The TVA responses to the recommendations from QTC Report IN-85-037-001 were rejected twice by QTC. These rejections were based on the fact that the TVA sampling program does not meet the requirements of Bulletin 79-02, Appendix "A". This evaluation shows that the TVA 79-02 program is adequate and has been accepted by the NRC.

However, it should be noted that the NRC did not respond in writing to TVA on WBN's 79-02 program until February 1985. Reviewing correspondence between TVA and the NRC associated with 79-02 has revealed NRC initiated correspondence exists only to request additional information in a specific area or to document an area where TVA was deficient. Positive feedback from the NRC is verbally communicated in some cases but documented positive feedback in the form of correspondence cannot be located. TVA has developed the philosophy that "no news is good news" with respect to the way the NRC does business. Since the NRC is the regulatory agency for TVA's nuclear program, open, well defined communication should be the standard, not the exception.

QTC performed a field inspection of three duct supports (2030-DW915-15H-1485, 2030-DW915-15H-1496 and 2030-DW915-15H-1497) that had a total of 20 concrete expansion shell anchors installed. A Hanger Quality Control Inspector was present and documented that the 20 anchors inspected were acceptable. However, two duct supports specified by number in the employee concern were not inspected by QTC.

Two field inspections were performed during the ECTG evaluation. The two duct supports not inspected by QTC were inspected by ECTG and Hanger Quality Control. Duct supports 2065-DW915-15H-1582 and 1583, containing 16 anchors, were inspected for plug depth and thread engagement and documented as being acceptable. A total of 32 anchors were inspected for duct supports 1-CB-H-31-62658, 61657 and 60656 located in the control building. Although some of these anchors had less than minimum thread engagement, they had been identified and determined to be acceptable per NCR 3409R. The plug depth for all anchors was acceptable.

Concern PH-85-035-007 addressed the use of 3/8-inch red heads instead of 3/4-inch red heads in supports for reactor coolant pump drains. The area specified in the concern was visually inspected and no 3/8-inch red heads were identified.

Conclusion:

The issue of anchors cut off is factual and has presented a problem for which corrective action has been or is being taken as a result of this employee concerns evaluation. However, it should be noted that, during the evolution of the anchor program at WBN, many problems have been previously identified and corrected. It should also be noted that some concerns in this issue, which were specific enough to visually verify installed conditions, were found not to identify improper anchor installations.

4.4.2.2 Sequoyah Nuclear Plant

The expurgated employee concern file contained no additional information.

The first methodology employed in the SQN-GCTF report was to compare TVA General Construction Specification G-32 pull test data with the results of the 79-02 sampling program and with the results of an extensive reinspection program conducted in response to the Quality Technology Company (QTC) investigation of a specific employee concern (XX-85-010-001). This comparison revealed acceptance rates of greater than 95 percent for each inspection/reinspection program. The fact that these three comparisons reflect comparable results (the results of the QTC reinspection program are initial results only) with very high acceptance percentages is especially significant when the timeframes of each program and the anchor installations are considered. The G-32 pull test data reflected tests performed from day one through approximately mid-1980. The 79-02 sampling program included anchors that had been installed from day one through early 1981. The reinspection program performed as a result of the aforementioned QTC investigation started in 1985 and is still in progress.

The SQN GCTF report also addressed the reinspection performed as a result of concern IN-85-237-001, but this concern resulted in approximately 426 reinspections at WBN, not at SQN as stated in the report. The report addressed the issue of sampling programs instead of individual testing and referenced the NSRS investigation (I-85-439-WBN) performed which determined this to be an acceptable practice. The GCTF report also addressed two open issues that were not researched by the SQN-GCTF: base plate flexibility and overtorquing. The evaluation performed on issues generic to SQN by the WBN-ECTG addressed the aforementioned sampling program issue and the overtorquing issue in the element report titled "Testing of Anchors" (C011306) and the base plate flexibility issue in the subcategory report titled, "Embeds" (C010400).

The WBN-ECTG Element Report for Anchors Cut Off (C011305) employed methodology that addressed the WBN 79-02 program as a whole, instead of addressing specific issues raised by each concern. The conclusion of the report states, "concerns identified for this element are generally factual and examples of the referenced deficiencies have all been previously identified per NCRs." The report referenced specific DNE comments and reports which verify the adequacy of the 79-02 and General Construction Specification G-32 sampling programs. The report concluded that there was no generic applicability because 79-02 had been addressed by each nuclear plant.

NRC OIE Bulletin 79-02 required inspection and verification of the following conditions with respect to anchor bolts in Seismic Category I systems:

1. For SSD anchors, insure that the shell is not contacting the back of the baseplate prior to pull testing.

2. Specified size and type of anchor is correctly installed.

3. Preload (pull test/torque test values) is equal to or greater than bolt design load.

A sampling program was required when sufficient documentation did not exist to verify the three areas described above. One recommended sampling technique was to randomly select/inspect one anchor bolt in each base plate - if this bolt failed, inspect all other bolts on that base plate. The final comment was that, "the test program should assure that each Seismic Category I system will perform its intended function." Revision 1 of the 79-02 Bulletin addressed additional inspection parameters that included verification of leveling nut installation during testing, anchor embedment depths, thread engagement, plate hole size, bolt spacing, plate and concrete edge distances and full shell expansion (cone depth). An additional requirement was that each site maintain sampling documentation of anchor bolts for NRC inspection. Also, an alternate sampling method was described which addressed statistical sampling that would provide a 95-percent confidence level that less than five-percent defective anchors were installed in any one Seismic Category I system. This sampling program was to be done on a system by system basis. (Note: The requirements listed here address inspection type parameters only - the design/analysis requirements are addressed in the subcategory report 10400 on Embeds.

The SQN (unit 1 and 2) 79-02 Anchor Inspection Program Procedure, Evaluation Criteria and Work Plan, Program for Verifying Correct Installation of Self-Drilling Anchors and the applicable Data Sheets for recording of required information were reviewed. It was determined that, with the exception of minor deviations which were approved/accepted by the NRC, SQN fully implemented the requirements of NRC OIE Bulletin 79-02. This is stated in the SQN Safety Evaluation Report, Supplement 2, Section 3.9.2.

The results of the SQN Anchor Inspection Program for 79-02 are found in the final response to TVA Nuclear Regulations and Safety Manager for transmittal to the NRC (NEB 810324 276) and in the Final Inspection Report to the NRC (A27 810403 011).

The summary of the conclusion in each report was that SQN had complied with the 79-02 requirements because:

1. The failure rates compiled by the 79-02 inspection data were comparable to those in SQNs G-32 pull test/inspection program which reflected the adequacy of the existing G-32 inspection program.

2. The NRC had previously reviewed the 79-02 inspection results as well as the G-32 data and determined that SQN was in compliance with 79-02 requirements.

3. Failure rates for the 79-02 inspection program were less than one percent - failure rates for the G-32 program were also less than one percent. (These failure rates included evaluations performed at the design level).

In addition, the SQN memorandum from H. L. Abercrombie to K. W. Whitt of April 24, 1986, concerning the NSRS Investigation Report XX-85-010-001 contains references to a telephone conversation from C. R. Brimer, SQN Site Services Manager to J. Burke, NRC Region II, which verified that SQN compliance with 79-02 was not a NRC issue. (However, further evaluation has identified a specific deficiency in the qualification and use of Rawl self-drilling anchors at SQN. The specific details of this subject as well as the CATD initiated subsequent to this finding are addressed in the Construction Category, SQN Element Report CO11301-SQN, Design of Plates and the Subcategory Report 10400, Embeds.) R2

A detailed review was performed of NSRS Investigation Report I-86-120-SQN which addressed seven concerns specific to SQN (SQP-5-005-001 thru SQP-5-005-007). Each issue is applicable to NRC OIE Bulletin 79-02 and/or TVA General Construction Specification G-32.

1. Modified Support Plates - Work Request (WR) 114789 was initiated to sample supports in the affected plant area for torched or beveled holes in baseplates. In addition, this sample was a

mechanism to reveal anchors installed outside of the G-32 requirements with respect to anchor perpendicularity.

This condition was described in concern SQP-5-005-004. The results of the sample program revealed no evidence of the alleged condition(s) and the concern was determined to be unsubstantiated. (To further verify anchor acceptance to the G-32 perpendicularity requirement, SMI-0-317-21 which was written to determine anchor bolt length as described in section 8 is referenced. This SMI randomly selected 111 baseplates for inspection and revealed six plates had discrepancies with respect to G-32 anchor inspection requirements. None of the identified deficiencies were due to anchor perpendicularity.) However, the NSRS sample did identify two bolts that were damaged because of anchor/plate misalignment (A0318R004 and A0508R005). These deficiencies are being tracked by SQN compliance as an open item and are being evaluated according to SQN-FCR-4651 and ECN L6744. (CATD No. CO11305-SQN-04)

2. Abandoned Anchor Holes - during the sample program of WR 114789 several abandoned anchor holes were found. The NSRS report concluded that the concern was factual but no violations of current G-32 criteria were noted. The WBN-ECTG performed a review of G-32 to determine the requirements for abandoned holes to be dry packed or grouted. The present criteria state, "the minimum clear distance between the hole for the working anchor (anchor in use) and the hole for an abandoned anchor shall be equal to the diameter of the larger of the two holes . . . the distance may be reduced for SSDs, wedge bolts and grouted anchors if the abandoned anchor is removed and the hole is grouted or dry packed." To further verify the NSRS findings on this issue a field evaluation was performed in the Motor Operated Valve Board Rooms 1A and 1B. This evaluation revealed the majority of the abandoned anchor holes had been grouted. Those abandoned anchor holes that were not grouted did not violate current G-32 criteria with respect to spacing between working anchors and abandoned anchors. Therefore, this evaluation agrees with

the findings of the NSRS investigation report, to wit: no violations of G-32 criteria occurred and no conditions adverse to quality (CAQ) were identified.

3. Shortened Anchor Shells - cone expander (plug) depths were checked as a part of the WR 114789 sample program and sixteen anchors were found to have plug depths outside current G-32 criteria; another three anchors had questionable plug depths. It was noted in the NSRS report that inspection of plug depth was not a requirement during the concerned individual's (CI) timeframe. The recommendation was made that the Division of Nuclear Engineering (DNE) evaluate the long/short plug depths. The DNE response (B45 860507 008) stated that initial evaluations showed some anchors may have a small reduction in the factor of safety but would still be significantly above the values required for operation since 79-02, Revision 1, requires a factor of safety of two for interim operation. DNE coordinated these facts with the SQN Compliance Staff and agreement was reached that this issue did not require resolution before restart.

   The logic for this was that no discrepancies had been found by the NSRS sample which had not been addressed previously by site NCRs or NRC OIE Bulletin 79-02. DNE also took exception to the NSRS sample in that current G-32 criteria were used to evaluate installations made in 1976. This statement was supported further in a memorandum (C23 860618 006) from DNE to the SQN - Site Director. It was noted that the G-32 criteria had been enhanced over the years and that in 1981, G-32 had been revised to incorporate the requirements of 79-02. The final comments were, "although each of these instances require review and, in some cases, an engineering evaluation, we see no programmatic breakdown or generic implication." This evaluation agrees with that comment. In addition, DNE is continuing to evaluate the results of the NSRS sample as referenced in the aforementioned DNE memorandum to determine additional action(s) that may be required to ensure compliance with current requirements of a

safety factor of 5. It was also stated in the DNE response that the anchors not meeting the plug depth requirements would be proof tested. This action is being tracked as an open item in the SQN Commitment Action Tracking System (CATS). (CATD No. CO11305-SQN-05)

4. Incorrectly Sized Anchors - the performance of WR 114789 revealed only two of the anchors inspected not to be the size required by the 47A056 typical drawing series, one being larger than required and one being smaller. The oversize anchor is acceptable as installed according to G-32 anchor substitution criterion. The support with the undersize anchor installed (1000HCAB749-A0519R015) is being tracked by the SQN Compliance Section as requiring correction/documentation, and is being handled by SQN Electrical Modifications. (CATD No. CO11305-SQN-06). The fact that an undersize anchor was installed (5/16" instead of 3/8") was verified in the memorandum C23 860618 006 from B. R. McCullough, Director of DNC. Also, the statement made in the same memorandum, "OE acceptance of variances from typical drawings, in effect at that time, required OE support design group approval but did not require formal documentation," was verified with the current responsible engineer (site-DNE) as potentially being the reason the undersize anchor was installed. The SQN Electrical Modifications section indicated that the work plan which will be initiated to "close" Engineering Change Notice (ECN) L6744 will also address further action that may be required on the subject support.

5. NonConforming Conditions - with respect to the comments in the NSRS report I-86-120-SQN on this subject, the following observations have been made:

   a. The current G-32 requirements, in effect when the WR 114789 sample program was performed, caused discrepancies to be identified which were not in violation of G-32 requirements at the time of installation/inspection in 1976 - 1977. The mechanism for evaluating the newer G-32

criteria and evaluating existing installations to these new criteria were NRC OIE Bulletin 79-02 and the subsequent sample programs that were performed (Most of the current G-32 requirements were implemented in 1981 to incorporate the inspection parameters found in 79-02).

b. Further evaluation is performed by DNE in many cases to determine whether the old installation is acceptable according to the new criteria from an engineering standpoint. If the DNE evaluation determines that a NCR type condition exists, then a NCR is initiated. For example, if an anchor is inspected and found to have less than one nominal bolt diameter of thread engagement (minimum requirement according to G-32) immediate action will be initiated to correct the problem. However, DNE has proven through detailed engineering evaluation and laboratory tests that approximately 3/4 nominal bolt diameter of thread engagement is adequate for the anchor to be considered suitable for service (perform its intended function without reducing the factor of safety). Therefore, the DNE evaluation is performed on what has been identified as a potential isolated problem and does not mean the entire plant needs to be inspected again for the same potential problem. At this point, there is no reason for DNE to believe that the factor of safety has been reduced because sample programs, including 79-02, have proven at least 95 percent adequacy.

6. WR 114789 Identified Items - much of the same information provided in the previous section on NonConforming Conditions is also applicable here. It should be stated again, however, that the SQN 79-02 reinspection program was the mechanism employed to evaluate installed conditions to these more recent acceptance criteria. Furthermore, the reinspection (sampling) programs initiated at SQN according to Quality Technology Company (QTC) investigations, Special Maintenance Instructions (SMI-2-317-24 R2 addressed in Section 4.3

"Testing of Anchors"), NSRS investigations and several NCRs, Significant Condition Reports (SCRs) and Problem Identification Reports (PIRs) which mainly address DNE considerations each serve to evaluate installed conditions to new criteria, establish new criteria and document the process in each case.

7. Even though the NSRS sample identified only one instance of insufficient thread engagement, the WBN-ECTG evaluation has chosen to address this issue since it relates directly to the SQN 79-02 program.

   It should be noted that the requirement for one bolt diameter of thread engagement for SSD type anchors was not incorporated into G-32 until Revision 6 in 1981. The 79-02 reinspection program at SQN, completed before 1981, was intended to reveal whether specific anchorage problems existed, to include thread engagement. Conversation with DNE-CEB engineers revealed that the G-32 requirement for thread engagement was based on the need for a simple requirement to be used by the installer in the field, not to establish the minimum engagement required to insure the specified load capacity would be obtained. As stated as an example in this section, tests conducted at TVA Singleton Materials Lab have proven the minimum thread engagement required to obtain the required load capacities in SSDs is approximately 3/4 nominal bolt diameter for most bolts. Therefore, the 95 percent adequacy factor for anchor installations according to 79-02 with respect to thread engagement is based on a very conservative G-32 requirement. To further support this methodology, SQN SMI-0-317-21 was initiated to survey 111 baseplates as a result of employee concern XX-85-010-001 which addressed nuts welded behind baseplates. Determining installed bolt lengths was the first consideration, and both ultrasonic testing and physical measuring was used to determine the actual bolt length. A total of 438 bolts were inspected for thread engagement and 1.6 percent did not have one nominal bolt diameter engagement as required by G-32. After DNE evaluation, only three (0.6 percent) were determined to have insufficient thread engagement to develop the full strength of the anchor.

8. Anchor Spacing--the NSRS sample identified 27 supports which violated some element of the current spacing criteria. Once again, it should be noted that G-32, R10 criteria were used to evaluate anchors installed to G-32, R4 criteria, as addressed in the memorandum from B. R. McCullough to H. L. Abercrombie dated June 18, 1986 on NSRS report I-86-120-SQN and recommendation I-86-120-SQN-5. DNE is also evaluating the anchor spacing deficiencies as described in memorandum B25 860507 008 from D. W. Wilson to H. L. Abercrombie. Conversation with DNE-CEB engineers revealed that preliminary review of the spacing violations had shown all would probably be acceptable, but detailed analysis/calculations would provide final acceptance or rejection. The conversations also revealed a NCR (GENQAB 8203 R1) which had been written to document potential inadequate spacing criteria. In response to this NCR, SQN performed a field sample in several plant locations which consisted of 114 anchor installations where SSDs were installed at less than G-32 minimum spacing. In addition, field inspections were conducted at these same locations to identify specific supports with significant loads and spacing less than the minimum. The results revealed all supports to have an adequate factor-of-safety as detailed in Revision 1 of 79-02 and the spacing violations addressed by the NCR had no significant effect on the actual anchor factor-of-safety. It was determined that no further corrective actions were required.

The subject of employee concern XX-85-010-001 was nuts welded to the back of baseplates. The evaluation of this issue has revealed the following:

1. Memorandum from H. B. Rankin, SQN Design Services to J. P. Vineyard, SQEP of January 30, 1986 (C01 86115 929) addressed specifically the subject of the concern. SQN-SMI-0-317-21 was written to conduct a survey of 111 baseplates regarding the allegation of nuts welded behind baseplates to fake anchorage. The aforementioned memorandum referenced six specific drawings that were reviewed; four of these were drawings 47A056-40, 47A056-40A, 48N207-26 and I-H47-282.

Drawing (47A050-4) addressed bars or small spacer plates installations behind the baseplate. Drawing 47A053-151 did show an alternate configuration which allowed nuts to be used below the baseplate on the anchor stud to level the plate, but only on floor attachments. The survey found several baseplates installed on vertical walls where nuts were used as a leveling device and SQN-OE was asked to evaluate the installations. The generic review determined the structural integrity of the support was not compromised (memorandum B25 860218 017). In addition, documentation was to be initiated to prohibit the use of leveling nuts in future installations and document on the applicable drawings the past use of the leveling nut method. This was verified during conversations with responsible Site Services and Electrical Modifications engineers. FCR 4247 was initiated to accomplish the drawing changes, but was subsequently cancelled because OEP-11, 3.5.C (Exceptions to the ECN Procedure) did not require a FCR to make a "cosmetic" drawing change only. (CATD No. CO11305-SQN-03)

Conclusions

The following conclusions address both specific concerns and generic issues at SQN. However, the summary is directed toward proving the adequacy of SQNs concrete anchor program and therefore, will also specifically address NRC OIE Bulletin 79-02:

1. Four specific concerns addressed the issues of abandoned anchor holes, torched/beveled holes in baseplates, anchors in contact with rebar and anchors installed outside of perpendicularity requirements. This evaluation revealed:

   a. Abandoned anchor holes - the concern was verified as being factual but no violations of G-32 criteria were identified.

   b. Torched/beveled holes in baseplates - this concern was not verified as being factual, as no holes were found which had been beveled or enlarged with a cutting torch.

c. Anchors exceeding perpendicularity--this concern was not verified as being factual, as no anchors were identified which exceeded the current criterion for perpendicularity.

d. Anchors contacting rebar--this concern was not verified as being factual as no anchors were identified which were in contact with rebar.

2. With respect to other anchorage issues, no deficiencies were found which, after review and engineering evaluation, caused a condition adverse to quality to be identified. The significance of this statement is amplified when it is recognized that the identified deficiencies were not unacceptable in the timeframe of the initial installation/inspection (1976-1977) but were deficient based on current, present day criteria. This provides the justification for detailed engineering evaluations of old installations to new criteria as opposed to using the NCR/SCR mechanism for each potential deficiency. DNE is committed to initiating proper CAQ type documentation only when engineering evaluation methodology fails to qualify or accept the installation "as is."

3. NRC OIE Bulletin 79-02--the sampling programs performed according to 79-02 were in compliance with those described by the bulletin. The bulletin listed two specific sampling methods that could be employed or, as an alternative, other methods could be used if justified. TVA used the random sample technique described in the bulletin which provided a 95 percent confidence level that less than 5 percent defective anchors were installed. With deviations approved and accepted, the NRC has accepted the results of the 79-02 program at SQN. (The deficiency on Rawl self-drilling anchors is addressed in the Construction Category, SQN Element Report CO11301-SQN, Design of Plates and Subcategory Report 10400, Embeds.) R2

   The results of the 79-02 inspections proved a greater than 95 percent confidence level as previously described.

4. General Construction Specifications G-32--the current revision to G-32 includes numerous changes (enhancements) not in effect during the timeframe of the subject concerns. These enhancements were a result of NRC OIE Bulletin 79-02 which identified, industry wide, the need for more detailed acceptance criteria and inspection procedures. The bulk of these enhancement were implemented in G-32 according to Revision 6 in 1981. However, the enhancements were not intended to be interpreted as absolute minimum acceptance criteria but as conservative requirements and guidelines to be used by the field when the anchor(s) is installed. The revising of G-32 is a process that "will continue" because as new methodology is recognized, areas in need of enhancement are identified and more specific criteria are required, revisions will be made to further improve the anchor program.

5. The following are areas identified by this evaluation that SQN should review as necessary to determine any additional action(s) that may be required:

   a. perform a detailed review of Modifications and Additions Instruction (M&AI) 10, R10, to include Change Number 86-893, to insure that all applicable G-32 anchor installation and inspection criteria have been implemented. (CATD No. CO11305-SQN-01)

   b. review 10 CFR 50, Appendix B, Criterion XVII to determine if violations have occurred with respect to color coded rebar sketches (IZ-11-8-76-0 through -16) potentially being a "QA record" but not being retrievable for review. (CATD No. CO11305-SQN-02)

   c. review drawings identified in this section to insure revisions are incorporated with respect to the use of leveling nuts behind baseplates. (CATD No. CO11305-SQN-03)

The BLN Employee Concern Investigation Report shows that an investigation was performed by the Construction Superintendent's Office on alleged altering of anchors. This investigation confirmed that a 1/2-inch SSD had been installed with the teeth sawed off. The anchor was identified, removed and Attachment B, "Bolt Anchor Test Report," of BNP-QCP-2.8, R13, "Bolt Anchors Set in Hardened Concrete" for the subject feature was invalidated October 18, 1984. (Note: The policy of the hanger unit for pull testing anchors is to pull 100 percent of anchors in a lot as long as they can attach the pull test apparatus to the anchor. If the apparatus cannot be attached due to scaffolding, supports, walls, ceilings, etc., a notation is made on the applicable attachment B of BNP-QCP-2.8 noting this condition.) This was the case in this instance.

Further evaluation by BLN produced 42 additional hanger baseplates that were suspect. All "Bolt Anchor Test Reports," Attachments B of BNP-QCP-2.8 were reviewed pertinent to the 42 hanger baseplates. Of the 42 examples, 10 were found to be consistent with the situation discussed above (i.e., only one SSD was pull tested with the other anchor not being tested because of an interference). Six of the ten hanger baseplates were picked at random for observations.

Two situations were pursued to determine if altered anchors did exist. They were:

Example #1: The hole was not drilled to the correct depth by the SSD shell, the shell's teeth were removed, then the anchor was installed per BNP-QCP-2.8. According to DNE, this situation can be verified by checking the cone expander depth.

Example #2: The hole was drilled to the correct depth by the SSD shell, the shell's teeth were removed, then the anchor was placed into the hole with the cone expander plug partially set. According to SMEL, this situation could be verified by placing a bolt in the shell and hitting the bolt with a heavy hammer.

The shell would be hammered deeper into the hole during the final setting of the cone expander plug.

Each SSD in the six hanger baseplates that had not been pull tested was inspected for conditions 1 and 2. The SSD anchors that had been pull tested were inspected for acceptable cone expander depth. These inspections were performed by a HQC inspector certified to BNP-QCP-2.8. This additional inspection identified no other examples of altered anchors.

Results of the inspections performed for NRC OIE Bulletin 79-02 show that of 193 SSDs tested, nine had unacceptable plug depth. According to the criteria of 79-02, a prooftest was performed on these nine unacceptable anchors. Each proof test was acceptable.

Interviews with cognizant craft personnel revealed that some SSDs may have been cut off and bolts may have been altered. Of the 13 personnel interviewed, none had actually seen or been involved in altering SSDs or bolts. They heard of this happening but each stated corrective as well as disciplinary action had been taken.

With respect to compliance with NRC OIE Bulletin 79-02, BLN has completed the initial field inspections required on SSD and wedge bolt anchors. The results are documented on inspection data sheets as well as other inspection data pertinent to each anchor. This information has been transmitted to DNE for evaluation but no further action(s) have been taken. Therefore, NRC OIE Bulletin 79-02 remains an open issue at BLN. (CATD 11300-BLN-01).

Conclusion:

It was assumed by this evaluation that the concerns of this issue were factual.

However, this evaluation found that instances of altering an anchor or anchor bolt had been corrected. Currently, training programs and worker attitudes are such that this is not a problem. Although procedural requirements may have been violated, proper corrective action had been taken to correct installed conditions and ensure that they do not recur. Furthermore, this evaluation shows that the safety of the plant has not been affected. It was also found that lead anchors as identified in concern HI-85-020-N02 were not used at BLN.

4.5 Visual Failure of Anchors

4.5.1 Generic Applicability

This issue addresses two concerns that identify specific areas at WBN and BLN where rusted and corroded anchors could be observed. The evaluations revealed that there was also a potential problem at BFN. In addition, even though the evaluation of this issue at SQN failed to reveal rusted/corroded anchor bolts in the plant location as specified by the employee concern, other plant areas may have a humid or corrosive environment which would be detrimental to existing bolt anchor installations.

4.5.2 Plant-Specific Applicability

4.5.2.1 Watts Bar Nuclear Plant

The expurgated employee concern file contained no additional information.

NSRS Report I-85-143-WBN identified concrete expansion shell anchors installed in the floor of the annulus area of Unit 1 Reactor Building that were rusted and corroded (Recommendation Q-85-020-001-01). DNC concurred with this finding and initiated NCR 6320.

NCR 6320 identifies 1/2" anchor bolts in HVAC duct supports in the floor of the annulus area of unit 1 that have obvious surface rust. This rust and corrosion was caused by intermittent exposure to standing water. The standing water was caused by a valve for floor drains being closed for preoperational testing. The closure of this valve was not a normal condition.

SCR WBN NEB 8513 was written for a discrepancy between design drawings, preoperational test procedures and operating instructions that allowed the valve to stay closed. The corrective action for this SCR was to install a loop seal that will allow the valve to remain open. This loop seal was installed and the drawings revised per ECNs 5866 (unit 1) and 5867 (unit 2). The SCR was then closed.

Ten rusty anchor bolts were removed, three of which fractured during removal. The three bolts were sent to Singleton Materials Laboratory for tests. It was revealed that the failure of these bolts was not influenced by the amount of corrosion present.

To prevent further corrosion, drawing 47A055-156 was revised under ECN 5914 to add a portland cement grout pad under the baseplate of the support. Although moisture may remain in the anchor hole, the oxygen necessary for continued corrosion will be depleted. Also, diffusion of calcium hydroxide into the water from the surrounding concrete and grout will raise the ph of the water to a level which will prevent corrosion. Grouting of the supports will be done for both units 1 and 2. This grouting was completed for unit 1 and the NCR was closed.

The corrective action for NCR 6320 included unit 2. The floor of the annulus area was field inspected for additional supports attached to the floor. The duct supports were reworked and pads were installed per ECN 5914.

4.5.2.2 Sequoyah Nuclear Plant

The expurgated employee concern file contained no additional information.

A detailed review was performed to determine action(s) taken by SQN on this issue. It was revealed that the PGCE (B25 851008 009) performed at SQN as a result of WBN-NCR-6320 had not identified rusted or corroded concrete anchor bolts in the plant area described in the WBN employee concern. Memorandum S53 860211 800 described the walkdown performed by SQN Mechanical Maintenance personnel. The walkdown consisted of a visual inspection of 53 pipe supports installed on the floor of the unit 1 and 2 annulus. All baseplates and anchors were determined to be acceptable. It was also stated that the baseplates in the annulus area were installed on grout pads and all surfaces were adequately painted to prevent corrosion. Therefore, no corrective action was required.

4.5.2.3 Bellefonte Nuclear Plant

The expurgated employee concern file contained no additional information.

The BLN Employee Concern Investigation Report addressed rusted anchors. Observations of the location addressed in the concern showed that a corrosive environment exists because of high humidity.

An analysis of the subject anchors by the Power Service Center Central Laboratory, in conjunction with Singleton Laboratory, revealed that although a corrosive environment exists, the anchors would perform their intended function. DNE stated that the "corrosive atmosphere" in the area was taken into account in the design calculations.

Review of BNP-QCP-10.27, R 10, "Housekeeping," revealed that the procedure did not specifically address rusting and/or deterioration of anchorages.

An interview with the supervisor of the Site Preventive Maintenance Unit revealed that this group does not perform surveillance inspections for rusting/deteriorating anchorages.

4.5.2.4 Browns Ferry Nuclear Plant

A detailed review was performed on this issue to determine action(s) taken by BFN. It was learned that BFN had responded to the Potential Generic Condition Evaluation initiated by DNE for WBN-NCR-6320 that no problem existed at BFN. This is documented on the PGCE (B41 851002 002) as well as an attached informal memorandum from B. Loney to R. E. Gaines dated October 18, 1985. However, further review of correspondence by the ECTG revealed a memorandum for R. Lewis to E. Schlinger dated April 3, 1986 (R36 860320 810) in which the statement is made, "The potential problem with concrete anchors located in the floor slab does exist at BFN." A walkdown was requested and an evaluation of walkdown findings, if required. The walkdown was performed and the results documented in a memorandum from J. P. Stapleton to R. L. Lewis dated May 19, 1986 (B22 860519 005). The walkdown concentrated on areas in unit 2 and areas common to unit 2. A summary of the findings is as follows:

- The walkdown identified several areas where rusted anchors were installed as well as areas that showed evidence of standing water in the past.

- No corrective actions were recommended prior to restart of unit 2. A similar walkdown was recommended prior to the restart of units 1 and 3 as well as additional inspection of the unit 2 steam tunnel.

- The final statement in the subject memorandum was, "The inspection provides sufficient basis for interim acceptance and recommends that BFN maintenance procedures, particularly painting, replacement with galvanized bolt and water/moisture control, provide the permanent solution to this problem."

Telecon with the responsible DNE engineer at BFN failed to reveal any additional information on the issue. He stated that the site Mechanical Maintenance Unit would have been the organization to initiate additional walkdown(s) and subsequent corrective action, if required. Telecon with the BFN Maintenance Superintendent also failed to reveal any additional action(s) being taken. It was discovered that the BFN Mechanical Maintenance Unit had, in fact, received the aforementioned memorandum (B22 860519 005) but had not initiated an evaluation of the issue as recommended.

Conclusion:

This issue is factual and presents a problem for which corrective action has been taken as a result of the employee concerns evaluation at WBN. This issue was previously identified and evaluated at BLN. This evaluation did not identify a problem at SQN. [illegible] has identified a problem but has not taken corrective action. Although DNE does not believe this is a significant problem, site procedures and preventative maintenance are lacking in that they do not address the condition identified by the employee concern. (CATD 11300-NPS-03)

4.6 Installation of Anchors

4.6.1 Generic Applicability

The concerns addressed in this issue question the adequacy of the methods used to install anchorages. Since bolt anchor installation requirements are found in a corporate document (G-32) this issue was evaluated at all TVA nuclear plants.

4.6.2 Plant-Specific Applicability

4.6.2.1 Watts Bar Nuclear Plant

The expurgated employee concern file contained no additional information.

Employee concern IN-86-115-001 was expressed on SSD anchors being overtorqued to close excessive gaps between baseplates and the wall. It was also stated that craft personnel were not trained to G-32, paragraph 3.2 requirements.

A detailed review was performed of NSRS Investigation Report I-85-659-WBN on the subject concern. The scope of the investigation was to determine if bolts in SSDs had been tightened more than the maximum allowed (1/4 turn after the bolt head contacts the plate) by section 3.2.5 of G-32 and whether craft personnel were trained in the implementation of this criteria. WBNP-QCP-1.42-2 and G-32 were reviewed, OE engineers, QC inspectors and craft personnel were interviewed and a field inspection was conducted. It was determined by NSRS that section 3.2.5 of G-32 did govern the tightening of bolts in SSDs. The NSRS determined during a field evaluation that a bolt turned 1/4 turn after the bolt head contacted the plate would not achieve firm baseplate restraint. Most installers would continue turning the bolt until considerable resistance was encountered indicating closure of the mating surfaces. Subsequent discussions with experienced QC and craft personnel revealed the general opinion that 1/2 inch and larger SSDs could not be damaged using a standard wrench unless a "cheater bar" was used. However, it was stated that SSD bolts smaller than 1/2 inch could be damaged if unreasonable wrench force was applied. The report concluded that SSD bolts had been tightened in violation of G-32 and that craft personnel had not been adequately trained in the applicable tightening criteria.

Four recommendations were made by the NSRS as a result of the investigation and included a program to verify anchor integrity, revision of G-32 to accommodate field installation tolerances, development of QC inspection procedures to verify SSD anchors are not damaged during installation or rework and training of engineers, craft, and inspectors to applicable G-32 requirements.

PIR-WBNCEB-8644 was initiated March 28, 1986, to document the potential nonconforming installation of SSD bolts as well as inadequate training of craft personnel on the tightening procedure detailed in G-32. It should be noted that the PIR was not determined to be significant, nor was the condition described by the PIR determined to be potentially generic to the other TVA nuclear plants.

With respect to the NSRS investigation report recommendations DNE initiated a memorandum (T25 860407035) detailing their response to the NSRS findings. The majority of the response is based on a field survey conducted by DNE-CEB and the NSRS at WBN.

The survey consisted of observing SSD bolt installation and tightening as well as interviews with HEU personnel, QC inspectors and responsible craft personnel. Summarization of the response is as follows:

- Responsible craft personnel stated they had not been trained on G-32 tightening requirements.

- Bolts were tightened using crescent wrenches but helical spring lock washers were not used.

- The craft used various sizes of crescent wrenches to tighten bolts, the wrench size depending on the bolt size. This practice served to limit the amount of effort applied to the bolts when installed (i.e. a 6 inch crescent wrench was used to install a 3/8 inch diameter bolt, a 8 inch wrench for 1/2 inch bolts, etc.).

- DNE expressed confidence based on preliminary evaluation only, that the tightening methodology used by the craft (wrench size dependent on bolt size) was acceptable and would not degrade the integrity of the SSD bolt. Therefore, DNE did not believe a sample program to determine if anchor failures had occurred as a result of the bolt tightening methods used would be required for corrective action of the aforementioned PIR.

- As part of the PIR disposition, G-32 was to be revised to provide more explicit tightening procedures to include limits on type/size of

wrenches used for tightening and provide for some degree of judgment to be used by the craft in determining adequate tightness.

- DNE also expressed confidence that G-32 (section 4.6.2) provided adequate control for inspecting bolt condition. This section of G-32 requires a minimum of one bolt on each attachment to be removed and inspected for tightness and thread engagement.

- Final comments were that G-32 tightening procedures had not been fully implemented and would be adequately addressed by PIR-WBNCEB-8644. Preliminary investigations indicated that the methodology used by the craft were adequate.

The corrective actions assigned in the PIR are as follows:

- Revise G-32, paragraph 3.25, to clarify procedures for tightening bolts and nuts on threaded rods installed in SSD anchors.

- Investigation of applicable documentation provided evidence that training on the SSD bolt tightening procedure was adequate.

- No corrective action was required with respect to craftsmen using various size crescent wrenches based on bolt size. While this methodology was not in full compliance with G-32, it was determined that overtightening would not occur and would provide an adequately tightened joint.

- With respect to the potential generic condition evaluation not being performed, it was stated that the identified problem was an isolated case.

Detailed evaluation by the ECTG of the NSRS and DNE findings has revealed the following:

1. The documented training described as adequate in the corrective action block of PIR-WBNCEB-8644 was not initiated as a "formal" (i.e. classroom environment, handouts, test, etc.) training program until the spring of 1985. Before this time, each craft was responsible for their own

training which normally consisted of the foreman reading a different procedure, construction specification, etc. to his crew after the weekly safety meeting. The only exceptions to this were isolated instances where specific training was required to satisfy the disposition of a NCR. The engineering and QC units conducted training in much the same manner except training was also performed whenever a new revision to a procedure or specification was issued, which the unit used on a consistent basis. Conversation with a former assistant craft superintendent revealed the training, conducted by the foreman, included only the reading of the procedure or specification then the answering of questions voiced by the crew. The foreman was trained by the assistant superintendent, who was responsible for training himself. The fact that the formal training was initiated in 1985, when the majority of construction was complete or being completed, puts considerable emphasis on the training effectiveness before 1985. This is highlighted further by the statement made to DNE-CEB/NSRS during their field survey (conducted in early 1986) when craft responsible for installing bolts stated that they had not been trained on G-32 bolt tightening requirements.

An additional point to be made concerns the ECTG evaluation of the anchor program at BLN. BLN has had a comprehensive, formalized training program on seismic support installation and inspection which includes an entire section on concrete anchorages, bolt tightening, etc., since early 1984. All crafts responsible for concrete anchor installation were required to attend the seven hour training class. During interviews with 13 foreman from three different crafts, it was learned that all were aware of and familiar with the G-32 bolt tightening requirements. However, less than half of the foremen stated that they actually performed bolt installation in the field exactly as detailed by G-32. Of the 13 interviews conducted, approximately seven different bolt tightening methods were described by the foremen. It should also be noted that the training described above was separate from the training administered to the crafts on various BLN-QCPs.

Therefore, documented training on daily operations such as bolt tightening was required for the responsible crafts as well as on seismic support installation and inspecti . The summary of these findings is that evaluation by the ECTG revealed BLN to have the most comprehensive and potentially effective training program of any TVA plant on concrete anchorages. However, it was determined that inconsistent application of bolt tightening criteria still existed. Therefore, the statement in the PIR that training at WBN was adequate seems somewhat ambiguous when all facts are considered.

2. Experienced HEU and QC personnel displayed considerable skepticism when confronted with the findings detailed in the DNE-CEB/NSRS field survey. The general concensus was that craft personnel would use whatever size crescent wrench was immediately available when bolt installation was required regardless of the bolt diameter. This attitude was corroborated further during conversation with a former WBN assistant steamfitter superintendent. His comments were that most fitters carried only one or two crescent wrenches, a 10 inch and a 12 inch. When only one wrench was carried it was usually a 12 inch because the larger size could be used in more situations than the smaller size. He also stated that he was not aware of a requirement, standard practice or recommendation to use various size crescent wrenches for bolt tightening based on the bolt diameter.

3. During the inspection of (16) 1/2 inch diameter anchors and (32) 5/8 inch diameter anchors for plug depth in the unit 2 Reactor Building and the Control Building, (described in section 4.4.2) the following observations were made by the ECTG with respect to bolt installation and tightness:

   - The individual who removed and reinstalled the 16 bolts in the Reactor Building used a 12 inch crescent wrench. During reinstallation the bolts were tightened to the point that two hands were used for the final effort. The individuals who removed

and reinstalled the 32 bolts in the Control Building used a 10 or 12 inch crescent wrench. During reinstallation of each bolt the final effort was made using both hands as well as considerable "body english." In both cases, a QC inspector was present to measure the plug depth and witnessed the tightening process.

4. Detailed discussions were held with responsible DNE-CEB Central Staff engineers on the effect of overtightening bolts installed in SSD type anchors. It was discovered that TVA had never conducted a detailed engineering evaluation or laboratory test on the ramifications of overtightening, the failure mode of the SSD shell and the bolt, etc.. It was stated that the reason for detailed evaluations or tests not being performed was because generic or significant problems had not been identified which required that type evaluation. Further discussion with DNE-CEB Central Staff and several other engineers at other plants revealed questions as to whether removing a bolt to inspect for proper thread engagement and the subsequent reinstallation and tightening would be sufficient mechanism to verify the bolt and anchor shell integrity. The G-32 requirements (section 4.6.2) for verifying bolt tightness for SSDs during the inspection process is, "The bolt tightness shall be acceptable if the bolt cannot be turned with the fingers. If the bolt (or nut for threaded rod) can be turned with the fingers, all bolts in the attachment shall be checked." This process is sufficient for determining whether the bolts are loose but does not provide for verifying anchor integrity if overtightening has occurred. This same observation was made by the WBN-Assistant Construction Engineer (CEU, MEU, WEU, HEU) in a memorandum (C24 860501 001) from the WBN Project Manager to the WBN Project Engineer which discussed PIR-WBNCEB-8644. It was stated that the 1/8 to 1/4 turn requirement was G-32 installation criterion and that no G-32 inspection requirement was provided to verify that bolts were not overtorqued. The statement was also made that NU CON believed training to be adequate.

In conclusion the ECTG evaluation of concern IN-86-115-001 has revealed the following:

1. The statements made in PIR-WBNCEB-8644 and in the aforementioned memorandums with respect to training at WBN being adequate are refutable. The finding is reinforced when consideration is given to the initiation date of the formalized training at WBN and the statement made by the craft that they had not been trained on G-32 tightening requirements.

2. The findings of the DNE-CEB/NSRS field survey with respect to different size crescent wrenches being used based on bolt diameter is also refutable. The ECTG findings on this issue proved to be disparate.

3. No detailed engineering evaluation has been performed to determine the consequence of overtightening bolts installed in SSDs. This is further amplified when consideration is given to the fact that six sizes of SSDs (1/4 through 7/8 inch diameter) are consistently used at all plants and three grades of bolts are allowed for use by G-32 (ASTM A 307, A 325, and ASTM A36 for threaded rod). Two different methods of tightening are allowed by the latest (proposed) revision (revision 12) to G-32, one of which states 5/8 inch diameter and larger bolts for SSDs or nuts for threaded rods are to be tightened until significant resistance is encountered. The disparity between individuals as well as interpretation of the term "significant resistance" further confounds consistency in the installation process.

4. G-32 does not provide adequate inspection criteria with respect to verifying anchor integrity after initial installation and tightening. Verification that the anchor bolt is not loose provides no assurance that the bolt has not been overtightened.

5. G-32 is considered to be the upper-tier criteria at all TVA nuclear plants with respect to concrete anchorage installation and inspection. SSD type anchors have been/are being used extensively at all TVA nuclear plants.

Therefore, the determination to not perform a potential generic condition evaluation at the other plants on the issue of overtightening was inadequate.

Employee Concern BNP QCP 10.35-8-23 was expressed at BLN concerning the extreme changes in anchor spacing criteria from the employees' first dealing with G-32 versus when he finally left. This concern was determined to be generic to all plants because the spacings between anchorages are also governed by G-32 at each plant.

A detailed review was performed of General Construction Specification G-32 to determine the current as well as past requirements for minimum spacings between concrete anchors.

Revision 6 of G-32 (February 17, 1981) incorporated major changes to the inspection criteria for concrete anchorages, to include minimum spacings between adjacent anchors and other features. Before revision 6, G-32 contained minimum spacings for SSD, wedge bolt, and grouted anchors installed adjacent to a free concrete edge. Also addressed was the minimum spacing allowed between a SSD anchor and a wedge bolt as well as the minimum spacing allowed if an anchor of any type was located adjacent to a grouted anchor. The spacings given in revision 6 of G-32 were included to incorporate the intent and parameters of NRC OIE Bulletin 79-02. Strip inserts (unistrut) embedded plates, embedded bolts, cast-in-place anchors and threaded inserts along with a more comprehensive and detailed spacing chart were added. This was a major change and spacing requirements from previous revisions seemed less than adequate in comparison.

Historical copies of G-32 were also reviewed. Revision 0 (1972) detailed spacing requirements with respect to the minimum distance between concrete anchors and a free concrete edge as well as the minimum distance between adjacent anchors The requirement was stated as, "no anchor shall be located closer than 5 bolt diameters to a free concrete edge or 10 bolt diameters to an adjacent bolt." Revision 2 of G-32 (March 28, 1975) stated, "no anchor shall be located closer than 10 bolt diameters to a free concrete edge if the anchor is

loaded in shear toward that edge, or 12 bolt diameters to an adjacent bolt." The 5 bolt diameters to a free edge requirement did not change. Revision 5 of G-32 (July 21, 1977) incorporated the first significant revision to the minimum spacing requirements. The minimum spacings to a free concrete edge were changed, expansion anchors and grouted anchors not being governed by the same criteria. Also, a table was added which detailed minimum spacings between adjacent expansion anchors based on the anchor diameter.

This information is presented as evidence that minimum spacing criteria has existed since the initial issue of G-32 in 1972. Revisions have occurred which enhanced as well as expanded the minimum spacing requirements. Therefore, while the concern expressed could be characterized as a legitimate concern, it was not entirely factual.

DNE initiated NCR-GENQAB-8203, R0, May 5, 1982, to document the fact that the spacing criteria detailed in G-32, R5 could have been inadequate under certain circumstances. A sampling program was initiated at each TVA nuclear plant to determine if expansion anchors for adjacent supports spaced closer than the minimum allowed by G-32, R6, had a significant effect on the capability of supports to carry their design loads. The details of the corrective action and results of the sample program performed at WBN are as follows:

> Review the approval rate for support variance requests to determine if failure to evaluate all anchors spaced closer than the minimum spacings in G-32 would have a significant effect on expansion anchor factors of safety. (G-32 permits the use of spacings less than the minimum tabulated in G-32 provided such occurrences are reviewed by designers on a case-by-case basis. At WBN, the review is accomplished by a support variance request.)
>
> A random sample of 60 support variance requests was taken. Only those variances which involved expansion anchors spaced closer than the minimum were included. For an infinite population, 60 occurrences with no failures, results in a 95-percent confidence level that no more than

5-percent of the total population would be defective. For the 60 support variance requests which were sampled, no rejections were discovered. Therefore, the possible spacing violations covered by this NCR had no significant effect on expansion anchor factor of safety. Therefore, the supports may be used "as-is."

The action required to prevent recurrence was as follows:

> Revision 6 to G-32 requires the field to maintain the minimum spacings given therein unless the OE drawing shows all anchors spaced closer than the minimum. If use of minimum spacings is impractical, the field must submit a written request to OE for approval. This assures that anchors spaced less than the normally applied minimum have been evaluated for the effect of the reduced spacing on anchor capacity. No further action to prevent recurrence is required.

The NCR was revised July 11, 1985, to delete Hartsville and Yellow Creek nuclear plants due to cancellation and to revise the corrective action for SQN. The corrective action, sample results and ARPR for WBN did not change.

In addition, NCR-WBNSWP-8106 was initiated February 19, 1981 to document expansion anchors in pipe supports installed in violation of G-32 spacing criteria. These anchors were installed in accordance with TVA drawing 47A050-17 which allowed minimum spacings less than allowed by G-32 based on the concrete strength. However, this drawing was issued without being reviewed by DNE-CEB as documented in revision 1 of the subject NCR. The corrective action included a design review of specific installations where spacing was less than that specified by revision 6 of G-32. Worst case loadings for each support as well as all possible combinations of anchor sizes for each condition were analyzed. The analysis showed that for all conditions the factor of safety against concrete failure was greater than four as required by Civil

Design Standard DS-C6.1. Therefore, the anchors were to be used as-is and no further evaluation was performed. The ARPR was to delete TVA drawing 47A050-17 and revise DS-C6.1 to further emphasize the consideration of all adjacent tensile anchors during reduced spacing evaluations. An ECTG review of the TVA 47A050 drawings revealed the spacing details on sheet 17 had been deleted and a note added referencing G-32 for minimum spacing requirements. This issue is also addressed in Construction Subcategory 10400, "Embeds."

Conversation with experienced HEU personnel at WBN revealed the following:

> The spacing criteria detailed in G-32 is somewhat complicated and has been revised considerably, beginning with the issuance of G-32, R6, in 1981. However, most of the revisions have served to increase the tolerances and make anchor installations less difficult when minimum spacings between anchors or other features were a consideration.

Conversations with responsible engineers in DNE-CEB Central Staff revealed the following:

> Many of the requirements for minimum spacings between concrete anchors or between anchors and other features have been imposed during a process that could be described as evolutionary. More restrictive installation requirements as well as those that provide greater latitude during installation have evolved within TVA and the nuclear industry during the process of nuclear plant construction. As new methodology is recognized and more specific criteria is needed, revisions have been and will continue to be made as required to improve the concrete anchor program.
>
> It was admitted that the anchor spacing criteria addressed in G-32 were somewhat complicated, even confusing. However, instead of imposing "cut and dried" requirements which would be easier to apply but offer less tolerance, DNE

chose to provide each site with as much installation tolerance as possible. Because DNE adopted this philosophy, the G-32 anchor spacing criteria has been revised several times and caused the interpretation of this criteria to be more difficult.

Employee Concern IN-86-262-005 was expressed at WBN on bolts installed in cable tray supports that did not have sufficient thread engagement. It was also stated that the bolts were too large for the bolt holes and may have been torqued.

A detailed review was performed of NSRS investigation report IN-85-585-WBN on the subject concern. This report documented the NSRS field inspection of the plant area described in the employee concern. The physical inspection failed to reveal any bolts installed incorrectly. The NSRS attempted to obtain additional information from the CI (through QTC) with respect to the actual location of the subject bolts. It was also suggested that the CI perform an inspection to confirm the presence of the improperly installed bolts. Each attempt was unsuccessful. The CI responded through QTC that he/she had simply heard the concern and had no firsthand knowledge of the bolt installations. The CI was only certain of the elevation in the Auxiliary Building. Based on these facts, the NSRS determined the concern to be unsubstantiated. Their final comment was that sufficient evidence existed to indicate that if there was a problem it had most likely been repaired.

A review was performed by the WBN-ECTG of WBN NCRs 1114R and 1158R as well as applicable correspondence. This review revealed both NCRs had been written to document surface mounted plates for cable tray supports where the bolt holes had been enlarged with a cutting torch to facilitate SSD bolt installation due to misalignment between the bolt holes and the anchors. This occurred on elevation 737.0 of the Auxiliary Building, the same location described in the employee concern. NCR 1114R identified 11 discrepant supports and NCR 1158R identified nine. The recommended disposition of NCR

1114R was to replace the affected baseplates with new plates. The ARPR was to revise WBNP-QCP 3.4 (Inspection and Documentation of Cable Tray Systems) R4 to require inspection of support plates requiring the use of SSDs after bolts are installed to determine that correct bolt sizes/lengths are installed and if correct installation practices are employed. The ARPR for NCR 1158R was the same but the disposition allowed repair of damaged plates where possible. The method of repair was described in memorandum SWP 780413 003 from the Watts Bar Design Project to Watts Bar Division of Construction, April 14, 1978. A detailed review was performed of WBNP-QCP 3.4, R5, to evaluate the revisions made as required by the disposition of the aforementioned NCRs. It was learned that the procedure had been revised as required and contained fully adequate mechanism to control future baseplate and bolt installations.

Concern HI-85-113-N02 and PH-85-002-026 were expressed in general terms each stating that concrete anchors had been improperly installed in the Auxiliary Building and throughout WBN. Specific anchor installation issues already addressed are overtightening, anchor spacing and thread engagement (more detailed information on thread engagement is found in section 4.4). Additional information on other anchor installation parameters which would serve to answer these general concerns is found in sections 4.4 (altered anchors) and 4.2 (damaged/cut reinforcing steel).

Conclusion

The issue is factual and presents a problem for which corrective action has been or is being taken as a result of this employee concerns evaluation.

The WBN-ECTG evaluation of concern IN-86-115-001 revealed a potentially generic condition adverse to quality (CAQ) exists at all TVA nuclear plants on the bolt tightening issue. (CATD No. 11300-NPS-02)

Employee concern QCP10.35-8-23 was expressed on old SSDs installed before the issuance of minimum spacing criteria. As expressed the concern was factual. However, the ECTG evaluation of this issue determined generic corrective action had been initiated in the form of NCR-GENQAB-8203. This NCR evaluated SSD installations performed before the detailed minimum spacing requirements addressed in revision 6 of G-32. No additional CAQs were identified on this issue, therefore, no further action is required.

For concern IN-86-262-005, the WBN-ECTG agrees with the NSRS findings that sufficient evidence existed to indicate that if there was a problem it has been repaired. This statement is further supported by the physical inspection performed by the NSRS which failed to identify any installations as described by the employee concern. Finally, WBNP-QCP 3.4 has been revised as required by the NCRs and contains adequate mechanism to control future bolt/baseplate installations. Therefore, no further action is required.

4.6.2.2 Sequoyah Nuclear Plant

The concerns and issues applicable to Anchor Installation were evaluated jointly with the concerns and issues applicable to Testing of Anchors. The findings are included in section 4.3.2.2

4.6.2.3 Browns Ferry Nuclear Plant

The expurgated employee concern files contained no additional information.

One site specific concern, BFN-IESC-85-01, identified a perceived problem with G-32 spacing violations. Drawing 48W1241-1, details E, F and G, shows a 2 inch by 2 inch area for locating a replacement anchor next to an existing anchor. By placing a replacement anchor in this area, a G-32 spacing violation is created.

DNE agreed that this was a problem and generated PIR BFN-CEB-8628. The corrective action for this PIR was to revise drawing 48W1241-1 to ensure that when wedge bolts were installed next to existing expansion shell anchors, the wedging device on the wedge bolt would be a minimum of two wedge bolt diameters below the bottom of the adjacent expansion shell anchors. Calculations were performed to support this requirement. This PIR is still open. (CATD 11300-BFN-01)

NCR GENQAB 8203 was initiated May 25, 1982 to identify a condition where Quality Control inspectors could have applied minimum spacing criteria found in TVA General Construction Specification G-32 to specific attachments being inspected without noting adjacent attachments. These adjacent attachments could influence anchor spacing requirements. As a result, it was possible that expansion anchors were installed at various plants that did not meet minimum spacing requirements when combined action of multiple attachments were considered.

This NCR was revised (Revision 1) July 9. 1985 to incorporate the results of the sampling program performed at SQN. This completed corrective action and action required to prevent recurrence at all TVA sites except BFN.

Repeated attempts to determine the responsible organization and the planned resolution of NCR-GENQAB-8203 were initially ineffective as well as extremely frustrating. After numerous phone calls and discussions with as many as six individuals in various organizations, the responsible organization was identified. The responsible individual of this organization stated that the NCR is scheduled for completion. The corrective action for this NCR is to perform a sampling program. (CATD 11300-BFN-02)

4.6.2.4 Bellefonte Nuclear Plant

The expurgated employee concern file provided no additional information.

The first BLN Employee Concern Investigation Report reviewed addressed the use of work releases for anchor drilling operations.

The BLN investigation revealed a work release was not required for self-drilling expansion shell anchors unless they are installed in concrete columns in the Auxiliary and Control Buildings (per BNP-QCP-10.6 Section 6.2.2.1), or unless they are recessed, (SSD anchors installed in accordance with Attachment G of BNP-QCP-2.8). A work release is required prior to drilling concrete for all other cases. According to BNP-QCP-10.6 Section 5.1, all craft, inspection, engineering and supervisory personnel are responsible for verifying that concrete drilling operations are carried out only when the operations are properly authorized and documented.

Since no specific instances and/or features were cited in the concern, it is difficult to determine if holes were actually drilled without a work release being initiated until after holes were drilled. However, it appears from the wording of the concern that the concerned employee felt that a work release was eventually initiated after holes were drilled. If a work release was later initiated, it would have required a follow-up hold point inspection by CQC-A in all drilling instances per BNP-QCP-10.6 Table 1, Note 15. This follow-up inspection would have identified any conditions adverse to quality. Therefore, it is felt that quality and safety would not have been compromised.

The second BLN Employee Concern Investigation Report reviewed addressed the change in anchor spacing due to revisions of General Construction Specification G-32.

This investigation revealed the problem had already been identified and corrected by TVA. Nonconforming Condition Report (NCR) GENQAB8203 was written to document this problem. This NCR required TVA to take a random sample of anchors inspected prior to revision 6 of G-32 and inspect to the requirements

of revision 6. Of the sample taken, all anchors passed inspection. With these type results, a 95 percent confidence level is achieved, i.e., of all anchors installed prior to revision 6 of G-32, only 5 percent would not meet present requirements. Therefore, the possible spacing violations covered by this NCR had no significant affect on the safety of expansion anchored supports. For this reason, the supports were used "as-is."

The general requirements for anchor installation are found in General Construction Specification G-32. The requirements for self-drilling expansion anchors that will be discussed in this report are: anchor recess and protrusion, anchor perpendicularity, and anchor bolt tightening and/or torquing. These requirements are found in section 3.2. Each of these requirements, as detailed in G-32, are as follows:

> The exposed end of the anchor shell shall not protrude from the concrete surface. The exposed end of the shell shall not be recessed more than 1/4-inch below the concrete surface.
>
> Self-drilling expansion shell anchors shall be installed to within 10° of perpendicular. Anchors exceeding this requirements shall be removed and replaced.

As discussed in section 4.3.2.2, G-32 does not contain a requirement for torquing anchor bolts in expansion shell anchors. Bolts are to be tightened between 1/8- and 1/4-turn after the bolthead comes into contact with the attachment. If a helical spring lock washer is used, the bolt is only tightened enough to fully compress the washer. No additional tightening to close gaps between the attachment and the concrete surface shall be done.

Site specific requirements for installation of self-drilling expansion anchors are found in BNP-QCP-2.8, Section 6.3.2. The aforementioned requirements from G-32 are found verbatim in this site procedure.

Additional site requirements are found in drawing series 3GA0059-00. This drawing series addresses pipe supports only. Drawing 3GA0059-00-21, Note 8, gives tightening requirements for removal and reinstallation of existing anchors as follows:

8. Tightening of bolting into SSD (REF NCR 4680):

Initial tightening of the bolt (or nut on a threaded rod) into SSD anchors shall be per G-32. For subsequent removal and reinstallation of the bolt, tightening shall be in accordance with G-32 except that additional tightening may be used to reduce the gap between the plate and concrete provided:

a. Prior to loosening the bolt(s) the gap is acceptable.

b. Only one bolt per plate is loosened at any time.

c. The bolt is tightened only enough to close the gap to the maximum allowable.

d. Only spud wrenches are used to tighten the SSD bolt (or nut on a threaded rod) without the aid of extension devices that would allow additional torque to be applied to the anchor assembly.

Additional site requirements for electrical supports are found in drawing series 4RA0560-X2, 4BA0892-X2, and 4BB0892-X2.

Drawing series 4RA0560-X2 applies to electrical installations in the reactor building. Drawing 4RA0560-X2-16A, note 14, gives torque requirements for anchor bolts used to attach electrical junction boxes to concrete and are as follows:

14. Torque values for anchor bolts (except wedge bolts) welded studs, and unistrut spring nut and bolt assembly shall be as follows:

    1/4-inch diameter bolts not less than 6 ft-lbs or more than 7 ft-lbs.
    3/8-inch diameter bolts not less than 19 ft-lb or more than 23 ft-lb.

1/2-inch diameter bolts not less than 40 ft-lb or more than 50 ft-lb.
5/8-inch diameter bolts not less than 70 ft-lb or more than 100 ft-lb.

Drawing 4RA0560-X2-2B, note 24, gives torque requirements for A307 anchor bolts used to attach conduit supports to concrete and are as follows:

24. All A307 1/4-inch bolts used to attach conduit straps shall be torqued 6-7 ft-lb, 3/8-inch bolts shall be torqued 19-23 ft-lb and a 1/2 inch bolt shall be torqued 40-50 ft-lbs.

Drawing 4RA0560-X2-20, note 40, gives allowances for exceeded torque requirements:

40. Should torque values as listed for bolts (note 24, 4RA0560-X2-2B) or welded studs (4RA0560-X2-13) be exceeded, the bolts or studs may be used providing bolt or stud failure does not occur during tightening. If failure does occur, the bolts or studs must be replaced.

Drawing series 4BA0892-X2 applies to electrical installations in the Auxiliary, Control, and Diesel Generator Buildings.

Drawing 4BA0892-X2-50A, Note 15, gives torque requirements for attaching electrical junction boxes to concrete and are as follows:

15. Torque values for anchor bolts, and unistrut spring nut and bolt assembly shall be as follows:

3/8-inch diameter bolts not less than 19 ft-lb or more than 23 ft-lb

1/2-inch diameter bolts not less than 40 ft-lb or more than 50 ft-lb

5/8-inch diameter bolts not less than 70 ft-lb or more than 100 ft-lb

1/4-inch diameter bolts not less than 6 ft-lb or more than 7 ft-lb

5/16-inch diameter bolts not less than 12 ft-lb or more than 15 ft-lb.

Drawing 4BA0892-X2-50C, Note 22, gives allowance for exceeded torque requirements:

22. Should torque values as listed in Note 15(4BA0892-X2-50A) be exceeded, the bolts may be used providing bolt failure does not occur during tightening. If bolt failure does occur, the bolt must be replaced.

Drawing series 4BB0892-X2 applies to electrical installations in the Auxiliary, Control, and Diesel Generator Buildings.

Drawing 4BB0892-X2-2, Note 28, gives torque requirements for A307 anchor bolts used to attach conduit supports to concrete and are as follows:

28. Phillips Redhead bolt anchors for supporting electrical conduit as detailed on drawings 4BA0892-X2-35 and -36 for conduit 3 inches and less in diameter shall be designated EA type under Civil Design Standard DS-C6.1 and be exempt from testing under TVA General Construction Specification No. G-32. All bolts used to attach conduit straps shall be torqued as shown in the table below. Any anchor showing evidence of slippage or poor installation shall be replaced.

TORQUE TABLE		WELDED STUDS	TORQUE REQUIREMENT
A307 Bolt Ø	Torque Requirement	1/4"Ø	4-5 FT-LB
1/4"	6 to 7 FT-LB	5/16"Ø	8-9 FT-LB
3/8"	19 to 23 FT-LB	3/8"Ø	16-17 FT-LB
		1/2"Ø	37-42-FT-LB
		5/8"Ø	74-84 FT-LB

Drawing 4BB0892-X2-2, Note 43, gives allowances for exceeded torque requirements:

> 43. Should torque values as listed in the torque table be exceeded, the bolt or welded studs may be used providing bolt or welded stud failure does not occur during tightening. If failure does occur, the bolts or welded studs must be replaced.

Interviews were conducted with QC personnel (two hanger QC inspectors, 2 Civil QC inspectors, one Instrumentation QC inspector, and two Electrical QC inspectors). These interviews revealed that each QC unit uses BNP-QCP-2.8 to perform anchor inspections. These interviews also revealed that bolt tightness acceptance criteria are found in site procedures for each respective discipline.

The site procedures discussed in the preceding step were reviewed. BNP-QCP-3.13 "Equipment Installation" applies to installation and inspection of electrical/instrumentation safety-related and limited QA equipment. Section 7.4.2.1 states that bolt tightness shall be acceptable if the bolt cannot be turned with the fingers. BNP-QCP-4.3 "Instrument Tubing Installation" applies to all Seismic Category Instrument impulse, sample, radiation monitoring, airlines and associated supports. Section 7.2.10.1 states that bolt tightness shall be acceptable if the bolt cannot be turned with the fingers. BNP-QCP-3.7, "Electrical Hangers," applies to all seismically qualified and limited quality assurance cable tray, conduit, and electrical equipment hangers. Section 7.11.1.3 states that all bolts or nuts having a torque requirement shall be tightened to the specific torque with a certified torque wrench. Section 7.11.1.4 states that any fastener having no torque requirements shall be secured so that their removal requires the use of tools. BNP-QCP-6.7 "Inspection of HVAC Duct and Mechanical Equipment Supports" applies to all permanently installed safety-related and limited quality assurance HVAC duct and Lakeside supports. Section 6.4.6.3.1, 6.4.6.3.1.1, 6.4.6.3.1.2, and 6.4.6.3.1.3 reads as follows:

Of the six steamfitter foremen interviewed, two stated that they tighten bolts in accordance with BNP-QCP-2.8, one stated - tighten snug (ordinary force on a 12-inch adjustable wrench) and back-off 1/4 of a turn, two stated - tighten snug and level baseplate and one stated - tighten snug. None of the foremen interviewed knew of instances where the bolts were tightened excessively to reduce baseplate gaps or instances where bolts were damaged by excessive tightening.

Conclusion:

This evaluation shows that the overall anchor program at BLN is adequate. However, procedural violations did occur in the area of anchor bolt tightening. This is a corporate problem, generic to all four TVA nuclear sites (CATD-11300-NPS-02).

5.0 COLLECTIVE SIGNIFICANCE

5.1 Significance of Each Issue

5.1.1 Design of Anchors

This issue was not found to be factual. Therefore no conditions were identified that would have an effect on the safe operation of TVA's nuclear plants.

5.1.2 Damage to Concrete/Rebar

At WBN this issue was found to be factual as well as a problem. However, corrective action had been initiated and completed prior to this evaluation. Therefore no conditions that would have an effect on WBN's ability to operate safely were identified.

At SQN the only problem identified was that documentation for rebar cutting may not be fully adequate. However it was learned that this problem was being addressed by the Engineering Category (Ref. SQN Element Reports 215.2(B) and 215.6(B)) from a generic standpoint. Therefore the significance of this problem will be addressed by the Engineering Category.

At BLN no procedural violations or conditions adverse to quality were identified, therefore, nothing that would have an effect on BLN's ability to operate safely was identified.

5.1.3 Testing of Anchors

At WBN two problems were identified that had not been previously corrected. Corrective action for these problems has been implemented and ECTG is tracking the corrective action on CATD 11300-WBN-05 and CATD 11300-WBN-03. It should be noted that the suitability for service of the involved systems is questionable pending completion of the corrective action.

At SQN a problem was verified relating to overtighting of bolts in SSDs. This was found to be a corporate problem. Corrective action for this problem is being tracked by CATD 11300-NPS-02. Until the effects of overtightening of bolts in anchor shells is analyzed, the suitability for service of all TVA nuclear plants is indeterminate. A problem was also identified in that G-32 does not contain sufficient information to allow pull test to be performed after baseplate installation. This is also a corporate problem. However, the evaluation revealed that this problem was not applicable to WBN. In addition, the ECTG evaluation revealed personnel responsible for performing pull tests on SSDs were aware that plate shimming was required when through-the-plate proof tests were performed. Although not a procedural requirement (except at WBN), plate shimming was found to be a standard practice at all plants. Therefore, this problem was determined to have no impact on the suitability for service of TVA's nuclear plants. Corrective action is being tracked by CATD C011306-NPS-01, CATD C011305-SQN-01 and CATD C011306-SQN-01.

At BFN, the performance of major reinspection programs for anchors under the scope of NRC OIE Bulletin 79-02 as well as anchors other than those addressed by 79-02 will serve to prove the adequacy of BFNs concrete anchor installations. The sample program for non 79-02 anchors (BFEPC20431) will also address deficiencies identified by BF-CAR 85-058. The reinspection of anchors addressed by 79-02 is still in progress. However, walkdown deficiencies identified by BF-CAR 86-0214 have raised questions with respect to the adequacy of inspections performed to date per BFEP-PI 86-05 and SMMI 5.1-A. In addition, a sample program will be performed to evaluate anchorages installed in piping systems 2-inch in diameter and less. The inspection/acceptance criteria for this program is still under development.

This evaluation has identified several discrepancies in the procedures and instructions governing the anchor reinspection and sampling programs described. Most of the deficiencies are minor but it should be noted that they are in addition to those identified by the aforementioned CARs. To summarize, the suitability for service of BFN is indeterminate pending completion of the reinspection/sampling programs and resolution of the identified deficiencies.

5.1.4 Anchors Cut Off

At WBN it was found that corrective action was not complete on a sampling of EA anchors. This is being tracked by CATD 11300-WBN-02. Also, corrective action was not complete relative to instrumentation support documentation. This is being tracked by CATD 11300-WBN-01. WBN DNE is to perform a 100 percent review of all support calculations affected by 79-02. This has not been completed and is being tracked by CATD 11300-WBN-04. Until the above corrective action is completed suitability for service cannot be determined for WBN. At SQN two damaged bolts were identified, correction for these deficiencies is being tracked by CATD C011305-SQN-04. Work request 114789 identified 19 anchors with questionable plug depth and one undersize anchor. Corrective action for this is being tracked by CATD C011305-SQN-05 and CATD C011305-SQN-06 respectively. Several drawings were identified that require revision to prohibit the use of leveling nuts in the future. Completion of this corrective action is being tracked by CATD 11305-SQN-03. Upon completion of these corrective actions, no other conditions exist with respect to this issue which would cause SQN's suitability for service to be questioned. For BLN, the evaluation of this issue identified no areas that would affect BLN's suitability for service. CATD 11300-BLN-01 was initiated because 79-02 has not been fully addressed at BLN. Initial field inspections have been completed but the results have not been evaluated by DNE. For BFN, this issue was evaluated in conjunction with the Testing of Anchors issue. Therefore, see section 5.1.3 for detailed significance applicable to BFN.

5.1.5 Visual Failure of Anchors

The evaluation of this issue at WBN identified a problem with corrosion of anchor bolts. This problem, however, has been corrected and no other problems were identified that would affect WBN's ability to operate safely. A problem was identified for this issue at BLN. However, this was determined to be a maintenance problem, therefore, BLN's

suitability for service is not affected. This was also determined to be a maintenance problem at BFN. Although testing and evaluation show that rust and corrosion do not affect the overall integrity of the bolt anchor or plant suitability for service, rusted and corroded anchors have been nonconformed and replaced at WBN and BLN, and a potential problem identified at BFN. For this reason, this problem needs to be addressed, possibly from a maintenance perspective, at the corporate level. (CATD 11300-NPS-03)

5.1.6 Installation of Anchors

The problem identified in this issue (overtightening of anchor bolts) was previously identified at SQN as a generic problem. The significance of this problem is stated in section 5.1.3. The problem identified above, and its significance, is applicable to all plants.

At BFN, two problems applicable to this issue were identified. Each is being addressed, one by a NCR, the other by a PIR. The problem identified by the NCR (NCR-GENQAB-8203 R1) on anchor spacing will be addressed by a sampling program which has not been initiated as of this date. The PIR (PIR-BFNCEB-8628) remains open although a significant amount of work has been performed to qualify wedge bolts installed in violation of required minimum spacings. The applicable drawing will also be revised. The significance of these problems are as summarized in section 5.1.3.

5.2 Collective Significance of the Subcategory

5.2.1 Generic

This evaluation revealed DNC and ONP managements' ability to recognize the need for and willingness to implement necessary employee training on specific subjects. However, a deficiency was identified in that management failed to recognize less than effective training programs as well as inconsistent field application of specific inspection parameters presented in training classes.

Also revealed was DNE, DNC and ONP management's ability to recognize the need for documenting nonconforming conditions, even conditions that could be defined as suspect and proving field installation adequacy through reinspection exercises. This positive aspect is somewhat offset by management's occasional failure to address all identified deficient conditions, regardless of the significance and generic implications.

DNE, DNC and ONP managements' continual willingness and ability to recognize the need for upgrading site procedures as well as upper-tier criteria to improve the concrete anchor program was revealed. However, failure to correct conflict between upper and lower tier procedures as well as management neglect in recognizing the need to procedurally implement all necessary instructions and standard practices to insure overall integrity of the concrete anchor program was also discovered.

Finally, DNE, DNC and ONP managements' ability and willingness to implement sample programs and specific procedural changes as required to satisfy the bulletin requirements was exemplary. This statement is made because this evaluation revealed a pronounced lack of communication as well as a failure to expedite issues on the subject bulletin by the NRC. TVA management was able to be reasonably effective in evaluating 79-02 issues even though the policy in communicating with the NRC was apparently "no news is good news."

However, these positive aspects are contradicted by DNE upper management's failure to insist on better communication, to include positive feedback and definitive timely response on 79-02 bulletin issues from the NRC. The decision to justify the existing methodology being used in some facets of the anchor program during that timeframe as opposed to making changes to insure compliance with an industry wide bulletin was reprehensible.

Current DNC, DNE and ONP employees were found to be fully competent as well as responsible in their abilities and commitments to quality. Isolated instances of failing to follow procedure were discovered at each plant but, in almost every case, no premeditated or blatant instances of procedure violation were identified.

In the past, however, especially during the time period of three to ten years ago, these positive aspects were not as obvious or prevalent.

The present caliber of work performed was found to be of a high quality. This finding is offset only by isolated instances of sloppy work which were obviously performed by a very small percentage of individuals. This finding is also true for past performance except that sloppy work and the percentage of individuals performing such work was higher.

Existing employee effectiveness has been enhanced considerably by specific training performed to improve field performance. This was not the case in the past, however, because of a generic attitude which seemed to categorize formal training as unnecessary and a waste of time. Training has improved as well as employee attitudes toward training, but each of these areas need further improvement.

From a historical perspective, the lack of specific upper tier criteria, especially in the time period beginning in the early 1970's, were discovered by this evaluation. During this time, adequate site procedures were almost nonexistent. This evaluation revealed that as the concrete anchor program evolved, more adequate site procedures were developed and upper-tier criteria were improved. Subsequently, the major problem was discovered to be a conflict between the upper tier criteria and site procedures. Upper tier criteria and site procedures were independent from each other in that site procedures were controlled and revised at the site level while upper tier criteria was handled at the DNE (corporate) level. This problem continued as recently as 1986. Technical adequacy has improved tremendously with respect to upper tier and site criteria. This evaluation revealed specificity could still be improved at the upper tier criteria level.

This evaluation has revealed that plant safety is indeterminate because a potential unanalyzed condition may exist in the area of bolt tightening. Otherwise, plant safety was not compromised with respect to the issues evaluated.

5.2.2 Plant-Specific

The statements made in section 5.2.1 are applicable to all TVA nuclear plants with two exceptions:

1. It was apparent that while problems were identified at BLN, employee effectiveness and technical adequacy are better than that found at SQN and WBN. This is due in part to the timeframe for construction of BLN as well as experience gained from construction of other TVA nuclear plants.

2. Because of the timeframe in which BFN was constructed, the issues related to past installations could not be effectively evaluated at BFN. A major effort is being made at BFN to qualify all anchor installations to current requirements.

6.0 CAUSE

6.1 Damage of Concrete/Rebar

6.1.2 Sequoyah Nuclear Plant

No specific CAQs were identified so no root cause is assigned at this time. A potential CAQ exists with respect to 10 CFR 50 Appendix B, Criterion XVII. If this CAQ is verified, root cause would be failure to follow procedure and/or failure to adhere to upper-tier criteria requirements.

6.2 Testing of Anchors

6.2.1 Watts Bar Nuclear Plant

The cause for the problems being tracked by CATD 11300-WBN-05 and CATD 11300-WBN-03 can be traced to a failure by DNC to incorporate all upper tier requirements into site procedures which resulted in inadequate procedures.

6.2.2 Sequoyah Nuclear Plant

The root cause for the potential deficiencies identified is incomplete procedures or a failure to incorporate all technical requirements by ONP and DNE.

6.2.3 Browns Ferry Nuclear Plant

The cause for reinspection and qualification of existing concrete anchors is the lack of specific installation and inspection criteria during the major portion of plant construction.

6.2.4 Generic

The cause for the generic problems identified by this evaluation is a failure by DNE to provide adequate upper tier criteria.

6.3 Anchors Cut Off

6.3.1 Watts Bar Nuclear Plant

The cause for the problems identified during evaluation of this issue at WBN could be traced to a failure by management to assure all requirements were fully implemented in site procedures and a failure by DNE to assure that design calculations were accurate and complete.

6.3.2 Sequoyah Nuclear Plant

The root cause for the potential deficiencies identified is failure to follow procedures and/or failure to adhere to upper-tier requirements.

6.3.3 Browns Ferry Nuclear Plant

The cause for problems identified is addressed in section 6.2.3, Testing of Anchors.

6.3.4 Bellefonte Nuclear Plant

The cause for the findings on this issue was direct (potentially blatant) violation of site specific concrete expansion anchor installation criteria.

6.4 Visual Failure of Anchors

The cause for the problems identified during evaluation of this issue at WBN, BFN and BLN is a failure by DNE to consider environmental effects on anchor bolts installed in a high humidity and corrosive environments.

6.5 Installation of Anchors

6.5.1 Browns Ferry Nuclear Plant

The root cause for the deficiencies identified during this evaluation is a failure by DNE to provide sufficient detailed installation criteria and consider all adjacent features.

6.5.2 Generic

The cause for the corporate problem identified during evaluation of this issue is a failure by DNE to provide adequate criteria.

7.0 CORRECTIVE ACTION

7.1 Corrective Action Already Taken or Planned

7.1.1 Damage to Concrete/Rebar

7.1.1.1 Plant-Specific

7.1.1.1.1 Watts Bar Nuclear Plant

Original calculations for various structures were not revised because new calculations or technical justification was prepared for all known rebar cuts. In addition, an OE Calculation Package was prepared which detailed the explanation of the program for documenting cut and damaged rebar. The cumulative effects for all cut and damaged rebar from initiation of construction through August, 1983, were evaluated and calculations were microfilmed as part of the permanent records.

7.1.1.1.2 Sequoyah Nuclear Plant

SQN Mechanical Modifications performed inspections on specific installations where anchor shells were potentially contacting rebar. The results indicated that no rebar had been cut nor was there contact between the anchor shell and rebar. In addition, M&AI 10, revision 10, section 3.1 states, "Unless otherwise called for, no reinforcing steel shall be cut to install anchors without specific approval from OE."

7.1.1.1.3 Bellefonte Nuclear Plant

Several instances were identified where concrete had potentially been damaged in some manner. However, visual examination revealed the areas to already have been repaired. BLN-QCP 5.4 (Concrete Curing and Repairing) is adequate for controlling/repairing concrete damage.

7.1.1.2 Generic

None

7.1.2 Testing of Anchors

7.1.2.1 Plant-Specific

7.1.2.1.1 Watts Bar Nuclear Plant

Several NCRs have been written to address various deficiencies specific to this issue. One NCR (3747R) resulted in complete reevaluation of the WBN anchor testing program. Revision of procedures, employee training and reinspection/rework of anchor installations were part of the reevaluation program.

7.1.2.1.2 Sequoyah Nuclear Plant

NCR-72D was originally initiated to document the continual failure of anchor pull tests in a specific plant location. A plant SMI was initiated to evaluate anchorages installed in this location because of understrength concrete being identified per NCR-72D. The SMI and a site Workplan (11693) each were mechanism to evaluate and/or correct anchor installations.

7.1.2.1.3 Browns Ferry Nuclear Plant

Complete reinspection programs for concrete anchorages under the scope of NRC OIE Bulletin 79-02 and detailed sample programs for anchors other than those addressed by 79-02 have been in place for several years. Anchorages are being inspected and subsequently accepted, repaired or replaced if outside the specified acceptance criteria.

7.1.2.2 Generic

None

7.1.3 Anchors Cut Off

7.1.3.1 Plant-Specific

7.1.3.1.1 Watts Bar Nuclear Plant

Numerous NCRs have been written to document from a generic standpoint the existence of altered anchors as well as to document specific instances of anchors that had been altered. Upon completion of these NCRs, a major revision was made to WBN-QCP 1.14 to incorporate all installation/inspection criteria found in G-32. Retraining of craft, engineering and QC personnel was also done.

7.1.3.1.2 Sequoyah Nuclear Plant

Several Site Work Requests and Special Maintenance Instructions had been initiated to reinspect and/or evaluate existing concrete anchor installations. It should be noted that the QTC/ERT and NSRS investigations of specific employee concerns resulted in documentation such as WRs and SMIs being initiated in many cases.

7.1.3.1.3 Browns Ferry Nuclear Plant

Actions taken at BFN to address this issue are detailed in section 7.1.1.2.3, Testing of Anchors.

7.1.3.1.4 Bellefonte Nuclear Plant

One specific instance of an anchor being cut off was identified at BLN but corrective action, including disciplinary action, is complete.

7.1.3.2 Generic

None

7.1.4 Visual Failure of Anchors

7.1.4.1 Plant-Specific

7.1.4.1.1 Watts Bar Nuclear Plant

NCR 6320 was initiated to document rusted/corroded anchorages identified as a result of a NSRS investigation. It should be noted that SCR-WBNNEB-8513 was initiated to correct the root cause of the problem which was a specified drain valve being closed. The affected supports have been repaired/reworked as required.

7.1.4.1.2 Sequoyah Nuclear Plant

As a result of the potential generic condition evaluation performed, a walkdown was done and no rusted or corroded concrete anchor bolts were identified. It was revealed that protective coatings were adequate and all floor mounted baseplates were installed on grout pads.

7.1.4.1.3 Browns Ferry Nuclear Plant

As a result of the potential generic condition evaluation performed at BFN (initiated per NCR 6320), a walkdown was done and several cases of rusted and/or corroded concrete anchor bolts were identified. The affected anchor installations were accepted on an interim basis. Further action is to be taken.

7.1.4.1.4 Bellefonte Nuclear Plant

Specific corroded/rusted anchor bolts were identified in a specified plant location. The bolts were subsequently removed and subjected to laboratory testing to evaluate the affects of the

rust/corrosion. It was determined that anchor bolt integrity was not affected; however the anchor bolts were still replaced.

7.1.4.2 Generic

None

7.1.5 Installation of Anchors

7.1.5.1 Plant-Specific

7.1.5.1.1 Watts Bar Nuclear Plant

NCR-GENQAB-8203 was initiated to document potential deficiencies with respect to concrete anchor spacing. A random sample of applicable installations failed to reveal any significant deficiencies. NCR-WBNSWP-8106 was initiated to document expansion anchors in pipe supports installed in violation of G-32 spacing criteria.

These installations were allowed by TVA drawing 47A050-17. A sample program failed to identify any discrepant supports with respect to the factor of safety and the applicable note on the aforementioned TVA drawing was deleted.

7.1.5.1.2 Sequoyah Nuclear Plant

The issue of Installation of Anchors was evaluated within the Testing of Anchors issue at SQN. See section 7.1.1.2.2.

7.1.5.2 Generic

None