

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:

SOUTH CAROLINA ELECTRIC & GAS )  
COMPANY, et al. )  
(Virgil C. Summer Nuclear ) Docket No. 50-395-OL  
Station, Unit 1) )

COUNTY OF RICHLAND )  
STATE OF SOUTH CAROLINA )

AFFIDAVIT OF D. A. NAUMAN

My name is D. A. Nauman. I am Group Manager, Nuclear Services, South Carolina Electric & Gas Company. My business address is 320 Main Street, Columbia, South Carolina 29218. I have previously testified in this proceeding. A statement of my professional qualifications may be found as Appendix A to my prefiled testimony following page 1388 of the transcript. Since the preparation of that Statement of Qualifications, I have been assigned additional responsibilities. The manager of Nuclear (Operations) Quality Control now reports to me. I have reviewed an undated document entitled "Affidavit in Support of Intervenors Motion to Reopen Hearings," apparently signed by Harold L. Jennings; a document entitled "Intervenor's Motion to Reopen the Record and Conduct Further Proceedings and Request for a Stay," dated August 10, 1982, and apparently signed by Brett Bursey, Intervenor; a document entitled "Intervenor's Supplemental Filing on Motion to Reopen the Record and to Conduct Further Hearings, dated August 26, 1982, and apparently

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signed by Brett Bursey, Intervenor, to which was attached a three-page document appearing to be a statement of Harold Lavern Jennings, dated August 11, 1982; and, finally, a four-page document entitled "Intervenor's Affidavit in Support of Motion to Reopen the Record and Request for a Stay," dated August 26, 1982, and apparently signed by Brett Bursey, Intervenor. The purpose of my Affidavit is to respond to the allegations raised in these documents concerning the efficacy of SCE&G's Quality Control Program as it relates to cadwelding. I shall also present the results of Licensees' investigation into the specific allegations contained in the statements by Mr. Jennings. In Attachment A, I address the allegations made by Intervenor concerning Licensees' cooperation with him in providing access to files and documents to assist him in his further inquiry into the matter.

First, by way of background, I shall explain what a cadweld is. "Cadweld" is a trade name and not a description of a welding process. The technical name of the process being accomplished is "mechanical butt splicing." In the process, a steel sleeve with internal ridges is placed over the ends of reinforcing bars which are to be joined. In our case, we used the process for only numbers 14 and 18 joints and a very limited number of numbers 11 to 14 transition splices. Metal retainers are placed at the ends of the sleeve to hold packing material in the sleeve. A graphite crucible and pouring basin are clamped

to the sleeve at the tap hole. A "thermite reaction" type powdered metal is placed in the crucible and ignited. The melted alloy flows into the sleeve while "slag" floats to the top of the mixture, outside the sleeve. After the material hardens, the clamped equipment is removed. The resultant sleeve and bar ends are mechanically locked together by the hardened filler metal around the rebar (with its deformations) and the sleeve. Despite the name, it is not a welding process.

Intervenor's Affidavit in Support of Motion  
to Reopen the Record and Request for a Stay.

Intervenor's first substantive point attempts to imply a problem with quality control; he asserts that "there were only two Non Compliance Notices [sic] regarding cadwelding during the entire construction process, both of which addressed the problem of inadequate Quality Control." This statement is not correct. During the period of cadwelding--from August 1974 through January 1979--there were 45 Deficiency Notices (DN) and 12 Nonconformance Notices (NCN) issued by SCE&G construction QC on the subject of cadwelding. (The terms DN and NCN were explained at pp. 1-2 of E. H. Crews' Supplemental Testimony following Tr. 2672.) These Deficiency Notices involved fifty (50) different cadwelds and the Nonconformance Notices related to over three hundred fifty (350) different cadwelds. By the words "Non Compliance Notices", Intervenor was apparently making reference

to two of the twelve Nonconformance Notices: Numbers 350 and 366. Intervenor's affidavit does not accurately represent the substance of those documents.

NCN 350 dealt with improper scribing and excessive spacing between reinforcing steel bar ends within cadweld sleeves. This condition was identified during QA surveillance. The non-conforming conditions described in NCN 350 would not be apparent after the cadweld setup was complete, and, therefore, would not be expected routinely to be identified by QC inspectors (it would be necessary to disassemble the setup to detect the problem).

NCN 366 dealt with excessive slag in tap holes and sleeves of cadwelds and was identified by a construction QC inspector. For slag to exist where filler metal was intended, the cadweld set-up must have been improper. A preshot check was routinely made by the cadwelder foreman. A cadweld identification tag was filled out by the foreman after checking specified items as indicated on the tag. This, together with watching the shot, would be the normal mode of preventing or identifying this type of problem. The identification tag was subsequently verified as complete by a QC Inspector. While we would have preferred to have scribe line/spacing problems identified during random QC inspection, with earlier detection of slagging conditions, the best chance of correction was with the first line supervisor, if not the cadwelder himself. Thus, the focus of these NCN's is

inadequate cadwelder performance and cadwelder supervision, not QC performance. As will be discussed in more detail later, an extensive evaluation/mock-up program was initiated because of these NCN's. Evaluation of "worst case" conditions established that cadwelds still performed above standards for "properly performed" cadwelds in each case. Much of this information is applicable to the present allegation and is one reason we remain confident in the hardware. In summary, both of these NCNs focus on inadequate cadwelder performance, not QC inspector performance.

Intervenor next asserts the existence of a deficiency notice of April 3, 1976, which supposedly cited QC for not properly marking rejected splices. There is no deficiency notice of that date. However, there is a deficiency notice (No. 367) dated April 1, 1976, and a deficiency notice (No. 371) dated April 6, 1976, both of which document a failure to spray rejected cadweld splices with red paint before being cut out. These deficiency notices were the basis for an NRC Region II Deficiency 76-3-A1(III) which was documented in Report 50-395/76-3, dated April 21, 1976. Both of these deficiency notices and the NRC deficiency relate to removed cadwelds, that is cadwelds which were cut out and discarded. The point of concern of that procedural non compliance was that discarded splices were not spray painted red before they were cut out. The worst result of this deficiency which could possibly occur is that a good

cadweld splice might have been unnecessarily cut out. It is noted that the good welds were spray painted white. There certainly was a concern with the failure to follow procedures, but there was no concern that the failure in this case could lead to a hardware deficiency.

The Intervenor references a letter dated July 1, 1974, from E. Wielkopolski,<sup>1</sup> of Gilbert Associates, to Harold Babb of South Carolina Electric & Gas Company. The Intervenor represents that this letter expresses fears about future inadequate splices being covered with concrete. This is totally fallacious. Cadwelding did not commence at Summer Station until August, 1974. The July 1974 correspondence dealt with a recommended change in the testing sequence and frequency associated with production and "sister" splices.<sup>2</sup> The recommendation being made in that letter was that a simpler and more easily understood testing procedure should be used rather than that which had been originally specified. The original Preliminary Safety Analysis Report specification requirements

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<sup>1</sup> The author of the letter was J. M. Torbet, who also signed it. E. Wielkopolski merely signed as the Project Manager. For consistency with Intervenor's reference, I shall refer to it as Mr. Wielkopolski's letter. It is identified by Gilbert Associates as CGGS-2706.

<sup>2</sup> "Sister" splices are performed on the same size bar in situ next to a production splice, but not part of the structure, using short segments of bar. The quality of the sister splice should be indicative of the performance of the cadweld crew under the conditions existing at the time. This includes location, position, size, atmospheric conditions, etc.

for testing were based on the best guidance available at the time the specification was generated. The PSAR was derived from NRC regulatory guides and American Concrete Institute standards in effect prior to July of 1974, which applied to more than prestressed, post-tensioned concrete reactor containments. However, ASME III, Division 2, a more appropriate standard, was in final drafting, was expected to be, and was subsequently issued by ASME and approved by NRC. Gilbert Associates was recommending the incorporation and use of the requirements of that about-to-be-issued standard. Mr. Wielkopolski's letter addressed the fact that the new code had not yet been finally approved by ASME or endorsed by the Nuclear Regulatory Commission. The question, then, in July 1974, was whether Licensees should utilize the latest (but not yet officially endorsed) technology. The concern expressed in Mr. Wielkopolski's letter was that because of the cumbersome and difficult-to-understand testing program, a potential problem may be created: once production was well underway, sufficient splices might not be tested because of the difficulty in keeping track of those which were tested. The architect-engineer was suggesting that the later code system was much simpler and more easily implemented and would provide an improvement in quality. This program was in fact subsequently adopted and used throughout cadwelding. The quoted part of Mr. Wielkopolski's letter addressed by the Intervenor was taken out of context and

misinterpreted and had nothing to do with the performance of cadwelding crews or quality control inspection.

Licensees are not aware of any concerns by Gilbert Associates about inadequately tested splices, nor is there any evidence supporting the allegations that inadequately tested splices were being covered with concrete. I am informed that Mr. Torbet is providing an affidavit on the matter. To the contrary, extensive documentation has confirmed that the cadweld testing program was functional and met or exceeded industry practice at that time. The results of the cadweld testing program have confirmed that our reject rate for cadwelds tensile tested was below that of the rest of the industry and there is no evidence to indicate substandard cadwelds.

Intervenor's discussions relative to the structural acceptance tests are rambling and garbled. I shall not attempt to address those comments point by point. As part of the structural acceptance test, the containment has been tested to pressures of 15% over design basis accident pressure. Not only was there extensive visual inspection on the exterior surfaces of the reactor containment building during the over-pressure testing, but detailed displacement and strain measurements were made. Strain measurements were made with strain gauges imbedded in the concrete on reinforcement provided for that purpose adjacent to the main cadwelded reinforcing steel. The results of the structural acceptance test were acceptable.

The Intervenor's discussion of Section 9.4 of Gilbert Associates' "Reactor Containment Building Structural Acceptance Test" (GAI Report No. 2278, March 18, 1981) displays his lack of understanding of the material. Section 9.4 discusses the extent of predicted cracking which would occur during the test in discontinuity regions of the concrete shell portion of the containment. These are regions of the shell which are adjacent to the base mat, the ring girder, and around locks and hatches. In Intervenor's presentation of Section 9.4, key words were omitted. The last sentence of the extraction should read: "Any cracks which might appear were expected to be limited to discontinuity regions and the cracks were expected to be small in width (less than 0.010 inch) due to the presence of the non-prestressed reinforcement." (Text omitted by Intervenor in his "quote" has been underlined.) Reference to page 26 of the report establishes that the small cracks which occurred in the discontinuity region of the shell below the ring girder were predictable and explainable. Five areas of the containment shell were carefully monitored for cracks during the test. Any hairline cracks which appeared were mapped and dimensionally inspected to confirm performance as predicted. Evidence of this activity exists yet today in the white painted areas obvious on the concrete exterior surface, which are shown in Figure 5 from the Brewer Engineering Attachment to the GAI Report 2278, which was attached to Intervenor's Supplemental Filing on Motion to

Reopen the Record and Conduct Further Hearings and improperly identified as "Figure No. 145 from the Reactor Containment Building Structural Acceptance Test GAI Report No. 2278." The few cracks which did occur were confined to the discontinuity regions of the containment shell and were acceptable.

The Intervenor refers to a surveillance report dated 12-21-77, supposedly authored by an individual named Lindler, and attempts to use that to establish that Licensees have "long been aware of serious systematic QC problems and the resulting below code work on rebar." Licensees are unable to find a Lindler Surveillance Report dated 12/21/77. Mr. Lindler was a quality control supervisor and did not produce surveillance reports (which is a QA function). There is, however, an extensive SCE&G/QA surveillance report (No. 12-21-77-1C) which deals with cadweld inspection and lists Mr. Lindler as the QC supervisor in charge. The surveillance which was the subject of the report began on December 20, 1977 and continued through March 23, 1978. The surveillance report established that all cadwelds in the affected area were acceptable prior to concrete placement.

The Intervenor next discusses cadwelds performed by Mr. Jennings and cadweld reports relative thereto. The quality assurance records establish that Mr. Jennings performed 279 cadwelds. It is possible, however, that there were some cadwelds on which Mr. Jennings performed work and for which he

was not listed as the cadwelder. This is procedurally allowed since some cadweld crews contained more than one qualified cadwelder. It was the cadweld foreman's responsibility to assure the acceptability of the cadweld based on his visual inspection, and it was also his responsibility to have the cadweld tag filled out and to list the appropriate cadwelder in the space provided. Intervenor further states that his review of the records reflects that only 52 cadwelds were visually inspected. This is not true. Every single cadweld was visually inspected after the shot by the foreman and independently by a QC inspector and accepted or rejected on the basis of that visual inspection. There is ample documentation (which Intervenor had the opportunity to review) to establish this. One hundred percent (100%) of Mr. Jennings' cadwelds were documented as being visually examined after the shot. Fifty-two of Mr. Jennings' setups for cadwelds were visually inspected and documented on acceptance checklists prior to the cadwelds being performed. This was in addition to the 100% post cadweld inspection. Pre-shot QC inspections were performed on a random basis and all inspections documented.

Intervenor's Supplemental Filing and Motion  
to Reopen the Record and Conduct Further Hearings.

As to Intervenor's general complaint about accessibility of Licensees' records, I have addressed that general issue in Attachment A.

Intervenor implies that Mr. Jennings' training in cadwelding was inadequate. Documents attesting to the adequacy of Mr. Jennings' training were contained in a "Certification Package" and were provided to Intervenor. He was given the opportunity to review them in detail. Intervenor apparently chooses to ignore the statements made by Mr. Jennings during an August 10, 1982, telephone conference conducted at the direction of the ASLB in which Mr. Jennings not only admitted that he was adequately trained, but praised the training program for its rigorousness in teaching him how properly to make a cadweld. In any case, Mr. Jennings does not allege that he was unable to perform cadwelds properly, but that he willfully and intentionally chose not to do them correctly.

The Intervenor attempts to make a connection between his allegations concerning cadwelding and the welding difficulties explored during the course of the hearings in this docket. This reflects the Intervenor's lack of understanding of two things-- what a cadweld is and who had QC responsibility for cadwelds. Any attempt to link activities alleged by Mr. Jennings to "welding" as discussed during the hearings is out of context in terms of technology, time and the organization responsible for quality control inspection. Contrary to the situation involving welding on safety-related piping, which was the principal subject of concern during the hearings and for which Licensees' contractor held the Code stamp and was responsible, Cadwelding quality control was totally the responsibility of SCE&G.

Although Intervenor references "the apparent falsification of QC documents," there is no evidence to support any implication of document falsification.

As reflected by Intervenor's statement in his supplemental filing, the reason given by Mr. Jennings for his alleged practice of falsifying cadwelds was construction and production pressure. Our review of records indicates that Mr. Jennings' best performance produced a maximum of four cadwelds on any one shift. Review of the records establishes that, routinely, other cadwelders could achieve up to ten cadwelds per shift with no noticeable effect on quality. It is understandable then that Mr. Jennings may have been urged to increase his productivity. But, for Mr. Jennings to project the pressure which he says he was feeling (because of his substandard performance) to all other cadwelders is not justifiable and is not borne out in the record.

In 1977 and 1978, the SCE&G conducted an extensive mock-up testing program for cadwelds as a part of the process of resolving NCN's 350 and 366 mentioned earlier. This program involved extensive tensile testing, X-ray analysis, sectioning of completed welds, cyclic tensile testing of defective cadwelds, and tensile testing of cadwelds purposefully voided or slagged and loaded with other foreign material in their sleeves. The results of this testing confirmed that tensile requirements were satisfied in each of these cases.

Following the receipt of Mr. Jennings' allegations, further mock-up testing was conducted in an attempt to duplicate the defective cadwelding techniques allegedly used by Mr. Jennings. The results of that testing program convinces Licensees that it is highly unlikely that cadweld sleeves could have substantial amounts of No. 9 tie wire melted into the sleeve area. This is because the No. 9 tie wire has a tendency to harden and block further entrance of additional melted tie wire material into the cadweld sleeve. The post allegation mock-up testing program also involved duplication of extensive loss of cadweld filler material as alleged by Mr. Jennings. The "blow by" or leakage of cadweld material during performance of a cadweld, as described by Mr. Jennings, results in a highly visible shower of sparks. Since Mr. Jennings performed much of his cadwelding during the night shift, this type of activity would have been readily observable by the quality control inspectors. In addition, the spattering of cadweld material resulting from such a phenomenon would be readily visible unless the individual performing the cadweld went to extraordinary lengths to clean up the material. The clean up effort in most cases would involve more work than reshooting the cadweld. This convinces Licensees that Mr. Jennings is grossly exaggerating concerning the extent of these alleged practices.

Also, following the receipt of the allegations, Licensees conducted interviews with all available personnel who had

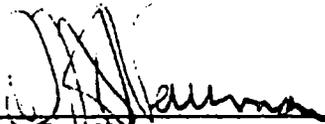
anything to do with cadwelding. Those interviewed were SCE&G QC supervisory personnel; four cadwelders (two of whom served with Mr. Jennings); one SCE&G QC inspector who inspected Mr. Jennings' work; the supervisor of night shift QC activity; and available QA personnel who performed surveillance during this time frame. These interviews produced no confirmation of Mr. Jennings' allegations of significant and widespread defects in cadweld splices. Attempts to reach other persons named by Jennings during the previously mentioned conference call proved unsuccessful.

In a further effort to determine the accuracy of Mr. Jennings' allegations, a thorough review of the Quality Assurance/Quality Control records was made. Those records are extensive, thorough and retrievable. This review confirmed the functioning of the cadweld quality program and revealed certain facts surrounding Mr. Jennings' cadwelding work as well as all cadwelding performed during the time of Mr. Jennings' presence on site. Mr. Jennings has alleged in his affidavit that he worked at the V. C. Summer Nuclear Station site for approximately three years. The records reflect that Mr. Jennings was on site from May 1975 to July 1976, and was a qualified cadwelder only from September 1975 to July 76 (a period of nine months). Contrary to Mr. Jennings' allegation that he performed over 1,000 cadwelds, the records reflect that he performed a total of 279 record cadwelds in the reactor base

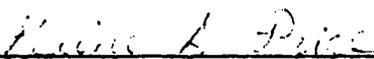
mat and exterior walls, with 111 of those being vertical and 168 horizontal. Mr. Jennings said in his statement of August 11, 1982 to the NRC inspectors and during the August 10, 1982 conference call that his concerns were only about defective splices in the vertical rebar. Again, however, as previously pointed out, it is possible that Mr. Jennings did perform work on more than 279 cadwelds. But his statement that he performed over 1,000 stretches the limits of credibility. There were over 25,000 cadwelds performed at the site (21,000 in the reactor containment), but slightly fewer than 5,000 were performed during Mr. Jennings' time on site. If Mr. Jennings' statement were to be believed, he would have performed twenty percent of all cadwelds performed on site by 44 cadwelders during his time there. Seven different SCE&G/QC inspectors inspected Mr. Jennings' work. All cadwelds by Mr. Jennings were visually inspected and four were rejected and removed. Seven vertical sister splices performed by Mr. Jennings were satisfactorily tensile tested. One vertical production splice performed by Mr. Jennings was cut out and satisfactorily tensile tested. During the period Mr. Jennings was on site, 44 Type I Quality Assurance Surveillances were performed, many of which observed the cadwelding process. There were two program audits (October 1975 and January 1976) conducted and documented as a part of the routine quality assurance program during this time. Two programmatic corrective action requests were issued in relation

to cadwelding. Forty-five deficiency notices and twelve nonconformance notices covering over 400 cadwelds were generated at the site. Finally, there have been over 80 production vertical splices in the reactor building area which were randomly selected, cut out and satisfactorily tensile tested. No evidence is available to indicate the widespread presence of significant defects in cadwelds which Mr. Jennings alleges.

In summary, the evidence examined casts a great deal of doubt on the accuracy of Mr. Jennings' allegations. Engineering evaluations have shown that even if Mr. Jennings' allegations are correct, there is no safety significance.

  
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D. A. Nauman

SWORN TO before me this  
9<sup>th</sup> day of September, 1982

  
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Notary Public for South Carolina

My Commission Expires: 7/14/90.

#### ATTACHMENT A

Mr. Bursey complains that SCE&G did not give him access to certain documents. Except for three unanticipated occurrence reports, which are a part of Licensees' Quality Assurance (QA) confidential information system, Intervenor or his representative were provided access to exactly the same information which has been provided to the Nuclear Regulatory Commission inspectors (specifically, Mr. J. Lenahan). The confidential information system was established to provide a mechanism whereby workers can provide information to the Quality Assurance Group and/or the NRC concerning construction and operating problems which they believe deserve attention. The system relies on assurance of confidentiality and to release those files would unnecessarily compromise its effectiveness.

I note that it was necessary for Licensees to contact the Intervenor in order to establish times and locations for the review of Licensees' records. He made no initiative. Licensee, on one occasion, to accommodate the Intervenor and make it less burdensome for him, agreed to provide information normally kept at the plant site, at its corporate offices in the Columbia. On that occasion, Licensee contacted the Intervenor to establish a convenient time for review of those records, and even though Intervenor agreed to a specific time, the Intervenor failed to appear. Again, Licensee initiated contact with the Intervenor, and at his request made those same records available to him the

following day. The Intervenor sent a representative. The Intervenor or his representative were in every case given unrestricted access to all records (except those previously mentioned) without any interference by Licensees for as long as the individual chose to review them.

Intervenor has complained that Licensees refused to provide names and addresses for former cadwelders. Licensees did provide a listing of all known active cadwelders during the period of interest, although full names and addresses were not provided. Intervenor was advised that this information would have to be secured by him from the personnel files of the company for whom these individuals worked, i.e. Licensees' constructor, Daniel International.

Intervenor complains that Licensees would not allow him to copy "certification" [identification] tags examined by him. These identification tags dealt with Mr. Jennings' qualification record on splices shot in the training area and had nothing to do with production splices. Since these certifications have nothing to do with the production splices, the assertion that there was a "practice of letting other welders sign off on certification tags to help each other meet production," is absurd. As noted, these tags related to qualification shots made in the training area under direct observation of a QC inspector. As explained in the body of my Affidavit, the production tags were usually filled out by the supervisor. He

complains that Mr. Jennings was unable to see these documents. However, he was free to bring Mr. Jennings or his representative and/or an expert with him or send Mr. Jennings and/or an expert as his representative to review those records. He never made any such request and, thus, has no reason to complain now.

It is apparent that a large part of the Intervenor's complaint about lack of documentation is merely a result of his inability to understand and comprehend records which were made available to him.