UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
TEXAS UTILITIES GENERATING COMPANY, et al.	)	Docket Nos. 50-445 and 50-446
	)	
(Comanche Peak Steam Electric Station, Units 1 and 2)	)	

APPLICANTS' EXPECTED FINDINGS OF FACT
REGARDING WELDING ISSUES TO BE RAISED
DURING THE HEARINGS OF FEBRUARY 20-24, 1984

By Memorandum and Order of December 28, 1983, the Atomic Safety and Licensing Board ("Licensing Board") directed that prior to future hearings each party must file expected findings of fact relating to the issues to be adressed during those hearings. During the February 20-24, 1984 hearings, two issues related to welding will be addressed, viz., (1) allegations of Darlene and Henry Stiner, and (2) allegations involving AWS and ASME Code provisions. Applicants' expected findings of fact regarding each issue are set forth below:

I. Expected Findings of Fact Regarding Allegations of Darlene and Henry Stiner

Allegations previously raised by Darlene and Henry Stiner which will be addressed during the February 20-24, 1984 hearings concern (1) weave welding, (2) downhill

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welding, (3) weld rod control, and (4) welding of misdrilled holes. Applicants[1], Staff[2], and CASE[3] have prefiled testimony regarding these issues to be presented at the hearings. Each issue is addressed below.

A. Weave Welding

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1 Applicants will present "Rebuttal Testimony of W.E. Baker, C.T. Brandt, M.D. Muscente, F.E. Coleman, C.R. Brown, J.D. Green, J.E. Hallford, I. Pickett, A.M. Braumuller, and S. Fernandez Regarding Allegations of D. Stiner and H. Stiner Concerning Weave Welding, Welding of Misdrilled Holes, Downhill Welding, and Weld Rod Control" ("Applicants' Craft Testimony"). The witness panel sponsoring this testimony consists of the following:

(1) The only three welders who were on H. Stiner's crews that are still remaining at CPSES, S. Fernandez (approximately 5 years as a welder at CPSES), J. Pickett (approximately 4 years as a welder at CPSES), and A.M. Braumuller (approximately 28 years as a welder, the last about 4 years at CPSES).

(2) Two welding foremen assigned to H. Stiner's crews during his two terms of employment, F.E. Coleman (over 18 years of welding-related experience, about 7-1/2 of which have been at CPSES), and C.R. Brown (approximately 6 years of welding-related experience, 4 of which have been at CPSES), respectively. The welding foreman is a non-supervisory technician who constantly monitors and assists the work of the five to 15 welders on his crew. Mr. Coleman also worked as a welder in the same areas as D. Stiner, and Mr. Brown welded in the same areas as H. Stiner during Stiner's first term of employment.

(3) One foreman and one general foreman over Mr. Stiner's crew (J.D. Green and H. Hallford).

(4) Mr. C.T. Brandt, QA Staff Engineer at the site who has interviewed many quality control inspectors, reviewed pertinent records and observed welders.

(5) Mr. W.E. Baker, Senior Project Welding Engineer
(footnote continued)

With regard to weave welding, Darlene and Henry Stiner had previously alleged that weave welding was common practice at CPSES and that this type of welding is in

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(with over 28 years of responsible positions associated with welding, over 4 of which have been at CPSES), who has observed welders and interviewed many welders, fitters, supervisors, and welding technicians.

(6) Mr. Muscente, a metallurgist with over 25 years of experience in responsible positions associated with materials selection.

2 The NRC Staff presented "Testimony of Leslie D. Gilbert and Robert G. Taylor on Plug Welding, Weave Welding, Downhill Welding and Weld Rod Control (Construction Quality)." ("Staff's Testimony.") Mr. Gilbert is a Reactor Inspector-Mechanical in the Engineering Section, Division of Reactor Project & Engineering Programs, Region IV, NRC. Mr. Gilbert has held responsible positions associated with welding for over 20 years. Mr. Gilbert has conducted periodic welding and NDE inspections of the piping system and containment liner for CPSES during the past 6 years.

Mr. Taylor is a Reactor Inspector in the Division of Reactor Projects & Engineering Programs, Region IV, NRC. Mr. Taylor has held responsible positions associated with welding for over 10 years. During the period from August 1, 1978 to January 21, 1984, Mr. Taylor was the Senior Resident Inspector-Construction for CPSES.

3 CASE presented "Testimony of CASE Witnesses Darlene and Henry Stiner." Personnel records reflect that Mr. Stiner was first hired at CPSES on December 5, 1979, and shortly thereafter underwent welder training. He became a structural welder on February 17, 1980 (qualified on Procedures 11065 and 10046). Mr. Stiner's last day of work (for his first term of employment) was November 26, 1980. During this approximately 41-week period, he was absent totally for six weeks and worked 30 hours or less during an additional eight weeks. Mr. Stiner was rehired as a structural welder in June 1981 and welded for

(footnote continued)

violation of procedures (Tr. 4147 and 4210-11). Further, Henry Stiner alleged that his foreman had directed him to weave weld in violation of procedures (Tr. 4211).

1. Applicants' and NRC Staff's Testimony

From the testimony of Applicants and the NRC Staff, Applicants expect that the following findings of fact will be made:

a. Weave welding is simply welding using an oscillating motion as opposed to a straight motion. Weave welding is not in itself contrary to applicable codes (Applicants' Craft Testimony at p. 7). Many companies welding in compliance with applicable code requirements use oscillation widths up to eight times the core diameter of the weld rod (Applicants' Rebuttal Testimony Regarding AWS and ASME Code Provisions at p. 19). Welding procedures used at Comanche Peak specify that the final welding bead width shall not exceed four core diameters of the width of the material being used to weld. Welding within these limits will not adversely impact welds at CPSES (Applicants' Craft Testimony at pp. 7-8).

b. In their testimony, both Darlene and Henry Stiner state that while they were in training, an instructor asked them to run a 5/16 inch oscillating bead on an I-beam (Tr. 4148 and 4211). They both stated that this was an illegal weave weld contrary to procedures. Applicants presented testimony that Darlene

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approximately three weeks. Mrs. Stiner was in a qualified welding position (though not welding the entire time) from February 27, 1979 to August 3, 1980. In short, both Mr. and Mrs. Stiner were active welders at Comanche Peak for a relatively short period of time. (Applicants' Craft Testimony at p. 5.)

and Henry Stiner (and all other trainees) welded this 5/16 inch fillet weld with a 3/32 inch E7018 electrode. Accordingly, up to a 3/8 inch oscillating weld (4 core diameter of the width of the weld rod) was clearly acceptable. Thus, Darlene and Henry Stiner had a misconception about what was an "illegal" weave weld. (Applicants' Craft Testimony at p. 8.)

c. Welders at CPSES are aware that weave welding in excess of the procedures is not authorized. (Id., at p. 9.) Indeed, training received by the welders (as testified to by Henry and Darlene Stiner) make this point clear (Tr. 4148 and 4211).

d. Weave welding in excess of four core diameters of the weld rod is not common practice at CPSES, as alleged by Darlene and Henry Stiner. If it were routinely practiced, it would have been detected by the welding foremen and welding technicians in the plant, who have testified directly (Messrs. Brown and Coleman) or through their supervisor (Mr. Baker) that they were not aware of any uncorrected excessive weave welding. Welders from Henry Stiner's crews and a welder who had welded in the same area as Darlene Stiner, coupled with the welding foremen from Henry Stiner's crews stated that neither they nor others they had seen welded using an oscillating motion in excess of four core diameters of the weld rod. The foreman and general foreman from Henry Stiner's crew provided similar testimony. (Applicants' Craft Testimony at pp. 9-11.)

e. Testimony reflects that if any foreman or supervisor intentionally directed any craft worker to violate established procedures, the foreman would be fired immediately. In this regard, welding foremen and supervisory personnel from Henry Stiner's crews testified that they had never directed him or any other welder to weave weld in excess of established procedures, or to take any other actions contrary to procedures. Further, welders from Henry Stiner's crews testified that they had never heard a foreman directing a welder to

take any actions contrary to procedures. In this regard, the one welding foreman who Henry Stiner stated had directed him to weld contrary to procedures (Mr. Coleman) has refuted Henry Stiner's allegations. It should be noted that Mr. Coleman has 18 years of welding experience. Mr. Coleman also testified that he has friends and relatives in the area and lives immediately adjacent to the plant, and would not take any action that would jeopardize the safety of the plant. (Id., at pp. 9-11.)

f. Welding Engineering Department conducts unannounced inspections of each active welder every approximate 14 days of welding. (For example, during the short time H. Stiner was actively welding, he was inspected 15 times and Darlene Stiner was inspected at least 28 times during the period she welded.) During the inspection, the welder's identification is verified and all filler material is checked to make sure that it is identified and is that listed on the Weld Filler Material Log. Also, filler material (e.g., weld rods) is checked for moisture, grease, or other contaminants. In addition, the welding being performed is checked to assure that it is acceptable. Other parameters checked include progression of travel (uphill or downhill), bead width, and weld rod control. During these inspections, excessive weave welding has not been reported as a problem. (Id., at pp. 12-13.)

g. In view of the training received by welders (both Darlene and Henry Stiner testified that after training they knew excessive weave welding was not allowed), coupled with the extensive checks and inspections by both construction and QA/QC, the probability of excessive weave welding on safety-related systems and class 5 supports which has not been identified and corrected is very low (Id., at p. 13).

h. In any event, even if excessive weave welding occurred on systems and supports welded on by the Stiners (mild or low carbon steels), from

> a metallurgical viewpoint there would have been no adverse impact. (Staff Testimony at p. 10.)

2. CASE's Testimony

CASE presented testimony of Darlene and Henry Stiner which contained eight allegations related to weave welding, i.e., (1) weave welding is not authorized; (2) even if weave welding up to four core rod diameters is authorized, it is common practice for weave welding in excess of this to occur; (3) there are no means to assure that heat input during weave welding is not excessive; (4) requirements regarding interpass temperatures are not met; (5) preheat requirements are not being met; (6) a foreman (Mr. Coleman) directed them to weave weld contrary to procedures; and (7) unauthorized weave bead techniques were used on welds where Charpy impact testing was required. In addition, CASE's testimony raises issues irrelevant to weave welding, e.g., heat input addressing welds other than weave welding. Further, Darlene and Henry Stiner attempt to provide expert testimony in the areas of metallurgy as it relates to heat input.

Applicants are reviewing CASE's testimony and determining areas of cross-examination and additional direct testimony needed to address the additional concerns raised

by CASE. Preliminarily, Applicants expect that as a result of cross-examination, findings of fact regarding CASE's testimony will include the following:

a. Neither Henry Stiner nor Darlene Stiner is an expert in the fields of metallurgy or welding engineering and, accordingly, specific sections of their testimony will be stricken.

b. Some areas of Darlene and Henry Stiner's testimony are not related to weave welding or are new allegations, and accordingly, will be stricken.

c. Weave welding not in excess of four core diameters of the weld rod used is authorized.

d. It is not common practice for weave welding in excess of four core diameters to occur at Comanche Peak.

e. Methods used to control heat input and interpass temperatures provide reasonable assurance that heat input will not adversely impact the weld.

B. Downhill Welding

In previous testimony Mr. Stiner had alleged that "once metal has been welded on and cut on with a torch, it builds up a magnetic field which causes arc blow" and to correct arc blow "lots of times, people will run a downhill weld instead of doing it correctly, because then you're going in the direction of the magnetic field" (Tr. 4246-4247).

1. Applicants' and NRC Staff's Testimony

From Applicants' and Staff's testimony, Applicants expect that the following findings of fact will be made:

a. Previous welding on metal or cutting metal with a torch will not cause the material to be magnetized. (Applicants' Craft Testimony at p. 14.)

b. Because of the method of ground used at CPSES, the small diameter electrodes and low amperage ranges used in the field for vertical welding (90-102 amps), arc blow for vertical welding is not a problem at CPSES. (Id., at p. 15.)

c. Downhill welding is an industry-accepted practice for many applications and if properly performed will result in acceptable welds. In this regard, neither the ASME Code nor AWS Code excludes any particular direction of progression. Rather, both Codes would allow the contractor to specify direction of travel. While the Codes do not exclude uphill or downhill welding, the Codes do state that regardless of which direction of progression is selected the welder must be qualified to weld in that direction. (Id., at p. 16.)

d. Brown & Root welding procedures do not authorize downhill welding at CPSES. However, some contractors (e.g., CB&I) have welding procedures which authorize downhill welding. (Id.)

e. From observations of welders at CPSES, in combination with interviews of numerous welders, welding technicians, fitters, welding foremen, construction supervision, and quality assurance personnel, (other than the testimony of the Stiners) there is no evidence that would support the conclusion that unauthorized downhill welding occurs on safety-related systems or class 5 supports at CPSES. (Id., at pp. 16-19.)

f. With the weld rod used at CPSES by H. and D. Stiner, welding downhill is just as time consuming as welding uphill. Thus, there is no incentive for a Brown & Root welder to weld downhill. However, the threat of disciplinary action provides a strong incentive to weld uphill. (Id., at p. 17.)

g. Foremen and supervisors of welders at CPSES are well aware that downhill welding for Brown & Root employees is unauthorized. It is common knowledge that if a foreman at CPSES directed a welder to perform a weld contrary to procedures, the foreman and the welder would be in jeopardy of losing their jobs. (Id., at pp. 11 and 18.)

h. Even if there had been some unauthorized downhill welding, the probability that it would have an adverse impact on plant safety is virtually zero. If the welder was experienced with downhill welding techniques, the downhill weld would in all likelihood be acceptable from a structural standpoint and there would be no impact. If the welder was not experienced, the downhill weld would have obvious unacceptable visual indications which would be detected by either the welding technician/foreman (before QC inspection) or by the QC inspector during his inspection. (Id., at pp. 19-20.)

2. CASE's Testimony

CASE will present testimony of Darlene and Henry Stiner regarding downhill welding which basically made two new allegations, viz., (1) that Darlene Stiner had performed downhill welding; and (2) that both Darlene and Henry Stiner had been directed to weld downhill, particularly in areas of limited access. In their testimony, both Darlene and Henry Stiner attempt to provide expert testimony regarding code interpretations and metallurgical properties as related to downhill welding. Applicants are reviewing the direct prefiled testimony of Darlene and Henry Stiner and attempting to determine what cross-examination and

additional direct testimony is needed to address the concerns raised. From preliminary observations, during cross-examination Applicants intend to show that neither Darlene nor Henry Stiner is an expert witness in the area of Code interpretation or metallurgy and, therefore, portions of their testimony should be stricken. Further, Applicants intend to show that with regard to restricted welding, CASE's concerns are not well founded.

C. Weld Rod Control

Mrs. Stiner had previously raised three occurrences of alleged weld rod control problems:

(1) She wrote an NCR on a welder who she alleged had used two weld rods that had been checked out and not returned the day before (Tr. 4166);

(2) She alleged that on one weld 75 rods were reported to have been used when it should have only taken three to four rods (Tr. 4164); and

(3) She found two bundles of rods laying in the plant which she alleged were turned over to a QC supervisor who did not investigate the incident but simply threw the rods in the trash (Tr. 44164).

In addition, Henry Stiner had previously raised one allegation of inappropriate weld rod control, i.e., one day when his crew was pressed to get "a particular line bought off down there by 5:30 that afternoon" he welded hangers with rods that were checked out to others in the crew

(Tr. 4220-4221). From these instances Darlene and Henry Stiner alleged that weld rod control violations were common practice at CPSES.

1. Applicants' and NRC Staff's Testimony

From the direct testimony of Applicants and Staff, Applicants expect that the following findings of fact will be made:

a. The Brown & Root weld rod control program at CPSES is based on a daily system of accountability where each welder is accountable for all weld material he uses on each shift. At the the end of each shift, unused rods, rod stubs and damaged electrodes are counted and where this count does not equal the number of rods issued, this information is entered on a welder's log which is periodically tracked by the distribution station attendant and reviewed by the Welding Engineering Department to assure that there is no trend of excessive rod stubs unaccounted for. If a welder does not turn in his filler material at the end of the shift, this can be a basis for termination of the welder. For example, the resolution of the NCR raised by Darlene Stiner regarding a welder violating the weld rod control program was the termination of the welder (Applicants' Craft Testimony at pp. 29-30).

b. The weld rod control program exceeds all ASME or AWS Code requirements for control programs. The Welding Engineering Department inspects the rod distribution stations for compliance with these procedures every two weeks. (Id., at pp. 21-23.)

c. In addition to the inherent controls built into the weld rod control program itself, there are other mechanisms which provide assurance that violations of the weld rod control program are detected. For example, the periodic inspections of each active

welder held approximately every 14 days, coupled with monitoring by welding technicians/foremen and other supervisors, provide assurance that violations are detected. In addition, QC inspections are conducted during which weld rod traceability is checked. If weld rod control procedures had been violated, in all likelihood they would be detected in these inspections. (Id., at p. 24.)

d. All welding on safety-related low carbon and mild steels at CPSES which is of concern here (the welding to which Darlene and Henry Stiner refer in their testimony) uses the same electrode (weld rod), E7018. Thus, the possibility of a welder in this area borrowing an electrode from another on his crew and getting the wrong electrode for the job is virtually non-existent. It should be noted that, in any event, welders are trained to know that they can only use the specific electrodes designated for that job. (Id., at p. 26.)

e. The adverse effects of leaving weld rods exposed is possible accumulation of moisture which would result in increased porosity. However, if unacceptable, this porosity would be detected by visual inspection and rejected. (Id.)

f. Even if there was an undetected violation of weld rod control procedures such as alleged by the Stiners, (i.e., using one day old weld rod and borrowing a weld rod from another welder on the same crew), the likelihood that such a violation would have an adverse impact on plant safety is virtually nonexistent. (Id., at pp. 26-27.)

g. After successful completion of qualification testing and prior to being released for production welding, each new welder at CPSES is given an orientation by welding engineering as to the requirements of this procedure. The importance of filler material control at the facility is explained to the welder and the welder is informed that any willful violation of the procedure will result in immediate termination. This orientation is documented and the welder signs a form indicating his understanding. (Id., at pp. 27-28.)

Treatment of welders who violate the program leaves little doubt but that weld rod control is taken very seriously at CPSES. (Id., at pp. 31-33.)

h. The four specific allegations of Henry and Darlene Stiner concerning weld rod control do not raise any issues which would have resulted in a situation adverse to plant safety. (Id., at pp. 28-31.)

i. Based on observations of welders in the plant, as well as discussions with numerous welders, fitters, foremen, QC inspectors, welding foremen and welding technicians, the weld rod control procedures at CPSES are, with very few exceptions, strictly adhered to. Further, even if a violation of procedures as raised by D. and H. Stiner occurs and is undetected, the likelihood of such a violation having an adverse impact on plant safety is virtually nonexistent. (Id., pp. 31-33.)

2. CASE's Testimony

CASE presented testimony of Darlene and Henry Stiner which made several allegations including (1) many welders kept rods out of the weld rod control cans longer than four hours, and (2) welders were encouraged to violate weld rod control procedures. In addition, CASE presented testimony regarding the issue of unplugged rod cans, an issue which the Licensing Board in its Initial Decision of January 28, 1983 at p. 36 ruled would have "no effect on safe power operation of the plant." Applicants are still analyzing the prefiled testimony of CASE and do not yet know what findings of fact may result from cross-examination, or what additional direct testimony may be needed to address these concerns.

D. Welding of Misdrilled Holes

Both Darlene and Henry Stiner had previously testified that welding of misdrilled holes in cable trays and pipe supports was "illegal" (Tr. 4154 and 4219). Further, they alleged that they welded misdrilled holes without QC inspectors present and this was somehow improper (Tr. 4154 and 4220). To illustrate that such welding was "illegal," Mr. Stiner stated that his foreman directed him to weld misdrilled holes, but told him not to get caught by QA (Tr. 4220). Further, Mr. Stiner alleged that his foremen would watch for QC inspectors while he welded misdrilled holes to assure that no one would catch him (Id.). In addition, Darlene Stiner appeared to express a concern that unacceptable slag deposits may remain in misdrilled holes that are welded (Tr. 4154-4155).

1. Applicants' and NRC Staff's Testimony

Applicants expect that from Applicants' and Staff's direct testimony, the following findings of fact will be made:

a. Procedures at Comanche Peak provide for welding of holes in material such as discussed by Darlene and Henry Stiner in their testimony. (Applicants' Craft Testimony at p. 34.)

b. Welding of misdrilled holes, termed "plug welding" by the Stiners, is not "plug welding" as defined by the AWS Code. "Plug welding"

noted in the Code is welding one member to another member using a hole in the first member. The purpose of "plug welding" is to secure two members together and not simply to fill a misdrilled hole as is the subject of the Stiners' concerns. (Id., at p. 35.)

c. From testimony of welders and welding supervisors alike, the welding technique to fill a misdrilled hole is very simplistic and not at all difficult. As described by Applicants' witnesses and Darlene Stiner (Tr. 4151), this technique entails (in overview fashion) welding one side of the hole and letting this cool. After flipping the plate, the slag in the hole from the initial welding would be removed by either a pencil grinder or a chipping hammer. (Although there are some types of welding electrodes manufactured that produce a slag cover that can be welded over, the low hydrogen electrode utilized at CPSES results in a slag covering that is so heavy that an arc cannot be established without first removing the slag.) Next, the second side of the hole would be welded. It should be noted that in the second weld (welding the second side of the hole), using normal welding techniques would cause any minor slag deposits remaining to float to the top of the weld material and thus not be trapped inside the weld. With the low hydrogen electrodes used by the Stiners, normal welding techniques assure that slag from welding the second side remains fluid, floats to the top of the weld and is removed. (Applicants' Craft Testimony at pp. 35-36, 39, 40-41.)

d. With the low hydrogen electrode used at the plant, it is very difficult, if not impossible, to weld over unacceptable slag deposits using normal techniques. Further, it should be noted that even if unacceptable slag deposits were welded over, in all likelihood, there would be unacceptable surface indications remaining. (Id., at 36.)

e. Skilled welders from the Welding Engineering Department of Brown & Root conducted tests using a low hydrogen electrode in an attempt to make unacceptable welds of 3/4 inch holes in 3/8 inch plates. Although these highly skilled welders tried, using normal techniques, to successfully weld over significant amounts of slag without leaving rejectable surface indications, they were unable to do so. When they were able to weld over unacceptable deposits of slag, they used abnormal welding techniques which were extremely time consuming. (Id., at p. 37.)

f. With regard to inspections of welded misdrilled holes, first, the welder himself inspects his work and, if unacceptable, he will correct it at that time. Further, misdrilled holes on safety-related systems or class 5 hangers require a quality control inspection. The type and timing of this inspection is entirely dependent upon the type of weld. At a minimum, all welds of misdrilled holes of cable tray or pipe supports on safety related systems or class 5 hangers would require a final visual QC inspection. During this final visual inspection, unacceptable surface indications would, in all likelihood, be detected. In sum, there is reasonable assurance that welds of misdrilled holes with unacceptable surface indications would have been detected and, as necessary, corrected. (Id., at p. 38.)

g. The weight of the testimony reflects that no welding foreman, or other supervisor directed a welder to weld outside procedures or stood watch for a welder while he performed actions contrary to procedures. It is common knowledge that if either a welder or foreman was caught doing these activities, they would be fired immediately. Further, testimony reflects that if this had occurred to welders, in all likelihood, they would have gone directly to the welding foreman or welding technicians to explain what was happening and stop such occurrences. (Id., at pp. 39-41.)

h. The technique used for welding misdrilled holes is extremely simple and does not require a highly skilled welder to perform acceptable welds. Further, it is very difficult with the type weld rod used by the Stiners to weld a misdrilled hole and leave unacceptable slag deposits (the apparent concern expressed by D. Stiner). Highly skilled welders from Brown & Root have attempted to do this and only after a number of tries were successful. In short, it is very easy to properly weld misdrilled holes and very difficult to leave slag deposits. Accordingly, the welds of misdrilled holes of the Stiners (both qualified welders) were, in all likelihood, acceptable. Further evidence of this is H. Stiner's statements that the welds were themselves visually acceptable (Tr. 4221). Accordingly, even if QC inspections were not performed on some welding of these holes, in all likelihood the welds themselves would have been acceptable. (Applicants' Craft Testimony at p. 42.)

i. An analysis was conducted to determine the effects of slag inclusions in a misdrilled hole on the strength of the weld. Test specimens of SA36 plate material with a minimum tensile strength requirement of 58 KSI were prepared. The specimens were approximately eight inches in length and 3/8 inch thick, and, in the area of concern, approximately 1.5 inches in width. A 3/4 inch diameter hole (which was to be welded) was drilled in the area of concern of each specimen. This hole, therefore, comprised 1/2 of the cross-sectional area of the test specimen. (In view of gage tolerance requirements under which a hole cannot be placed nearer than 1-hole diameter to the edge of the material (here being 3/4 inch), this configuration is extremely conservative.) The hole in one of the specimens was properly welded and radiographed to assure that it was perfect. After numerous attempts and using abnormal welding techniques, the hole in the second specimen was welded with significant slag deposits remaining. The second specimen was radiographed showing major slag inclusions

> throughout the weld, including one which was about 1/4 inch at its widest point, 1/2 inch in length and about 1/8 inch thick. Tensile tests were performed on each specimen. The first specimen (with the good weld) failed at a tensile strength of 71,639 psi. Significantly, the failure occurred in the specimen material and not the weld material (i.e., the weld material was stronger than the base material). The second specimen (with major slag inclusions) failed at a tensile strength of 69,918 psi, still significantly above the 58,000 psi required of the material. In sum, even when skilled craftsmen attempted to weld a worse case weld such that major slag inclusions were present in the material, the strength of the resultant weld was not significantly lower than the strength of the base material. In short, even if some degree of slag was present in a weld of a misdrilled hole, there is reasonable assurance that it would not have had a significant adverse impact on the strength of the material. (Id., at p. 43-44.)

2. CASE's Testimony

CASE presented the testimony of Darlene and Henry Stiner regarding welding of misdrilled holes which basically reiterated allegations made in previous testimony. In addition, the following new allegations were made: (1) Mr. Stiner alleges that Mr. Coleman directed him to make at least 20-30 plug welds of misdrilled holes in the cable spreading room, contrary to procedures; (2) Mrs. Stiner alleges that she welded misdrilled holes on the "fab tables;" and (3) the Stiners allege that they, "like all or

most of the welders" grounded off welds of misdrilled holes and painted their surfaces with gray paint to assure that QC would not be able to detect these welds.

Applicants are still analyzing the testimony of Darlene and Henry Stiner and do not yet know precisely what findings of fact may result from cross-examination or what additional direct testimony may be needed to address these concerns.

II. CASE Allegations and Board Concerns Involving AWS and ASME Code Provisions

In its August 22, 1983 Proposed Findings, CASE alleged that the ASME Code was flawed in that it did not contain ten specific AWS Code provisions. Accordingly, CASE asserted that welding at CPSES in accordance with the ASME procedures was unacceptable.

In its January 3, 1984 Memorandum, the Board requested that additional testimony be provided as to the requirements of the AWS and ASME Codes, if any, concerning weave welding, downhill welding, preheat and cap welding.

Applicants have filed testimony[4] addressing each of the Board's concerns, and five of the nine

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4 Applicants filed "Rebuttal Testimony of W.E. Baker, M.D. Muscente, J.D. Stevenson and R.E. Lorentz, Jr. Regarding Allegations Involving AWS and ASME Code Provisions." ("Applicants' Code Testimony.")

outstanding allegations regarding the AWS Code raised by CASE (the tenth alleged AWS Code provision, "calculation for effective throat of flare bevel welds," was closed out by the Board's Memorandum and Order of December 28, 1983 at p. 41). The five alleged AWS Code provisions raised by CASE and addressed in Applicants' testimony which will be litigated during the February 20-24, 1984 hearings are as follows:

(1) "Preheat requirements for welds on plates over 3/4 inch thick,"
(2) "Drag angle and work angles (which limit the space allowed for the welder to function,"
(3) "Beta factor for tube-to-tube welds,"
(4) "Lap joint requirements," and
(5) "Limitation on weld sizes relative to plate thickness."

From Applicants' testimony, Applicants expect that the following findings of fact will be made:

1. The process of making acceptable welds entails at least three distinct but interrelated activities, *viz.*, (1) design of the weld joint, (2) selection of a prequalified welding procedure (if applicable) or development and qualification by testing of a welding procedure to assure that the weld joint (and others with similar important parameters) can be welded so as to meet the design strength requirements, and (3) training and qualification of welders to assure that they are capable of welding with the procedure developed. (Applicants' Code Testimony at p. 2.)

2. With regard to design of the weld, both the AWS and ASME Codes contain some requirements in this area (*e.g.*, AWS D1.1 Code Section 2, Design of Welded Connections, and ASME Code, Appendix XVII). However, neither code

provides all the details necessary to design a weld joint, and both codes rely heavily on the designer to assure that the weld joint is designed to meet the design and operating loads. To do this, the designer uses numerous reference sources and his skill as an engineer to provide a proper design which, pursuant to Appendix B to 10 CFR Part 50 and other regulatory requirements, goes through several review and approval stages before acceptance. The ASME and AWS Codes are primarily fabrication codes and not design codes. Thus, specific and complete design details are not included in either code. (Id., at p. 3.)

3. Both the AWS and ASME Codes include requirements for development of welding procedures that will result in welds that are adequate for their intended uses. The ASME Code requires that all welding procedures used for the fabrication and installation of components and their supports be qualified and found to be acceptable by test pursuant to the requirements of Section IX of the ASME Code. On the other hand, the AWS Code provides for the use of either prequalified welding procedures (i.e., not requiring qualification testing prior to their use) or welding procedures which are qualified and found to be acceptable by test. In short, the ASME Code allows welding only with procedures based on qualification testing, while the AWS Code allows welding with welding procedures qualified by testing or with prequalified procedures. (Id., at pp. 4-5.)

4. The AWS Code is used for some welding of non-ASME components (such as some cable tray supports and some building structures) at CPSES. In addition, the AWS Code is frequently used by designers and engineers at CPSES as a reference (along with numerous other industry documents) in performing tasks such as design, design review or verification of weld parameters. (Id., at p. 10.)

5. In qualifying by test welding procedures in accordance with the requirements of Section IX of the ASME Code (similar to Section 5 of the

AWS D1.1 Code), a draft welding procedure is first written describing the precise status of certain variables specified in Section IX of the ASME Code (essentially the same specified in the procedure qualification section of the AWS Code). A test plate or pipe is prepared and welded in strict accordance with the draft welding procedures. Tests specified by code are performed using specimens removed from the test plate or pipe. If acceptable results are obtained from the testing, the procedure has been qualified and a Procedure Qualification Record (PQR) is prepared listing the specified parameters used for the welding in the form of essential and non-essential variables. (ASME Section IX specifies essential and non-essential variables for each welding process.) (Id., at pp. 6-7.)

6. If a welding procedure is qualified by test in accordance with each provision of Section IX of the ASME Code, use of that procedure will produce welds that are structurally sound and as adequate for their intended use as welds produced using either prequalified procedures of the AWS Code or procedures qualified by test in accordance with the AWS Code. (Id., at pp. 8-9.)

7. All welding procedures qualified by test pursuant to the ASME Code for use at CPSES follow the requirements of Section IX of the ASME Code. (Id., at p. 8.)

8. With regard to CASE's allegation that provisions of the AWS Code regarding "preheat requirements for welds over 3/4 inch thick" are not included in the ASME Code, the AWS D1.1 Code addresses preheat requirements for prequalified procedures in Subsection 4.2, "Preheat and Interpass Temperature Requirements." (If procedures are to be qualified by test pursuant to the AWS Code, the preheat requirements specified in subsection 4.2 need not be used.) While Appendix D of the ASME Code, Section III, provides guidance for preheat requirements (very similar to that provided in the corresponding sections of AWS), the ASME Code

states that during welding procedure qualification, the preheat requirements which have been actually tested and produce acceptable welds are the ones to be specified in the applicable procedures. Accordingly, the ASME Code contains provisions that adequately consider preheat requirements as raised by CASE. In addition, qualification of procedures in accordance with the ASME Code has resulted in preheat requirements in the applicable CPSES welding procedures that in all cases either meet or exceed those preheat requirements set forth in the AWS Code. In sum, CASE's allegation that preheat requirements set forth in the AWS Code are not adequately considered in the ASME Code is without merit. (Id., at pp. 12-13.)

9. With regard to CASE's allegation that provisions of the AWS Code regarding "drag angle and work angles" are not included in the ASME Code, neither the AWS nor ASME Codes contain "drag angle" or "work angle" requirements or restrictions. Accordingly, CASE's allegation is baseless. However, in its February 1, 1984 Answer to Applicants' Motion for Reconsideration, CASE attempts to provide clarification of its concern and apparently now states that the Welding Handbook, Seventh Edition, Volume 2, somehow requires that work angle or drag angle should be an explicit design consideration. However, testimony reflects that contrary to CASE's statement, this Handbook does not state or imply that the drag angle or work angles of a welder should be an explicit design consideration. Rather, regardless of the weld joint design, the Welding Handbook states that proper work orientation of the weld rod (e.g., drag and work angle) are "automatically taken into account" by the trained welder. (Id., at pp. 13-14.)

Where the area which surrounds the weld of concern is limited so as to potentially adversely impact a welder's ability to maintain proper weld orientation, as a matter of practice at CPSES welders are used who have practiced and been tested in these

configurations. Many times mock-ups of the configuration (including simulating the limited space) are constructed to provide precise conditions the welder will encounter. A qualification listing and matrix of the "specially" qualified welders is maintained. (Id., at pp. 14-15.)

In any event, CASE's stated concern regarding improper work angle and drag angle is that it may cause slag entrapment, porosity and undercut. These potential defects are no different than potential concerns regarding any other weld. Because of welder training and qualification, coupled with inspections and surveillance of the Welding Engineering Department and QA/QC, there is reasonable assurance that any problems regarding slag entrapment, porosity and undercut will be detected and corrected, as necessary. (Id., at p. 15.)

10. With regard to CASE's allegation that provisions of the AWS Code regarding "Beta Factor for tube-to-tube welds" are not included in the ASME Code, the Beta Factor (the ratio of the diameters of two adjoining tubes) is referenced in Section 10 of AWS D1.1 Code, subsection 10.12.5, 10.13.5 and Figure 10.13.5. In essence, these references provide that if the Beta Factor is greater than 1/3 for tube-to-tube (circular) connections and greater than 0.8 for box (rectangular) connections, the weld procedure used must be qualified by test (the greater the Beta Factor, the more likely that stresses at the joint will be higher). In short, where the likelihood of greater stresses is present, the Beta Factor is used in the AWS Code to indicate that qualification of a procedure by test is required. Significantly, the ASME Code requires that all weld procedures be qualified by test, without consideration of the likelihood of greater stresses. Accordingly, the ASME Code adequately addresses this AWS Code provision by requiring the more conservative qualification by test

instead of use of a prequalified AWS procedure, and CASE's allegation is without merit. (Id., at pp. 15-16.)

It should be noted that in Mr. Doyle's testimony (CASE Exhibit 669, Vol. I, p. 112), he states as his concern that the Beta Factor limit of 1/3 applies for shielded metal arc fillet welds used when welding trunnions to pressure boundary piping. Since such a trunnion would be an "integral attachment" to the piping, the AWS Code does not apply and the weld must be designed to the applicable pressure boundary subsection in ASME, i.e., NB, NC, or ND. AWS D1.1 (as stated in ¶1.1.1) clearly does not apply to this case (i.e., pressure boundary piping) and Mr. Doyle's concerns are unfounded. (Id., at p. 16.)

11. With regard to CASE's allegation that provisions of the AWS Code regarding "lap joint requirements" are not included in the ASME Code, subsection 8.8 of the AWS D1.1 Code provides lap joint requirements for building structures. These requirements are the same as those set forth in Paragraphs XVII-2431, 2452.3(c), 2453.1, 2452.9 and 2283.1(c) of Appendix XVII of the ASME Code (mandatory to CPSES welding in conformance to ASME requirements).

In short, these ASME Code provisions (with which applicable welding at CPSES complies) are the same as related requirements in the AWS Code. Accordingly, CASE is not correct in stating that the ASME Code (used at CPSES) does not adequately consider lap joint requirements as noted in the AWS Code. (Id., at p. 17.)

12. With regard to CASE's allegation that provisions of the AWS Code regarding "limitation on weld size relative to plate thickness" are not included in the ASME Code, limitations on weld size relative to plate thickness are addressed by AWS D1.1 Code in Subsections 2.7 (fillet welds) and 2.10 (partial penetration groove welds). These subsections basically provide that with regard

to fillet and groove welds, welds to be made without qualifying the applicable procedure by test shall conform to the minimum size requirements of Tables 2.7 and 2.10.3, respectively. These requirements are identical to or less stringent than those required at CPSES by the ASME Code in Appendix XVII, Table XVII-2452.1-1. Accordingly, CASE's allegation that this AWS Code provision was not adequately considered is incorrect. (Id., at pp. 17-18.)

13. With regard to the Board's question relating to the applicable code provisions concerning weave welding, neither the AWS nor ASME Codes establish specific requirements limiting weave or oscillating pattern welding. However, for shielded metal arc welding (the welding of concern), bead width is listed as a supplementary essential variable for procedure qualification testing pursuant to Section IX of the ASME Code when impact properties are specified, and a nonessential variable when not specified. In either case, applicable CPSES welding procedures are tested using the upper limit on bead width of four times the core diameter of the weld rod being used. Other industries which comply with the codes employ bead widths in excess of four times the rod core diameter, up to and including eight times the rod core diameter. In sum, although there are no specific code requirements regarding bead width (other than considering it as a supplementary essential or non-essential variable, as stated above) relevant procedures at CPSES adequately consider this factor. (Id., at pp. 18-19.)

14. With regard to the Board's question concerning the code provisions related to downhill welding, neither the ASME nor AWS Codes exclude use of downhill or uphill welding. However, the ASME Code and the AWS Code specify that the direction of travel must be listed in the welding procedure. At CPSES, Brown & Root welding procedures state that in all instances the direction of progression will be upward. Other contractors, in a few instances, have performed qualification

testing using downward progression, and downhill welding by those contractors is thus permissible. In short, direction of travel is considered at CPSES and is appropriately factored into welding procedures. (Id., at p. 20.)

15. With regard to the Board's question on code requirements concerning preheat, this issue was previously addressed in relation to CASE's allegations regarding "preheat requirements for welds on plates over 3/4 inch thick" (see ¶8, supra at 24).

16. With regard to the Board's question on code requirements concerning cap welding, there are no additional code requirements regarding cap welding. Code requirements for other welding apply equally to cap welding (cap welding is not terminology common to welding; the usual reference is a cover pass or a reinforcement pass). Subsection 3.7.1 of the D1.1 AWS Code (1975 Revision) specifically endorses such welding. (Applicants' Code Testimony at pp. 20-21.)

To the extent that CASE is concerned that new weld material cannot be placed on an old weld without some adverse structural impact, CASE's concern is without merit. Neither code provides any restrictions in this area, or even requires its consideration as an essential or non-essential variable. Such practice occurs daily when a welder takes a lunch break during a weld, or stops in the middle of a weld due to crew change or even to change a weld rod. In all such instances the welder simply follows his procedure to complete the weld. This would require actions such as cleaning the weld surface and assuring that preheat requirements, if any, are met (in most instances $60^{o}F$). (Id., at p. 21.)

CASE has stated that its specific concern is that some fillet welds at CPSES were found to be 1/16 inch below minimum size specified in the ASME Code, and that the minimum size of the welds may have resulted in miscellaneous cracks (cause by external loading on the

undersized weld), internal cracking or underbead cracking which would be aggravated when additional material was used to build up the welds. (Id., at pp. 21-22.)

These welds, however, were subsequently corrected by following appropriate welding procedures that consisted of, among other things, cleaning the weld, assuring preheat requirements were being met, welding the additional pass and obtaining a final QC visual inspection. (Id.)

In view of the characteristics of the base material and low hydrogen electrodes used, coupled with the initial designs and preheat requirements, the likelihood of such cracking is very remote. Further, no cracks were identified by either the welders or QC inspectors for any of the undersized welds. If cracks had been a problem, at least some of them would have been detected and reported. (Id., at pp. 21-26.)

In short, to the extent that CASE is concerned that "cap welding" has resulted in covering over cracks in existing welds, there is reasonable assurance that this did not occur. (Id.)

Respectfully submitted,

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February 16, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
TEXAS UTILITIES ELECTRIC COMPANY, et al.	)	Docket Nos. 50-445 and 50-446
	)	
(Comanche Peak Steam Electric Station, Units 1 and 2)	)	(Application for Operating Licenses)

CERTIFICATE OF SERVICE

I hereby certify that copies of the foregoing "Applicants' Expected Findings of Fact Regarding Welding Issues to be Raised During the Hearings of February 20-24, 1984" in the above-captioned matter were served upon the following persons by overnight delivery (*), or deposit in the United States mail, first class, postage prepaid, this 16th day of February, 1984, or by hand delivery (**) on the 17th day of February, 1984.

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