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PRELIMINARY SITE REPORT

DIABLO CANYON

SAN LUIS OBISPO COUNTY

CALIFORNIA

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C O N T E N T S

		Page
I	INTRODUCTION	1
II	SITE AND ENVIRONS	2
III	METEOROLOGY	6
IV	GEOLOGY	10
V	SEISMOLOGY	13
VI	HYDROLOGY	15
VII	CONCLUSIONS	17

APPENDIX 1	USGS MAP "SAN LUIS OBISPO"
APPENDIX 2	PACIFIC GAS AND ELECTRIC COMPANY METEOROLOGY OFFICE REPORT ON DIABLO CANYON SITE
APPENDIX 3	PACIFIC GAS AND ELECTRIC COMPANY DEPARTMENT OF ENGINEERING RESEARCH REPORT NO. 5326-65: DIABLO CANYON NUCLEAR PLANT SITE, PRELIMINARY GEOLOGIC INVESTIGATIONS
APPENDIX 4	REPORTS OF DR. R. H. JAHNS, CONSULTING GEOLOGIST
APPENDIX 5	GEOLOGIC MAP OF CALIFORNIA SAN LUIS OBISPO SHEET, 1958
APPENDIX 6	GEOLOGIC EXPLORATION TRENCHES

I - INTRODUCTION

The following information is presented as a summary of preliminary studies on the site and environs of a proposed nuclear power plant for Pacific Gas and Electric Company in the vicinity of Diablo Canyon, San Luis Obispo County, California. This summary has a threefold purpose:

1) To evaluate the suitability of Diablo Canyon as a site for a nuclear power plant.

2) To summarize the data presently available in order to establish a more exhaustive and comprehensive site investigation.

3) To establish preliminary site-influenced design and operating criteria.

A summary of preliminary findings relating to these goals is presented as a conclusion in Section VII of this report.

The information presented herein has been gathered from public records, recognized authorities, consultants, and Company specialists in the research and design fields.

II - SITE AND ENVIRONS

A. Location and Area

The Diablo Canyon site is located adjacent to the Pacific Ocean in San Luis Obispo County, California, approximately 190 miles south of San Francisco and 150 miles north of Los Angeles. The site lies twelve miles west southwest of the City of San Luis Obispo, the county seat. Figure II-1 shows the location of the proposed site. Figure II-2 shows the area up to sixty miles adjacent to Diablo Canyon. The area within a six-mile radius of the site is shown in Figure II-3. A copy of the USGS map "San Luis Obispo" is included as Appendix 1.

The site contains approximately 585 acres south of Diablo Canyon Creek which are leased to the Company for a term of 99 years with an option to renew for an additional 99 years. One hundred to two hundred additional acres will be acquired on the north side of Diablo Canyon Creek. The site boundaries and the estimated plant location are illustrated in Figure II-4.

The site is situated on a sloping terrace, 60 to 150 feet above sea level, bordered by the Pacific Ocean on the southwest and the San Luis Mountains on the northeast.

B. Access

The site is accessible from the town of Avila Beach by an unimproved, privately-owned road. A similar road approaches the site from the northwest. The nearest public routes are county roads located in Clark Valley, four miles north, and See Canyon, five miles east.

U. S. Route 101 is the main highway serving the coastal region. Its nearest point lies about ten miles to the east of Diablo Canyon, separated

from it by the San Luis Mountains. State Route 1, ten miles to the north, carries moderate traffic between San Luis Obispo and the coast.

There are no deep water dock facilities within sixty miles of the site. Small craft harbors are located at Morro Bay and San Luis Obispo Bay.

The Southern Pacific Company operates the nearest railroad which approximately parallels U. S. Route 101. Construction of a spur track to the site is not contemplated; however, a new access road will be built from the existing Point San Luis Road at Avila Beach to the site prior to plant construction.

C. Population

The portion of California within a sixty-mile radius of the site is rather sparsely populated. Although the site is approximately centered in San Luis Obispo County, a sixty-mile radius also encompasses portions of Monterey and Santa Barbara Counties. The population of this area has grown approximately 25 percent in the period 1960 to 1965. This growth rate has been typical of the State as a whole. Table II-1 shows population trends of the three counties and the State of California. Table II-2 shows the growth of the largest communities within sixty miles of the site during the past five years.

No communities are located inside a six-mile radius of the proposed site. The nearest residence is 1-1/2 miles north. Most of the communities are located adjacent to U. S. Route 101 with the majority centered in the Santa Maria Valley. There are only three cities of more than 10,000 people witnin sixty miles of the site; these are San Luis Obispo (25,750), Santa Maria (31,200), and Lompoc (14,415). Table II-3 shows the distribution of

communities around the site and their population as reported in the 1960 census.

The population does not vary much with the season; however, there is an occasional weekend influx of people in the vicinity of Grover City and Morro Bay. The lands adjacent to the coastline for eight miles in both directions from Diablo Canyon are privately held and have not been open to the public.

The owner of the coastal property extending southeasterly from Diablo Canyon to Avila Beach has indicated plans for low density residential and recreational development.

D. Land Use

The San Luis Mountains dominate the general area. The economy is primarily dependent on agriculture. The terrain east of U. S. Route 101 is a relatively uninhabited and inaccessible mountainous region, a large portion of which is included in the Los Padres National Forest. West of Route 101, the upland country is used primarily for grazing beef and, to a lesser extent, dairy cattle.

Farming is the predominant activity in the San Luis and Santa Maria Valleys. Major products are fruits, grain, sugar beets and truck crops. Approximately 19 percent of the total employment and 29 percent of the total income of the area is agriculture.

Industry is small and of a local nature serving the agricultural needs of the area. Food processing and the production and refining of crude oil are major industries of the region, although the numbers employed are not large. Commercial and sport fishing are important industries in the areas of Morro Bay and Port San Luis. Tourism also contributes to the economic pattern.

The largest industrial complex is Vandenberg Air Force Base located thirty-seven miles southeast of the site. The U. S. Army maintains Camp Roberts and the Hunter-Liggett Military Reservation approximately forty miles north of the site. These bases account for the area's high proportion of employment in Government.

TABLE II-1

POPULATION TRENDS OF THE STATE AND COUNTIES SURROUNDING DIABLO CANYON

	Counties				
Year	Monterey	San Luis Obispo	Santa Barbara	State of California	
1940	73,032	33,246	70,555	6,907,387	Note 1
1950	130,498	51,417	98,220	10,586,223	Note 1
1955	161,400	63,100	110,200	13,004,000	Note 2
1960	198,753	81,044	168,962	15,717,204	Note 1
1965	221,600	100,500	243,900	18,726,000	Note 2
1970	276,800	127,900	334,800	21,734,000	Note 3
1975	331,000	152,400	410,300	24,830,000	Note 3
1980	396,600	178,600	491,300	28,137,000	Note 3

Notes:
1. U. S. Bureau of the Census Figures
2. State of California Department of Finance Estimates.
3. State of California Department of Finance Projections, Special Report of February 15, 1963

TABLE II-2

GROWTH OF COMMUNITIES OVER 1,000 POPULATION WITHIN SIXTY MILES OF DIABLO CANYON

Community	Population		Percent Increase
	1960	1965	
Arroyo Grande	3,291	6,862	108.5
Atascadero	5,983	11,500*	94.5
Cambria	Not Available	1,570*	-
Cayucos	Not Available	1,964*	-
Grover City	5,210	5,975	14.7
Guadalupe	2,614	Not Available	-
Lompoc	14,415	23,998	66.5
Morro Bay	3,692	6,960	88.7
Orcutt	1,414	Not Available	-
Paso Robles	6,677	7,375	10.5
Pismo Beach	1,762	2,000	13.5
Oceano	1,317	1,664	25.3
Santa Maria	20,027	31,200	55.8
San Luis Obispo	20,437	25,750	26.0
Shell Beach	1,320	2,160	13.7
Solvang	1,325	Not Available	-

1960 population figures from U. S. Bureau of the Census

1965 population figures from California State Department of Finance and local Chamber of Commerce estimates.

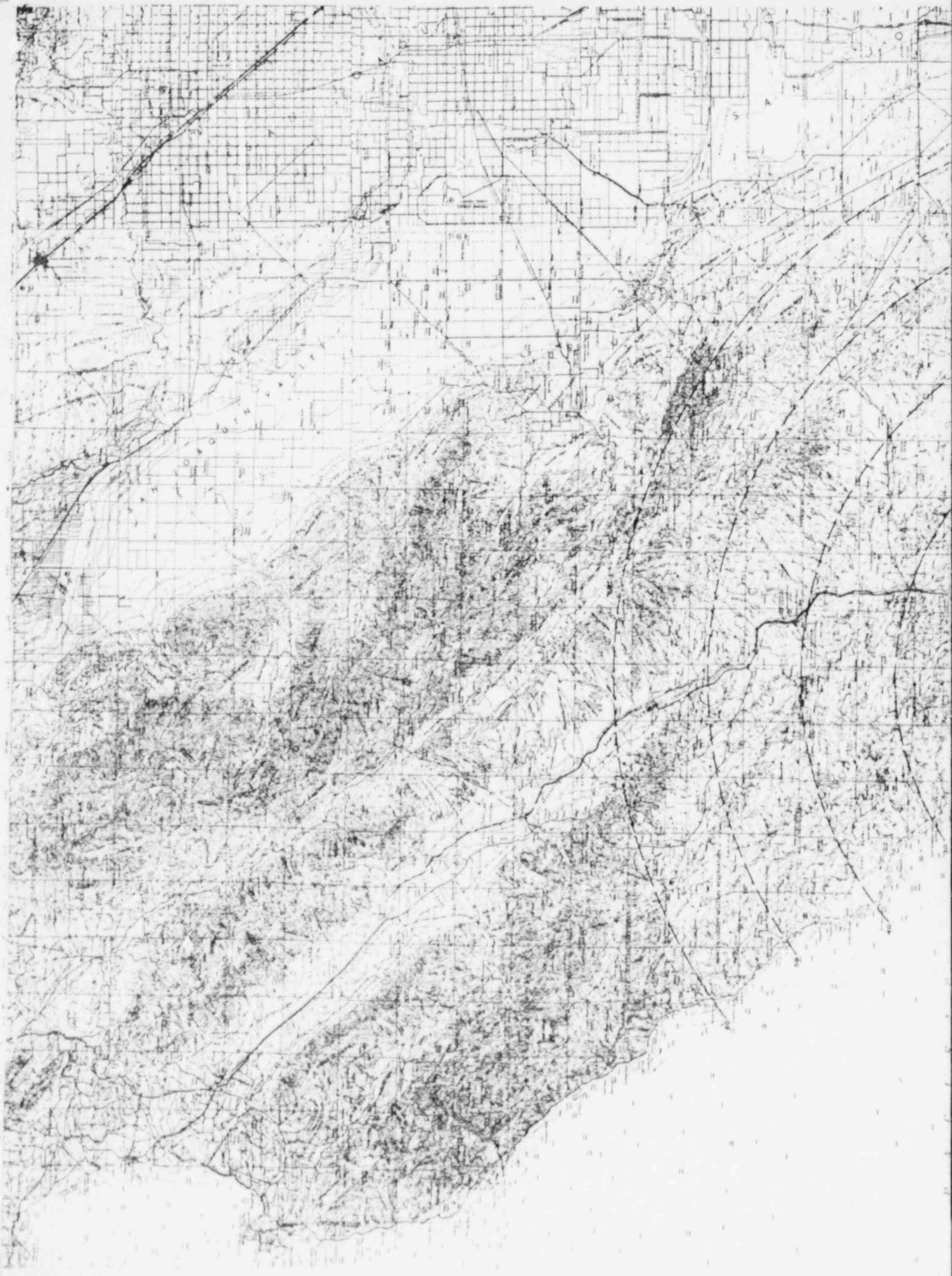
* Estimates of California State Division of Highways for January, 1963.

TABLE II-3

POPULATION OF COMMUNITIES WITHIN A SIXTY-MILE RADIUS OF DIABLO CANYON SITE

Community	County	Population	Airline Distance (miles)	Direction
Harmony	San Luis Obispo	Less than 250	22	NNW
Cambria	San Luis Obispo	2000	28	NNW
Cambria Pines	San Luis Obispo	Less than 250	29	NNW
San Simeon	San Luis Obispo	Less than 250	36	NNW
Bryson	Monterey	Less than 250	45	NNW
Lockwood	Monterey	Less than 250	53	NNW
Jolon	Monterey	Less than 250	56	NNW
Baywood Park	San Luis Obispo	Less than 250	8	N
Morro Bay	San Luis Obispo	3,692	11	N
Cayucos	San Luis Obispo	1,700	17	N
Bradley	Monterey	Less than 250	46	N
Pleyto	Monterey	Less than 250	46	N
San Ardo	Monterey	Less than 250	56	N
Atascadero	San Luis Obispo	5,983	21	NNE
Templeton	San Luis Obispo	Less than 1,000	24	NNE
Paso Robles	San Luis Obispo	6,677	30	NNE
Estrella	San Luis Obispo	Less than 250	37	NNE
Whitley Gardens	San Luis Obispo	Less than 250	37	NNE
San Miguel	San Luis Obispo	Less than 1,000	39	NNE
Parkfield	Monterey	Less than 250	54	NNE
Santa Margarita	San Luis Obispo	Less than 1,000	19	NE
Cushing	San Luis Obispo	Less than 250	20	NE
Creston	San Luis Obispo	Less than 250	28	NE
Shandon	San Luis Obispo	Less than 1,000	40	NE
Cholame	San Luis Obispo	Less than 250	47	NE
San Luis Obispo	San Luis Obispo	20,437	13	ENE
Pozo	San Luis Obispo	Less than 250	28	ENE
La Panza	San Luis Obispo	Less than 250	37	ENE
Simmler	San Luis Obispo	Less than 250	49	ENE
Edna	San Luis Obispo	Less than 250	14	E
Avila Beach	San Luis Obispo	Less than 250	7	ESE
Shell Beach	San Luis Obispo	1,820	12	ESE
Pismo Beach	San Luis Obispo	1,762	13	ESE
Grover City	San Luis Obispo	5,210	15	ESE
Oceano	San Luis Obispo	1,317	16	ESE
Arroyo Grande	San Luis Obispo	3,291	17	ESE
Berros	San Luis Obispo	Less than 1,000	20	ESE
Nipomo	San Luis Obispo	Less than 1,000	24	ESE
Guadalupe	Santa Barbara	2,614	24	SE
Santa Maria	Santa Barbara	20,027	29	SE
Casmalia	Santa Barbara	Less than 250	32	SE
Orcutt	Santa Barbara	1,414	33	SE
Garey	Santa Barbara	Less than 250	38	SE
Sisquoc	Santa Barbara	Less than 250	40	SE
Los Alamos	Santa Barbara	Less than 1,000	47	SE
Buellton	Santa Barbara	Less than 250	56	SE
Los Olivos	Santa Barbara	Less than 1,000	56	SE
Solvang	Santa Barbara	1,325	59	SE
Santa Ynez	Santa Barbara	Less than 1,000	60	SE
Surf	Santa Barbara	Less than 250	39	SSE
Lompoc	Santa Barbara	14,415	45	SSE

FIGURE II-1 SITE LOCATION MAP



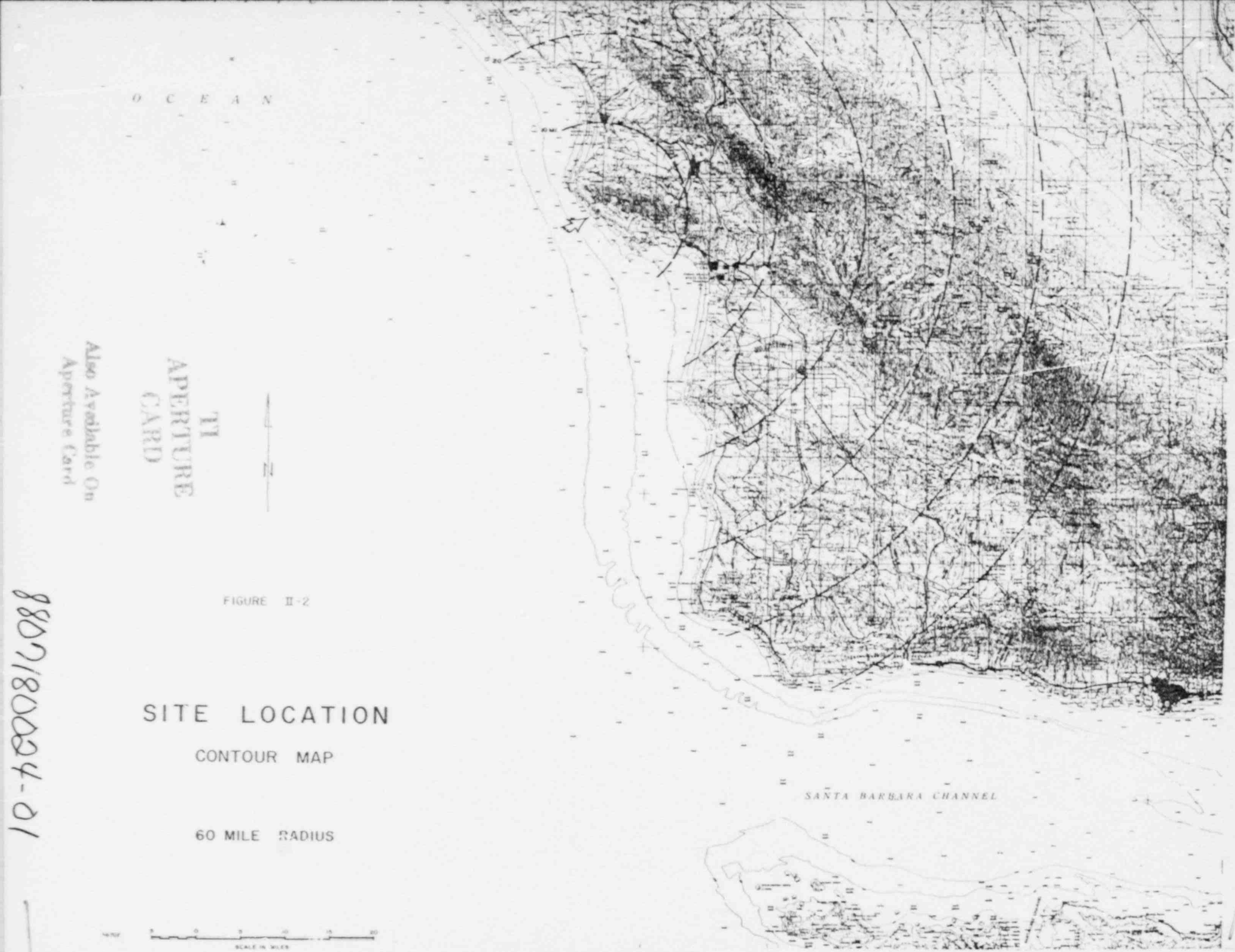


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FIGURE II-2

SITE LOCATION

CONTOUR MAP

60 MILE RADIUS

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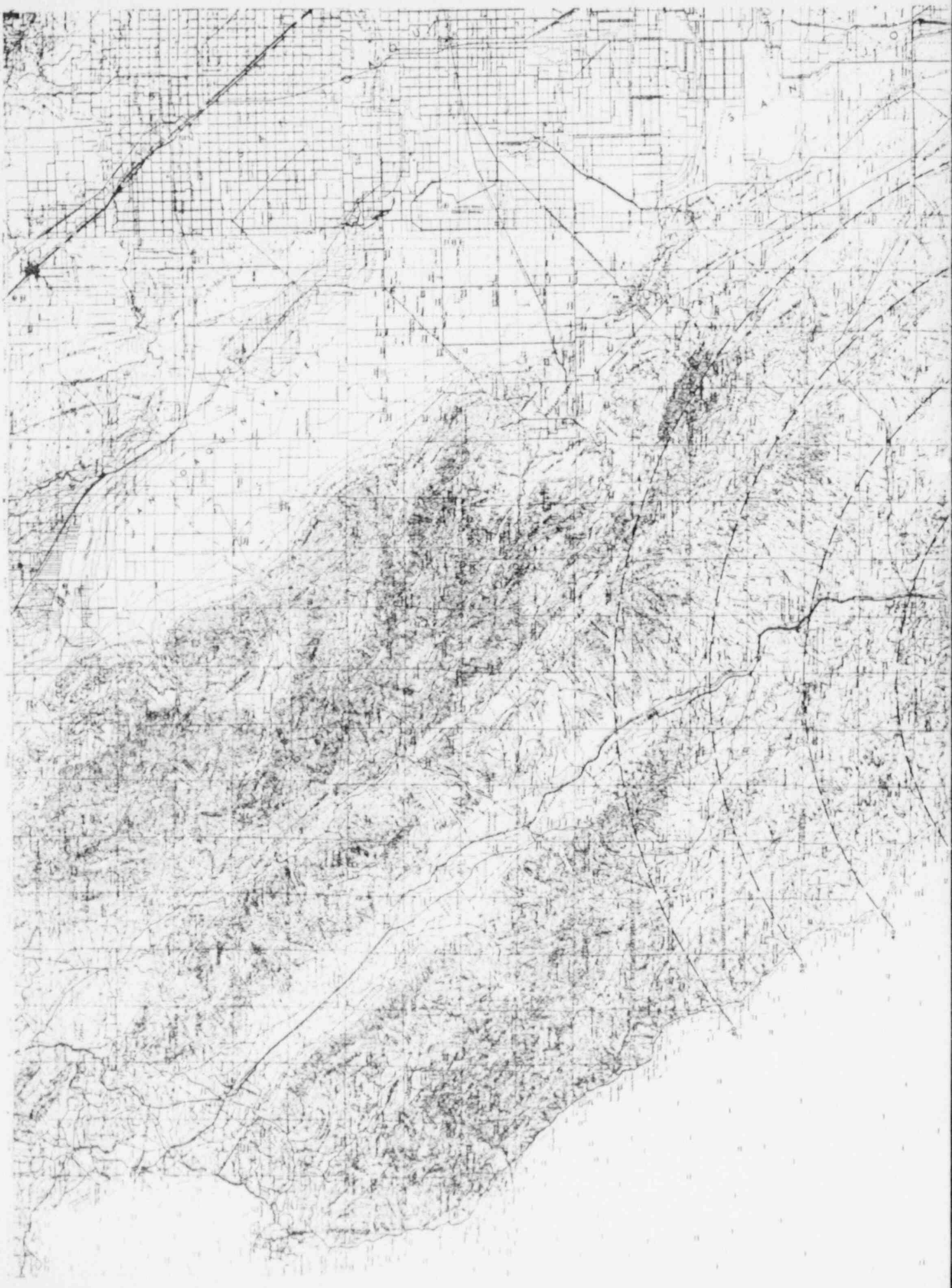

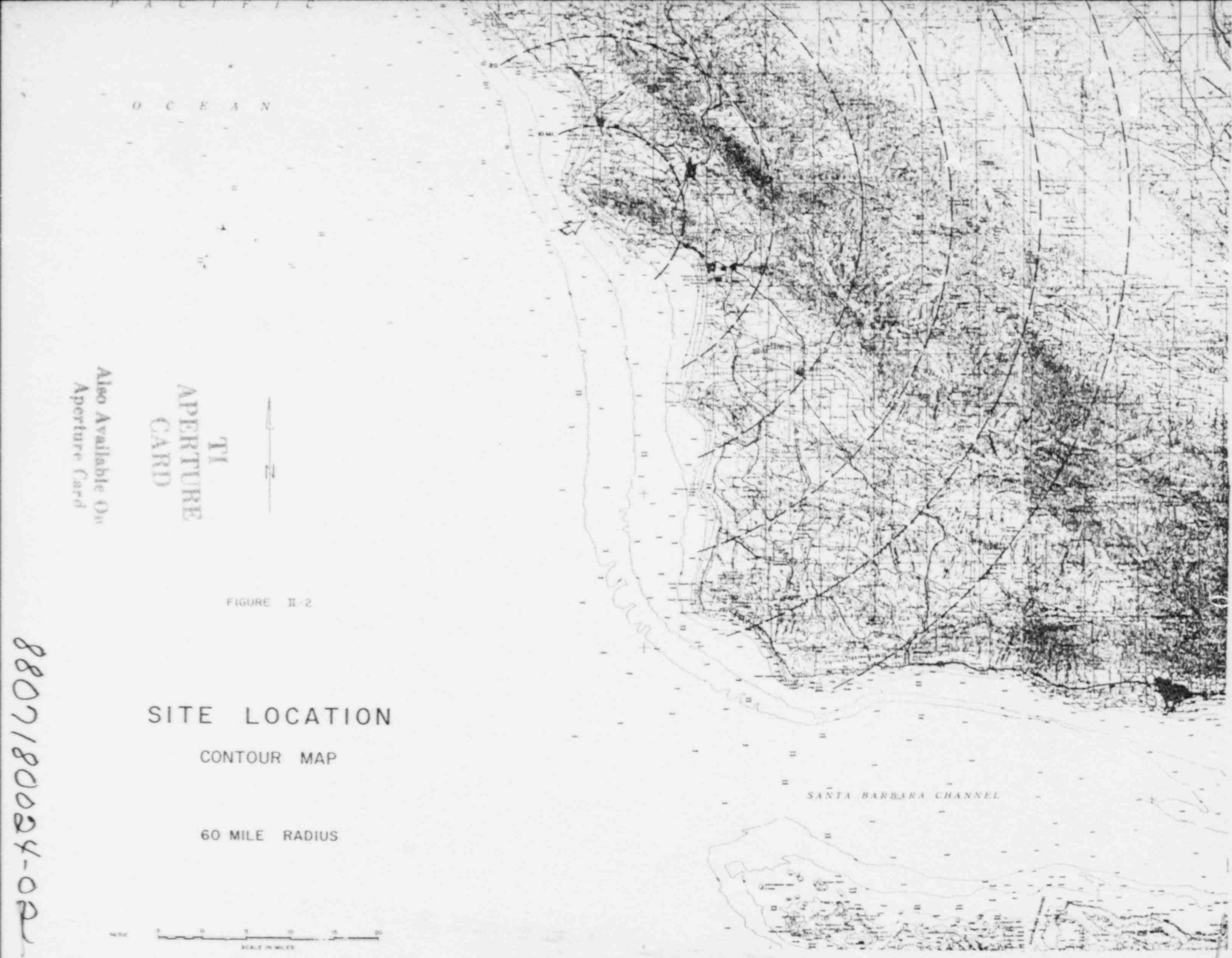

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FIGURE II-2

SITE LOCATION

CONTOUR MAP

60 MILE RADIUS

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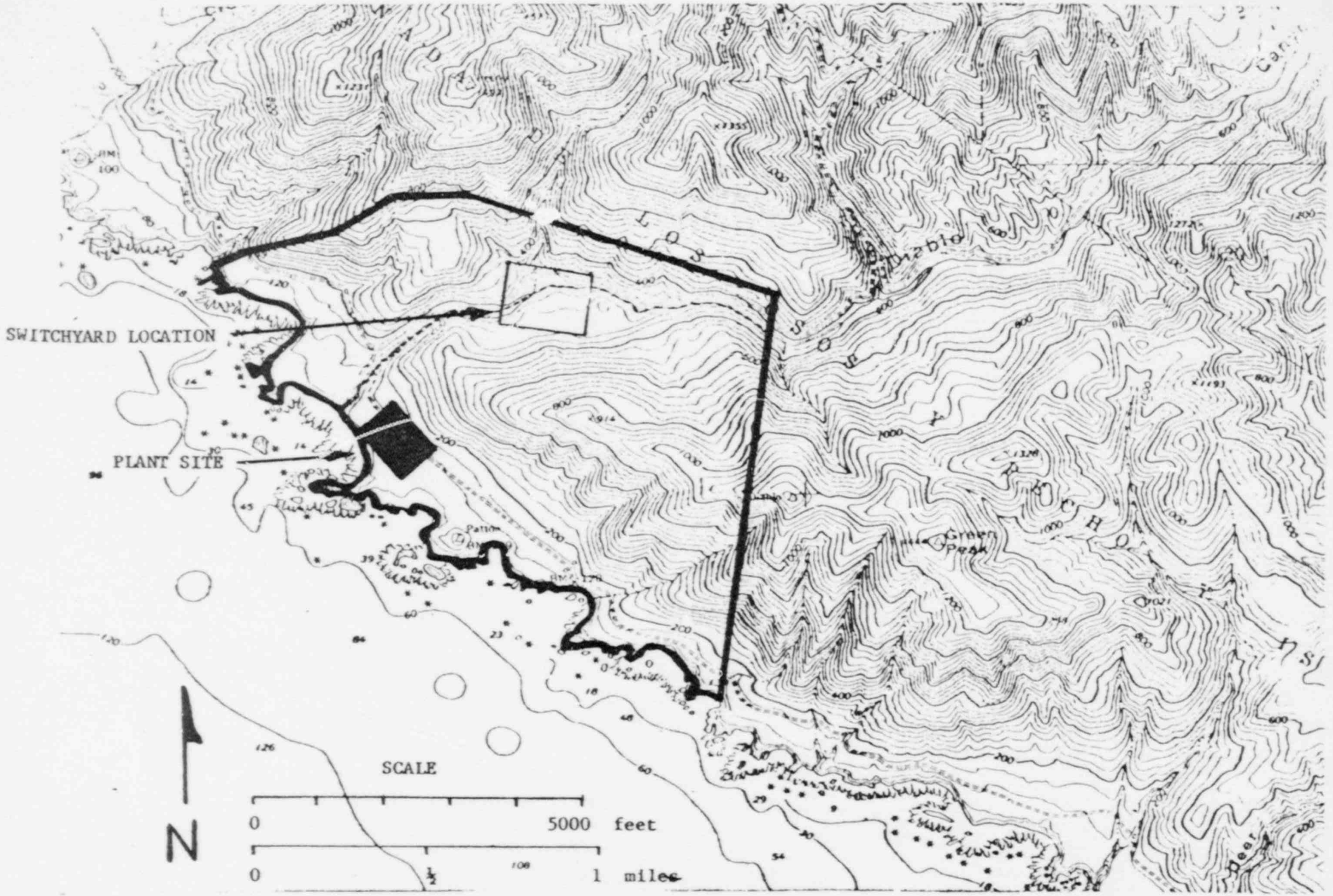

FIGURE II-4 PROPERTY LINE AND PLANT LOCATION

III - METEOROLOGY

A. General

The climate at the proposed plant site is typical of the central California coastal region. In the summer or dry season, mainly May through September, the Pacific Anticyclone lying to the west of California prevents Pacific storms from moving eastward across the State. In the winter or wet season, mainly November through March, the Pacific Anticyclone moves southward allowing Pacific storms to enter the State. More than 80 percent of the total annual precipitation falls during this five-month period. April and October are basically transition months separating the two seasons.

Annual temperature variations around the area of the plant site indicate the strong maritime influence on this region. Most stations along the coast show only a five to ten degree difference in mean temperature from the coldest winter month to the warmest summer month.

During the dry season surface winds prevail from the northwest; while in the wet season southeast winds are frequent. Moderate to strong sea breezes are common along most of the California coast during the dry season. During the wet season strong winds are associated with the more vigorous storm systems.

Cloudiness occurs mainly with winter storm activity. However, a high frequency of fog or low stratus clouds is evident during the dry season.

B. Summary

Sufficient records are available to describe the seasonal rainfall, surface temperature patterns, and prevalent winds which can be expected at

the Diablo Canyon site. Pertinent data is summarized in Appendix 2 and indicates the following:

1. Mean temperatures are mild, varying from 52°F in the coldest month (January) to 60°F in the warmest month (August). Extreme temperatures will range from nearly 100°F in the summer, to as low as 26°F in the winter.

2. The normal amount of rainfall is approximately sixteen inches but is likely to vary from nine inches in a dry year to twenty-seven inches in a wet year. More than 80 percent of the precipitation falls during the wet season (November-March).

3. Wind data from Santa Maria and Point Arguello (thirty-forty miles to the southeast) indicates that winds will prevail from the northwest quadrant 40-50 percent of the time on an annual basis. The average annual wind speeds at the 1,000 millibar level* (370 feet) will be approximately ten miles per hour. At the 950 millibar level* (1780 feet) the average annual wind speed increases to fourteen miles per hour. Persistent winds greater than forty miles per hour can be expected several times a year. Severe weather, such as tornadoes and hurricanes, is practically non-existent in this area.

4. A strong low level temperature inversion, typical of California's coastal climate during the dry season (May-September), will also prevail in this area. The height of the temperature inversion will average 1,640 feet during the afternoon of the dry season (May-September). In the early morning hours the inversion height is closer to 1,210 feet for the same time of the year. During the wet season the inversion will lift and become weaker as

* Height based upon U. S. Standard Atmosphere

the storm track across the Pacific shifts southward. The air mass under the temperature inversion is relatively unstable and should provide a mixing layer for gaseous emissions.

The diffusion capabilities of this site will vary considerably between the coastal plain where the plant will be located and the 900-1,200 foot ridge which extends southeastward along the coast. Under prevalent northwesterly flow, channeling (a restriction to flow) is expected to occur near the point where the southeast boundary of the site intersects the ocean. On-site measurements will be made to establish the degree of channeling and the gradient of the low-level turbulence between the coastal plain and the hilly terrain to the east of the plant site.

C. Further Investigations

In order to obtain meteorological data of a pertinent local nature for design and operating considerations, it is planned to construct a measurement network at the site. Measurements will be oriented toward obtaining the meteorological data used as input to analytical models available for describing diffusion. The fundamental measurements that will be made are:

1. Horizontal fluctuations of the wind.
2. Vertical fluctuations of the wind.
3. Wind speed.
4. Wind direction frequency.
5. Inversion height.
6. Atmospheric stability.
7. Plume expansion parameters.
8. Rainfall measurements.

The proposed network will include one 250 foot tower at the plant site and one 100 foot tower on top of a 914 foot hill overlooking the site. Additional equipment will be situated at the southern boundary, at the mouth of Diablo Canyon, approximately one mile up the canyon, and at other locations if found necessary. Such a layout will provide information to evaluate the turbulent regimes on the coastal plain and the hilly inland terrain as well as the frequency and magnitude of wind movement in Diablo Canyon.

The main field verification effort will be the release of fluorescent particles in a powder form from the meteorological tower. Where possible, smoke tests will be conducted at the same time to cross-check the location of the downwind fluorescent particle samplers. In addition, the smoke tests will provide data for a more accurate determination of the plume expansion parameters utilized in the diffusion model calculations.

IV - GEOLOGY

A. Introduction

The proposed site has been investigated by Dr. Richard Jahns, Dean of the School of Mineral Sciences, Stanford University, who has prepared a detailed geological map of the reactor site which is included in Appendix 4. In addition, Mr. Massimo Micheli, a P. G. and E. geologist, has made an investigation which is included in Appendix 3. A geologic map of California, San Luis Obispo Sheet, is included in Appendix 5. Comments on geology which follow below were derived from a review of the geologists' reports.

B. Topography

As shown in Figure II-4, it is proposed to locate the reactor on the ocean-cut terrace which ranges in elevation from about 60 to 150 feet above sea level. Near the plant site the terrace has a width of approximately 1000 feet. At the seaward edge of the terrace there is a near-vertical cliff about 60 feet high which shows clearly a cross section of the geological formations. Back from the shore and extending for several miles, the site is surrounded by the San Luis Mountains, an area of steep, brush-covered hillsides. Diablo Creek, which reaches the ocean near the reactor site, has a summer flow of only a few gallons a minute and is the only all-year stream in the vicinity of the plant site.

Preliminary USGS Topographic sheets of the area at a scale of 1: 24000 are available. The Company is preparing photogrammetric maps of the site at a scale of 1"=200 ft.

C. Geological Description

Bedrock in the site area is Tertiary in age and comprises

marine shales, sandstones, and fine-grained tuffaceous sediments, along with a considerable variety of tuffs. All these rock types are firm and compact, although they represent a wide range in hardness and resistance to erosion.

The bedrock is overlain by marine and non-marine deposits of Pleistocene age. The base of this terrace section rests on a platform of marine erosion, the age of which can be estimated as at least 120,000 years.

Both the sedimentary and volcanic units of the bedrock dip steeply, and it is apparent that the rocks have been subjected to common geologic folding and deformation. The effects of these processes can be readily recognized, especially in the contacts between the sedimentary and volcanic materials. Several small faults can be clearly identified in the bedrock, but no indications of significant faulting, such as large zones of gouge or breccia, have been found.

Neither the bedrock platform on which the terrace materials rest nor the overlying sequence of terrace deposits show evidence of offset by any fault in the area. Evidence for such offset was searched for with particular care, notably in the vicinity of recognized faults within the bedrock section, but none was found.

D. Foundations and Excavations

The reactor and other major components of the power plant will be founded on bedrock. Elevation of the plant yard level has not been selected, but it is expected to be between forty and eighty feet above sea level. Bedrock elevation at the plant site is indicated to be higher than elevation eighty feet and, therefore, even if the foundation excavations below yard level are shallow, the plant will rest on a rock foundation.

Rocks making up the bedrock series have variable properties, but will unquestionably carry the loads to be imposed on them by the power plant structures.

E. Landslides

The terrace and the slopes above appear to be quite stable and no landslides threaten the proposed reactor site. Very extensive excavation which will extend into the surrounding hills will be required for the reactor and turbine-generator. It is not expected that any difficulties with sliding ground will be created in this area by the excavation.

The geologists have recognized potential landslides in the area above the switchyard. Because this area is well removed from the reactor plant area, they would not represent a hazard to the reactor.

F. Proposed Work

To investigate the geological features of the site further, and in particular to demonstrate the absence of recent fault activity, a series of trenches are being excavated in the vicinity of the reactor, as shown by the drawings in Appendix 6. The trenching plan involves a total of about 2400 feet of trenches arranged so as to reveal geological features at the reactor location. The trenches will be dug through the terrace materials and three feet into bedrock. Maximum depth of the trenches may reach fifty feet.

G. Conclusions

On the basis of geological investigations made up to this time, it is believed that the Diablo Canyon site is satisfactory insofar as geological factors are concerned. There is reason to expect that the subsurface investigations now underway will establish beyond question the suitability of the site.

V - SEISMOLOGY

A. Introduction

The Company proposes to obtain the services of seismological consultants to investigate thoroughly and to advise on seismological aspects of the site. Meanwhile, the geologists who have investigated the site have made some comments on certain phases of seismology. The following summary is drawn largely from this source.

B. Faults

No large or active fault is known to exist within the site area. The site is forty or fifty miles west of the San Andreas Fault. The Nacimiento Fault is about twenty to thirty miles away, but it is not considered active. There are other mappable faults with a northwest-southeast trend at varying places in the Coast Range; however, no major faults have been mapped near the Diablo Canyon site. Reference to the San Luis Obispo sheet of the Geologic Map of California (Appendix 5) will show a series of small faults along the northeast side of the San Luis Range. These faults are the nearest shown on the geologic map and are about five miles away from the site.

The Earthquake Epicenter and Fault Map of California (reproduced in part in Appendix 3) shows essentially the same faults as the Geologic Map of California and, in addition, shows the location of epicenters and earthquake magnitudes for all earthquakes exceeding magnitude 4.0 during the period 1934 to 1961, together with major earthquakes prior to this period. The Diablo Canyon area is remarkably free of earthquake epicenters.

Within a radius of forty miles no earthquakes of magnitude of 6.0 or greater have occurred within the period of record. Northwest of the site, about forty miles away, there is an epicenter for a 6.0 magnitude earthquake. Northeast of the site, on the San Andreas Fault at a distance of about fifty miles, there are two epicenters of magnitudes 6.0 and 6.5. Southwest of the site at a distance of about sixty miles is plotted the epicenter of the largest earthquake in the area, magnitude 7.3.

C. Seismic Design and Tsunamis

The seismological consultants will be asked to recommend an earthquake frequency reponse spectrum for design of the plant and to comment on the hazard to the plant from tsunamis.

VI - HYDROLOGY

A. Domestic Water Supplies

Water supply for the City of San Luis Obispo is derived principally from Salinas Reservoir, about twenty-three miles northeast of the plant site. Whale Rock Reservoir on Old Creek, seventeen miles north of the site, and Chorro Reservoir about thirteen miles northeast of the site are also used. There are a few small uncovered reservoirs in connection with the San Luis Obispo Filter Plant which is located about three miles north of San Luis Obispo and about eighteen miles northeast of the plant site. There is a proposal to build a reservoir on Lopez Canyon, a tributary to Arroyo Grande Creek. This reservoir would be about twenty miles east of the plant site. Small towns in the San Luis Obispo area depend on wells.

The underlying formations in the mountainous regions tend to be relatively impervious and there are no large underground aquifers. The area is relatively arid with an annual rainfall of about fifteen inches, and except for large valleys like the Santa Maria Valley, underground water supplies are difficult to locate.

Underground water at the plant site is expected to be no more than minor seepage from the terrace materials.

B. Flooding of the Site

There is no hazard to the plant from flooding. Diablo Creek, with a drainage area of about four square miles, is incapable of a flood that would jeopardize the plant and, in any case, the topography of the plant site is such that flooding is not conceivable.

C. The Sea

Maximum tidal range in the area is about five feet. The plant site is fully exposed to the Pacific Ocean, with little natural protection. The reactor will be located high enough to be unaffected, and protection from storm waves will be provided for the condenser cooling water intake and discharge. Studies prepared by the U. S. Army Engineers and others have indicated that waves approximately twenty feet high are appropriate for design.

VII - CONCLUSIONS

On the basis of information available, the proposed site appears suitable for construction and operation of a nuclear power station incorporating either a pressurized or boiling water reactor of current or improved design. Investigations are being undertaken to obtain additional information necessary to complete the evaluation of the site and to establish design criteria.