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Minutes of the
ACRS Subcommittee Meeting of
San Onofre 2&3
January 31, 1981
Inglewood, California



The ACRS Subcommittee on San Onofre 2&3 met on January 31, 1981 in Inglewood, California. The purpose was to conduct a site visit and to discuss the seismology and geology of the site as part of the review for an operating license.

ACRS members present were M. Bender - Subcommittee Chairman, D. Okrent, W. Mathis, and D. Ward. ACRS consultants attending were S. Philbrick, J. Maxwell, G. Thompson, and E. Luco.

Presentations were made by H. Rood - NRC/NRR, W. Moody - Southern California Edison (SCE), J. Smith - SCE Consultant, R. McNeill - SCE Consultant, S. Biehler - SCE Consultant, P. Ehlig - SCE Consultant, D. Moore - SCE Consultant, R. Shlemon - SCE Consultant, E. Heath - SCE Consultant, S. Smith - SCE Consultant, T. Cardone - NRC/GB, B. Slemmons - NRC Consultant, G. Green - USGS, J. Devine - USGS, and L. Reiter - NRC/GB.

No written statements or requests for presentation time were received from members of the public prior to the meeting. At the time of the meeting, however, a request for presentation time by G. Barlow - Intervenor, was received and granted. Following the meeting, an Intervenor report was received from Mr. Barlow.

Attachments include the presentation schedule and a list of documents considered by the Subcommittee.

Introductions

H. Rood - NRC/NRR and W. Moody - SCE gave introductions. The Staff issued in January 1981 a SER on seismology and geology, separate from the main SER, which is to be issued in February 1981. The reason is to expedite licensing, which has progressed at a slower pace than has plant construction. The Staff requested the ACRS to review seismology and geology issues at the February full Committee meeting to ease the schedular difficulties.

The purpose of the Subcommittee meeting was to review information developed since the CP stage and to reaffirm the adequacy of the design basis SSE.

Design Basis SSE

Smith and McNeill, SCE Consultants, described the design basis SSE. Extensive studies were performed beginning at the CP stage in 1969. The plant designs meet the following bases: 2/3g horizontal acceleration; 0.44g vertical acceleration; Modified Mercalli Intensity 10; Ms 7 earthquake 8 km offshore. No capable faults were found within 5 miles of the site. The Offshore Zone of Deformation (OZD) was determined to be the controlling feature for the site.

January 1975 Earthquakes in the San Juan Capistrano Embayment

S. Biehler, SCE Consultant, discussed this topic. The earthquakes (magnitudes 3.3 to 3.8) have been attributed to differential settling in the embayment. They were potentially significant in that their epicenters lay close to the Cristianitos fault, which is considered to be extinct. It has been concluded that the quakes were unrelated to the Cristianitos fault.

Area Mapping and Regional Tectonics

The above topics were discussed by J. Smith and P. Ehlig - SCE Consultants. During excavation for the plants several features, termed "A, B, C, and D" features, were found. The features are considered to be joints. They were formed over 125,000 years ago and less than 4 million years. The joints are 1/4" to 6" wide; exhibit lateral shear with no vertical displacement; are straight; and are on the order of 50 feet to 800 feet long. Their formation is attributed to localized stress relief of stress patterns that no longer exist. The features are not unique to the site.

A 24 square mile onshore area around the site was geologically mapped. The Cristianitos was the only major fault noted. It passes within 1 km of the plants, but has been stable for at least 125,000 years. A number of wave-cut terraces exist at various elevations above sea level. The terraces are of various ages, depending on their elevation. They show no evidence of displacement due to fault movements. Consideration of regional geology would indicate

that the Cristianitos fault has been inactive for 3 to 4 million years. The Cristianitos fault formed from gravity glide associated with the once deep Los Angeles basin, which is now filled.

Offshore Geology

B. Moore, SCE Consultant, described the offshore geology, including the Offshore Zone of Deformation (OZD). A topic of study has been whether the Cristianitos fault intersects the OZD. The Cristianitos fault was traced as far as 2 km offshore. There is no evidence that it extends further, which indicates it is separated from the OZD by ~6 km. The mechanisms that formed the Cristianitos fault were said to be no longer operable. The Cristianitos fault appears to be different in age and style from the OZD.

A region of folding and faulting exists offshore. The USGS has named it the "Cristianitos Zone of Deformation". It does not appear to be associated with the Cristianitos fault nor with the OZD.

Coastal Geomorphology

R. Shlomon, SCE Consultant, discussed the characteristics and origins of the coast. During the past 125,000 years, the San Onofre site has been very stable relative to Southern California as a whole. The offshore morphological evidence supports the onshore mapping discussed previously. In particular, there are wave-cut terraces 40,000 and 80,000 years old that are not displaced by the Cristianitos fault.

Earthquake Magnitude on the OZD

E. Heath, SCE consultant, presented an evaluation of maximum earthquake magnitude on the OZD. The OZD is considered to be the controlling feature for design of San Onofre 2&3. The OZD runs along the Southern California coast north toward Santa Monica and south toward San Diego. Its total length is uncertain. There are a number of segments which, for the purpose of determining a magnitude for the SSE, are presumed to be joined together, though there is no evidence to indicate this is so.

There are several methods for postulating earthquake magnitudes that could result from a fault. They are:

- fault length; generally no more than 20-30% of the fault ruptures during a single event.
- historic evidence.
- slip rate, i.e. there is a correlation between slip rate along a fault and resultant earthquake magnitude.
- moment magnitude, which is slip rate times fault area times shear modulus.
- total displacement.

All were used to support the design basis SSE.

Upper-Baja Studies

Because of the importance of fault length in determining possible earthquake magnitude, geologic studies were made in the region south of San Diego to determine whether the OZD connects with faults in the Baja region. No connections were discovered.

Intervenor Presentation

G. Barlow, intervenor, presented information in disagreement with SCE and NRC.

The points made were as follows:

- By linking the OZD to a couple of faults in the Baja region, a total length for the OZD of 350-390 km can be obtained, as opposed to 200 km that was postulated for design analysis.
- The Cristianitos fault is connected to the OZD and to the Whittier-Elsinore fault.
- There is evidence of movement on the Cristianitos fault within the past 10,000 years.
- The phenomena of focusing can cause higher-than-expected ground accelerations at the plant site.
- Earthquake data indicate the design value used for vertical acceleration (0.44g) is too low.
- Other studies have postulated higher earthquake magnitudes on the OZD.
- The "A, B, C, D" features are part of the Cristianitos fault system.
- Settling for anything more than zero risk in the operation of San Onofre is criminal.

SCE Response to Intervenor Comments

SCE was allowed the opportunity to respond to Barlow's comments:

- Further offshore evidence was sited, showing that the Cristianitos has been inactive for at least 80,000 years.
- No evidence exists that the Cristianitos extends further than previously indicated.
- No evidence to link the OZD with various Baja faults.
- Focusing was analyzed and found to be not significant for the plant.
- Evidence was sited that the 0.44g design value for vertical acceleration was adequately conservative
- The "A, B, C, D" features are local joints and are not part of a fault.

Vibratory Ground Motion

R. McNeill, SCE Consultant, discussed methods used to validate the 0.67g design value for ground acceleration. Data from the 1979 Imperial Valley earthquake was used to verify the San Onofre analysis, with good results obtained. A survey of worldwide earthquake data was also used, which again confirmed the conservatism of the San Onofre value. For design purposes, peak vertical and horizontal accelerations were assumed to be in-phase, whereas in actuality this is seldom so.

NRC Review of Geology and Seismology

T. Cardone (NRC/GB), B. Slemmons (NRC Consultant), G. Green (USGS), and J. Devine (USGS) described the fault structure associated with San Onofre site. The information was in general agreement with that presented by SCE, with no significant points of contention.

Dr. Maxwell indicated that he sees little likelihood of the OZD being a continuous fault. The USGS makes no connection between the Cristianitos fault and the Cristianitos Zone of Deformation.

It was noted that a USGS report prepared for FEMA and used as a reference by Barlow was used by him in an incorrect manner.

L. Reiter (NRC/GB) summarized the NRC review of seismology issues. The Staff is in basic agreement with the Applicant. The Applicant's analyses were performed in a reasonable and conservative manner.

Future Meetings

The Subcommittee will meet on February 18, 1981 and on March 11, 1981 in Washington, DC to discuss the licensing review of San Onofre 2&3; non-seismology and geology issues.

DOCUMENTS CONSIDERED BY THE SUBCOMMITTEE

1. Southern California Edison Presentation -99 slides
2. Earthquake Magnitude Potential of the OZD: B. Slemmons - 2 slides
3. USGS Mapping of Faulting in the San Onofre Vicinity: G. Green - 2 maps
4. NRC Conclusions from Review of Geology: T. Cardone - 10 slides
5. NRC Review of Seismology: L. Reiter - 33 slides
6. Intervenor Report on San Onofre 2&3 Seismology and Geology: From Richard Wharton to Richard Savio, dated February 2, 1981.

- Tentative Presentation Schedule -

San Onofre 2&3 Subcommittee Meeting
 Airport Park Hotel
 600 Avenue of Champions
 Inglewood, California
 January 31, 1981

	<u>Organization/ Speaker</u>	<u>Presentation Time</u>	<u>Approximate Time</u>
MEETING WITH THE APPLICANT AND THE NRC STAFF (OPEN SESSION)			
1.0 Subcommittee Chairman's Opening Remarks		10 min	8:30 am
2.0 Staff Introduction - Purpose and Scope of Review	NRR/H. Rood	10 min	8:40 am
3.0 Applicant Introduction	SCE/W.C. Moody	5 min	8:50 am
4.0 Basis for Selection of the SSE at the CP Stage	SCE/J. Smith	20 min	8:55 am
5.0 Additional Information since the CP Review			
5.1 January 3, 1975 Earthquake	SCE/S. Biehler	20 min	9:25 am
5.2 Area mapping & regional tectonics	SCE/J. Smith, SCE/P. Ehlig	20 min	9:55 am
Break		10 min	10:25 am
5.3 Offshore Geology	SCE/B. Moore	20 min	10:35 am
Offshore Zone of Deformation			
5.4 Coastal Geomorphology	SCE/R. Shlemon	30 min	11:05 am
5.5 Maximum Earthquake Magnitude on the Offshore Zone of Deformation	SCE/E. Heath	30 min	11:40 am
Break for Lunch			12:25 pm
5.6 Vibratory Ground Motion	SCE/R. McNeill	30 min	1:25 pm
6.0 Summary and Conclusion		10 min	2:05 pm
^o Geology	SCE/J. Smith		
^p Seismology & Ground Motion	SCE/S. Smith		

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	<u>Organization/ Speaker</u>	<u>Presentation Time</u>	<u>Approximate Time</u>
7.0			
7.0 Review of Information Since the CP Stage			
7.1	NRC/GB T. Cardone	10 min	2:20 pm
7.2	NRC/GB B. Slemmons	15 min	2:35 pm
7.2 Offshore Zone of Deformation Slip rate vs. Earthquake Magnitude			
Break			
7.3	USGS/Green	15 min	3:00 pm
7.3 Offshore Geology, Cristianitos Fault			
7.4	NRC/GB L. Reider	25 min	3:30 pm
7.4 Seismology			
• Magnitude of SSE			
• Vibratory ground motion			
• Issues raised in Diablo Canyon review relevant to San Onofre			
8.0	SCE/W.C. Moody	15 min	4:10 pm
8.0 Applicant Response to NRC Remarks			
9.0	NRR/H. Rood	10 min	4:30 pm
9.0 Concluding NRC Remarks			
10.0		20 min	4:40 pm
10.0 Executive Session			
10.1			
10.1 Future Meetings			
10.2			
10.2 Future Agenda			
			5:00 pm

ADJOURNMENT

- NOTES (1) A maximum of 30 minutes will be allowed for receiving oral statements from members of the public, if requested.
- (2) The speakers should limit their prepared presentations to the time allowed. An allowance, amounting to approximately 50% of the presentation time, has been made for questioning by the Subcommittee.