U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Report Nos. 50-528/83-10
50-529/83-07
50-530/83-05

Docket Nos. 50-528, 50-529, 50-530

Licensee: Arizona Public Service Company
P. O. Box 21666
Phoenix, Arizona 85036

Facility Name: Palo Verde Nuclear Generating Station

Inspection at: Palo Verde Site, Wintersburg, Arizona

Inspection conducted: June 1, 1982 through March 11, 1983

Inspectors:

J. H. Eckhardt, Reactor Inspector — Date Signed 4/21/83

L. E. Vorderbrueggen, Senior Resident Inspector — Date Signed 4/21/83

J. O. Elin, Reactor Inspector — Date Signed 4/21/83

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Approved by:

T. Young Jr., Chief
Reactor Projects Section No. 2 — Date Signed 4/21/83

Summary:

Inspection on June 1, 1982 through March 11, 1983
(Report Nos. 50-528/83-10, 50-529/83-07, and 50-530/83-05)

Areas Inspected: A special inspection by regional and resident inspectors and investigators of allegations concerning electrical construction inadequacies. This inspection involved 206 inspection-hours by four NRC inspectors and 284 hours by three investigators for a total of 490 inspection hours.

Results: One item of noncompliance was identified in the area of quality documents (paragraph 2).

stated to me that they may have put a check, star, or other identifying mark in the lower left hand corner of the form to indicate they had also signed cards for terminations that had not been performed by them. I was directed to sign two to three cards in some weeks, and other times I flatly refused to sign them. I personally signed only maybe a dozen cards altogether and this was when I was in hot water and "I was told either do it or get another job." I estimate that 250 to 300 cards are involved which covered the work of five crews over the period from 1981 to 1982. I know the following individuals were directed and did falsely sign termination cards indicating they had performed the termination: "D", "E", "F", "G", "H", "J", and "C". I also observed a couple of termination cards which were already signed with my name, but it was not my signature and I have no knowledge of who signed my name.

I observed some Quality Control (QC) inspectors sign termination cards at their trailer office indicating that they had inspected the terminations. I do not know if the QC inspectors did or did not inspect the actual terminations."

b. NRC Findings: Portions of the allegation were substantiated.

The Palo Verde Bechtel construction procedures require that records be made and retained for each Class 1E electrical termination. The record is referred to as a "termination installation card". The front side of the card includes such informtion as termination number, cable number, separation group and location; and also, the signature of the electrician performing the termination ("installed by"), the date installed, and the crimp tool number used. The back side of the card is the QC inspection record of the termination. The inspector examined all Unit 1 Class 1E termination records for terminations completed through May 1982. The purpose of the review was to identify any inconsistencies or distinguishing marks on the cards as alleged. Of the approximate 7000 to 8000 cards examined, 127 cards were affixed with the alleger's signature in the "installed by" position in the lower left hand corner. Of these 127 cards, one card was affixed with the sysmbol in the lower left hand corner as alleged identifying that the particular termination had not in fact been installed by the electrician (the alleger) whose signature appeared on the card. Of the remaining cards, nine cards were affixed with other distinguishing marks in the lower left hand corner. These nine cards were signed by two different electricians. During interviews, these two electricians indicated that the marks did not have any significant meaning; the marks were merely for field tracking purposes.

During the review, the inspector also noted approximately 12 cards where the installer's name was printed versus written in the appropriate space. On these cards, there were notes in the remarks section indicating that these cards were duplicates of the originals. Discussion with Bechtel indicated that in some cases, the cards had been lost or misplaced and the name of the installer who had worked on the termination in a particular panel as determined by other cards or informal field tracking records was

printed on the card along with the crimping tool number he was using during the period of terminations in the panel. These terminations were then inspected by QC as appropriate.

A total of thirteen electricians, three foremen, one general foreman, and one superintendent were interviewed and questioned concerning the practice of signing termination cards in the "installed by" block for terminations they had not actually performed. Of these electricians, eight indicated that they had been requested to sign termination cards for terminations they had not installed and for which they were told that the termination cards had been lost or misplaced. These electricians indicated that they responded in four different ways to the requests: (1) they refused to sign the cards, (2) they signed the cards after visually inspecting the termination to ensure it was satisfactory, (3) they signed the cards after reterminating the connection, and (4) they signed the card without examining the termination. Review of the cards and termination inspection program and interviews with QC personnel indicated that these terminations were subsequently inspected by QC.

Of the eight electricians who indicated that they had been requested to sign the cards, none of them indicated that they had been pressured into signing the cards. They stated that they had merely been requested to sign the cards and "were not pressured in any way"; even the ones who indicated they refused to sign the cards. They also indicated that they had been requested to sign "1 or 2 cards" (one electrician indicated "3 or 5 times") over a one year period. Additionally, the electricians generally indicated that the terminations involved "black" (non Class 1E) cables; however, a "few Q Class" (Class 1E) terminations were involved. One foreman interviewed indicated that the signing of the cards involved approximately 12 cards that were lost and included both "Q and non-Q class".

The exact number of Class 1E termination cards that have been incorrectly signed is not known; however it is estimated (based on the number of Unit 1 electricians responsible for terminations and comments obtained from those interviewed) that from 50 to 100 Class 1E termination cards may be involved.

In addition to the problem of discrepant signatures on the termination cards, the crimp tool number recorded on the cards in question is also discrepant. In the cases where the electrician signed termination cards for terminations they did not install, they either recorded the crimp tool number for the crimp tool they had in their possession at the time of signing or used a "dummy" crimp tool number (B-9999) that they use for bolt type termination connections. A calibration check of crimp tools is performed at 90 day intervals as an aid in assuring the quality of terminations. If a crimp tool fails the calibration check, then the terminations that have been performed with that termination tool during the 90 day period can be reinspected and recrimped if necessary. The primary purpose of recording the crimp tool number on the termination card is to have a

record of terminations so that those terminations affected can be reinspected or recrimped, if necessary, in the case where a crimp tool is found out of calibration or in the case where it is determined that an incorrect type of crimp tool may have been used. A review of the calibration records of hand type crimp tools, indicated that there were no crimp tools of this type that failed the calibration check during the time period in question.

The requirement and instructions for completing termination installation cards are given in Bechtel procedure WPP/QCI-255 0, "Cable Terminations". The procedure satisfies 10 CFR Part 50, Appendix B, Criteria V and XVII which require that activities affecting quality shall be accomplished per instructions and that records of these activities shall be maintained.

Contrary to these requirements, the record of Unit 1 Class 1E electrical termination 1ESI22AC1RE2 dated November 13, 1981 for the Safety Equipment Status Board shows the name of an individual and a crimp tool number when, in fact, the termination was made by another individual using another crimp tool. In addition, approximately 50 to 100 such records of Unit 1 Class 1E terminations were estimated to be similarly incorrect. This estimate is based on statements of personnel involved in the work. The number of records affected is a small percentage of the approximate 7000 to 8000 Unit 1 termination cards.

The fact that certain Unit 1 electrical termination installation cards do not reflect the signature of the actual installer and do not reflect the crimp tool number of the crimp tool actually used to make the termination is not in accordance with the above mentioned requirements and is considered an apparent item of noncompliance. (Enforcement item 50-528/83-10-01)

3. Allegation Regarding Improper Splicing of Quality Class Safety-Related Cables

a. Allegation:

"Sometime after the first of the year in early January 1982, General Foreman "K" directed that splices be made on red and green safety-related control cables which had previously been burned by slag from overhead welding which fell on the cable trays. "K" asked me to provide him with heat shrink tubes to be used on these splices. I did not observe the splices but believe that they were made with black heat shrink tubing which were then covered by other cables. The locations for these splices are in cable trays in overhead of corridor areas of the Auxiliary Building of Unit 1 at the 100 foot level at about the 118 foot elevation southeast section and at the 120 foot level at about the 138 foot elevation in the southwest section. The electricians tried not to alert QC personnel to these splices so that the cables would not have to be repulled and reterminated. I do not know if QC personnel ever inspected or accepted these cables".

b. NRC Finding: The allegation was not substantiated.

The inspectors examined the cables installed in the cable trays in the area alleged to have the spliced cable. This examination did not reveal any spliced or damaged cable.

During the interviews, the Unit 1 cable pulling Foreman "K", indicated that he was aware of a cable located in the Unit 1 Control Building that had been damaged and repaired with "shrink tubing." He indicated that the damage had been repaired per the disposition of a NCR and then subsequently rejected.

The inspection disclosed two NCRs that deal with this cable, which is located at the 100 foot elevation of the Control Building. The first NCR (Number EJ-477 dated May 20, 1980) indicates that Class 1E cable 1EHDO1AC1RH (600 v control cable type A371) was found to have a 3/16 inch diameter gouge in the outer jacket located where the cable passed through 90 degree horizontal tray section 1EZJ1AATRAA (cable footage marker 92354). The NCR specified repair of the outer cable jacket with Raychem WCSF sleeve. The cable jacket was repaired by this method and inspected and accepted by QC on September 9, 1981. The second NCR (Number EJ-1402 dated September 9, 1981) indicates that the same cable (Number 1EHDO1AC1RH) was found to have a 3/8 inch rip in its outer jacket at tray section 1EZJ1AATRAB (footage marker 92350). The disposition of this second NCR was to cut off and scrap the cable ends, abandon the remaining section of cable in the tray, and install a new cable. This work was completed on September 21, 1981. Specification 13-EM-306, paragraph 12.1 does not allow repair of Class 1E cable. The disposition of the first NCR (Number EJ-477) should not have allowed repair of the cable as it did. (open item 50-528/83-10-02)

4. Allegation Regarding Use of Improper Insulation on High Voltage Terminations

a. Allegation:

"An insulation material is used where lugs contact terminals to smooth sharp points especially near bolts to prevent damage to heat shrink tubing. Originally, it was the practice to use a product of the 3M Company called Scotchfill 2200 which came in a black pad which was squeezable or formable. Later, a material which I believe was supplied by the Rayco Company identified as 130 C which is in the form of a 1/2 inch wide tape and was used to perform this function. The 130 C is hard or firm. It was noted by site personnel that Scotchfill 2200 was rated at 600 volts and a Request for Information (RFI) was sent to Bechtel engineering about November 1980 questioning this practice of using Scotchfill 2200 for terminations. Bechtel replied that Scotchfill 2200 or 130 C could be used inter-changeably. In October or November 1981, a new specification was issued which required the use of only 130 C on high voltage terminations. After the issue of the new specification we started using 130 C on all high voltage splices. It was believed that the reason for the change to 130 C was based upon the fact that Scotchfill 2200 was squeezing out of the heat shrink tubing and the

heat shrink tubing was cracking where it contacted the corners of termination bolts. Scotchfill 2200 was originally on splices on the High Pressure Safety Injection Pumps, Low Pressure Safety Injection Pumps, circulating water motors on the end of the turbines, and the emergency motors of the water intake for the cooling towers and the spray ponds. The change in specifications was not retroactive to these or other motors previously terminated. While performing megger checks and high potting, the Start-up personnel removed the termination on all of the above motors except the emergency motors of the water intake for the cooling towers, which are safety-related. Because of this, all of the other motors indicated had their Scotchfill 2200 replaced with 130 C."

b. NRC Finding: The facts presented were determined to be correct, but have no safety significance.

The Scotchfill 2200 filler material was replaced with Raychem 130 C on all of the motors except for the cooling tower water intake motors as alleged. However, the cooling tower water intake motors are not safety-related. They are non-Class 1E motors; the ultimate heat sink is the spray pond and not the cooling towers.

The technical acceptability of Scotchfill 2200 will be determined and, if it is found to be unacceptable, other safety-related applications will be examined further during a future inspection. (Followup item 50-528/83-10-03)

5. Allegation Regarding the Use of a One Bolt Lug when a Two Bolt Lug was Required

a. Allegation:

"In some instances, Bechtel directed the installation of a one bolt lug, which has a 45 to 65 amp rating, on motors that run at 120 amps and run's 480 amp surge. This occurred when motors were received from the manufacturer without any lugs attached. Bechtel engineers, "L" and "M", directed that one bolt lugs be installed on these motors. This took placed at about the last part of November or early part of December 1981. One of the motors that was set up with a one bolt lug coming off of the motor and connecting it to a field cable that had a two bolt lug was the spray pond pump on the north side of the pond at the west end of Unit 1. Two bolts were put into the two bolts lug to make it look like there were two individual two lug bolt properly connected. But the spray pond pump on the south side of the spray pond had a two bolt lug coming off of the motor. This use of a one bolt lug was done in all the motors mentioned in Item 4 above except for the circulating water pump.

"N" was advised by me of this attempt to make the connections look like they had two individuals two bolt lugs fastened together when one lug was only a one bolt lug. "N" prepared a Nonconformance Report (NCR) on this problem but I believe construction personnel destroyed the NCR. The improperly fastened one bolt lugs can be

identified by either feeling through the heat shrink or by means of x-ray."

b. NRC Finding: The facts presented were determined to be partially correct, but have no safety significance.

The two men identified in the allegation; "L" and "M" were interviewed. The following information was learned from the interviews and additional investigation into the subject on site.

Motor manufacturers normally supply lugs (terminal connectors) along with the motors they deliver. In those cases where the motor leads are size No. 2 or smaller, the connectors have only one bolt hole. This is the industrial standard; connectors for size 2 cable and smaller have only one bolt hole while the larger size connectors will have two bolt holes. When a pump motor with a size 2 connector is served by a feeder cable larger than No. 2, the terminal connectors have two bolt holes. The one hole connectors on the motor leads will bolt to one of the holes in the feeder cable connector which is standard procedure. Quite frequently the unused hole in the two hole feeder cable connector will have a bolt installed (as a spacer) to facilitate wrapping and insulating the connection.

Of the pump motors in question, the spray pond pumps and the circulating water pumps, only the spray pond pumps are safety-related, i.e., Class 1E. The circulating water pump supplies cooling water to the condenser for condensing turbine exhaust steam. The spray pond pump motors (600 HP) along with the motors of other safety-related pumps: HPSI (1000 HP), LPSI (500 HP), containment spray (800 HP), essential cooling water (800 HP) and auxiliary feedwater (1000 HP) were investigated. These pump motors are all energized from 4160 volt switchgear by 4/0 feeder cables. Four aught cable terminating connectors (larger than No. 2) have two bolt holes. These cables, larger than required, and equipped with two hole connectors serve the various pump motors identified above. The larger motors (1000 HP) with a normal full load current of approximately 125 amperes are energized through feeder cables (4/0) rated at approximately 290 amperes. The reference in the allegation to the use of 45 to 65 amp rated connectors with relation to the normal practice, which is to use conductors (feeder cables/connectors) that have ampacity of not less than 125 percent full load rating of the motor, is in error. It was determined that the reference in the allegation to 45 to 65 amp rating was not the rating of the connectors but were manufactures reference numbers stamped on the connectors. The terminal connector's ampacity is rated for the size cable it terminates. The rating of the cable and connectors was found to be more than adequate for the motors they served.

Review of the design and records of the feeder cable and motor connections for the above identified pumps demonstrated the connectors to be of adequate current carrying capacity and the installation to be of good workmanship quality.

6. Allegation Regarding Improper Training and Qualification of QC Inspectors

a. Allegation:

"I was called on several times during my employment to spend a couple of days training new QC inspectors for electrical. Many of these inspectors had no background in the electrical field and the only training they received was the amount of time I could spend with them in their initial two days of training.

An instance that demonstrates the QC inspectors lacking electrical knowledge occurrred when "B" and "A" wanted me to splice the QC cable in a manhole in front of the spray pond of Unit 1. The cable had been run for the suction motors but the cable was too short. The code does not allow this splicing. I had to go to five QC inspectors before I could find one to say the splicing of the QC cable was not to be done. The other QC inspectors were not sure of what to do so they apparently went along with the desires of the construction personnel. As a result of the direction of the last QC inspector, name unrecalled, the cables were pulled, and cables of the correct length were run."

b. NRC Finding: The allegation was not substantiated.

The licensee's training program for qualifying QC inspectors who perform inspections of electrical and instrumentation installations during the construction phase of nuclear power plants was examined. This examination also included reviewing the training records of 29 electrical and instrument QC inspectors.

The training program conforms to the requirements of ANSI N45.2.6 dated 1973, "Qualifications of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants." Three levels of inspectors (Levels I through III) are trained and certified at the Palo Verde site. A Level I inspector has the least responsibility with the basic education and experience requirements. Successive levels of inspectors have greater responsibility requirements and entail greater requirements in education/training and experience.

The training program is a supervised formal program consisting of lectures, reading assignments and demonstrations. The material embraced in the training program is:

(1) Applicable IEEE (industrial) standards

(2) Applicable quality control procedures

(3) Applicable work plan procedures/quality control instructions

(4) Applicable specifications and procedures

(5) Interpretation of drawings and symbols

(6) Electrical processes: grounding, cable installation, cable termination, megger testing, heat shrink insulation, component maintenance, conduit and tray support and installation, etc.

Proficiency evaluation of the QC inspectors is determined by written examination, performance demonstration, and an oral examining board. Inspecting personnel are evaluated initially and at two year intervals.

With reference to the allegation concerning the splicing a cable in a man-hole in front of spray pond No. 1, Section 7.2C of Electrical Specification 13EM306 allows for the splicing of cable. Cable splices are authorized by field engineering on a case by case basis. A formal written request to make a cable splice must be prepared on a Field Change Request (FCR) form. The splice can be made only after it has been authorized by field engineering. QC inspectors inspect to approved documents. They do not have the authority to make field engineering decisions.

The review of the QC inspector training program and the individual training progress records has illustrated that the licensee's training program conforms to the requirements and recommendations of ANSI N45.2.6-1973.

This allegation will be examined further in a future inspection. (Followup item 50-528/83-10-04)

7. Allegation Regarding Repeated High Potential Testing on the Same Cable

a. Allegation:

"The Termination Book defines procedures for terminations and high voltage testing. The procedure specifies only one "high pot" test for cable manufactured by Anaconda Copper. This procedure was not properly being followed by personnel in construction and Start-up who are repeating the "high-pot" tests. Because of the ineptness of some of the engineers assigned to testing, I estimate that some of the cables have been tested four or five times. A typical high pot for 13,800 or 4160 volt cables is to pump 69,500 volts through the lines."

b. NRC Finding: The allegation has no technical merit.

Purchase Order 10407-13-EM-029 through Revision 8 (July 1981), purchase specification for 5 and 15 kv power cable manufactured by the Anaconda Company was reviewed for restrictions imposed on high voltage testing. No restrictions on high voltage testing were identified.

Bechtel Procedure WP/P-QCI No. 256.0 Revision 5 of June 2, 1982, was reviewed for restrictions imposed on high voltage testing. This procedure establishes methods for insulation resistance testing of both Class 1E and Non-Class 1E electrical equipment and cable. This procedure defines methods used for insulation resistance or "MEGGER"

testing of components and cable and D.C. high potential testing or "high potting". No restrictions on the number of high potential tests which may be performed on equipment or cable was identified. This is consistent with IEEE STD 400 (1980), "IEEE Guide for making High Direct Voltage Test on Power Cable Systems in the Field".

8. Allegation Regarding Omission of O-Rings

a. Allegation:

"Bechtel is not always using O-rings on the conduit to cabinet connections as required in cabinets downstairs in the Control Building at the 100 foot elevation. These cabinets are located underneath piping systems, and the cabinets are required to have water integrity. They were out of O-rings for six months and just kept piping."

b. NRC Finding: The allegation has no technical merit.

The particular electrical cabinets referred to by the alleger are not specified as water tight. Also, the area above these cabinets does not contain piping. The general electrical drawing specifies sealing material as an acceptable substitute for O-rings where conduits enter the cabinets.

9. Allegation Regarding Block Walls

a. Allegation:

"Between the A and B sides at the 100 foot elevation around the safety-related battery room, the wall is constructed of cinder blocks, however, the wall was supposed to have been a concrete wall."

b. NRC Finding: The facts presented were determined to be correct, but have no safety significance.

The control building and auxiliary building do, in fact, contain various masonry block walls ("cinder block" as referred to by the alleger). Specifically, the seismic Category I control building has a masonry block partition wall for fire protection which devides the building into two halves from elevation 74' to 100'. Also, each Class 1E battery room is constructed with masonry block walls to separate the divisions of dc power supply. These walls were designed to retain their structural integrity in the event of an earthquake. The existance and design basis of the block walls is discussed in Appendix 3A of the FSAR and shown in Figures 3A-20 through 3A-24.

10. Allegation Regarding Conduit Damaged by Core Drilling Not Repaired

a. Allegation:

"In the Auxiliary Building on the Southeast corner by the 100 foot elevation and about 15 feet above the floor, they drilled cores into the wall and in doing so, drilled into some conduit. Some of the damaged conduit was located approximately 18 inches into the containment wall. "R" and "S" were assigned the task of patching the damaged conduit. Because "R" and "S" could not reach the damaged conduit within the containment wall, they just plugged up the area around the hole in the wall in an attempt to isolate the damaged conduit. My concern is that thermal expansion will cause a rubbing of the insulation against the rough holes bored into the conduit causing a short. In addition, these holes could cause an induction problem as there are different voltages involved."

b. NRC Finding: The allegation was not substantiated.

The damage to the conduit did, in fact, occur during core drilling and is documented in NCR EC-1304 dated August 4, 1981. The conduit in question, IEZCIEARK12, is located in the main steam supply structure (MSSS) floor slab at the 100' elevation. The disposition of the NCR specified the application of General Electric silicon seal to the cleaned edges of the piece of conduit cut out by the core drill, wedging the piece in place for 24 hours, filling the hole with grout, and finally cleaning the interior of the conduit to remove any debris remaining from the drilling operations.

During interviews with the personnel involved, the inspectors determined that a portion of this work was performed from the Auxiliary Building side of the wall. This was apparently the effort that the alleger observed. The interior of the conduit was subsequently visually inspected by the NRC and a licensee's QA Engineer with the aid of a boroscope. This inspection verified that the interior of the conduit does not contain any sharp or rough edges.

11. Allegation Regarding Use of Improper Cable

a. Allegation:

"At the 100 and 120 foot elevation in the Auxiliary Control Building, the Q cables to the cabinets are not properly installed. The field run cables were too large for the lugs that would fit on the termination strip supplied with the equipment. To overcome this problem, the cables were cut approximately two or three feet from the cabinet and a smaller sized cable was spliced to the field cable. These modifications were for every cabinet, which are located on the feeder side. This splicing of the small cable to the larger cable can be observed in the raceway."

b. NRC Finding: The facts presented were determined to be partially correct, but have no safety significance.

The installation specification for cable splicing, terminations and supports is Specification 13-EM-306, Bechtel Job Number 10407

Revision 5 of October 7, 1981, which states in paragraph 8.2.5, "Special Termination Situations" that:

> "Where terminations cannot be made due to mismatching of field cable and lugs on vendor equipment, the following options shall be applied:
>
> (1) Equivalent undrilled (black) terminal lugs may be used; field to drill as required, or field shall do minor filing to termination lugs.
>
> (2) Existing vendor terminal blocks may be replaced with larger blocks procured under Specification 13-EM-009. For quality Class Q Class 1E equipment replacement of blocks will require an engineering approved FCR.
>
> (3) The field shall make pigtail termination splices within eye sight of the connection point and in no case farther than 18" from the connection point. Exceptions to this shall be handled as per 7.2.C. The following procedure shall be used:
>
> (a) Terminate to the device/terminal block with a pigtail (using field cable) of the maximum size wire which will be received by the device/terminal block. The current carrying capacity of the pigtail wire shall be equivalent or greater than the vendor wire or wires.
>
> (b) Crimp appropriate lugs to the pigtail and field cable and make a connector to connector bolted splice per 8.2.1d, 8.2.3 and 8.2.4.

The licensee stated compliance to Regulatory Guide 1.75 and IEEE-384 of 1974, in the final safety analysis report, paragraph 8.3.1.2.2.1b.

Regulatory Guide 1.75 states in Section C, "Regulatory Position," paragraph 9 that "cable splices in raceways should be prohibited". This paragraph also states that although this position against splices in raceways is prudent, "splices are not, by themselves, unacceptable. If they exist, the resulting design should be justified by analysis."

The licensee stated that qualification of splice connections used on Class 1E cables will be reported to NRC with Class 1E electrical equipment qualification data.

The inspector sampled selected switchgear on the 100 and 120 foot levels of the Auxiliary Building in the "wraparound" area to confirm that splices were present on safety-related, Class 1E circuits. Splices were found in motor control centers IE-PHB-M36, IE-PHB-M34, IE-PHA-M35 and IE-PHB-M33. The specific breakers identified with splices were: M3436 diesel generator B lube oil circulating pump,

M3435 battery charger "BD" supply, M3422 fuel and Auxiliary Building essential air flow fan, M3606 LPSI flow control valve, M3621 LPSI flow control valve, M3322 HPSI flow control valve, and M3328 diesel generator A lube oil curculating pump. This review did not attempt to identify all such splices even within the identified motor control centers, but rather it substantiated the existance of such splices as described by the alleger. In each of the above cases the inspector verified that the splice consisted of a bolted connector to connector splice through crimped lugs as described in the cable termination specification. In each of the above cases the inspector further verified that the conductor area in circular mils "of the spliced in pigtail" was equal to or greater than the conductor area of the vendor supplied cable connecting the termination to the breaker. In two cases the termination strip had been eliminated and the pigtailed cable terminated directly on the breaker, thereby eliminating the possibility of bridging shorts between phases on the terminal strip due to the cable lug size utilized. In these two cases the "pigtail" conductor size was equivalent to the size of the vendor supplied cable on the supply side of the breaker. The spliced in "pigtails" were observed to be less than 18" in length.

In each case observed, the inspector verified that the "pigtail" splice was made in conformance to the requirements of the licensee's specification. Several termination cards for the cables involved were reviewed and in each case the use of "pigtailed" leads was documented along with the field change request (FCR) which authorized the installation.

The inspector additionally notes that it is common industry practice to terminate cables with "pigtailed" ends, particularly in cases where due to long cable runs, larger cable than normally specified for current capacity are required to reduce voltage loss at the load.

This allegation although confirmed to be factually accurate is judged to be without technical significance. The licensee appears to have controlled and documented the use of "pigtail" splices in accordance with the requirements of the safety analysis report.

12. Allegation Regarding Inadequate Number of X-Ray Inspections of Splices

a. Allegation:

"At present, about one out of every 10 electrical splices are being x-rayed, but I consider this number of x-rays to be insufficient for a good QC inspection system."

b. NRC Finding: The allegation has no technical merit.

There are no requirements from either the NRC, electrical codes, or Palo Verde construction specifications that require radiograph of electrical cable splices or terminations. Therefore, the allegation that only one out of ten splices are being radiographed is not significant.

13. Exit Interview

No exit interviews were conducted with licensee management since the investigation was performed in accordance with the administrative rules of the Office of Investigations.