studies of host-rock mineralogy-petrography using samples from drill cores and outcrops. These activities support studies described in section 8.3.1.3.2 of the SCP.

3.5.2.3 Sorption Activities.

The objective of the sorption activities is to provide data as input to the prediction of radionuclide movement from the repository to the accessible environment. Ongoing experiments include batch, crushed tuff column, and circulating column sorption experiments using tuff samples representative of the various mineralogic and stratigraphic characteristics of Yucca Mountain. Sorption coefficients of actinides and other important waste elements will be determined and used to estimate radionuclide retardation. Another sorption task involves studying the effects of microbes on sorption. This task involves determining the growth properties of microbes taken from soil samples collected from drilling locations at Yucca Mountain. Drilling fluids are used as the energy source for microorganism growth. Sorption coefficients of radionuclides on tuff in the presence of microbes will be determined. These activities support studies described in section 8.3.1.3.4 of the SCP.

3.5.2.4 Natural Isotope Chemistry Activities.

The objective of the activities related to natural isotope chemistry is to provide data on infiltration rates at Yucca Mountain. Chlorine-36 to total chlorine ratios are measured in Yucca Mountain soil samples, and changes in the ratio with depth are used to estimate infiltration rates. These activities support studies described in sections 8.3.1.3.1 and 8.3.1.2.2 of the SCP.

3.5.2.5 Ground Water Chemistry Activities.

The objectives of ground-water chemistry studies are to analyze the composition and the geochemical controls of the composition of pore waters in the unsaturated zone and in the saturated zone in and near Yucca Mountain. The saturated zone water chemistry has been well characterized and samples from Well J-13 are being used in the sorption and dynamic transport geochemistry tasks. Characterization

of pore waters from unsaturated zone samples is just beginning. These fluids will be extracted by applying pressure to the core sample, by centrifugation of the crushed core sample, or by vacuum distillation. These activities support studies described in section 8.3.1.3.1 of the SCP.

4.0 Planned Site Characterization Activities

The current schedule for the NNWSI Project assumes that the SCP will be completed in April 1987. At this time, the NNWSI Project does not expect to begin any new site characterization activities prior to issuance of the SCP.

Before any new site characterization activities can be started, the DOE must have appropriate agreements with the Bureau of Land Management for continued land access. DOE must also obtain the necessary environmental permits to comply with all Federal, State, and local environmental requirements during site characterization. In addition, the DOE must prepare study plans in consultation with the State and the NRC.

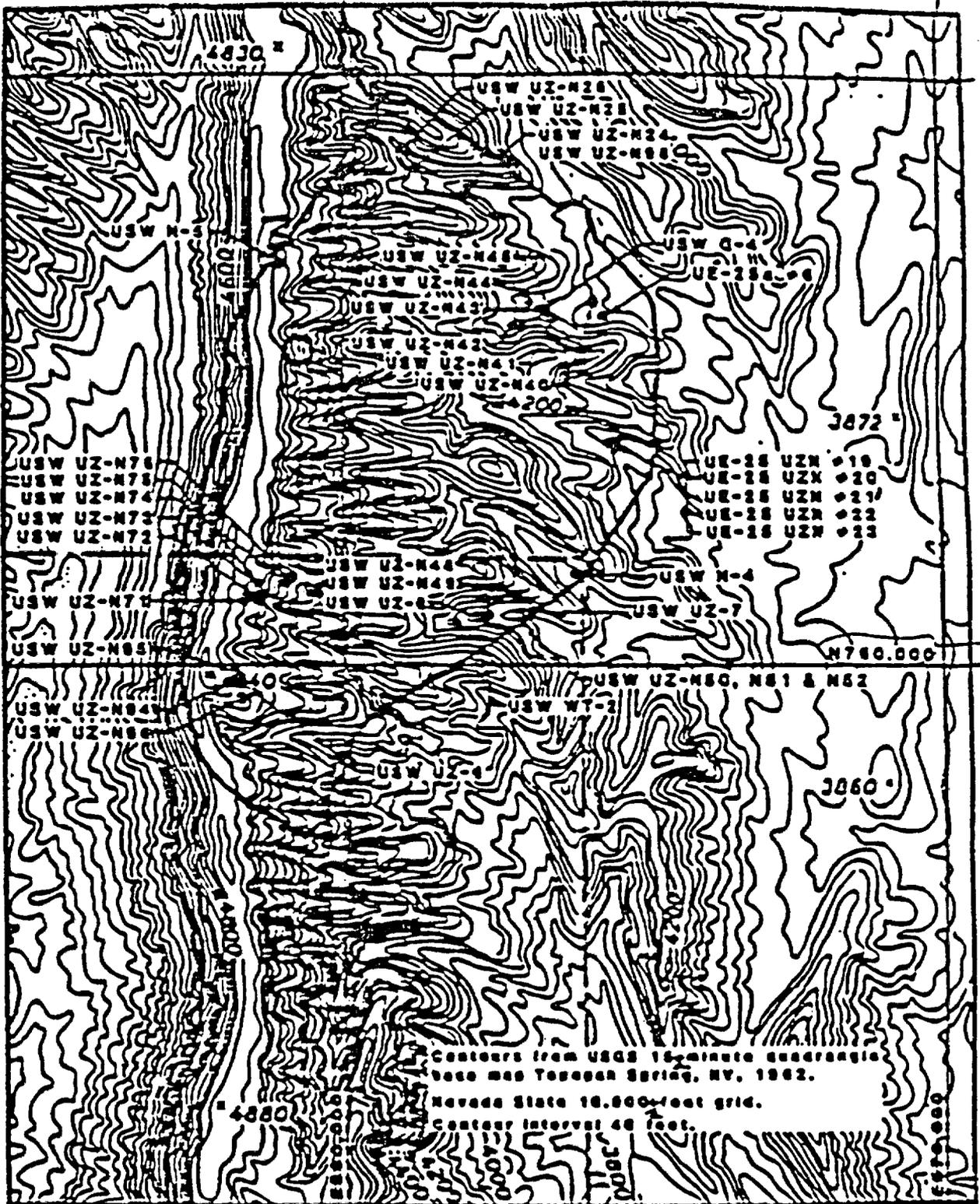


Figure 1. Drillholes located within the outline of the perimeter drift.

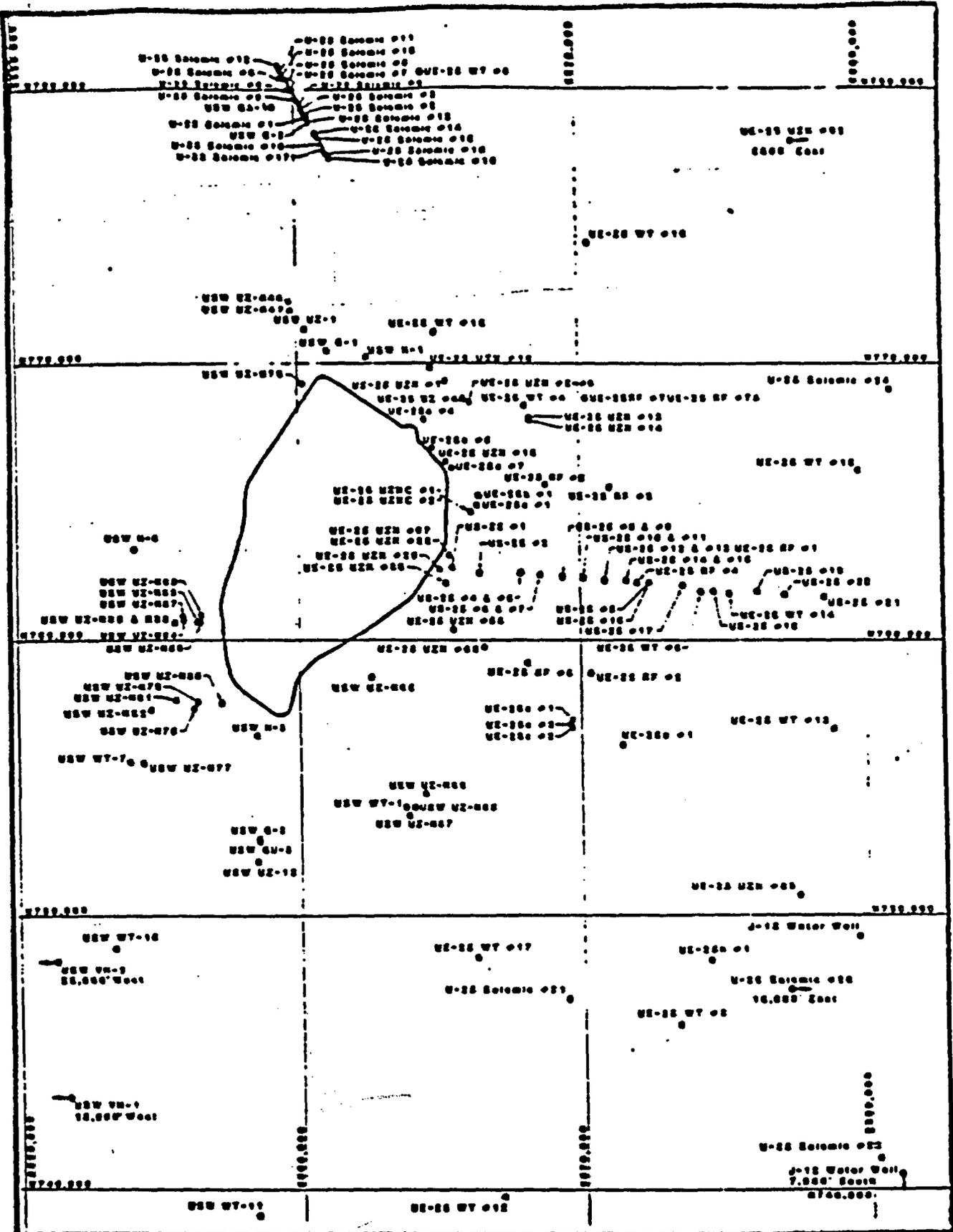
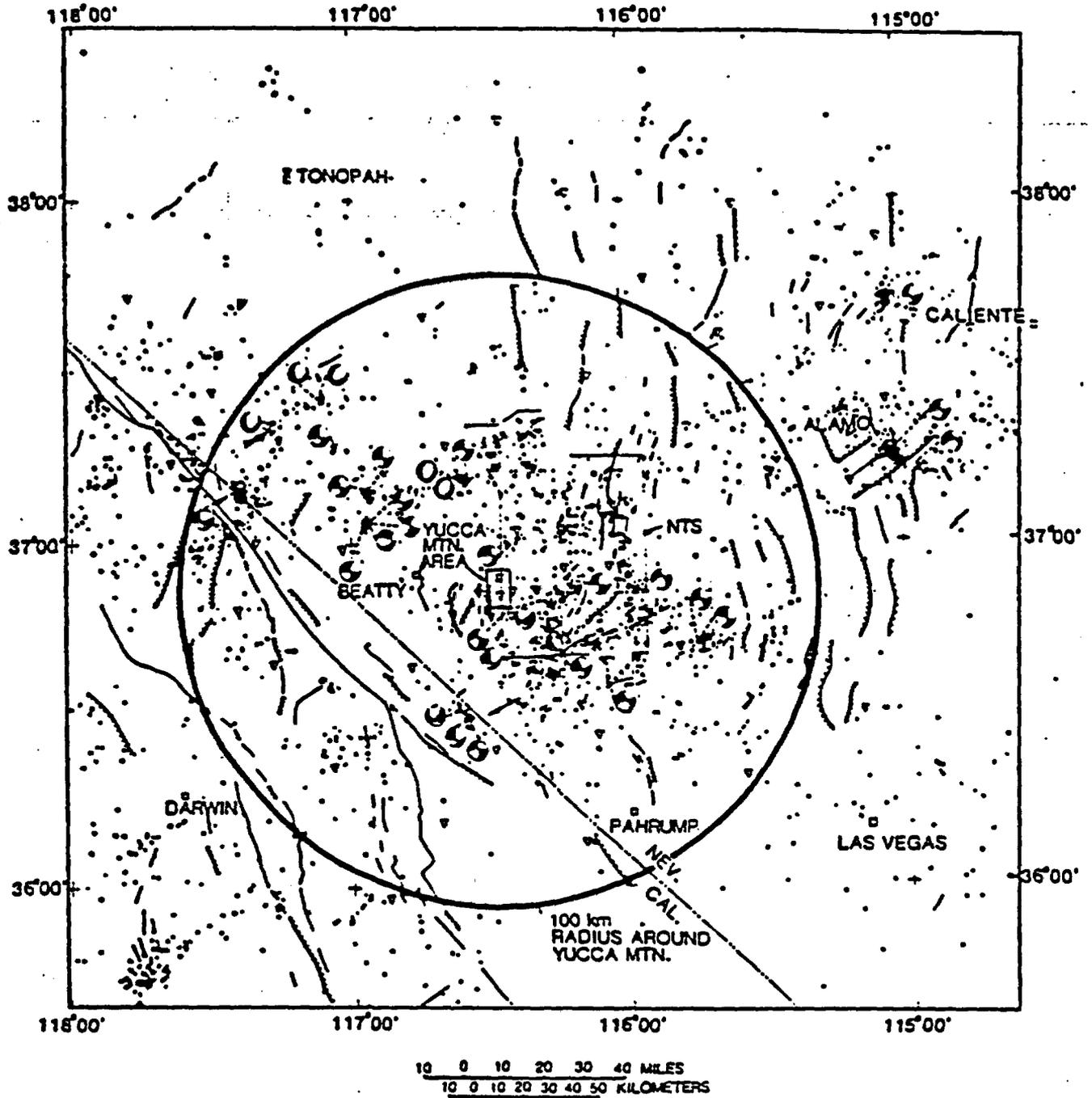


Figure 2. Drillholes located outside of the perimeter drift but within 10km of the perimeter drift.



ALL IMPORTANT QUATERNARY FAULTS ARE SHOWN OUT TO A 100 km RADIUS OF YUCCA MOUNTAIN MAP IS INCOMPLETE IN SOME AREAS BEYOND THAT CIRCLE.

— UNUSUALLY LINEAR MTN. FRONT WHERE PERSISTENT FAULT ACTIVITY HAS MAINTAINED A PROMINENT SCARP IN BEDROCK. A STEEP LINEAR MNT. SEGMENT WHERE YOUNG DEPOSITS ARE NOT OBVIOUSLY OFFSET.

— FAULT KNOWN OR SUSPECTED TO HAVE HAD A SURFACE MOVEMENT IN LAST 2-3 MILLION YEARS

— LINE OF VOLCANIC VENTS OF QUATERNARY AGE

⊙ SEISMOGRAPH STATION

⊙ SINGLE AND COMPOSITE FOCAL MECHANISMS LOWER HEMISPHERE PROJECTION OF THE FOCAL SPHERE WHERE SHADED AND UNSHADED QUADRANTS REPRESENT COMPRESSIONAL AND DILATIONAL FIRST MOTIONS RESPECTIVELY.

• $M_L < 1$ • $2 \leq M_L < 3$

• $1 \leq M_L < 2$ • $3 \leq M_L$

Figure 3. Regional Map showing locations of the regional seismic network.

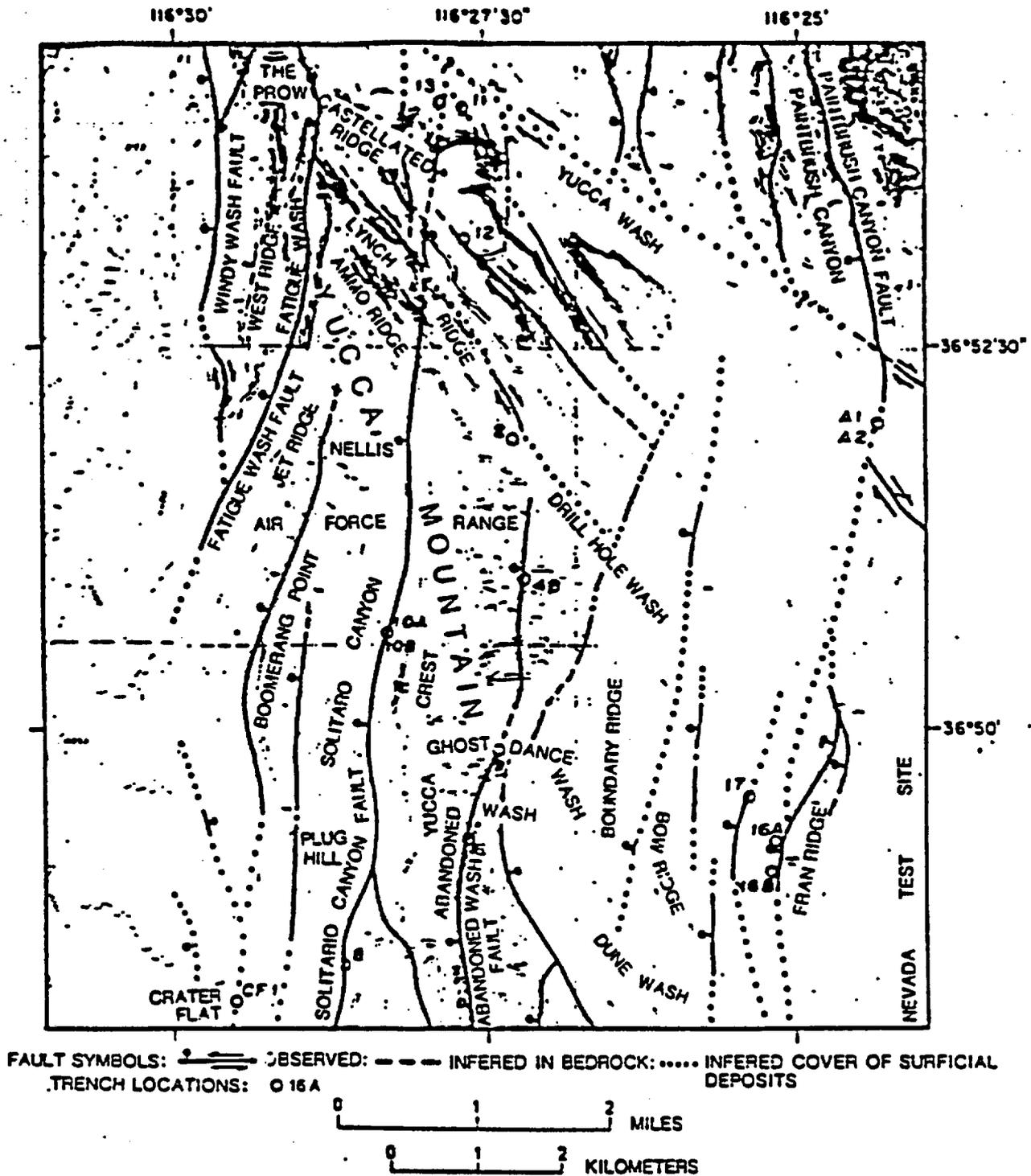


Figure 4. Trenches located along faults at Yucca Mountain interpreted from geologic mapping

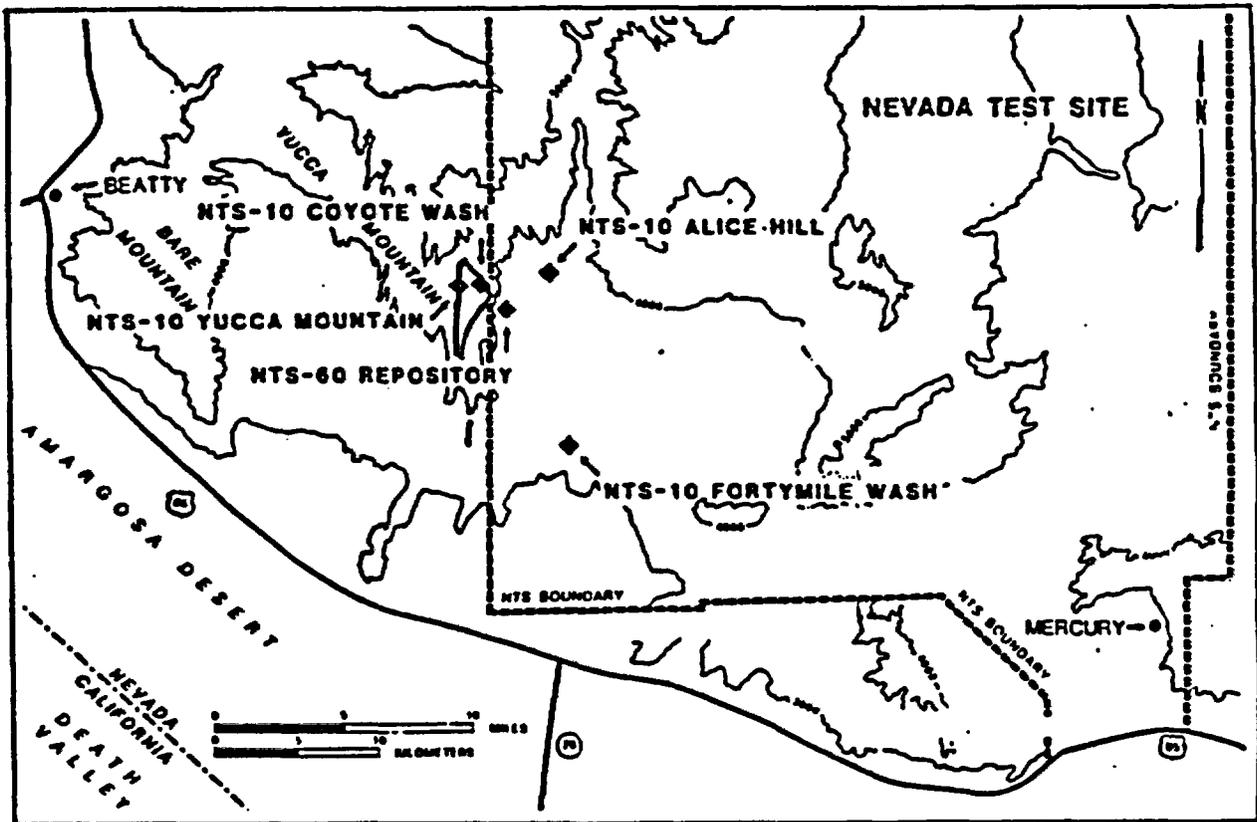


Figure 5. Meteorological monitoring sites

1-16-87

REVISED SCP CHAPTER 8 STRUCTURE *

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APPENDIX E

Environmental Requirements Imposed Upon Site Characterization and Repository Development by the Nuclear Waste Policy Act of 1982 and Associated Descriptions of the Environmental Requirements That Apply to Site Characterization and Repository Construction at the Yucca Mountain Site

Environmental Requirements Imposed Upon Site Characterization and Repository Development by the Nuclear Waste Policy Act of 1982 and Associated Descriptions of the Environmental Requirements That Apply to Site Characterization and Repository Construction at the Yucca Mountain Site.

1. Nuclear Waste Policy Act (NWPA).
 - a. Issue guidelines for recommendation of sites for repositories (Site Suitability Determination).
 - b. Prepare an environmental assessment (EA) for each site nominated for site characterization, evaluate site suitability using the guidelines, evaluate effects of site characterization on the environment, and assess impacts of repository development.
 - c. Conduct site characterization in a manner that minimizes environmental impacts identified in the site characterization plan (SCP).
 - d. Prepare an SCP for each site to be characterized, evaluate site suitability using the siting guidelines, and include plans for mitigating environmental impacts if the site is determined unsuitable for repository development.

- e. If the site is determined unsuitable for a repository, take reasonable and necessary steps to reclaim it and to mitigate environmental impacts caused by site characterization.
- f. For any site recommended for a repository, prepare an environmental impact statement (EIS) that is pursuant to compliance with the National Environmental Policy Act (NEPA) that addresses or reflects a site suitability determination consistent with the siting guidelines and that is not construed to amend or detract from licensing requirements of the Nuclear Regulatory Commission (NRC).

2. National Environmental Policy Act (NEPA).

- a. Mandated by NWPA.
- b. Applies only to repository development (construction, operation, closure, abandonment).
- c. NEPA sets forth a procedure for and requires environmental review and documentation.
- d. NEPA requires integration of analyses, studies, and surveys needed for complying with other environmental requirements.

3. Nuclear Regulatory Commission Rules for Disposal of High-Level Radioactive Wastes in Geologic Repositories.
 - a. Compliance is mandated by NWPA.
 - b. Applies only to repository development.
 - c. Requires an environmental report (ER) based on quantitative information and discussing environmental regulatory compliance.

4. Federal Land Policy Management Act (FLPMA).
 - a. Consult with U.S. Bureau of Land Management (BLM) on need for special use permit or land withdrawal where BLM land is involved, and proceed accordingly.
 - b. An environmental assessment (EA) could be required.

5. Materials Act.
 - a. If gravel or rock is to be extracted from BLM land, BLM approval must be obtained.
 - b. An extraction plan and environmental assessment may be required.

6. Floodplain and Wetlands Executive Orders.

- a. Publish notice of proposed action in Fed. Reg.
- b. Prepare floodplain/-wetlands assessment of any action in a floodplain/-wetland.
- c. Consult with U.S. Fish and Wildlife Service (FWS).
- d. Evaluate the practicability of the proposed floodplain/-wetlands action taking into account public comments.
- e. Evaluate practicable alternatives.
- f. Take into account mitigating measures and design the proposed action to minimize potential harm to the floodplain/wetlands.
- g. Publish statement of findings for floodplain/-wetland actions.

7. Endangered Species Act.

- a. Consult with U.S. FWS regarding probable occurrence of protected species in site vicinity.
- b. If necessary, conduct biological survey and assessment.
- c. Prepare mitigation plan if required.

- 8. National Historic Preservation Act (NHPA) and Related Statutes.
 - a. DOE must consult with the Nevada State Historic Preservation Officer (SHPO).
 - b. Archaeological surveys will be needed of areas to be disturbed.
 - c. If significant resources are discovered, avoidance or reclamation in accordance with the NHPA may be necessary.

- 9. American Indian Religious Freedom Act.
 - a. DOE must consult with the Bureau of Indian Affairs and any affected Native American tribal leaders.
 - b. If Native American sacred areas are discovered, alternative sites must be considered.

- 10. Noise Control Act.
 - a. DOE must monitor and abate environmental noise during project.

- 11. Clean Air Act.
 - a. See Nevada air quality statutes.

- 12. Solid Waste Disposal Act (SWDA).
 - a. See Nevada Solid Waste Management Statute.

- 13. Resources Conservation and Recovery Act (RCRA).
 - a. See Nevada Hazardous Waste Management System.

- 14. Clean Water Act.
 - a. See Nevada Pollutant Discharge Elimination System.
 - b. Designated State agency must approve plans for sewage treatment system, and State discharge regulations apply.

- c. If construction occurs in a stream bed, consult with the Corps of Engineers to determine requirements for a Section 404 dredge and fill permit.

- 15. Safe Drinking Water Act (SDWA).
 - a. Consult with U.S. EPA or designated State agency if any material is to be injected into potable ground water, including test well tracer injections.
 - b. Potable water supply must meet U.S. EPA Safe Drinking Water Standards and distribution system plans must be approved by designated State agency.

- 16. Protection and Propagation of Native Fauna; Miscellaneous Protection Measures.
 - a. A collector's permit from the Nevada Department of Wildlife is required to take native animals for purposes of study.

- 17. Unlawful Removal or Destruction of Flora.
 - a. A permit is required from the Nevada Division of Forestry to destroy native flora; all species of cacti are protected from removal or destruction.

- 18. Preservation of Prehistoric and Historic Sites.
 - a. A permit is required from the Nevada Department of Museums and History to study, collect, or excavate cultural resources.

- 19. Utility Environmental Protection Act.
 - a. Affects location and construction of electric, gas, telephone, telegraph, sewer, and water lines and facilities.
 - b. Controls land clearing, excavation, or potentially disruptive action to the environment.

20. Appropriation of Public Waters and Regulations for Drilling.

- c. Permit to construct from the Nevada Public Service Commission requires location facility description summary of environmental studies made and other relevant information.
- d. Application to be reviewed by PUC and by State Environmental Commission.
- e. Public hearing may be required.
- f. PUC must determine nature of probable environmental impact.
- g. PUC must determine that facility conforms to State and local environmental requirements
- a. Federal agencies must apply to the Nevada State Engineer for rights to use public waters.
- b. A permit to appropriate well water will specify casing, appliance, repair and sealing requirements.
- c. Water well drillers must be licensed and must keep logs and records.

21. Air Pollution.

- a. Allows for regulation of air contaminant sources via construction and operating permits from the Nevada Division of Environmental Protection.
- b. Adopts EPA standards for criteria pollutants and PSD.
- c. Operator of emitting facilities must register and report location, size, and height of source and process, fuels, nature, rate, and duration of emissions.
- d. Fees may be charged for processing permit.
- e. Allows for annual variances from applicable regulations.
- f. All government sources of air pollution must comply with State and local air quality laws, regulations, and ordinances.
- g. Potentially applies to boilers, incinerators, mining, cement plants, and other designate industrial processes.
- h. Federal PSD regulations also may apply to certain projects.
- i. An open burning permit also may be required if such activity is to occur.

22. Nevada Water Pollution Control Law.

- a. A discharge permit from the Nevada Division of Environmental Protection may be required for any discharges to the rock storage pile.
- b. Package plants for sewage treatment must be permitted, and a permit also must be obtained for constructing any treatment works.
- c. Public hearings may be required for permits.
- d. An underground injection control (UIC) permit is required for injecting fluids into a well where water quality degradation may occur.

23. Public Water Systems.

- a. Specifications for potable water systems must be approved by the Nevada Health Division.
- b. Potable water systems must comply with primary drinking water standards.

24. Collection and Disposal of Solid Waste.

- a. Plans for solid waste disposal must be reviewed by the Nevada Division of Environmental Protection.
- b. A permit for solid waste disposal may be required.

25. Disposal of Hazardous Waste.

- a. Handling, storage, transportation, and disposal of designated hazardous wastes must not constitute a hazard to health, safety, and the environment.

- b. Designated materials such as some drilling wastes, spent oil and solvents must be registered with the Nevada Division of Environmental Protection and disposed of in an approved manner.
 - c. Disposal facilities for hazardous wastes must be permitted by NDEP.
- 26. Licensing of Radioactive Materials.
 - a. A license to use a radioactive source for well logging and for ground-water studies is required from the Nevada Bureau of Regulatory Health Services.
 - b. A licensee must allow State inspectors to inspect licensed operations.
- 27. Construction and Labor Camps and Food Establishments.
 - a. Allows for the Nevada Health Division to inspect sanitary conditions and food facilities where five or more persons are employed.
- 28. Uniform Plumbing Code.
 - a. New construction must conform to the National Uniform Plumbing Code.
- 29. Uniform Building Code and Fire Code.
 - a. New construction must conform to the National Uniform Building Code and the Nevada State Fire Marshall Code.
 - b. Construction cannot obstruct water flow in a floodplain.

APPENDIX F

Letter of May 13, 1987 from D.L. Vieth (DOE) to R.R. Loux (NWPO)
Responding to State of Nevada Comments on the EMMP for NNWSI



Department of Energy

Nevada Operations Office
P. O. Box 14100
Las Vegas, NV 89114-4100

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MAY 14 1987

MAY 13 1987

NUCLEAR WASTE PROJECT OFFICE

Robert R. Loux, Jr. Executive Director
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ENVIRONMENTAL MONITORING AND MITIGATION PLAN (EMMP) COMMENTS

Thank you for your timely submittal of formal comments on the working draft of the EMMP as documented by your correspondence of February 23, 1987. We appreciate the efforts expended by the staff of the Nuclear Waste Project Office (NWPO) in producing a consolidated comment package from the comments you received from the various state and local agencies that participated. The comments will be incorporated in future versions of the EMMP to the extent that they contribute to the intent and purpose of the plan, namely to document compliance with Section 113(a) of the Nuclear Waste Policy Act (NWPA).

Those comments that were of a general nature were grouped by the NWPO into the following categories. Those categories along with responses to the subject comments are presented below.

"Absence of site-specific environmental data base"

Response: The Yucca Mountain Environmental Assessment (EA) establishes the pre-site characterization environmental baseline conditions. This baseline is derived from field studies in many technical areas, analogy or extrapolation in some areas, and expert judgement in other areas. This compilation is considered to be standard methodology used in preparing environmental assessments, and has historical precedents dating to the first implementation of the National Environmental Policy Act (NEPA).

NWPA requires that a NEPA Environmental Impact Statement (EIS) be prepared which addresses repository construction, operation, closure, and decommissioning. According to guidance from the Department of Energy (DOE), General Counsel, it is the intent of NWPA that this EIS consider "baseline" conditions to be those of the fully characterized site. A full environmental baseline will be included in the forthcoming EIS. That baseline will have been a subject of hearings and consultations with involved federal agencies, state and local agencies, and the public as required. The DOE policy position on this issue is documented in a letter from Ben C. Rusche, Director, to Governor Richard H. Bryan dated March 18, 1987 (enclosure 1).

MAY 13 1987

Robert R. Loux, Jr.

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"Incomplete Site Characterization Plan (SCP)"

Response: The SCP and the corresponding field study plans exist in draft form. The SCP is undergoing internal review and refinement prior to distribution to the states and tribes. A final SCP is not needed to begin the EMMP process, since the basic types of activities have been identified.

"Lack of a comprehensive and integrated environmental program"

Response: The EMMP and associated field studies are one component of a larger environmental program. That program covers the time period from selection as one of the sites to be characterized through the completion of the EIS process. The EMMP is a focused effort with a specific objective, independent of other environmental activities. This specific objective is the monitoring of those site characterization activities which are thought to have the potential for significant adverse environmental impact.

As you are aware, the working draft of the EMMP is an early version for use in open consultations with the states and affected parties. The Nevada Nuclear Waste Storage Investigations Project is eager to continue with an open and effective consultation process regarding the EMMP. We welcome the opportunity to meet and discuss your concerns at your convenience.


Donald L. Vieth, Director
Waste Management Project Office

WMPO:EVJ-1629

Enclosure:
As stated

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MAR 18 1987

Info



Honorable Richard H. Bryan
Governor of Nevada
Carson City, Nevada 89710

Dear Governor Bryan:

Thank you for your letter of February 9, 1987, to Secretary Herrington regarding the current plans of the Department of Energy to collect site-specific environmental data from the Yucca Mountain site to determine the environmental impacts of site characterization activities.

Section 113(a) of the Nuclear Waste Policy Act of 1982 (the Act) requires the Department to conduct site characterization activities in a manner that minimizes any significant adverse environmental impacts. To ensure this, the Department prepared draft Environmental Monitoring and Mitigation Plans (EMMPs) which are currently under review by the States and Indian Tribes. As described in the EMMPs, site-specific environmental data will be collected before and during site characterization activities. This data will be used to monitor those aspects of the site that have the potential for experiencing significant impacts. Measures will be identified to avoid or minimize these impacts before they occur. If the site is found unsuitable, this data, along with that in the Environmental Assessments and information collected to comply with applicable regulatory requirements, will provide a sufficient basis for the Secretary under Section 113(c)(4) to take reasonable and necessary steps to reclaim the site and to mitigate any significant adverse environmental impacts caused by site characterization activities.

In addition, Section 114(f) of the Act requires the Department to prepare an Environmental Impact Statement (EIS) to accompany any recommendation to the President to approve a site for a repository. That EIS must consider as alternatives sites for which site characterization has been completed under Section 113 of the Act. The extensive site-specific environmental data which the Department will be collecting during the site characterization phase will serve as the basis for the development of this EIS.

Sincerely,


Ben C. Rusche, Director
Office of Civilian Radioactive
Waste Management