

**DRL MEETING ON SAN ONOFRE 2 & 3**  
**BETHESDA, MARYLAND**  
**FEBRUARY 24, 1971**

This meeting on San Onofre geology-seismology was attended by representatives of SCE, NOAA, USGS, SDG&E, Bechtel, Dames & Moore, CE, DRL, and the Director of Regulation. The SCE geology-seismology test review board was also present. This included:

R. Jahns	M. Hill	R. Scott	S. Smith	D. Moore
J. LeConte	J. Smith			

J. Fischer, Dames & Moore, who did the original seismological study attended also. Dr. B. Page and J. Hard represented the ACRS. (A complete list of attendees is attached at the end of this report.)

In his opening remarks, Ortega noted that the plant excavation has been held up and that plant component delay costs are mounting. He stated that some design work, e.g. on the containment, is proceeding on the basis of the spectra submitted in the PSAR.

Gail Hunt Comments

Hunt summarized the SCE position on geology-seismology. He noted that SCE feels there is no reason to extend Newport-Inglewood fault beyond Laguna Beach, that no long continuous faults exist offshore, and that the Newport-Inglewood, if it becomes active, will be within its 90 Km length. Records from the Borrego Mountain quake used in conjunction with a Newport-Inglewood quake along its entire length would give 17% g at the site. For the DBE, the following quakes were considered with the following results:

Newport-Inglewood	- - -	17% g
San Jacinto	- - - - -	11% g
San Andreas	- - - - -	25% g

Design spectra were submitted in Amendment 6.

E. Baltz (USGS) Comments

The USGS position is as follows: There appears to be a continuous zone of deformation extending SE from the Newport-Inglewood fault to as far as San Diego and that this probably extends into Mexico. The zone of deformation is characterized by folds and faults. Faulting is suggested offshore from the plant. South of the plant, underwater displacements are seen. In San Diego, quaternary deposits are displaced as much as 200 feet. For all these and other reasons, USGS disagrees with the applicant's geologic model.

OFFICE ▶

SURNAME ▶

DATE ▶

L. Murphy (NOA) Comments

If only historical activity is considered, Murphy felt that he could come up with seismological conclusions which would be unchallenged. He also noted that NOA cannot predict earthquakes and that they therefore have worked out procedures for evaluation of reactor sites.

DRL apparently is in agreement with NOA that the Newport-Inglewood fault would have to be extended offshore to San Diego. With this assumption, NOA is faced with a very long major structure within a few miles of the San Onofre plant. Therefore, a great earthquake will have to be considered for this plant. The San Fernando records are still being evaluated; NOA is not in a position to give the AEC recommendations based on that quake. Murphy made several observations on this quake:

1. The quake location is well fixed ( $34^{\circ} 23.8'W$ ,  $118^{\circ} 23.6'W$ )
2. The magnitude was 6.6
3. Accelerations of the order of 0.33-0.7 g were seen at the dam about five miles from the epicenter (acceleration peaks of  $\sim 1$  g were seen). The vertical component was  $\sim 0.7$  of the horizontal. At  $\sim 25$  miles, 0.25 g was seen. In Pasadena, 0.21 g was experienced.

Therefore, Murphy concluded, a great earthquake five miles from the San Onofre site will give site accelerations "considerably greater than 0.50 g."

H. Wagner (USGS) Discussions

Wagner had reviewed the data which resulted in the conclusion that Newport-Inglewood zone extends offshore. The anticline offshore from the site is faulted in several locations. Wagner divided the zone offshore into three segments: Laguna, San Onofre, and Oceanside. In the Laguna segment, several faults are identified. Also, the contact between the two acoustic units is linear in this area. The onshore formation is Miocene or upper Miocene. In any event, the linearity extends to Newport-Inglewood.

The San Onofre segment consists of a faulted bedded anticlinal structure. A deformed zone exists at the top of the anticline which may either be highly folded or faulted. In some locations, definite faults are seen in the beds. Younger crestal beds overlay the broken zone in some locations. Also, the Christianitos fault (near the San Onofre site) can be extended offshore to the deformed zone and its intersection can be seen.

OFFICE ▶					
SURNAME ▶					
DATE ▶					

In the Oceanside segment, offsets from faulting are seen in the sparker data. Southward projections of these offsets extend into the onshore Rose Canyon fault near San Diego.

Dr. Ziony (USGS) Comments

Ziony reviewed the geologic structure of the Newport-Inglewood and extended zones. Studies are being made in the San Diego area. Numerous faults of Pleistocene age are present. These include the Rose Canyon Fault. These faults seem to extend into Mexico, as an extension of San Diego Bay. The Tijuana Valley runs into the active San Miguel fault in Mexico. (Ziony agreed that the Christianitos is inactive.) Pleistocene faulting is seen offshore, too. Ziony felt that he had to disagree with the applicant that motion had not taken place offshore in the last 26 million years.

Discussion

Baltz admitted that the USGS has data which the applicant had not seen. Ortega expressed his concern about San Fernando data having an adverse effect on the San Onofre site. Representatives of the applicant had some problems with the interpretation of the sparker data since the data is sparse and was taken only along the suspected deformed zone. However, the USGS felt the anticlinal trend NW-SE was convincing supporting evidence of a continuous deformed zone. The applicant also argued that the San Diego area faulting has not been characterized adequately to say it's of the same nature as Newport-Inglewood. The similarities are that they both consist of fairly short segments of surface faulting, the large vertical displacements are similar, quaternary deposits are displaced, and the general topography is similar. Dip slip seems to predominate in the recent San Diego quakes. It was not clear that this was also true offshore. The applicant pointed out that the type of slip might be important in estimating the quake magnitude and accelerations.

The applicant also questioned the extent and orientation of the graben-like features which USGS uses to support their arguments. On one flank of the grabens, the fault is vertical. This appeared to support Wagner's idea that the blocks are actually grabens. The applicant, however, was of the opinion that these features are erosional in nature and that the conclusion that a continuous deformed zone exists is tenuous. J. Smith had problems with USGS's extension and interpolation of linear features many miles apart into one large, long zone of deformation. Baltz, however, felt that the shoe is on the other foot and informed the group that the applicant should prove otherwise.

OFFICE ▶					
SURNAME ▶					
DATE ▶					

Dr. Jahn's Comments

Jahn felt that the presence or non-presence of the subduction zone under Newport-Inglewood is not really important. This subduction zone represents a great fault, of great continuity, etc., but which no longer exists as a fault. He also felt that what is needed is better definitions of what is being discussed when talking of "deformation zones." He felt that embracing a great fault on this zone was nonsense. The features in the zone are short and discontinuous unlike faults like the San Andreas. He cautioned against jumping to an unwarranted conclusion. West was very interested in determining who, at this point, would be deciding whether or not the zone of deformation would be the source of a great earthquake.

S. Smith was concerned that NOA was assuming continuous breakage (faulting) in determining that accelerations "much more than 50% g" would be experienced at San Onofre. Continuous breakage apparently does not exist. The magnitude-fault length relationship (Bonilla's) refer to surface rupture lengths, per J. Smith. Wagner agreed that, based on onshore data, the fault is probably not continuous in the deformed zone. S. Smith also felt that L. Murphy is wrong in going from fault length to magnitude since many other factors are involved. (Murphy was not present to rebut.)

Baltz questioned the applicant's written statements that the Newport-Inglewood zone of deformation does not extend very far offshore. M. Hill commented that Newport-Inglewood was a line of in-echelon folds and faults characterized by right-slip movements of a maximum of 10,000 feet. These characteristics do not extend southeastward, in Hill's opinion, since the south end of the Newport-Inglewood zone is significantly different in cross-section than farther north. This evidence indicates to Hill that the zone is fading out offshore. Ortega repeated S. Smith's question regarding what model is being used to determine DBE magnitude and site accelerations.

R. Scott noted that Murphy's suggested acceleration values are in a range which may prevent building the plant because it will be uneconomic or beyond the state of the art. DeYoung pointed out that Murphy needs to hear further discussion and arguments to relax his present opinion.

In view of the lack of a physical basis to proceed otherwise, Ortega suggested that the Staff give them the required spectra, such as is done with a double-ended pipe break, and then let SCE see if they can design a plant to the criteria. Baltz was concerned about defending this approach in a public hearing while R. Scott noted that the present mumbo jumbo method of determining the DBE is not defensible either.

OFFICE ▶					
SURNAME ▶					
DATE ▶					

R. Scott Presentation, San Fernando Earthquake of 1971

Some 200 strong motion records are currently being evaluated for this quake. Scott (and Page) noted that a D. C. distribution yard within the area of the epicentral location had been totally destroyed and was a shambles. Accelerations from the records ~5 miles from the epicenter gave 0.5-0.7 g with individual spikes to 1.0 g. At 12 miles (at a Holiday Inn) the horizontal acceleration was 0.16 g while the vertical acceleration was about 0.28 g. In Los Angeles, about 25 miles away, accelerations of 0.10-0.14 g were typical.

Overthrust faulting at the base of a mountain range caused surface movement up to 2-3 feet in length in several areas. (Dr. Page noted that this fault did not show on the maps though a ground water obstruction was known, so the fault could have been inferred.) The San Andreas structure was exposed to ~0.37 g from this event but was not activated by this. Dr. Mann asked SCE how this earthquake applies to the San Onofre site and what the basis is for this conclusion. This matter is still being studied though some very large concrete structures such as a 500' high dam close to the epicenter were relatively undamaged. This dam was probably designed to less than 0.15 g. Dr. Hill felt that the San Fernando Earthquake would have little application to San Onofre since the geology is different for the two locations. S. Smith noted that the February 9 quake, in a general way, confirmed the geologists' view of Southern California. Jahns seemed to agree with this statement.

Dr. Mann tried to get some assurance that the 0.4 g experienced 25 miles away from the 6.6 magnitude earthquake was a predictable result. Fischer (D&M) admitted that he was surprised though S. Smith felt that the 0.4 g record was close to the epicentral area. Scott reported that San Onofre experienced about 0.025 g from the event. Ortega stated that SCE would be evaluating the San Fernando Earthquake with respect to the San Onofre site. Apparently the San Onofre 2 & 3 site is being evaluated using a method developed recently by S. Smith. This is the first time this method is being used, and it doesn't necessarily conform to previous correlations which would have predicted lower accelerations both at the epicenter and at the San Onofre site. This matter is still being studied.

In attempting to get at the significance of the features seen in the off-shore surveys, Dr. Mann drew the following comments from the attendance. Hill - The feature may not be continuous between Newport and San Diego. Jahns - The significance of this deformed zone is not important when compared to major faults. Baltz - A year old USGS report to RDT on the San Fernando area recommended magnitude 6.5 as a design basis earthquake. This was estimated using the fault length method. He added, "That's the way the coastline crumbles."

OFFICE ▶

SURNAME ▶

DATE ▶

Ortega suggested an approach where SCE looks at how strong a plant can be built and then work back to earthquake magnitude in the deformed zone. DeYoung stated that the Regulatory Staff would review any material submitted.

\*\*\*

OFFICE ▶					
SURNAME ▶					
DATE ▶					