DEC 14 1981

Docket Nos.: 50-361/362

MEMORANDUM FOR: The Atomic Safety and Licensing Board for the San Onofre Nuclear Generating Station, Units 2 and 3

FROM: Robert L. Tedesco, Assistant Director for Licensing, DL

SUBJECT: BOARD NOTIFICATION - NEW GEOLOGIC INFORMATION AND RECENT SEISMIC ACTIVITY - SAN ONOFRE 2 AND 3 (Board Notification 81-48)

On November 19, 1981 the NRC staff issued Board Notification 81-42 which transmitted recent correspondence from Mr. David W. Phifer regarding the geology in the vicinity of the San Onofre site.

On November 19, 1981 the NRC staff issued Board Notification 81-43 which provided information on a notification by Southern California Edison (SCE) of a recent swarm of small seismic events near the San Onofre site.

On December 8, 1981 the NRC staff issued Board Notification 81-45 which transmitted the SCE evaluation of the Phifer letter and additional information about the recent seismic swarm.

The purpose of this memorandum is to provide the Board with the NRC staff's evaluation of the material contained in the three Board Notifications discussed above. No additional staff review of these issues is planned.

Original Signed by
Robert L. Tedesco

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
1. NRC Memorandum dtd. December 8, 1981.
2. NRC Memorandum dtd. December 9, 1981

cc: See attached lists.

Contact:
H. Rood
49-28427

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DATE	12/10/81	12/10/81	12/11/81				

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San Onofre

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 14 1983

Docket Nos.: 50-361/362

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Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
1. NRC Memorandum dtd. December 8, 1981.
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cc: See attached lists.

Contact:
H. Rood
49-28427

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 0 8 1981

MEMORANDUM FOR: Darrell G. Eisenhut, Director
Division of Licensing, NRR

FROM: Richard H. Vollmer, Director
Division of Engineering, NRR

SUBJECT: TRANSMITTAL OF REPORT ENTITLED "GEOSCIENCES BRANCH REVIEW OF SOUTHERN CALIFORNIA EDISON's REPORTS ON THE 6-9 NOVEMBER 1981 EARTHQUAKES IN THE SAN ONOFRE REGION

Attached is the Geosciences Branch review of two reports submitted by the Southern California Edison Company which deal with the occurrence of a series of small earthquakes in the San Onofre region during the period of November 6-9, 1981. These reports were transmitted to the NRC by cover letters to Director, Office of Nuclear Reactor Regulation from K. P. Baskin of Southern California Edison Company dated November 18, 1981 and November 30, 1981. The occurrence of these earthquakes was the subject of a recommended board notification (Memorandum R. H. Vollmer to D. G. Eisenhut, November 18, 1981).

Based on our review of the reports and our assessment of other information available we conclude that this series of earthquakes does not provide any new information which causes us to change our position on the capability of faults in the area or on the vibratory ground motion as stated in the SONGS Units 2 and 3 Safety Evaluation Report and at the Atomic Safety and Licensing Board hearing.

Richard H. Vollmer, Director
Division of Engineering

Attachment:
As stated

cc: w/attachment
R. Vollmer
J. Knight
R. Jackson
L. Reiter
S. Brocoum
A. Cardone
R. Rothman
D. Eisenhut
H. Rood
L. Chandler

Dup of 8112160021

Geosciences Branch Review of Southern California Edison's Reports on the 6-9 November 1981 Earthquakes in the San Onofre Region

We have received two reports from Southern California Edison Company (SCE), dated November 18, 1981 and November 30, 1981, about the earthquakes which occurred in the San Onofre region from November 6 to November 9, 1981. The following is a summary and a review of the information contained in these reports.

A swarm of 20 small earthquakes was detected and located about 12 km SSE of the SONGS by the California Institute of Technology (Caltech) seismic network during the period 20:37 GMT November 6 to 00:47 GMT November 9, 1981. The largest earthquake had a magnitude M_L = 3.0.

SCE obtained the P- and S-wave arrival times from Caltech and located the earthquakes using a velocity model developed for the region near SONGS. Based on these locations most of the earthquakes appear to cluster with a maximum horizontal dimension of about 3 km and with one event located about 5 km from the center of the cluster. To improve the accuracy of the relative location of the events they also used the master event method to compute epicenters. The master event method is a technique in which smaller less well-recorded events in a sequence are located relative to a larger better recorded event thus improving the accuracy of their epicenters. This resulted in a tighter grouping of the epicenters. They estimate a horizontal uncertainty of 1 km for the location of the largest event (M_L = 3.0) which was used as the master event. The other earthquakes were relocated to within about 1 km of the master event. The resulting cluster has a maximum horizontal dimension of

about 2 km. SCE states that the earthquakes lie in or near the mapped expression of the Offshore Zone of Deformation (OZD). The depth of earthquakes is difficult to determine reliably without several seismic stations located within a source depth of the earthquakes or a very localized calibration for station delays, neither of which is the case for this sequence of earthquakes. However, based on their experience in locating events in southern California they estimate that the true depth could be between 2 and 14 km and most likely in the range 5-8 km.

Focal mechanisms for the five largest earthquakes were also computed by SCE but only the mechanisms for the two largest events were believed to be adequate because of the relatively few stations which had good unambiguous recordings of first motion direction for the smaller events. Both of the larger events' mechanisms indicate predominant strike-slip motion and the best fitting focal planes to the first motion data and the estimated uncertainty are:

Strike	Dip
$N43^{o} \pm 10^{o}W$	$72^{o} \pm 20^{o}SW$
$N50^{o} \pm 6^{o}E$	$80^{o} \pm 20^{o}NW$

As a result of their analysis of these two focal planes SCE considers the northwest trending fault plane to be the most likely plane, and characterizes the sequence as representing right-lateral strike slip motion on a steeply dipping fault paralleling the OZD direction and in or near the mapped expression of the OZD.

SCE also notes that in the period 1934-1979 there have been at least six earthquakes in this same area (the largest of these was a magnitude M_L = 3.5 which occurred in 1934) and that earthquakes swarms of this type are not unusual occurrences in the region surrounding SONGS.

As a result of their analyses, SCE indicates that these earthquakes occurred on the OZD in an area where such events might be expected.

Based on our review of the SCE reports and our own knowledge of the information available for this region, we find that the earthquakes occurred in an area where the OZD and the projected CZD are near each other (1.5 km apart as depicted by Greene and Kennedy, Geologic Structure Map - San Onofre Offshore, SONGS 2 and 3 SER, Appendix F).

Due to the proximity of these features, the horizontal uncertainty of the master event location (1 km) and the horizontal dimension of the cluster (2 km) the epicenters cannot be unequivocally associated with either zone. The OZD and the projected CZD in that area are nearly parallel so the strike of the focal mechanism fault plane does not help in determining in which if either of these zones the earthquakes occurred. The earthquake epicenters appear in a cluster; there is no evidence that they delineate any known or hypothesized fault or structure. Since the earthquakes occurred at depths of several kilometers, trying to correlate them with surface expressions of structure may not be very useful for making estimates of fault capability. The earthquakes in the swarm were small ($M_L \leq 3.0$) and in this region of relatively low seismicity, earthquake swarms like the one of November 6-9, 1981 are not unusual. Historically there have been at least six earthquakes in the vicinity of the swarm area. The two largest of these had magnitude of M_L = 3.5 and M_L = 3.4.

Based on the above we conclude that this swarm of earthquakes occurred somewhere in the vicinity of the OZD and the CZD where these two zones are very close to each other and the precise location remains subject to some uncertainty due to the limitations inherent in the science of seismology. These earthquakes, however, occurred in a region where such swarms have occurred previously and their proximity to the OZD is typical of other earthquakes which have occurred in the area. The occurrence of these earthquakes does not provide evidence to cause us to consider the CZD as being capable.

Based on our analysis of these events, we find no new information which causes us to change our position regarding either the capability of the Cristianitos Zone of Deformation or the adequacy of the proposed vibratory ground motion description for the SONGS 2 & 3 site.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

DEC 09 1981

MEMORANDUM FOR: Darrell G. Eisenhut, Director
Division of Licensing, NRR

FROM: Richard H. Vollmer, Director
Division of Engineering, NRR

SUBJECT: TRANSMITTAL OF REPORT ENTITLED "REVIEW OF PHIFER ALLEGED FAULTS"

Attached is the staff's review of the October 8, 1981 letter from David Phifer to NRC and the applicant's evaluation (dated November 25, 1981) as requested by the staff. The report of Phifer was the subject of a Board Notification by R. L. Tedesco on November 19, 1981. This review was conducted by Tom Cardone of the Geosciences Branch and concludes that on the basis of Mr. Phifer's letter and the applicant's evaluation, the conclusions reached in the Safety Evaluation Report remain valid.

We suggest that the staff review (Attachment 1) and the applicant's evaluation (Attachment 2) be forwarded to the Board.

Richard H. Vollmer, Director
Division of Engineering

Attachments:
As stated

cc: w/attachments
R. Vollmer
J. Knight
R. Jackson
S. Brocoum
L. Reiter
A. Cardone
R. Rothman
H. Rood
R. Morris, USGS

Dup of
8112160052

Review of Phifer's Alleged Faults
San Onofre 2 & 3
December 5, 1981

The staff has reviewed Mr. David Phifer's letter to NRC dated October 8, 1981 and the applicants evaluation of this letter made at our request which is entitled "Report on the 'Aliso Canyon Fault' and the Alleged 'Mountain Top Fault Zone', Camp Pendleton, California, November 25, 1981." The staff did not attend the September 19, 1981 field trip. For the sake of clarification, the staff was not invited to attend the September field trip by Mr. Phifer or anyone else, and contrary to Mr. Phifer's comment on page 3 in his October letter, the staff did not agree with the conclusions he expressed on the July 17, 1981 field trip.

In his letter Mr. Phifer listed 11 zones of deformation observed or inferred by him based on his geologic interpretations. They are:

- Cristianitos
- Rose Canyon/Newport Inglewood
- Offshore Zone of Deformation (OZD)
- San Onofre Mountain
- Horno Summit
- Mateo Canyon
- San Onofre Canyon
- Horno Canyon
- Pulgas Canyon/Piedre de Lumbre Canyon
- Aliso Canyon
- Mountain Top

As stated by Mr. Phifer the first three zones have been evaluated in detail and are well documented in the NRC staff's Safety Evaluation Report and in testimony given at the seismic safety hearing.

The fourth through the ninth zones listed were evaluated by the applicant and staff at the time of the safety hearing. As stated by the staff at that time, we agreed with the applicant's findings and conclusions that the fourth through ninth zones of deformation as postulated by Mr. Phifer either do not exist, or are minor faults and therefore not significant to the San Onofre site in the context of 10 CFR Part 100, Appendix A.

The remaining Aliso Canyon and Mountain Top zones of deformation are addressed in detail in the applicant's evaluation report of November 25, 1981. The applicant concluded:

1. If the Aliso Canyon fault zone exists, it is over 9 miles southeast of the site. Since the OZD is 5 miles from the site, it controls the seismic design. Therefore, the Aliso Canyon fault zone is of no significance to the safety or seismic design of San Onofre Nuclear Station.
2. They find no evidence for Mr. Phifer's Mountain Top Fault Zone. The alleged structure is not supported by the geologic evidence and is considered speculation.

We have reviewed the applicant's evaluation and agree that the alleged Aliso Canyon fault is at a greater distance from the site than the OZD and, therefore, it is of no seismic significance to the San Onofre site. With regard to the applicant's second conclusion, the staff did not attend the September 19th field trip to visit the area of Mr. Phifer's Mountain Top Fault Zone. However, based on our confidence in the mapping and interpretations of this area contained in earlier reports of investigations by Messrs. Ehlig, Shlemon, and West, we also find that the conclusion presented on this fault is reasonable.

In view of the above, we find no reason to change the conclusions reached in our Safety Evaluation Report.

REPORT ON THE "ALISO CANYON FAULT" AND THE ALLEGED "MOUNTAIN TOP FAULT ZONE" CAMP PENDLETON, CALIFORNIA

November 25, 1981

SOUTHERN CALIFORNIA EDISON COMPANY AND
SAN DIEGO GAS AND ELECTRIC COMPANY

Dup of
~~8112160024~~

During the Atomic Safety Licensing Board hearings for San Onofre Nuclear Generating Station Units 2&3, Mr. D. W. Phifer, a retired Marine Corp Colonel, identified what he believed to be six previously undisclosed geologic structures that he alleged were new and could influence the seismic safety of the plant. The Applicants examined his features with Mr. Phifer and then in the field independently and later again with Mr. Phifer and the NRC staff. Documentation in "Report on Limited Appearance of Mr. D. W. Phifer and Alleged Geologic Features" dated July 29, 1981, was then prepared by the Applicants and it discussed in detail each of his alleged new geologic discoveries.

The features discussed and the conclusions reached are:

- "Horno Summit Fault" pp. 4-15
  - Mr. Phifer's suggestion of as much as 20 miles of right lateral displacement is speculative and is contrary to the fact that bedrock formations and contacts are continuous across the hypothesized trend of the fault. It is Applicants opinion that the fault does not exist.
- "Horno Canyon Fault" pp. 16, 17
  - Marine Terraces at elevation 325 project across the fault at Horno Canyon without offset. This surface is 300,000 years old and any fault would be that age or older and not be capable.
- "San Onofre Mountain Fault" pp. 17, 18
  - The inferred "San Onofre Mountain Fault" is not a tectonic feature; but rather a collection of geomorphic and sedimentary feature mis-identified as a fault.
- "Piedre de Lumbre/Las Pulgas Canyon Fault" pp. 15, 16
  - Sediments deposited between these two canyons were layed down as fluvial sediments on a Pleistocene floodplain that is lower in elevation than the adjacent marine terraces. The lower elevation of the fluvial sediments represents a depositional sequence, not faulting.

o "Mateo Canyon Fault" pp. 19-21

- Paired fluvial terrace surfaces can be matched across San Mateo Canyon and the age of these terraces are judged to be 100,000 years old. Thus any faulting, if present, would be at least that old.

o "San Onofre Canyon Fault"

- Vertical offset of 20 feet is unsubstantiated. Stream cutting across resistant San Onofre breccia and eroding soft strata of the Monterey Formation is a normal erosional process and doesn't require faulting to achieve an offset.

The report concludes that these "are not capable faults" and have no significance relative to the seismic design of the San Onofre Units. Further, Mr. T. Cardone, of the NRC Staff in the response to reviewing the field evidence and the Applicants report on the alleged features states that "...I don't see anything in Mr. Phifer's postulated faults or presentation that poses a hazard to the site..." and that he agrees with the evidence and interpretation by the Applicants (Cardone, Tr. 6024:6-18).

On August 17, 1981, Mr. Phifer forwarded to Edison a draft of a letter and supporting maps and photographs he proposed sending to the Nuclear Regulatory Commission. This information was essentially the same as that submitted to the Commission on October 8, 1981. Contrary to the comment by Mr. Phifer on pg. 3, Mr. McNey and Dr. Ehlig were not in agreement with his conclusions regarding the July 17, 1981 field trip. In addition to the features discussed in the limited appearance report described above, Mr. Phifer identified:

o Cristianitos Fault

o Offshore Zone of Deformation

- Rose Canyon/Newport Inglewood (Fault Zones) which have been analyzed by the Applicants in detail as apart of the licensing proceedings. The Cristianitos fault is not capable, the offshore Zone of Deformation is 5 miles west of the site and the Rose Canyon/Newport Inglewood (Fault Zones) are the south and north ends of the offshore Zone of Deformation. Mr. Phifer agreed on page 5 of his October letter they have been studied.

New concerns raised in the letter of October 8, 1981 were:

- "Mountain Top Fault Zone"

- "Aliso Canyon Fault"

These latter two features are discussed in subsequent paragraphs of this report.

A field trip was then hosted by Mr. Phifer on September 19, 1981 and several members of the geologic community as well as consulting firms were invited.

Attendees were:

Mr. Larry Carlson, USMC Natural Resources Office

Mr. M. W. Hart, Geocon Consulting Engineers and Geologists

Mr. G. T. Farrand, Geocon Consulting Engineers and Geologists

Mr. A. E. Farcas, Geocon Consulting Engineers and Geologists

Mr. D. W. Phifer, Coastal and Nearshore Consultant

Mr. J. L. McNey, Southern California Edison

Dr. P. L. Ehlig, Consultant

The trip included revisiting those locations identified in the limited appearance report. They were:

- Vandergrift Boulevard landslide
- Piedre de Lumbre/Las Pulgas Canyon fluvial sediments
- Las Pulgas Ammo Dump area of the Horno Summit Fault
- Horno Summit Ridge
- Rifle Range 214 Fault

and

- Fault F location
- San Onofre Mountain
- Horno Canyon landslide at the beach.

The latter three stops were to observe features of the alleged "Mountain Top Fault Zone." While visiting the stops along the "Mountain Top Fault Zone", origin of the tuff bed, minor faulting and conditions leading to the development of the landslide at the mouth of Horno Canyon were described in detail by the Applicants. Dr. Ehlig and Mr. McNey believe that the interpretation of the geology is in error and without technical merit. The Aliso Canyon Fault was not visited.

"Mountain Top Fault Zone"

As described by Mr. Phifer on page 3 of his October 8, 1981, letter to the NRC, the "Mountain Top Fault Zone" (MTFZ) which trends NE-SW, is longer than 3 miles, has a vertical displacement of greater than 600 feet with the east side up, and a width of about 1 1/2 miles. The map signed by David Phifer and dated August 14, 1981 accompanying the subject letter shows the MTFZ bounded by two nearly north-south trending faults. All of the eastern fault and most of the western fault are portrayed on the map by dashed lines which indicates the faults are inferred according to the map legend. Between the bounding faults, the map shows seven short faults with trends ranging from about north 30 degrees west to north 15 degrees east. In pages 4-5 and 4-6 of Enclosure 1, accompnaying the subject letter, Mr. Phifer provides additional information on his MTFZ.

The central part of the fault bounding Mr. Phifer's MTFZ is the same as the F fault which is described along with the E fault (Ehlig, Written Testimony, Contention #3, pp. 1-4; Tr. 2898-2905). The F fault is exposed in a quarry on the northeast side of the old Coast Highway. Here the fault is a discrete nearly planar feature with a strike of about north 15 degrees west and an average dip of 78 degrees to the west. The age of the fault is imprecisely known, but it cuts rocks 14 to 15 million years old and shows no evidence of cutting the coastal terrace. The fault is most likely 4 to 10 million years old. The unconformity (erosional surface) separating the base of the Monterey Formation from the underlying San Onofre breccia is about 25 feet lower in elevation on the west side of the fault than on the east side. Striations produced by fault movement occur in more than one direction on the fault

surface but steeply inclined striations predominate suggesting movement was primarily down the dip of the fault. The age of this fault is uncertain but it was most likely active sometime between ten million years ago and four million years ago based on regional tectonic relationships (Written Testimony, Contention #3, Ehlig, p. 3:21-26; and p. 4:1-2).

The fault shown on the east side of the MTFZ by Mr. Phifer appears to be conjectural. The Applicants know of no mappable faults along the alignment shown on his map. Where his inferred fault crosses the mouth of Horno Canyon, two marine terraces project directly across the canyon with shoreline angles at about 275 feet and 325 feet above sea level. Based on association with the marine isotope chronology (Shlemon, 1978) the 325 foot platform is at least 300,000 years old. Thus, if any fault were present it would be that age or older, and it would not be considered capable according to 10CFR100 Appendix A. On page 4-5 of Enclosure 1 accompanying his letter to the NRC, Mr. Phifer presents reasons for believing significant faulting has occurred within his MTFZ. His principal reasons include:

1. The presence of a tuff bed at an elevation of about 800 feet southwest of San Onofre Mountain which he believes is similar to tuff at an elevation of about 200 feet near the mouth of Horno Canyon.

2. Marine Terraces Qt2, Qt3 and Qt4 (Phifer designations) are continuous across his MTFZ but end abruptly near fault F.

3. There is a zone of extensive landslides along the coastal projection of his MTFZ.

4. Capistrano Formation is exposed at similar elevations as younger San Mateo Formation along the coastal projection of his MTFZ.

5. Offshore bathymetry at depths of 30 and 60 feet appears displaced.

In regard to the tuff bed, it is Applicants' understanding that Mr. Phifer is suggesting that a tuffaceous bed in the San Onofre breccia exposed at an elevation of about 920 feet in the cut along San Onofre Peak trail correlates with a tuff bed which crops out in the breccia a few hundred feet northeast of the old Coast Highway in the area extending from 1/2 miles northwest of Horno Canyon to 2 miles southeast of Horno Canyon. The latter tuff contains pumice lapilli indicating a nearby source and is about 15 feet thick whereas the tuff on San Onofre Mountain is fine-grained and only a few feet thick. The Applicants find no basis for correlating the two tuff beds. Fine-grained tuff beds have a scattered occurrence within the San Onofre breccia. They indicate volcanism was active in the region simultaneous with deposition of the San Onofre breccia.

Mr. Phifer is correct in noting that remnants of marine terraces are aligned across his MTFZ from Horno Canyon to near fault F. There are four terraces in this area, not three as indicated by Mr. Phifer. They have shoreline angles at elevations of about 275, 325, 375 and 450 feet. Terraces are present northwest of fault F and have shoreline angle elevations correlative with those to the southeast of fault F; however, the degree of terrace preservation is less because the area was a headland. The Applicants have observed nothing which would indicate the terraces are offset by faulting.

The extensive landslides along the coast are rotational failures which have occurred where wave erosion has removed lateral support from clay-rich beds in the seaward dipping Monterey Formation. Terrace deposits resting on the Monterey Formation have been extensively deformed within these landslides. However, no deformation or faulting is visible in the in-place terrace deposits exposed in scarps on the landward side of the landslides. The landslides such as that exposed at Horno Canyon are controlled by the lithology and seaward dip of the Monterey Formation and are not a manifestation of a deeper seated deformation as suggested by Mr. Phifer.

Mr. Phifer's suggestion that both the Capistrano and San Mateo Formations are exposed where his MTFZ projects to the coast is based on the mapping of Moyle (1973). Dating by microfossils demonstrates that the Monterey Formation constitutes bedrock beneath the terrace deposits along the entire coast from the Cristianitos Fault to Las Pulgas Canyon (Ehlig, 1977). The exposed part of the Monterey Formation includes lithologies similar to parts of the Capistrano Formation and the San Mateo Formation which is a submarine fan facies of the Capistrano Formation (Ehlig, 1979).

Contrary to Mr. Phifer's belief, the Applicants see no evidence suggesting displacement of offshore bathymetry at depths of 30 and 60 feet.

In conclusion, the Applicants find no evidence for Mr. Phifer's Mountain Top Fault Zone. The F fault which forms the west side of the hypothesized zone was previously mapped and reported. The eastern boundary fault appears to be hypothetical. We find no evidence indicating a through going fault along the

trend shown on Mr. Phifer's map. In particular, the contact between the San Onofre breccia and underlying Eocene sandstone appears to be undisplaced where Mr. Phifer places his inferred fault on the northeast side of San Onofre Mountain. As indicated by Mr. Phifer, minor faults are locally present within the San Onofre breccia; however, the Applicants attribute this to the massive, brittle nature of the breccia and not to the presence of a zone of faulting. We agree with Mr. Phifer's observation that a group of marine terraces remnants extend across his hypothesized Mountain Top Fault Zone in an undisturbed alignment. Because the older terraces are at least 300,000 years old, we find no evidence to support the contention that there are capable faults within the hypothesized Mountain Top Fault Zone nor does the MTFZ intersect the Horno Canyon Fault to form a deformed zone expressed by landsliding. Thus, the alleged structure is not supported by the geologic evidence and is considered speculation.

Aliso Canyon Fault

The feature described as the "Aliso Canyon Fault" by Mr. Phifer has been analyzed by the Applicants using geomorphic expression of the marine terraces and drainage and inspecting aerial photographs. This fault is shown on his map accompanying the October 8, 1981 letter, and shows a dashed line and querries representing an inferred or questionable fault for essentially the length of the feature. Access to Aliso Canyon is limited due to military activities and because the north-east portion is within a Camp Pendleton firing range. The Applicants analysis of the feature determined that marine terrace break-in-slope at the 300, 400 and 500 ft. contours project across Aliso Canyon without deflection. Remnant marine terrace surfaces between

elevation 460 and 520 are about 1,000 feet wide occur east and west of Aliso Canyon, projecting across with no discernable vertical or horizontal separation. The continuity of topographic expression along trend of the terrace break-on-slope surface and the presence of accordant elevations in the uniform soils argues for no major structural deformation since the terrace formation. Terrace surfaces at this elevation north of Las Pulgas were developed over 400,000 years ago (Shlemon, 1978, Figure 12). If the same relationship holds at this location, any faulting along Aliso Canyon would be older.

The Applicants find no evidence for offset bathymetry contours on the offshore axis of Aliso Canyon.

Aliso Canyon is over 9 miles southeast of the site and trends about N40E. If a fault is present, the orientation will not intersect the arc of the 5 mile radius from the site and lies at least 4 miles beyond such a boundary. Geomorphic evidence for significant deformation is absent and even if faulting were present, the Offshore Zone of Deformation 5 miles from the site controls the seismic design. The "Aliso Canyon Fault", if present has no significance to the safety or seimic design of San Onofre Nuclear Generating Station.

The Applicants are not aware of any other geologic disclosures since conclusion of the Atomic Safety and Licensing Board hearings on August 4, 1981.

JLMcNey:npm