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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of SOUTHERN CALIFORNIA EDISON COMPANY, et al. (San Onofre Nuclear Generating Station, Units 2 and 3).	)	Docket Nos. 50-361 OL 50-362 OL AFFIDAVIT OF LUCIEN HERSH IN SUPPORT OF MOTION FOR SUMMARY DISPOSITION OF INTERVENOR FRIENDS OF THE EARTH, ET AL., CONTENTION 1a (DEWATERING WELLS).

STATE OF CALIFORNIA,)
) ss.
COUNTY OF LOS ANGELES.)

LUCIEN HERSH, being first duly sworn, deposes and says that if called as a witness herein he can competently testify, as follows:

1. I am currently employed by Bechtel Power Corporation (hereafter "Bechtel") as Assistant Project Engineer on the construction project known as San Onofre Nuclear Generating Station, Units 2 and 3, San Onofre, California (hereafter "SONGS 2 and 3"), and have held that position since January 1979. In that capacity, I am responsible for all physical design and the coordination of the associated project disciplines in connection with the engineering of the SONGS 2 and 3.

2. My educational background is as follows: I received my Bachelor of Science degree in Civil Engineering in 1966 and my Master of Science degree in Civil Engineering in 1967 from the University of California at Berkeley. My Master of Science Degree involved studies emphasizing structural mechanics and design.

3. I have been a registered Professional Civil Engineer in the State of California since 1970. I am a member of the American Society of Civil Engineers. My general work experience consists of three summers as an engineering assistant with the City of Vernon, California while I was in my undergraduate program and then one year as a research assistant with a U.S. Air Force research program during my year as a graduate student at the University of California, Berkeley. Upon receipt of my Master of Science

Degree, I commenced employment with Bechtel and have been employed with Bechtel at all times since 1967.

4. During my first eleven and a half years with Bechtel I was assigned to the Civil/Structural Discipline and in that capacity was responsible for analysis and design of various categories of structures and system supports subjected to both static and dynamic loading. During my first three years with Bechtel, I worked on electric power transmission and distribution systems, a power system for the Safeguard anti-ballistic missile system and a fossil fuel electrical generation station in Louisiana. On these projects I was involved in evaluating and designing for seismic and other dynamic events and their effects on structures and equipment of various types. For example, my work in connection with the anti-ballistic missile system involved designing for the various events associated with a postulated nuclear strike by enemy missiles and the resulting impacts upon the ground and the various structures and equipment.

5. I have spent my last eight and a half years employed on the SONGS 2 and 3 Project. I spent my first one and a half years (January 1972 - May 1973) as Leader of the Containment Group, a subgroup within the Civil/Structural Discipline. In that capacity, I was responsible for the analysis and design of the containment structure. In this

process, I undertook numerous feasibility studies on the seismic-withstand capability of the containment structure with reference to different geometrical and size considerations. Thereafter, I became Assistant Group Supervisor for the Civil/Structural Discipline (May 1973 - September 1974) and in that capacity was responsible for the coordination of the design of all Seismic Category I structures at SONGS 2 and 3. In this capacity, I undertook many of the same responsibilities that I had as Containment Group leader but with respect to additional structures. In addition, I became involved with the other disciplines in analyzing the seismic qualifications of various systems and equipment. Thereafter, I spent approximately four years (September 1974 - December 1978) as Group Supervisor of the Civil/Structural Discipline responsible for all aspects of the civil/structural design for SONGS 2 and 3. In this capacity I also coordinated the support of Bechtel's geotechnical department.

6. Bechtel Power Corporation is the Engineer/Constructor for the construction of SONGS 2 and 3. Engineering work on SONGS 2 and 3 began in early 1969 and has been underway ever since. I personally became involved in the SONGS 2 and 3 project in late 1971.

7. A construction permit was issued for SONGS 2 and 3 by the U.S. Atomic Energy Commission in October, 1973. Site preparation began in March, 1974 and consisted of excavation which proceeded down to the elevation of the ground water table. No subsurface cavities were revealed or indicated during the extensive excavation and borings program associated with the Site preparation process.

At that time, a system of construction dewatering wells was also installed. Dewatering systems such as that employed at San Onofre are commonly used on construction sites where construction of foundations below the water table is necessary. The purpose is to remove water from the areas of excavation thereby allowing construction of the portions of the structure located below the water table.

8. The construction dewatering well system consisted of one test well, ten operational wells on the Site (Wells 1 through 10) and two operational wells off the Site (Wells 11 and 12), which were drilled during the period of March through August of 1974. I have attached hereto and by this reference incorporate herein as Exhibit A (Reference No.19), a document entitled "Plot Plan of Dewatering Well System, San Onofre Nuclear Generating Station, Units 2 and 3", which is a plot plan of the SONGS 2 and 3 site (hereafter the "Site") on which I have noted the locations of the twelve operational wells and the single test well. The

operational wells each bear numbers which will be referred to herein and have previously been likewise referred to in the reports and the other various documents which have been submitted to the Staff of the Nuclear Regulatory Commission (hereafter the "NRC Staff"). Each of these documents and reports are identified and given a reference number in the accompanying "List of Project References in Support of Motion for Summary Disposition of Intervenor Friends of the Earth, et al.'s Contention 1a (Dewatering Wells) (hereafter the "Project References List"). Each of the exhibits attached to this affidavit include a parenthetical cross-reference to the reference number of the document or report identified in the Project Reference List.

9. Each operational well was 200 ft. deep and consisted of a 14-inch diameter steel casing and a graded gravel filter envelope situated within a 30-inch diameter well bore. The lower 110 ft. of the casing was fluted to allow water to flow into it and to the bowl of the turbine water pump which was located well below the proposed draw-down zone, and was specified to pump 1,500 gallons of water per minute. Exhibit B (Reference No. 20) entitled "Typical Section; 30-Inch Diameter Dewatering Well, San Onofre Nuclear Generating Station, Units 2 and 3", which is attached hereto and incorporated herein by this reference,

provides a typical cross-section of a site construction dewatering well.

10. I was not directly involved in the design and construction of the Site construction dewatering well system. However, since assuming the position of Civil/Structural Engineering Group Supervisor in September, 1974, I have been responsible for the operation and initial decommissioning of the dewatering well system. Accordingly, I am thoroughly familiar with the design and construction of said system.

11. The twelve operational wells were in operation during the period August, 1974 through February, 1978. Exhibit C (Reference No. 30) entitled "Summary of Well Maintenance", which is attached hereto and incorporated herein by this reference, summarizes the operational history of the Site dewatering wells. The design, construction, and operation of the Site construction dewatering well system was conducted within the normal standards of engineering practice and nothing of significance other than the items mentioned herein were noted in connection with the wells in this system. In particular, no subsurface cavities were detected or indicated when the well borings for the dewatering well system were installed.

12. The normal engineering practice at the conclusion of the construction of foundations, when it is no longer necessary to have the area dewatered, is to decommission the wells by cutting off the casing below grade, filling the casing with sand, capping the casing, and compacting the area around the casing and backfilling with compacted material as necessary up to grade. In May, 1977, such decommissioning had been accomplished at Wells 4, 5 and 8, and was being performed on Well 6 when settling occurred at this latter well indicating the existence of a potential subsurface cavity.

13. In order to examine this anomaly thoroughly, and properly respond, a Joint Investigation/Demobilization Task Force (hereafter the "Task Force") was formed in May, 1977 consisting of representatives of Southern California Edison Company (hereafter "SCE"), Bechtel, Woodward-Clyde Consultants (hereafter "WCC") and Dr. Robert L. McNeill. Key personnel involved were Professor McNeill, John A. Barneich (WCC), Jeffrey Yann and Howard Smith (SCE), Robert Blodnikar and Arthur Arnold (Bechtel). I was the Chairman of this Task Force and have held that position throughout the entire investigation and demobilization of the Site dewatering wells. As Chairman, I have been generally

responsible for all of its activities. I have been particularly responsible for Bechtel's activities in this process.

14. The Task Force's work has involved extensive investigative field work and laboratory testing to determine the size, content, extent, shape, location, and structural effect of all cavities. The Task Force has also studied the mode of cavity formation and the related question of whether additional cavities were likely to have been formed.

15. Dr. McNeill and Mr. Barneich have had primary responsibility for analysis of the geotechnical and seismic design implications of the presence of the cavities. Bechtel's primary responsibilities included the preparation and implementation of engineering specifications to investigate, demobilize, and analyze the structural implications of all cavities associated with the site construction dewatering well system. Bechtel also performed the construction work consisting of drilling of borings and the grouting of the various areas as more fully set forth below. Finally, Bechtel was responsible for monitoring structural settlement or the absence thereof at the Site, with particular emphasis on the area potentially affected by the presence of the cavities associated with the construction dewatering well system. SCE's participation was directly managed by Kenneth P. Baskin, SCE's Manager of Generation Engineering Services,

and included overall Task Force managerial supervision, reporting Task Force action to the NRC Staff and other licensing-related activities, as well as overall financial and scheduling input to the Task Force.

16. Pursuant to NRC Staff request, the investigation and demobilization of the Site construction dewatering wells has been extensively documented. The most significant documentation are the reports periodically submitted to the NRC Staff during the period February, 1978 through August, 1979. These reports are listed as Reference Nos. 1 through 18 in the accompanying Project References List.

17. During the period November, 1977 through August, 1979, I participated in five separate meetings with NRC personnel to discuss the situation. Three of these meetings took place in Washington, D.C., and two at the job site. At the two job site meetings, representatives of Intervenor Friends of the Earth, et al. participated and took part in site tours of the Site construction dewatering well system. At all these meetings, I and the other members of the Task Force reported to the NRC Staff on the various investigations and demobilization processes and the various analyses, studies and engineering and construction operations that were being performed pursuant to NRC Staff direction or approval. In addition, two informal meetings were held at the request of an NRC Staff geologist to

provide a status update. One of these informal meetings was held in San Francisco and the other at the Bechtel design office in Norwalk. At all pertinent times the NRC Staff was kept fully informed of the Task Force's activities.

18. One or more of three basic investigation/demobilization procedures were used to analyze each well and to discover whether there were cavities at any of them such as that discovered during the initial demobilization of Well 6, as described in Paragraph 12 above. These procedures, which were developed by Bechtel or WCC, after consultation with Dr. Robert L. McNeill, as more fully explained in the accompanying affidavit of Robert L. McNeill, were as follows:

(a) Exploration drilling was employed to determine conditions in the areas surrounding the wells. Deep drillings ensured that all significant cavities were identified and the maximum depth of cavities determined, and provided subsurface information for the design of a grouting program. Additional near-surface borings were then drilled to locate shallow cavities or zones of disturbed material and delineate their extent and shape, investigate the properties of the cavity infill materials, provide access for grouting and provide a check on the effectiveness of the

grouting program while it was in process. The holes drilled were both vertical and on various angles. This program was employed on Wells Nos. 6, 7 and 8.

(b) A deep drilling/cross-hole seismic program provided borings drilled to the full depth of the well from which a cross-hole seismic investigation was undertaken. The borings themselves provided data on the characteristics of the subsurface material. Seismic waves were then transmitted from one boring to another and their wave forms were analyzed to determine the nature of the material through which the waves passed. Where cross-hole seismic data were interpreted to be anomalous, additional deep borings were drilled for the purpose of determining whether cavities were present and to perform further cross-hole seismic investigation. This program was employed on Wells Nos. 3, 4, 5 and 10.

(c) Airlift cleaning of the gravel pack and removal of the well casing was performed on certain wells and after measurement and investigation of the well bore, they were filled with a measured volume of concrete to match the anticipated volume. This procedure was performed on Wells No. 1, 2 and 9.

(d) The test well was used to develop design criteria for the dewatering well system. It was operated for only a few days during the pumping test and was not

operated during the actual dewatering of the site. The television log of the wellbore revealed 6 feet of sediment in the bottom of the well. It is probable that this material fell into the well during construction. Also, the television log revealed the casing to be slightly encrusted for the most part with some enlarged louver openings through which the filter gravel could be observed to be intact. Based on these observations and considering the limited use of the well, it is my professional opinion that no cavities could have developed. The well was demobilized by filling the casing with gravity grout.

19. Soil samples were obtained for laboratory testing and standard penetration tests and were performed at regular intervals in all borings to further interpret visual material classifications. Gyroscopic and slope-indicator surveys were performed on many of the bore holes to determine the location of the bore hole with depth, to aid in the interpretation of bore hole data and to verify the closure spacings of the holes.

20. Grout was placed in the cavities and the bore holes using both gravity and pressure-injection methods. Gravity grouting was used primarily to fill any large open cavity spaces emptied by airlifting, and to help stabilize the upper portions of the cavities. It was also used to backfill wells where the well casing had been removed and

the wellbore measured, and around the casing in bore holes being prepared for the cross-hole seismic surveys. The pressure grouting program followed gravity grouting of the open cavity spaces at the top of the cavities (created by the emptying of the cavity-infill sand with the airlift). Its objectives were to fill any remaining voids and to provide for nominal densification of the cavity-infill materials. Grouting was done in stages on a grid pattern around the known or suspected cavity locations to ensure complete filling of the cavities.

21. The Task Force investigated each of the twelve operational dewatering wells (and the test well). A summary of this investigation effort is found in Exhibit D (Reference No. 31) entitled "Summary of Investigation/Demobilization of Dewatering Wells", which is attached hereto and is incorporated herein by this reference. Specifically, the Task Force's investigatory efforts were as follows:

(a) Wells Nos. 11 and 12 were located outside of the Site and their distance from Seismic Category I structures precluded any possibility of any cavities potentially associated with these wells affecting such structures. Therefore, no investigation work was carried out on these wells other than to decommission them in the fashion described in Paragraph 12 above.

(b) Wells Nos. 1, 2 and 9 were investigated thoroughly. In each instance, the filter material and casing were removed, mechanical surveying measurements were made at frequent intervals to the full depth of the wells, and it was determined that native material surrounded the well bore. The well was filled with concrete equal in volume to that anticipated by the previous measurement. Therefore, it was concluded that no subsurface cavities were associated with these wells.

(c) Wells Nos. 3 and 10 were also found to be of little significance as problem areas because these wells were not located within a significant proximity to SONGS 2 and 3 Category I Structures, and only a relatively small cavity was detected and defined at Well No. 3. Both wells were completely demobilized by backfilling with sand, gravel and concrete.

(d) Wells Nos. 4 and 5 received more attention. Direct observation revealed one small cavity in close proximity to Well No. 5. The cavity at Well No. 5 was stabilized by drilling and pressure grouting. Thereafter, drilling exploration was completed at both wells to their full depth. These borings revealed no cavities. These borings were also utilized to perform a cross-hole seismic survey under the direction of WCC. As described in the

accompanying affidavits of Robert L. McNeill and John A. Barneich, cross-hole seismic analysis revealed no additional cavities.

(e) I was most extensively involved in the investigations and demobilization of Wells Nos. 6, 7 and 8. Their proximity to Seismic Category I Structures required an extensive examination. More detailed summaries of these wells are provided in Paragraphs 22, 23 and 24 below.

22. Well No. 6

The cavity in Well 6 was outlined by exploratory drilling, further defined by airlift cleaning, as well as sonar and mechanical caliper surveying measurements, and ultimately established by exploration drilling and grouting. The initial exploratory drilling consisted of 35 borings to locate and define the cavity, determine whether the cavity extended beneath structures, provide access for bulk grout placement, and determine effectiveness of bulk grout placement. These borings ranged from 4.5 feet to 213 feet in depth for a total of 3,103 lineal feet. 120 cubic yards of bulk grout was placed in the cavity area cleaned out by the airlift operation. The deep exploration drilling program consisted of 26 borings totalling 4,339 lineal feet; 19 borings were completed to the full depth of the well, 4

were terminated near surface after encountering underground buried obstructions, and 3 were terminated before reaching full depth after drifting into the well bore.

The exploration/grout program consisted of a total of 74 borings with a total of 6,575.5 lineal feet divided into three separate phases. Borings drilled in each stage were grouted prior to proceeding to the next phase. The first phase consisted of 45 borings to determine the depth and lateral extent and characteristics of cavity infill material. The second phase included 13 angle borings across the long axis of the cavity already defined to supplement the grouting of the cavity fill materials. The third stage consisted of 7 closure or check holes to close out the grouting pattern and to check on the completeness or effectiveness of the grouting program. In addition to the general program defined above, 9 other angle holes were drilled under the edge of the auxiliary building to assure that the cavity did not extend under the structure. 500 sacks of cement were placed in the grouting operation which equates to approximately 27 cubic yards of grout (when adjusted to account for hydration and water loss due to injection under pressure). A drawing, entitled "Contour Map of Cavity Area and Borings Surrounding Well No. 6", showing the locations of the borings and the aerial extent of the detected cavity is attached hereto and by this reference

incorporated herein as Exhibit E (Reference No. 24). A total of 2.7 miles of exploratory and grout holes have been placed around Well 6. A summary of the investigation/demobilization program for Well 6 is attached hereto and by this reference incorporated herein as Exhibit F (Reference No. 21) entitled "Plans and Sections Views of Dewatering Wells No. 6 Cavity, San Onofre Nuclear Generating Station, Units 2 and 3", and Exhibit G (Reference No. 32) entitled "Investigation at Well 6, San Onofre Nuclear Generating Station, Units 2 and 3." Based on the data produced by this investigation, it is my professional opinion that:

(a) No significant cavities existed below a depth of 140 feet;

(b) The cavity was linear, narrow and steep sided, with a maximum width of 11 feet at a depth of 40 feet, it did not extend under the Auxiliary Building and it is filled with sand and grout and contains no open voids; and

(c) Pressure grouting injected lenses and dikes of grout into the disturbed sand resulting in densification.

23. Well No. 7

The cavity at Well No. 7 was detected and partially defined by airlift cleaning of the annular area between the casing and the side of the well bore, and

established by exploration drilling and grouting. The initial phase of exploratory drilling consisted of 54 borings to locate and define the cavity, determine whether the cavity extended beneath structures, provide access for bulk grout placement, and determine the effectiveness of grout placement. These 54 borings ranged in depth from 23.5 feet to 200 feet for a total of 4,012 lineal feet. 49 cubic feet of bulk grout was placed in the cavity area cleaned out by the air-lift operation. The deep exploration boring program incorporated 37 additional borings with a total length of 5,240 lineal feet; 24 of these borings were completed to the full depth of the well, one was terminated 5 feet short of the full depth due to hard drilling, one was terminated at 122 feet depth after drifting into the well bore, nine were terminated near surface after encountering buried obstructions and two were terminated at approximately 20 ft. depth due to mechanical problems with the drill set-up. The exploration/grout program included 142 borings comprising a total of 10,952 lineal feet. These borings were placed in two separate stages. The first stage consisted of 118 total borings drilled in and around the assumed cavity to determine its length, depth and lateral extent. Since prior exploration indicated the cavity could possibly extend under the structure, a series of 24 angled borings were included in the stage 1 borings adjacent to and

beneath the Auxiliary building and 3 vertical borings were drilled through the basement of the structure. Each vertical boring placed inside the structure encountered native material. All stage 1 borings were grouted prior to proceeding with the stage 2 work. The 24 stage 2 borings were located to complete closure and check completeness of effectiveness of the grouting program. A total of 1,432 bags of cement or approximately 79 cubic yards of grout were placed (when adjusted to account for hydration and water loss due to injection under pressure). The effectiveness of the grout program was further documented when the walls of an excavation adjacent to the auxiliary building revealed grout seams from 1 to 3 inches in width scattered throughout the zone of uncompacted fill immediately above the ground water table. A drawing entitled "Contour Map of Cavity Area and Borings Surrounding Dewater Well No. 7", showing the locations of the borings and the aerial extent of the detected cavity, is attached hereto and by this reference incorporated herein as Exhibit H (Reference No. 25). A total of 3.8 miles of exploratory and grout holes have been placed around Well 7.

A summary of the investigation/demobilization program for Well No. 7 is attached hereto and by this reference incorporated herein as Exhibit I (Reference No. 22) entitled "Plan and Section Views of Dewatering Well

No. 7 Cavity, San Onofre Nuclear Generating Station, Units 2 and 3", and Exhibit J (Reference No. 33) entitled "Investigation at Well 7, San Onofre Nuclear Generating Station, Units 2 and 3". Based upon the data produced by this investigation, it is my professional opinion that:

(a) No significant cavities exist below a depth of 120 feet;

(b) The cavity is linear and narrow, filled with sand and grout and contains no open voids;

(c) Only a narrow finger of disturbed sand extends approximately 9 feet under the edge of the Auxiliary Building. Vertical holes located inside the structure placed to intersect this feature encountered only native material;

(d) Significant grout take and extensive grout travel and communication between holes demonstrate good penetration throughout the cavity region; and

(e) Pressure grouting injected lenses and dikes into disturbed material resulting in a densification.

24. Well No. 8

The cavity at Well No. 8 was detected by airlift cleaning the inside of the casing (previously demobilized by sand filling), further defined by airlift cleaning of the annular area between the casing and the inside of the well bore, and ultimately defined by exploration drilling and

grouting. The initial exploratory drilling consisted of 66 borings to locate and define the size of cavity, determine whether the cavity extended beneath the Unit 3 Containment Structure, determine the effectiveness of bulk grout placement, and to re-grout following additional removal of cavity fill material by airlift operation. The depth of these borings ranged from 15 feet to 110 feet for a total of 3,166 lineal feet. 190 cubic yards of bulk grout was placed in two stages to fill the void created by airlift operations. This was followed by pressure grouting to stabliize the grout. (It should be noted that the balance of the exploratory borings were placed from the bottom of an excavation at elevation +30. Therefore the cumulative length of borings cannot be compared directly to the totals for the other wells.) The deep exploration drilling program consisted of 19 borings totalling 3,171 lineal feet; 17 borings were completed to the full depth of the well, one was terminated after drifting into the well bore and the other boring was terminated due to mechanical problems with the support jack causing misalignment of the boring. The exploration grout program consisted of a total of 108 borings with a total of 6,304 lineal feet. The borings were placed in four separate stages with the borings drilled in each stage being grouted prior to proceeding to the next phase. The first stage included 54 borings in and around the assumed cavity to

determine its depth and lateral extent. Fourteen vertical borings and nine angle borings were drilled adjacent to and immediately under the edge of the Unit 3 Containment Structure to assure that the cavity did not extend under the structure. Three additional angle borings were also included in the stage 1 work. These borings were advanced along the axis and across the axis of the defined cavity. The second phase consisted of 8 additional borings in and around the cavity region to better define the depth and lateral extent. The third phase included 28 borings to close out the grouting pattern in areas where previous bore holes had higher than average grout take. The fourth and final stage incorporated 18 borings to check the completeness and effectiveness of the grout program. A total of 251 sacks of cement or approximately 19 cubic yards of grout was placed (when adjusted to account for hydration and water loss due to injection under pressure). A drawing entitled "Contour Map of Cvity Area and Borings Surrounding Dewatering Well No. 8", showing the location of the borings and the aerial extent of the detected cavity, is attached hereto and by this reference incorporated herein as Exhibit K (Reference No. 26). A total of 2.4 miles of exploratory and grout holes have been placed around Well 8.

A summary of the investigation/demobilization program for Well 8 is attached hereto and by this reference incorporated herein as Exhibit L (Reference No. 23) entitled "Plan and Section View of Dewatering Well No. 8 Cvity, San Onofre Nuclear Generating Station, Units 2 and 3", and Exhibit M (Reference No. 34) entitled "Investigation at Well 8, San Onofre Nuclear Generating Station, Units 2 and 3". Based upon data produced by this investigation, it is my professional opinion that:

(a) No significant cavities exist below a depth of 115 feet;

(b) The cavity is narrow with a maximum width of 6 feet near the well bore and 16 feet in the backfill region near the containment structure, and is filled with sand and grout and contains no open voids.

(c) Data from closely spaced angle holes extending beneath the containment structure demonstrate that the cavity does not extend under the structure or is insignificantly narrow at that location.

(d) Pressure grouting injected lenses and dikes of grout into the sand resulting in densification.

25. Exhibit N (Reference No. 35) entitled "Exploration Prior to Exploration/Grouting Program, San Onofre

Nuclear Generating Station, Units 2 and 3", and Exhibit O (Reference No. 36) entitled "Exploration/Grout Program Summary, San Onofre Nuclear Generating Station, Units 2 and 3", which are attached hereto and incorporated herein by this reference, provide a comparison of the lineal feet of borings and amount of grout placed at the three principal wells where cavities were identified. In my professional opinion the results of these investigations indicate that all significant cavities have been identified and that all detected cavity areas have been properly filled with sand or grout and contain no voids.

26. The primary purpose of the extensive investigations, analyses, drilling and grouting programs accomplished by the Task Force was to establish the maximum areal dimensions of all existing cavities; then based on this information to establish with maximum certainty that there will be no unacceptable adverse effects on the capability of the structures and equipment of SONGS Units 2 and 3, to withstand the Design Basis Earthquake as a result of the presence of any cavities located beneath the Site.

It is my professional opinion that considering Design Basis Earthquake loading conditions, as well as normal static conditions, there are no adverse effects on the capability of the structures and equipment of SONGS 2

and 3 to withstand design basis seismic events. By way of illustration, Exhibit P (Reference No. 37) entitled "Summary of Maximum Effects of Cavities on Structures", which is attached hereto and incorporated herein by this reference, contains a summary of maximum effects of cavities on SONGS 2 and 3 structures. I am familiar with the data and methods used by WCC to derive the information in Exhibit P. Based on the foregoing, it is my professional opinion that the structural effects of the detected cavities are not significant.

This opinion is based upon the following facts:

(a) The dynamic response analyses performed for SONGS 2 and 3 Seismic Category I structures assume a variation of ±30 percent in the soil structure interaction parameters. This more than accommodates the maximum 8% variation identified in Exhibit P.

(b) The originally calculated static settlements for SONGS 2 and 3 were of the order of 1/2 inch and therefore the maximum 8% increase in settlement values would be of no consequence.

(c) The original factor of safety against bearing

failure of SONGS 2 and 3 was in excess of 100 and therefore the maximum 8% reduction in bearing capacity would be of no significance.

25. In reaching my conclusions about the absense of adverse structural affects upon SONGS 2 and 3 Category I Structures, I have also considered information derived from investigations and analyses performed with respect to the Unit 3 Electrical Tunnel as shown on Exhibit Q (Reference 29), which is attached hereto and by this reference incorporated herein. The tunnel spans the cavity region at Well No. 8. Despite the presence of the cavity beneath the structure, even assuming that the cavity region affords absolutely no support within the cross-hatched area shown on Exhibit Q (Reference 29), the calculated stress for all components of the tunnel are within the specified stresses allowable for reinforced concrete members.

DATED: June 3, 1980

Lucien Hersh
LUCIEN HERSH

Subscribed and sworn to before
me this 3 day of June, 1980.

Nancy A. Getman
NOTARY PUBLIC
For the City and County of Los Angeles
State of California.

My Commission Expires on 10-1-82

OFFICIAL SEAL
NANCY A. GETMAN
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
My comm. expires OCT 1, 1982

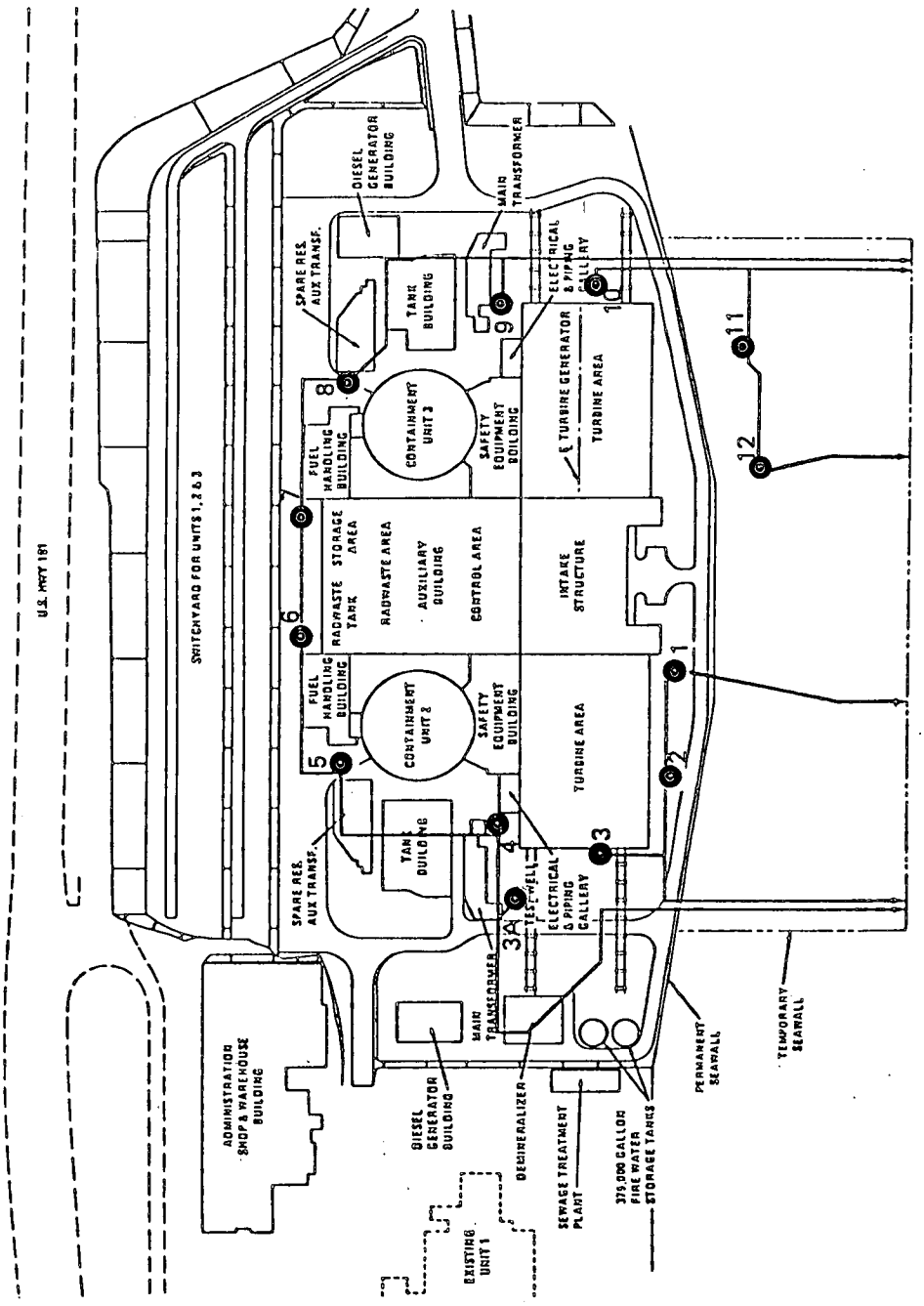


EXHIBIT A (REFERENCE 19)

Plot Plan of Dewatering Well System,
San Onofre Nuclear Generating Station, Units 2 and 3

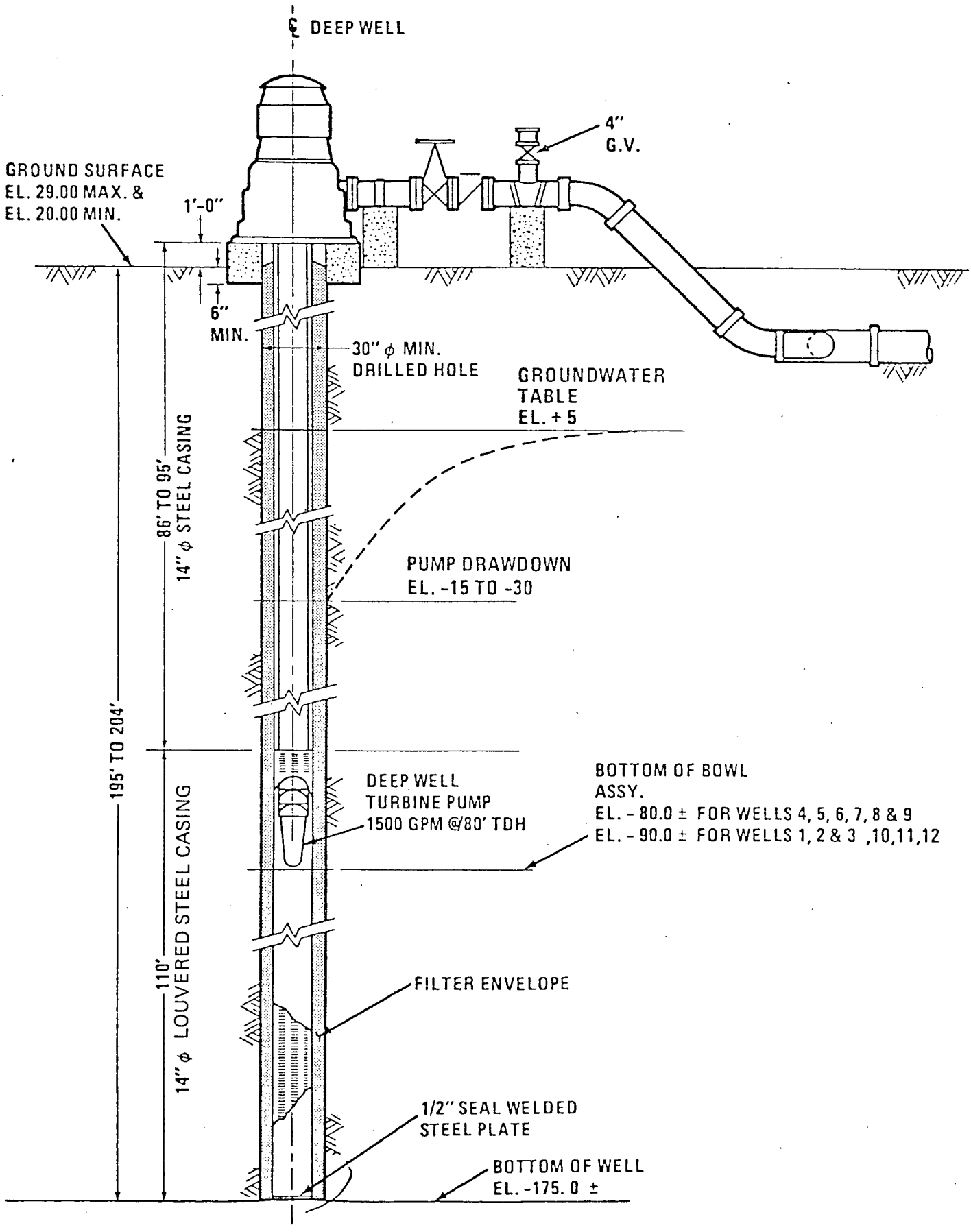


EXHIBIT B (REFERENCE 20)
Typical Section; 30-Inch Diameter Dewatering Well,
San Onofre Nuclear Generating Station, Units 2 and 3

EXHIBIT C (REFERENCE 30)

SUMMARY OF WELL MAINTENANCE

Well No.	Date Well Pumping Stopped[1]	Total Operating Days[2]	Maintenance Rating[3]	Remarks
1	02 Nov 1977	950	Average	
2	10 Nov 1976	735	High	
3	19 Jan 1977	710	Very low	
3A	N/A	N/A	N/A	Test well only operated a few days
4	29 Jun 1976	620	Very low	
5	15 May 1976	625	High	
6	04 Jun 1976	545	High	
7	12 Aug 1976	565	Very high	About 7 months after start up the well filled with sand to about 100 ft and was bailed. A new 10-in. well casing was inserted to allow continued operation of the well.
8	05 Jun 1976	650	High	
9	29 Nov 1975	475	High	
10	14 Feb 1978	1175	Low	
11	24 Mar 1977	950	Average	
12	14 Feb 1978	1285	Low	

Notes:

1. It is assumed that all wells began pumping on 1 August 1974 and pumped intermittently through to this date.

2. Total number of operating days obtained from daily logs by adding the number of days the well was in operation beginning on 1 August 1974 through to date the well was finally stopped (Note 1 above). Because this is only a rough estimate, the number of days have been rounded to the nearest five.

3. A subjective, normalized rating based on a review of the maintenance records for the well. The rating is normalized with respect to the average level of maintenance for all wells.

SUMMARY OF INVESTIGATION/DEMOBILIZATION OF
DEWATERING WELLS

Well Number	Description of Investigation/Demobilization
1,2,9	Annulus airlift cleaned, well casing removed, wellbore measured, and wellbore filled with concrete.
3A	Test well--only operated a few days, casing inspected, and filled with concrete.
3,10	Shallow investigation at Well 3 by borings identified and delineated a small cavity. Borings and crosshole seismic measurements made to bottom of both wells. Results of investigations, and analyses considering the distance to Seismic Category I structures, show no cavities of structural significance at either well. Well casings filled and capped.
4,5	Shallow investigation at Well 4 by open excavation detected no cavity. Shallow investigation at Well 5 using borings and pressure grouting detected and delineated a small cavity. Deep drilling and cross-hole measurements made to bottom of both wells. Results of investigation show no cavities of structural significance exist at either well. Well casings filled and capped.
6,7,8	These wells primarily investigated by deep drilling and exploration/grouting in detected cavity areas. Filled cavities were detected and delineated for further evaluation of effects on adjacent structures. Well casings were filled.
11,12	Located outside plant area at considerable distance from Seismic Category I structures. Therefore, no investigation work carried out on these wells.

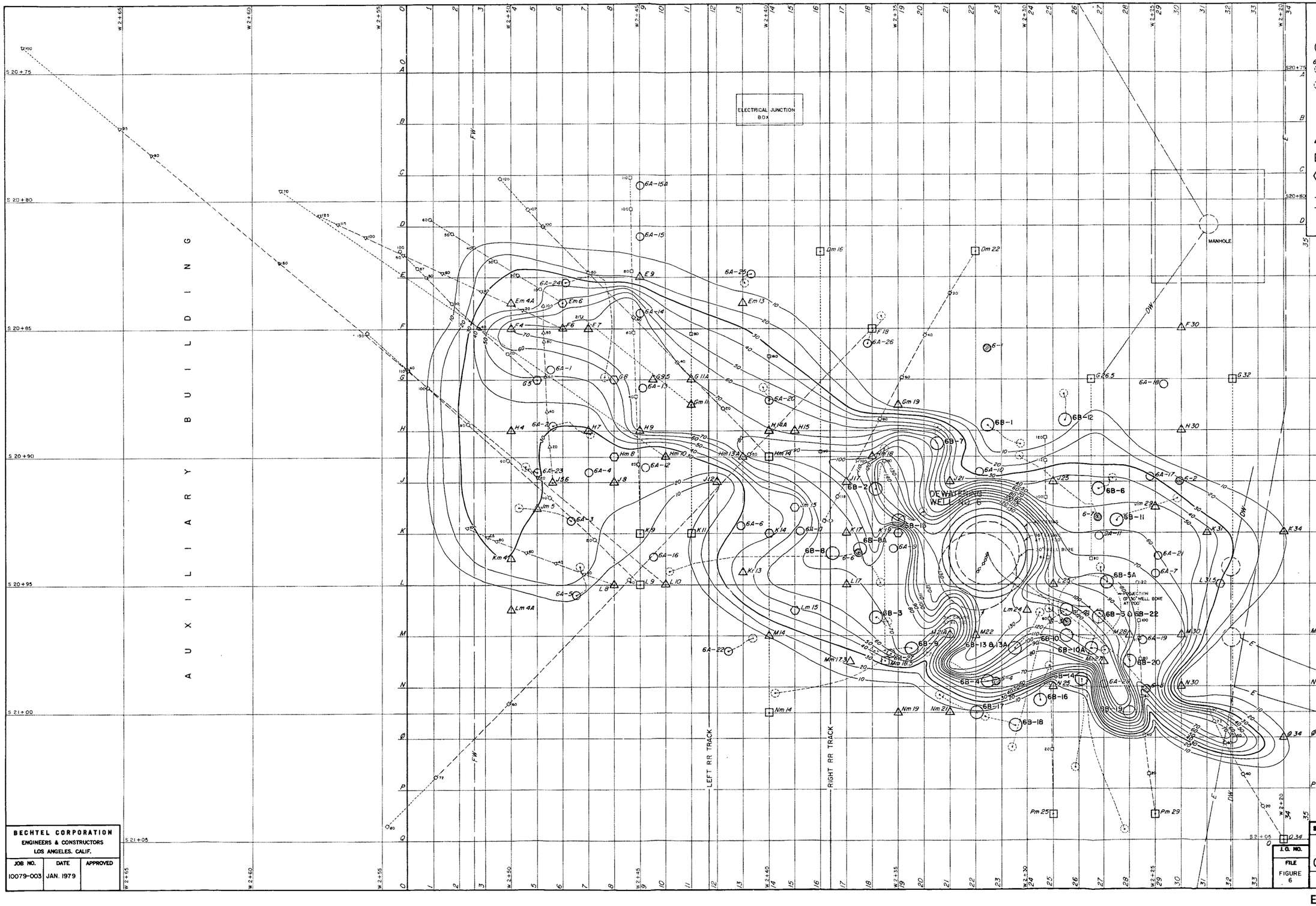


EXHIBIT E (REFERENCE NO.

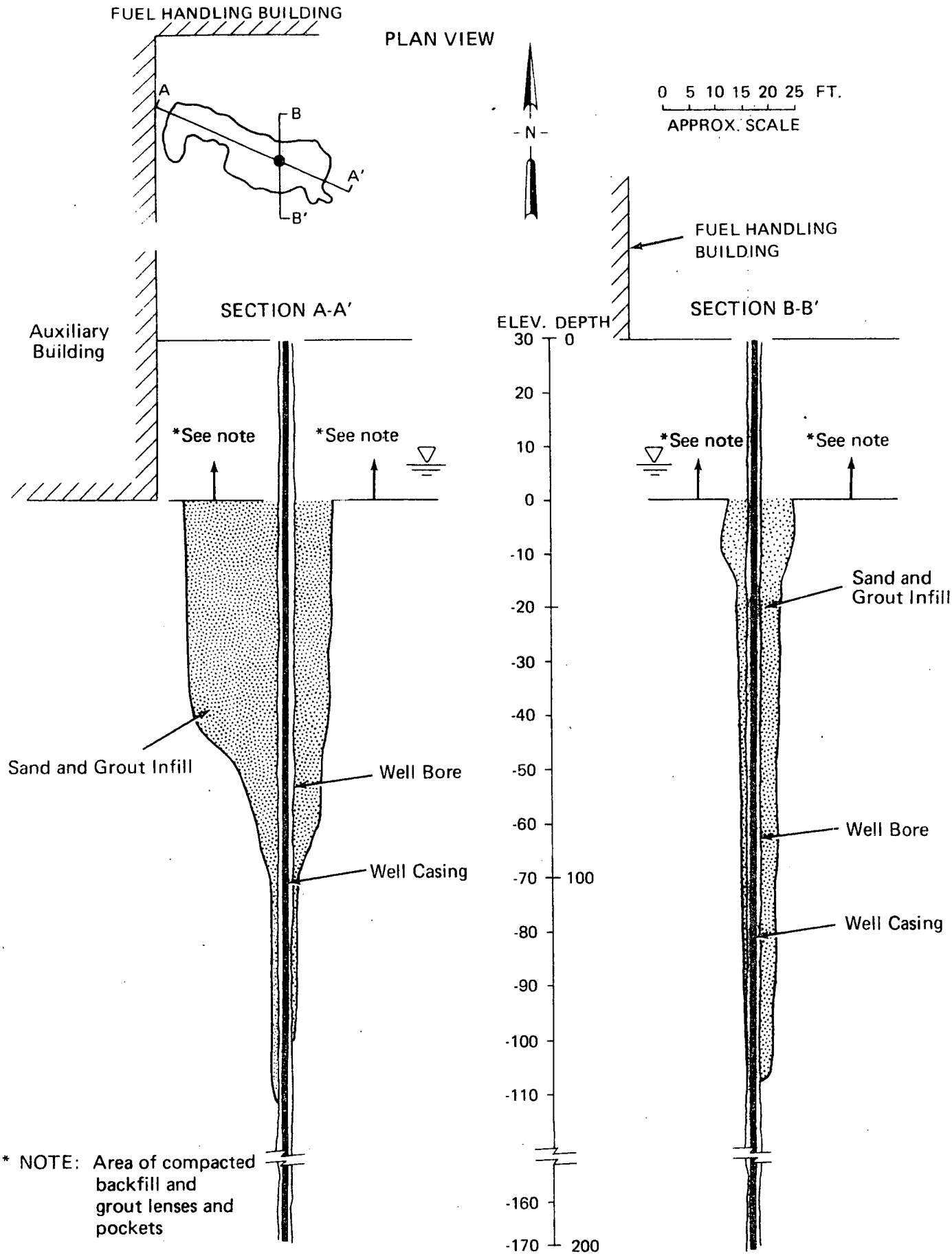


EXHIBIT F (REFERENCE 21)
Plan and Section Views of Well No. 6 Cavity,
San Onofre Nuclear Generating Station, Units 2 and 3

EXHIBIT G (REFERENCE NO. 32)

SONGS UNITS 2&3

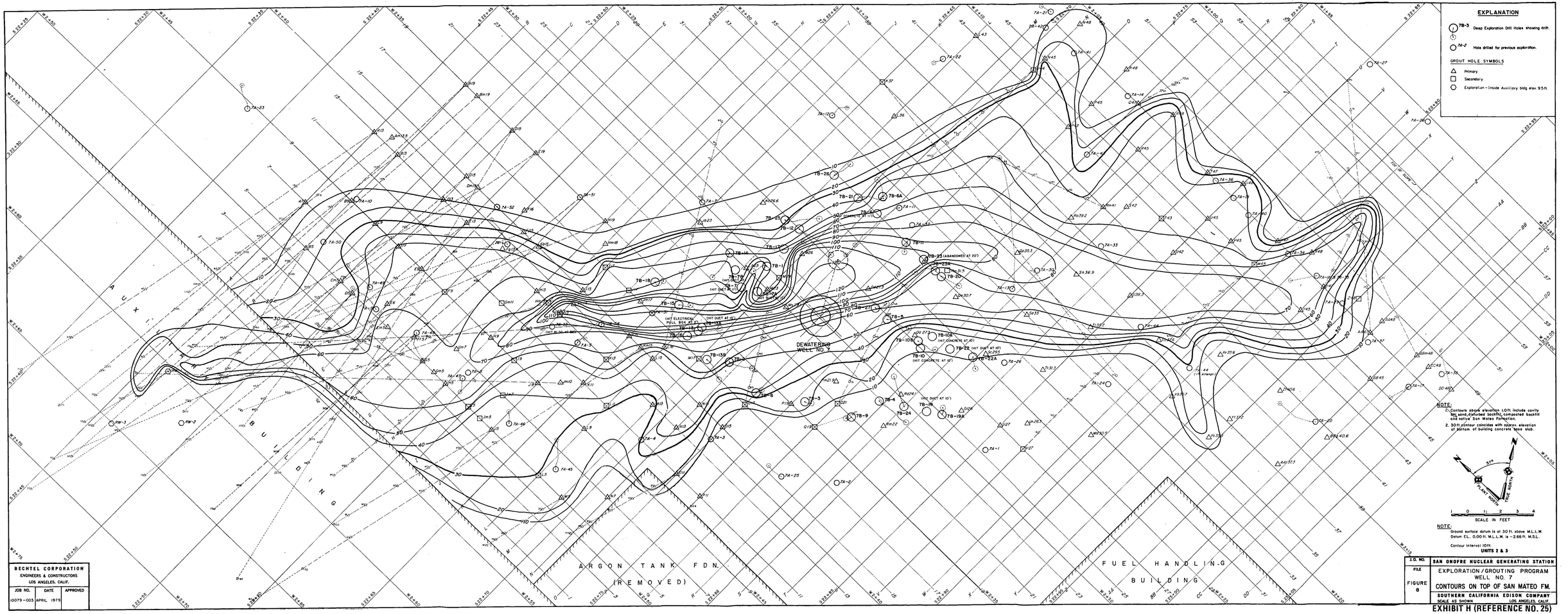
INVESTIGATION AT WELL 6

EXPLORATION PRIOR TO EXPLORATION/GROUTING PROGRAM

NO. OF HOLES PRIOR TO DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	NO. OF HOLES IN DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	TOTAL HOLES PRIOR TO EXPLORATION/ GROUT PROG	LINEAL FEET
35	4.5-213 FT	3103 FT	26	8-200 FT	4339 FT	61	7442 FT

EXPLORATION/GROUT PROGRAM SUMMARY

GROUT PLACED PRIOR TO PROGRAM		NO. HOLES IN PROGRAM	GROUT PLACED (SACKS)	APPROX YDS	TOTAL GROUT PLACED (YDS)
(YDS)	(SACKS)				
120	528	74	500	27	147



BECHTEL CORPORATION ENGINEERS & CONSTRUCTORS LOS ANGELES, CALIF.		
JOB NO.	DATE	APPROVED
10079-003	APRIL 1979	

J.O. NO.	SAN ONOFRE NUCLEAR GENERATING STATION
FILE	EXPLORATION / GROUTING PROGRAM WELL NO. 7
FIGURE 8	CONTOURS ON TOP OF SAN MATEO FM.
	SOUTHERN CALIFORNIA EDISON COMPANY LOS ANGELES, CALIF.
	SCALE AS SHOWN

EXHIBIT H (REFERENCE NO. 25)

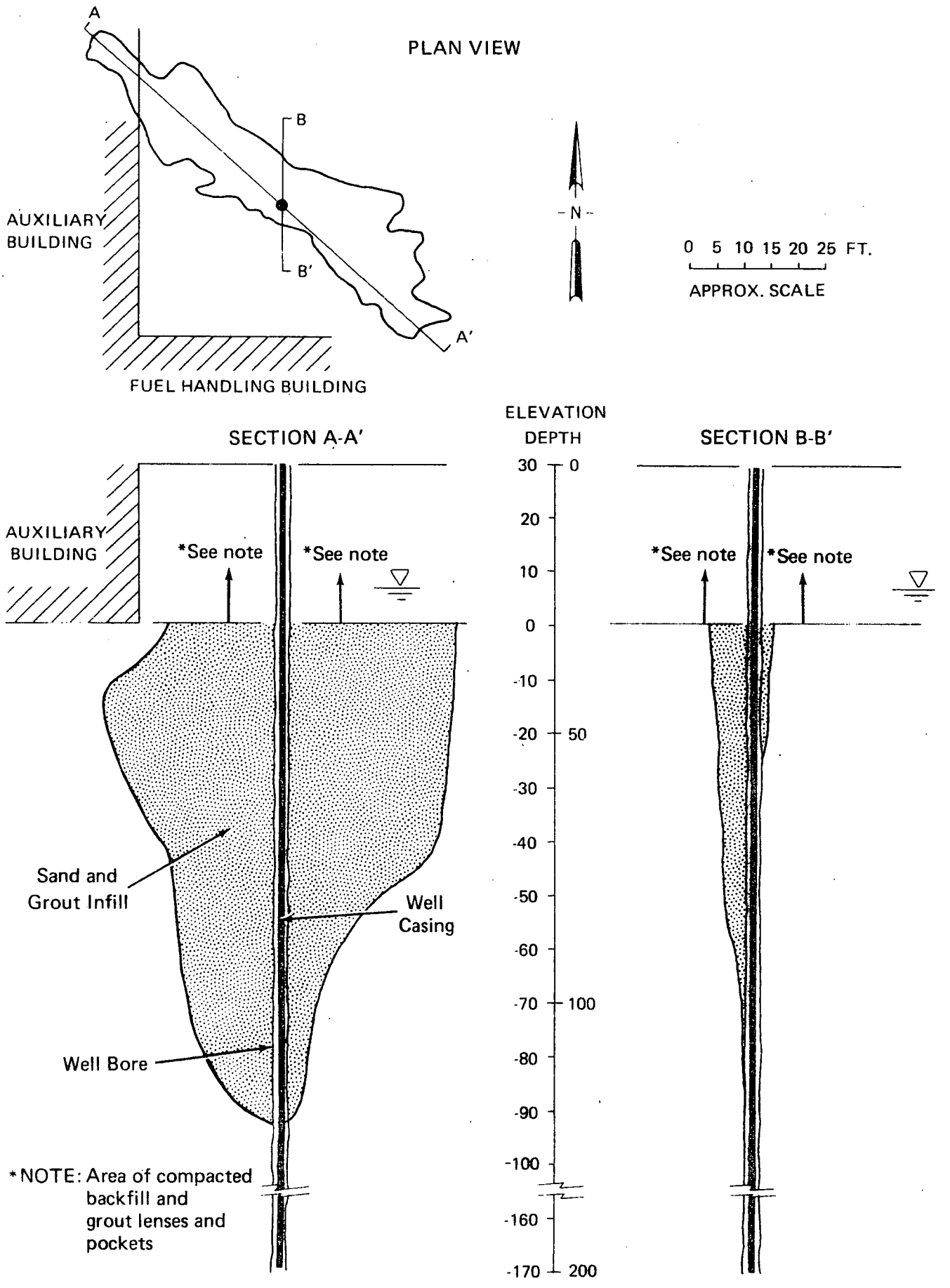


EXHIBIT I (REFERENCE 22)
Plan and Section Views of Well No. 7 Cavity,
San Onofre Nuclear Generating Station, Units 2 and 3

EXHIBIT J (REFERENCE NO. 33)

SONGS UNITS 2&3

INVESTIGATION AT WELL 7

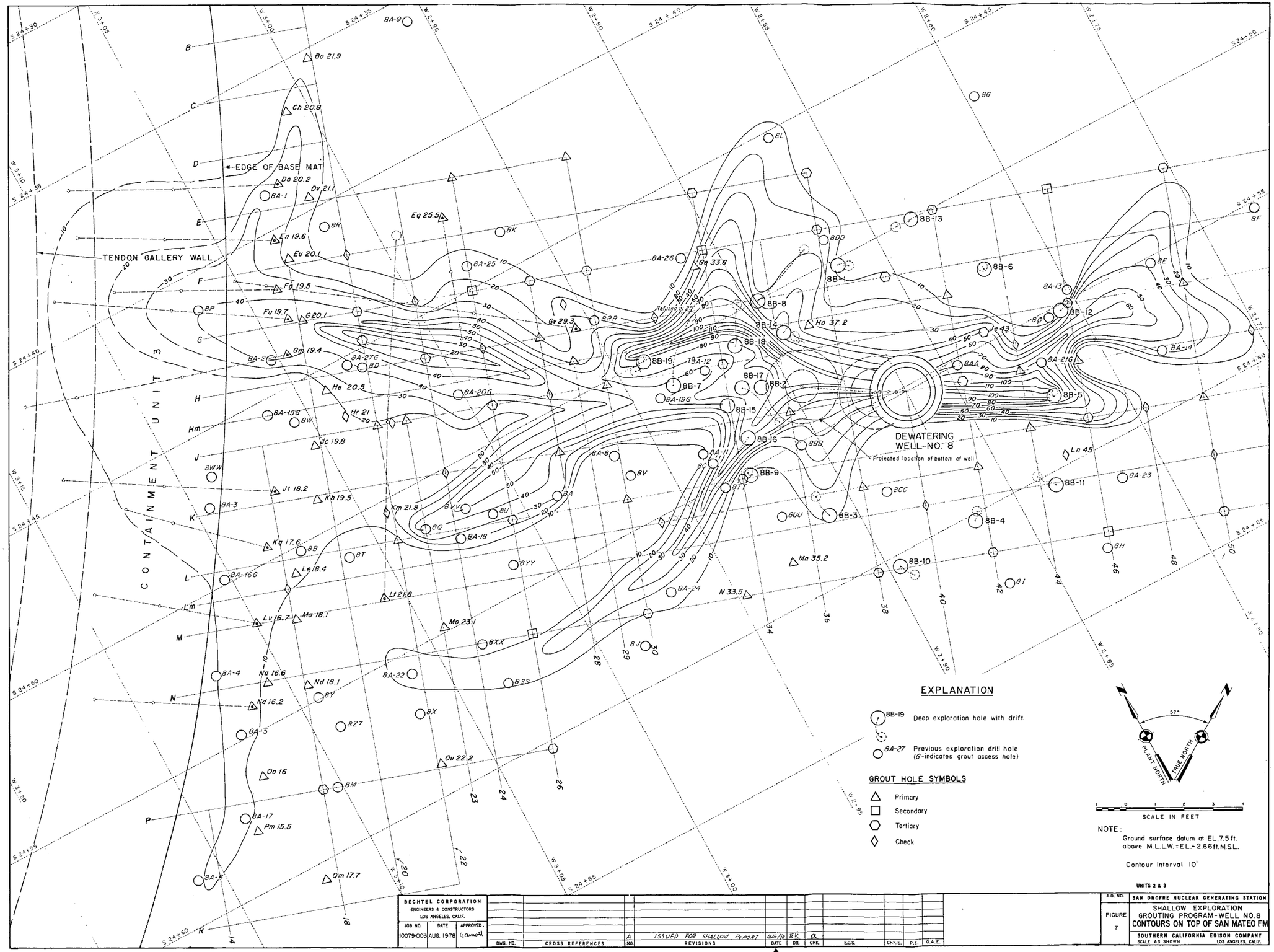
EXPLORATION PRIOR TO EXPLORATION/GROUTING PROGRAM

NO. OF HOLES PRIOR TO DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	NO. OF HOLES IN DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	TOTAL HOLES PRIOR TO EXPLORATION/ GROUT PROG.	LINEAL FEET
54	23.5-200 FT	4012 FT	37*	2-200 FT	5241 FT	91	9252 FT

*INCLUDES II INCOMPLETE HOLES.

EXPLORATION/GROUT PROGRAM SUMMARY

GROUT PLACED PRIOR TO PROGRAM		NO. HOLES IN PROGRAM	GROUT PLACED (SACKS)	APPROX YDS	TOTAL GROUT PLACED (YDS)
(YDS)	(SACKS)				
49	828	142	1,432	79	128



BECHTEL CORPORATION ENGINEERS & CONSTRUCTORS LOS ANGELES, CALIF.		
JOB NO. 10079-003	DATE AUG. 1978	APPROVED
DWG. NO.	CROSS REFERENCES	
NO.	REVISIONS	DATE / BY / DR. / CHK. / E.G.S. / CHF. E. / P.E. / G.A.E.
A	ISSUED FOR SHALLOW REPORT	AUG/78 EV. YK
J.O. NO.	SAN ONOFRE NUCLEAR GENERATING STATION	
FIGURE 7	SHALLOW EXPLORATION GROUTING PROGRAM - WELL NO. 8 CONTOURS ON TOP OF SAN MATEO FM	
SOUTHERN CALIFORNIA EDISON COMPANY SCALE AS SHOWN LOS ANGELES, CALIF.		

EXHIBIT K (REFERENCE NO. 26)

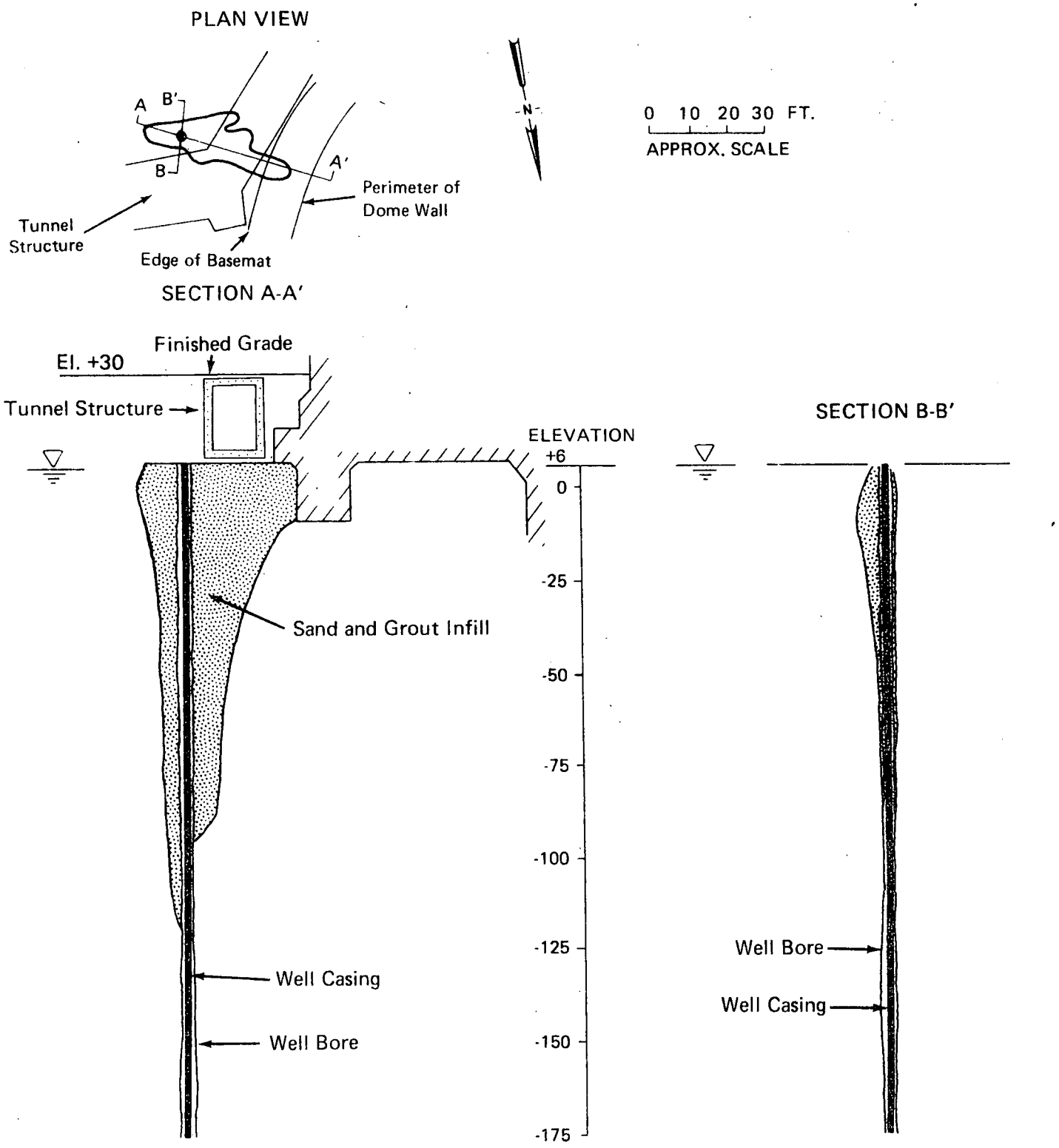


EXHIBIT L (REFERENCE 23)
Plan and Section View of the Well No. 8 Cavity,
San Onofre Nuclear Generating Station, Units 2 and 3

SONGS UNITS 2&3

INVESTIGATION AT WELL 8

EXPLORATION PRIOR TO EXPLORATION/GROUTING PROGRAM

NO. OF HOLES PRIOR TO DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	NO. OF HOLES IN DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	TOTAL HOLES PRIOR TO EXPLORATION/ GROUT PROG	LINEAL FEET
66	15-110 FT	3166 FT	19	21-180 FT	3171 FT	84	6337 FT

EXPLORATION/GROUT PROGRAM SUMMARY

GROUT PLACED PRIOR TO PROGRAM (YDS)	GROUT PLACED PRIOR TO PROGRAM (SACKS)	NO. HOLES IN PROGRAM	GROUT PLACED (SACKS)	APPROX YDS	TOTAL GROUT PLACED (YDS)
190	388	108	251	19	209

EXHIBIT M (REFERENCE NO. 34)

EXHIBIT N (REFERENCE NO. 35)

SONGS UNITS 2 & 3

EXPLORATION PRIOR TO EXPLORATION/GROUTING PROGRAM

WELL #	# OF HOLES PRIOR TO DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	# OF HOLES IN DEEP EXPLORATION PROGRAM	DEPTH RANGE	LINEAL FEET	TOTAL HOLES PRIOR TO EXPLORATION/ GROUT PROG.	LINEAL FEET
6	35	4.5-213'	3103'	26	8-200'	4339'	61	7442'
7	54	23.5-200'	4012'	37*	2-200'	5241'	91	9252'
8	66	15-110'	3166'	19	21-180'	3171'	84	6337'

*INCLUDES II INCOMPLETE HOLES.

EXHIBIT O (REFERENCE NO. 36)

SONGS UNITS 2 & 3
EXPLORATION/GROUT PROGRAM
SUMMARY

WELL #	GROUT PLACED PRIOR TO PROGRAM (YDS)	(SACKS)	# HOLES IN PROGRAM	GROUT PLACED (SACKS)	APPROX YDS	TOTAL GROUT PLACED (YDS)
6	120	528	74	500	27	147
7	49	828	142	1,432	79	128
8	190	388	108	251	19	209

SUMMARY OF MAXIMUM EFFECTS OF CAVITIES ON STRUCTURES

Structure	Well No.	Maximum Decrease of Dynamic Stiffness* (percent)		Maximum Increase in Settlement of Structure (percent)	
		Translation	Rocking	Total Vertical	Differential
Containment Unit 3	8	4	5	4	5
Auxiliary Units 2 and 3	6,7	2	2	2	2
Fuel Handling Unit 2	6	<1	3	<1	3
Fuel Handling Unit 3	7,8	<1	8	<1	8

* Affecting dynamic response of the structure during earthquake shaking.

EXHIBIT P (REFERENCE 37)

EXHIBIT Q (REFERENCE 29)

Maximum Interpreted Effect of the Cavity on the Tunnel Structure,
San Onofre Nuclear Generating Station, Units 2 and 3