APPENDIX A

TECHNICAL EVALUATION REPORT FOR AUDITS OF IMPELL AND BECHTEL CONCERNING THE SONGS 1 SEISMIC UPGRADE OF PIPING SUPPORTS AND EQUIPMENT

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November 1984

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Prepared for the
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Under DOE Contract No. DE-AC07-76ID01570
FIN No. A6456

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1. INTRODUCTION

In December of 1983, Southern California Edison Company (SCE) submitted a proposal[1] to the Nuclear Regulatory Commission (NRC) for returning the San Onofre Nuclear Generating Station Unit 1 (SONGS 1) to service. The proposal was reviewed, and a Safety Evaluation Report (SER) was issued by the NRC in February of 1984.[2]

One of the requirements of the SER[2] was that implementation of the proposal and resulting plant modifications be reviewed. Criteria for the review are delineated in the SER[2] and in Reference 3. This was accomplished for the return to service (short term) requirements during audits at the Impell Corporation (Impell) office in Walnut Creek, California, at the Bechtel Power Corporation (Bechtel) office in Norwalk, California, and an inspection of SONGS 1, by EG&G Idaho personnel (M. J. Russell) and NRC staff (T. M. Cheng). Implementation of long term requirements was not reviewed. This will be done at a later date. The audits and inspection spanned July 26, 1984, through August 1, 1984. Impell is responsible for the seismic analysis of mechanical equipment, large bore piping and pipe supports. Calculations for four representative piping systems and associated supports were chosen for audit at Impell (see Table 1). Three pieces of safety-related equipment were chosen for later review of their documentation (see Table 2). Results of the audit are presented in part 2 of this report. Bechtel is responsible for the seismic analysis of small bore piping (via the walk-down criteria), the seismic analysis of supports requiring no modification, the redesign of supports which need strengthening, and the design of new supports. Calculations for the supports of the four systems which fell within the Bechtel scope were audited at the Bechtel office. In addition, walk-down results for a small bore piping system (RC-115) were also audited. Results of this audit are presented in part 3. SONGS 1 was then inspected. All piping supports for

which calculations were audited at the Impell and Bechtel offices were inspected to ensure that each component could perform its intended design function. Five supports were not inspected for the reasons indicated in Table 1. In addition to piping and supports, twelve equipment items were inspected as required by the SER[2] (see Table 2). Note that two of the items in Table 2 were not inspected as a result of a lack of time. The supports and equipment inspected were sufficiently numerous and diverse to allow an adequate evaluation of the program despite the items not inspected. Results of the inspection are presented in part 4 of this report.

Results of a review of the small bore piping walk-down criteria are presented in part 5 of this report.

2. RESULTS OF THE IMPELL AUDIT

Although the Impell program was found to be generally acceptable, three issues were raised during the audit. Each issue is discussed below.

Support number S45 was not included in the piping analysis of calculation number RC-102, CV-100/-101 (Rev. 2). Since the support was located on an actuator of a valve and the valve eccentricity was not included in the piping model, there was a concern that the associated piping could be damaged by loads resulting from the eccentricity. A calculation was performed by Impell that showed stresses resulting from the eccentricity were acceptably small.

Results of piping calculation number RC-102, CV-100/-101 (Rev. 2) indicated unusually large seismic acceleration values for valve number CV-304. Confirmation was requested that operability of the valve was ensured, given the large acceleration. The valve was shown to be qualified for acceleration levels above those required.

A support at node point 154 was not included in the piping analysis of calculation number CV-11 (Rev. 1). Since the support was located on a valve actuator, and the eccentricity of the valve was not included in the piping model, there was a concern that the piping could be damaged by loads resulting from the eccentricity. However, a weight was assigned to the valve in the analysis that was five times the actual weight. For the short term, this is adequate compensation for the lack of conservatism resulting from neglecting valve eccentricity. For the long term, the effect of eccentricity on the valve nozzle welds needs evaluation. The weight of the valve was rigidly supported, so that there was no concern that a spring hanger was improperly set as a result of the weight difference. In addition, operability of the valve in the unsupported condition had been addressed.

Three pieces of safety-related equipment were chosen for documentation review as indicated in Table 2. This was not done during the audit because of a lack of time. The review remains to be done as a part of the long term effort.

3. RESULTS OF THE BECHTEL AUDIT

Although the Bechtel program was found to be generally acceptable, several issues were raised. The issues and their resolutions are discussed below.

The analysis of support number SI-20-8111-J030 (piping calculation number AF-02) consists of a fixed-fixed beam analysis with piping loads applied. There were no calculations for the hardware attaching the pipes to the beam. Since the hardware was standardized welded pipe straps determined by pipe size, calculations were not required. The straps were inspected in the field and appeared to be adequate. Field inspection showed the beam ends to be rigidly attached to concrete embedments, so that the fixed-fixed support assumption is acceptable.

Support number SI-03-0050-H005 (piping calculation number MS-01) is a vertical support designed so that it will apply a torque to the pipe when acting. Confirmation that this effect was considered in the piping analysis was requested and received. The support point had been offset from the pipe centerline in the model, so that torsion was included.

Support number SI-03-0050-H006 (piping calculation number MS-01) consists of dual, parallel snubbers. Different loads were specified for the snubbers. This appeared anomalous, since dual snubbers typically are installed to share a load too large for a single snubber. In this case, the snubbers were installed on a relief valve header. Both snubbers were included in the piping model. The load difference resulted from a torque generated by relief valve actuation. Since the snubber's function includes resistance to this torque, the difference in loads is not anomalous.

A snubber on the main steam line (piping calculation number MS-01, support number not recorded) was attached to the pipe with a clamp. Since the snubber is designed with an axial offset of 6° and no lugs were included in the design, slippage of the clamp was possible. This could make the support inoperative. This possibility was poorly addressed in the

analysis. However, offsets of up to 10° can be tolerated without lugs because of the axial friction load capability generated by the transverse component of the snubber load.

Support number SI-01-5011-H00B (piping calculation number RC-102, CV-100/-101) includes a beam to which a second support (SI-01-5011-H00M) is attached. Only the effect of the -H00M support torsional loading was checked for the beam in the -H00B calculation. The concern was that the full loading on the beam had not been considered. However, a different calculation (FCR no. X-U1-319-P) did include the full beam loading.

4. RESULTS OF THE SONGS 1 INSPECTION

All completed piping supports inspected in the plant appeared capable of performing their intended design function. The support configuration for each piping system appeared to provide adequate support to ensure functionality of the piping should it be subjected to the postulated earthquake loads. Incomplete piping supports were all backed by paperwork that indicated they were not complete with one exception (see below). Incomplete supports are identified in Table 1. Inspection of the safety related equipment showed that it has been brought to a level of support comparable to that of plants built to current seismic requirements.

Several issues were raised during the inspection. The following paragraphs provide a discussion of the issues, including their successfull resolution.

Inlet piping to both auxiliary feedwater pumps (G-10 and G-10S) appeared to be very flexible, raising a concern about integrity of the pump inlet nozzles. However, calculations have been performed that assure integrity of the nozzles.

Valve number AWF-506 (piping calculation AF-02), located on the inlet piping to the auxiliary feedwater pump (GS-10), appeared to be poorly supported, raising a concern that a seismic event could fail the adjacent elbow. However, calculations have been performed that assure the integrity of the elbow. This also alleviated a concern about the sister valve to AWF-506, which is located on the inlet piping to the GS-10S pump. The geometry was identical, but the sister valve was smaller than AWF-506, so that integrity of the AWF-506 valve's associated piping ensures the integrity of the sister valve's piping.

Support number SI-08-2014-H005 (piping calculation number CV-11) is a rod hanger with approximately 7 ft of 1/2 in. rod. There was a concern that credit had been given in the piping analysis for positive vertical

support. This was not a problem because the support analysis addressed buckling of the rod by a comparison of deadweight versus the positive vertical seismic load. The deadweight load was larger, so that the rod would not be subjected to a compressive load during a seismic event.

Solenoid valves SV-3401, -3402, -2401, and -2402 (piping calculation number RC-115) were observed to have no lateral support for their eccentric masses. The need for such support could not be ruled out by visual inspection. Follow-up of this concern revealed that an analysis of this piping had been performed. The analysis indicated that lateral supports were unnecessary.

Support number SI-08-2014-H001 (piping calculation number CV-11) was installed so that it provided support in a direction that could induce thermal loads. This was not considered in the piping analysis. Follow-up on this concern revealed that this piping has a design temperature under 200°F, so that thermal loading is insignificant.

Support number SI-08-2033-H501 (piping calculation number CV-11) was observed to be incomplete in the field, although supporting paperwork indicated that it had been completed. Follow-up on this concern indicated that a non-conformance report (NCR) had been issued for the support with three items listed, one of which was the lack of completion. The NCR was closed out upon completion of the other two items, due in part because the NCR had been poorly written. Rework of the support has been initiated to ensure completion. Since this type of problem was encountered in only one of the 136 supports inspected, it has been classified as an isolated incident. Modification to the program in place is not recommended.

Results of confirmatory piping/support analyses,[4] have raised a concern about the adequacy of the structures to which some of the pipe supports inspected were anchored. Specifically, some pipe supports may subject the I-beams to which they are attached to unacceptable torsion loads as defined by the long term criteria. However, short term criteria are not as stringent, so that short term operation of the plant is not impacted by this concern. This conclusion is supported by the results of

5. REVIEW OF SMALL BORE PIPING WALK DOWN CRITERIA

The "Walk-Down Criteria for Evaluation of Safety Related Small Bore Piping (2 in. and smaller) and Tubing" contained in a recent SCE submittal (Reference 5) to the NRC has been reviewed. Information from this document and telephone conversations with SCE during April 1984 created the basis for this evaluation. Initial concerns with the small bore piping walk-down criteria included no anchor movement evaluation, no specific consideration of loading induced by valve eccentricity, and inadequate evaluation of small bore piping supports.

The subsequent information from SCE indicated that thermal and seismic anchor movement (SAM) effects are being considered. With respect to SAMs, SCE stated that the run piping computer analyses included sufficient branch piping in order to evaluate significant inertia and SAM loading on the branch piping. Where branch lines were connected to a header that was not specifically analyzed along with the branch, header thermal and seismic movements were taken into consideration in the support of the branch line. SCE also indicated that all existing piping and tubing systems which would have rigid supports added to the support configuration would be reevaluated with respect to thermal loading. Existing piping and tubing systems not modified should be adequate for these loads based on past operating experience.

The walk-down criteria now specifically require that valves with extended operators should be given proper attention for the possible stiffening or support of the valve operators. In addition, SCE indicated that valve functionality for small bore piping and tubing was being handled in the same manner as large bore valves, per the balance of plant mechanical equipment and piping (BOPMEP) criteria.

Finally, with respect to small bore pipe supports, SCE indicated that the individuals performing the walk-downs are experienced personnel. They would not overlook poor design situations. SCE also indicated that piping with long runs having little or no lateral support were checked to insure that excessive deflection of the piping would not cause damage to the

piping or other equipment. When verifying existing spans between supports, appropriate span reductions were used where concentrated masses or multiple bends existed in the piping run. SCE did indicate that span lengths were developed so that weight stresses were kept very low (~2500 psi). Pipe clamp nuts and locknuts would be visually checked for proper installation. All of these items provide partial assurance that the small bore piping supports will be low stressed and redundant. However, this evaluation of support adequacy does involve a significant amount of engineering judgment. Therefore, a number of sample analyses should be made verifying acceptable supports, acceptable pipe stresses, and acceptable valve eccentricity loading. SCE is currently responsible for choosing prospective systems for the sample analyses which will investigate all of the above mentioned aspects.

The proposed walk-down criteria appear acceptable for short term operation. However, the analytical verification of the small bore piping and tubing walk-down criteria should be completed before long term operation is permitted.

6. CONCLUSION

Results of the audits and plant inspection allow the conclusion that a program has been instituted which meets the design requirements of the SER[2] and Reference 3 for short-term operation of SONGS 1. For long term operation, the review of piping and supports will continue. The following items, previously discussed in this report, should be included in the long term effort:

1. Documentation for the three pieces of equipment identified in Table 2 should be reviewed.

2. The effect of valve mass eccentricity on the nozzle welds should be evaluated for the valve located at node point 154 in piping calculation no. CV-11.

3. I-beams to which pipe supports are attached should be evaluated to ensure that they are not subjected to unacceptable torsion loads by the supports.

4. The small bore piping walk-down criteria should be analytically verified.

7. REFERENCES

1. M. O. Medford (SCE) ltr to D. M. Crutchfield (NRC), "Docket number 50-206, Return to Service Plan, Seismic Reevaluation Program, San Onofre Nuclear Generating Station Unit 1," December 23, 1983.

2. H. R. Denton (NRC) ltr to K. P. Baskin (SCE), "Proposed Restart Plan for San Onofre Nuclear Generating Station, Unit number 1," February 8, 1984.

3. W. Paulson (NRC) ltr to R. Dietch (SCE), "SEP Topic III-6, Seismic Design Considerations, Guidelines For Seismic Evaluation Criteria for the SEP Group II Plants-Revision 1," September 20, 1982.

4. S. L. Morton, SEP Evaluation of Safety Injection Piping and Charging and Pressurizer Spray Piping for SONGS 1, Revision 1, EGG-EA-6365, to be published.

5. M. O. Medford (SCE) ltr to the NRC; Docket No. 50-206, "Return to Service Plan, Criteria for Walkdowns of Small Bore Piping," SONGS 1; June 8, 1984.

TABLE 1. SAFETY RELATED PIPING AND SUPPORTS REVIEWED

Piping Calculation Number	Support ID		
AF-02	SI-06-8110-H503[a]	SI-20-8110-H004	SI-20-8110-H023
	SI-09-8110-H504	-J030	-H024
	-H010	-H017	-H025
	SI-20-8110-H027	SI-20-8111-J030	SI-20-8111-H025
	SI-06-8111-H302[a]	-H016	-H026
	SI-09-8111-H303	-H022	-H027
	-H009	-H023	SI-20-8110-H026
	SI-20-8111-H003	-H024	-H028
CV-11	SI-01-2014-H001[b]	SI-08-2014-H004	SI-08-2103-H001
	-H302[c]	-H001	-H002
	-H303	-H005	SI-08-2038-H001
	-H304	-H010[a]	SI-08-2016-H001[a]
	SI-08-2014-H303	-H501	SI-08-2033-H501[a]
	-H002	SI-08-2037-H001	
MS-01	SI-02-0001-H002	SI-02-0002-H008[a]	SI-03-0050-H003[a]
	-H003[a]	-H003	-H005[a]
	-H004[a]	-H004	SI-10-0051-H006[a]
	-H005	-H005[a]	-H005[a]
	-H006[a]	-H006[a]	-H001[a]
	-H007[a]	SI-03-0050-H006[a]	-H003[a]
	-H008	-H001[a]	-H002
	SI-02-0002-H001[a]	-H004	-H004
	-H007	-H002[a]	
RC-102/CV-100	SI-01-2080-H00H	SI-01-2081-H00D	SI-01-5025-H0FA
/CV-101	-H00G	-H00K	-H00J[e]
	-H00I	-H00L	-H00K
	-H00J	-H30B	-H00A
	-H00C	-H00A	-H00L

TABLE 1. (continued)

Piping Calculation Number	Support ID		
	-H00K	-H00M[d]	SI-01-5011-H011
	-H00L	-H00R	-H00K
	-H00D	SI-01-5011-H00C	-H00J
	-H00E	-H00N[e]	-H00Q
	SI-01-2081-H00N	-H00M	-H0FA
	-H00P	-H00B	-H00H
	-H5FA	-H00A	-H00G
	-H50H	SI-01-5024-H00A	-H00E[a]
	-H00F	SI-01-5025-H00G	-H00D
	SI-01-5011-H0YZ	-H00D	SI-01-5025-H00P
	-H0ZZ	-H00E	-H00H
	SI-01-5025-H00M	-H00F	SI-02-2080-H00F
	-H00C		-H00A
RC-115	SI-01-5000-H00A[b]	SI-01-5000-H0FA	SI-01-5000-H00R
	-H00C	-H00K	-H00S
	-H00D	-H00L	-H00T
	-H00E	-H00M	-H00U
	-H00F	-H00N	-H30D
	-H00G	-H00P	-H30E
	-H00H	-H00Q	-H30F

a. Construction was not completed for this support.

b. This support was not inspected due to a lack of time.

c. This support could not be inspected because it was buried in sand.

d. Thorough inspection of this support was not made because it was located in an extremely high radiation area.

e. This support could not be inspected because it was embedded in pipe insulation.

TABLE 2. SAFETY-RELATED SONGS 1 EQUIPMENT

Auxiliary Feedwater Turbine Driven Pump G-10[a]
CVCS Test Pump G-42
Seal Water Injection Filter C-42N, C-42S[b]
Seal Water Supply Filter G-2A, G-2C
Seal Water Supply Filter G-2B
Seal Water Heat Exchanger E-34[a]
Charging Pump Oil Coolers (water-cooled)
Charging Pump Oil Coolers (air-cooled)
Charging Pumps G-8A, G-8B[a]
Auxiliary Feedwater Motor-Driven Pump G-10S
Seal Water Return Filter C-40

a. Documentation of these items will be reviewed as part of the long term evaluation.

b. These items were not inspected due to a lack of time.