

U. S. NUCLEAR REGULATORY COMMISSION

REGION V

Report No. 50-397/83-54

Docket No. 50-397

License No. CPPR-93

Licensee: Washington Public Power Supply System
P. O. Box 968
Richland, Washington 99352

Facility Name: Washington Nuclear Project No.2 (WNP-2)

Inspection at: WNP-2 Site, Benton County, Washington

Inspection conducted: November 5 to December 4, 1983

Inspectors:

A. D. Toth, Jr.
A. D. Toth, Senior Resident Inspector

12/28/83
Date Signed

Approved By:

R. T. Ladd
R. T. Ladd, Chief, Reactor Projects Section 1

12/27/83
Date Signed

Summary:

Inspection on November 5 - December 4, 1983 (Report No. 50-397/83-54)

Areas Inspected: Routine, unannounced inspection of construction quality reverification activities, status of previous inspection findings, and plant completion status. The inspection involved 103 inspector hours onsite by the Senior Resident Inspector.

Findings: No items of noncompliance or deviations were identified.

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DETAILS

1. Persons Contacted

a. Washington Public Power Supply System (WPPSS)

- *G. Afflerbach, Assistant Plant Manager
- *J. Baker, WNP-1 Operations Manager
- *R. Barbee, Plant Engineering Supervisor
 - J. Bufus, Test and Startup Supervisor
- *H. Crisp, Construction Manager
- *D. Feldman, Plant Quality Assurance Supervisor
- *J. Garvin, Quality Engineering Manager
- *R. Glasscock, Licensing and Assurance Director
- *R. Johnson, Project Quality Assurance Manager
 - R. Knawa, Reverification Program Manager
- *J. Martin, Plant Manager
- *M. Monopoli, Manager of Operations Assurance Programs
- *J. Peters, Plant Administrative Manager
 - P. Powell, Licensing Engineer
- *J. Shannon, Director of Power Generation
- *V. Shockley, Health Physics/Chemistry Supervisor
- *D. Walker, Operations Quality Assurance Manager

b. Burns and Roe Engineering Incorporated (BRI)

- R. Sanan, Resident Group Supervisor - Civil
- R. Sabol, Quality Assurance Engineer
- H. Tuthill, Engineering Quality Assurance Manager

c. Bechtel Power Corporation

- *D. Cosgrove, Quality Assurance Engineer
- *J. Gatewood, Project Quality Assurance Engineer
 - D. Johnson, Manager of Quality
- *M. Leach, Reverification Group Supervisor
 - N. Powell, Site Engineering Manager

d. Bonneville Power Administration

- *W. Chin, Project Representative

e. Energy Facility Site Evaluation Council

- *G. Hansen, Senior Engineer

*Denotes personnel present at the exit management meeting.

In addition to the personnel noted above, the inspector interviewed various other construction, engineering, operations and quality control personnel from the licensee and contractor organizations.

2. General

The senior resident inspector was onsite November 5, 7-12, 14-19, 21-23, 25-26, 28-30, and December 1-3, 1983.

A resident inspector in-training (R. Waite) was assigned to the site November 21 and was onsite November 21-23 and 25, 1983.

The following regional office inspectors and managers visited the site this month for routine inspection activities. Their activities are documented in other separate inspection reports.

- ° A radiation safety inspector (G. Yuhas) was onsite November 28-30, 1983 and December 1-2, 1983, to review preoperational testing records for radiation monitoring systems.
- ° A fire protection inspector (K. Scown) and a consultant from Brookhaven National Laboratory (E. MacDougall) were onsite to review safe shutdown and associated circuit issues.
- ° Three regional office inspectors (W. Willet, D. Haist, and J. Burdoin) were onsite November 15-18, 1983, for review of construction and operations testing program matters.
- ° Two regional office inspectors (F. Cassella and K. Pendergast) were onsite November 15-18, 1983 for site orientation.
- ° A regional office inspection supervisor (R. Dodds) was onsite November 7-23, 1983 to assist with construction and preoperational testing inspections and to assess construction outstanding items.

On November 1, 1983, the plant construction and operations responsibilities were formally consolidated under the Plant Manager (J. Martin), and the position of Program Director abolished.

By letter dated October 31, 1983, the licensee has recognized the organizational changes and requested that NRC address all WNP-2 correspondence to the Manager of Regulatory Programs (G. C. Sorensen).

3. Construction Reverification Program

In response to the June 17, 1980, NRC inquiry under 10 CFR 50.54(f), the Supply System, Bechtel, and site contractors have been engaged in a construction reverification program which includes review of records and reinspections of hardware installed prior to July 1980. Reports of the reverification program activities have been submitted to NRC by the licensee on a bi-monthly basis since 1980. Clarification of licensee commitments has been documented in NRC Inspection Reports 50-397/83-10, 83-25 and 83-27.

During the current period the licensee completed the final report of this activity. Previously, NRC resident inspectors had examined the volumes relating to work by contractors for the fire protection system (Contract 216: Sentry), heating and ventilation (Contract 217-TWC: The

Waldinger Company), and instrumentation (Contract 220-JCI: Johnson Controls Incorporated). Regional office personnel reviewed the report of the containment vessel erection (213-PDM: Pittsburgh Des Moines Company). Regional office inspectors had also reviewed the special reports relating to grout reinspection and concrete evaluation.

During the current period the resident inspector examined the final reports for work by the mechanical contractor (Contract 215-WBG: Wright-Schuchart Harbor/Boecon/General Energy Resources Incorporated), in addition to a report of the site wide nondestructive testing (NDE) activities. The inspector also examined the reports for work by the painting contractor (Contract 219/234-OBC: O. B. Cannon). Regional office personnel reviewed the reports of work by the electrical contractor (Contract 218-F/L: Fishbach and Lord). Regional office personnel also reviewed the report of reviews of the various contracts labelled prepurchased or inactive. The inspectors interviewed personnel and examined procedures, records and in some cases hardware in conjunction with these reviews. In some cases the inspectors were familiar with specific 100 percent or sampling-type review/reinspection/rework programs referenced in the reports. The reviews by the regional office staff are documented in separate NRC inspection reports, whereas the resident inspector's reviews are discussed below:

a. Mechanical Contract (Contract 215-WBG)

The WBG organization reviewed all of the documentation for its safety-related (quality class 1) work conducted prior to June 1980; this was done under direct management by Bechtel personnel, and monitoring by quality control engineers as follows:

- (1) It included review of each purchase order and compilation of a certified heat log of materials; during subsequent reviews of work packages, this log was used to ascertain use of acceptable materials.

The final reverification report mentioned ten purchase orders for which the WBG organization could not achieve resolution, and which were transmitted to the construction manager (Bechtel) for final resolution. The inspector identified the specific ten and examined the actions by Bechtel relating to three (Purchase Orders numbered 12393, 824205 and 10343). The Bechtel actions appeared conservative and appropriate. Where the material certifications could not be obtained, Bechtel downgraded the material classification such that subsequent 100 percent reviews of work packages would not accept the materials for higher grade applications.

- (2) It included development of a list of all welders, date of qualification to each procedure, and date the welder worked on each weld joint; during subsequent reviews of work packages, this list was used to ascertain work by qualified personnel for each weld. These two data bases were fundamental to the reviews, and steps were taken to resolve discrepancies

associated with them. Various ASME code cases were invoked, with State and NRC approvals obtained, to allow acceptance of items which would have been discrepancies under the original codes committed to in the FSAR. For example, where some records of welder qualification could not be found, WBG was able to invoke the latter code addenda to qualify the welders after the fact, by researching the records to identify the first weld made by the welder, and assuring that an acceptable radiograph existed for that weld. This was successful for all but one welder. Additionally, each work package which involved welding was reviewed by the WBG welding engineering group, providing a check of selections of proper weld procedures for the materials involved and other welding specification and record parameters.

- (3) It included review of each design change, open and closed inspection reports and nonconformance report in each work package to ascertain the status of the matter and evidence of resolution. Items which could not be resolved using available documentation were transferred to Bechtel for evaluation and examination of the current field conditions (if needed) and disposition action, such as repair, rework, accept-as-is, or determination of non-validity.

The review had the benefit of the 1981 restart program procedure reviews, and the efforts to clear backlogs of open issues (audit findings, NRC findings, nonconformance reports, corrective action reports) and the associated problem trending evaluations. Such evaluations resulted in special requirements checklists, which were later converted into lists of generic problem areas; these were considered either in the document review process or during reinspection activities in the field. The reverification report was ambiguous as to whether each documentation related generic problem was specifically incorporated into the WBG documentation review activity, and the inspector requested demonstration of this proposition. The Bechtel manager who had directed the WBG review program in 1981-1982 (N. Powell) was interviewed and attested to how WBG review guides and work procedures were combined to address the particular generic problem areas.

The vigorous document backlog activity resulted in much rework in the field. Many of the old items, plus new issues identified by ongoing activities (including NRC inspections of Bechtel work) resulted in 100 percent reinspection of prior completed work or work in-progress (with associated rework/repair as warranted), such as for piping weld-arc-strikes and surface defects, pipe wall thickness at weld joints prepared for inservice inspection, radiographs, grout, anchor bolts, lubrite plates, weld-o-lets, sway strut end-assemblies, pipe-whip restraints, bolting of steel, and sacrificial shield wall welds. Additionally, much of the WBG work was incomplete when turned over to Bechtel in August 1981. Some complete work was also returned to the incomplete status, as backlogs of design change requests were resolved with revised specifications and design change instructions issued to the field.

As a result, some completed work was considered to be work "in-progress," and subject to subsequent final inspections.

As a result of the above activities, many of the generic problems to be found with completed work were already identified within action plans for correction. When this work was subjected to reverification inspections, the inspectors then found that the items had already been corrected, or some corrective action control documentation existed to show that the discrepancy was already identified, or there existed a planned reinspection program specifically directed to the specific attribute in question. It was principally due to this situation that the reverification program final report has been able to conclude:

- ° "The safety-related work performed under Contract 215 prior to July 1980 was executed in an adequate manner and is acceptable, or has been addressed by the project in a corrective action program."
- ° "Although a number of deficiencies were discovered in the reinspection of this work, they were typically not significant. Even those considered important enough for rework would not have limited the ability of the components to perform adequately."

In addition to the documentation review, the final report describes the program of hardware reinspection, including a description of scope, consideration of known/suspected generic problem areas, sampling plans and basis, results and analysis of results.

- (1) The reinspections addressed each safety related system. A basic 10 percent of the piping isometric drawings were selected for each system, and all piping and pipe supports on those isometric drawings were visually reinspected. Only items which had been completed by WBG were included in the samples. Random sampling techniques were utilized. A check requested by NRC demonstrated that this resulted in the expected correlation with the amount of work performed in each period (quarterly) prior to July 1980. The reinspection scope eventually included:
 - (a) 137 of 806 structural steel connections (1500 welds)
 - (b) 15 of 93 pipe whip restraints (200 welds)
 - (c) 409 of 4039 large bore pipe supports (8200 welds)
 - (d) 57 of 480 large bore piping isometrics (800 welds)
 - (e) 252 of 2500 small bore pipe supports (800 welds)
 - (f) 71 of 553 small bore piping isometrics (900 welds)
- (2) The reinspections did not include work performed by a WBG subcontractor, GEI&SE (General Electric Installation and Service Engineering). The licensee rationale for this consisted of consideration that the contractor had an ASME Code stamp and the Bechtel final documentation review for this contractor indicated no quality problems. Furthermore, at the

inception of the restart and reverification program, the NRC regional management concurred that this contractor would not require consideration under the 10 CFR 50.54(f) request, due to it's working under an approved NRC quality assurance program. (However, the licensee has subsequently identified that this contractor was working under the WBG quality assurance program, and the NRC approved general GE topical program did not appear to be applicable).

The NRC inspector noted that this subcontractor had experienced some material handling or identification problems (NRC Inspection Reports 50-397/80-08 paragraph 3.b.(1).(d) and 82-12 paragraph 3.a) and was included with the site contractors who had not originally included proper criteria for skew weld configurations (report 81-21). Craft personnel for this contractor also came from the same union halls as the other contractors. For the singular residual item identified by the contract 215 reverification reinspections (a discrepancy with fillet weld size on socket welds at flanges) the GEI&SE work was not reinspected to ascertain absence of the problem (the work of this contractor includes control rod drive piping, which was predominantly socket welds). The inspector requested reconsideration of the basis to exclude the GEI&SE work from the reverification program.

The licensee provided additional information, including evidence of a late 1979 audit which resulted in a stop work for GEI&SE for nonresponsiveness to the licensee audit findings, and subsequent termination of the contract and assumption by Bechtel. Some preservice inspection data was noted to provide additional confidence in critical butt welds for the control rod drive system piping, which was the principal site activity of this contractor. The licensee interviewed the GEI&SE quality control supervisor for the site work, and determined that few flange fillet welds were involved for this contract; the Bechtel reverification manager (M. Leach) attested that his field survey confirmed few flange welds and these appeared to have been installed of appropriate larger size than those at socket weld joints. Additionally, an as-built program was conducted, using approved procedures and surveillance by Bechtel quality control staff (although this did not include weld reinspection aspects). The additional data appeared to serve as sufficient basis for assuring adequacy of work for this contractor.

- (3) The report documents the reinspection result categorization and evaluation for trends and generic aspects. The frequency of occurrence and the safety significance have been considered. Structural steel and piping were considered separately. Identified discrepancies which the Engineer evaluated and dispositioned as "Accept-As-Is" were included in the examination for trends, but not further analyzed. In response to prior NRC interest, the report also documents the analysis of those discrepancies which the Engineer had evaluated and

dispositioned as "Rework." The analysis takes credit for other programs, such as the pipe support as-built program, which included inspection check points expected to detect discrepancies. Each type discrepancy has been analyzed, with extenuating circumstances noted for many. The frequency and safety significance of each appears to have been considered. The report summarizes that: "99.63 percent of the welds in the sample were acceptable by inspection or engineering evaluation. Further evaluation by the Engineer has shown all the welds in the sample to be structurally adequate, although design margins have in cases been reduced. The data and analysis presented in the report appear to support the conclusion, and appear reasonable with consideration of the backlog/corrections programs previously described above.

During the course of the WBG documentation review program (which involved over 300 field engineers) and during the reverification reinspection program, NRC resident inspectors were routinely onsite. They interfaced with many of the personnel during record reviews, plant tours and work inspection activities. Communications were open and frank between the inspectors and such staff; licensee and contractor management did not attempt to discourage such communication. The inspectors considered such communications and monitored the activities of the WPPSS quality "hotline" program and employee termination exit interview activities. The NRC office telephone exchange was listed in the plant directory and in the city directory. Occasionally some problems were identified, but these were addressed. The inspectors concluded that the reviewers and inspectors were generally satisfied with the integrity of the review and reinspection process, and with management's support in identifying and addressing issues as they arose.

Based upon the data in the final report, the supplemental data for subcontractor GEI&SE, and NRC inspectors' observations since July 1980, the reverification program for the WBG work appears to have met the requirements of the NRC letter to WPPSS under 10 CFR 50.54(f). The results provide a high degree of assurance that specified materials were procured and installed to the requirements of the final approved specifications and regulatory requirements. This recognizes that deficiencies occurred and these have been identified and required corrective actions defined and implemented. The inspector identified no items of noncompliance or deviations.

b. Nondestructive Examination (NDE) Activities

The Supply System had generally limited the reverification program to documentation reviews and visual reinspections of completed work. However, the NRC also questioned the validity of prior nondestructive examination work (NRC Inspection Reports 50-397/83-25 and 83-27). The Supply System letter to NRC dated July 18, 1983

(G02-83-618) described that prior nondestructive examination efforts would be addressed.

The final NDE Reverification Report identifies all site contractors that included NDE in their work scopes. The Supply System gave consideration to prior investigations and corrective actions of a reverification nature, and excluded some work from consideration due to its inaccessability or non relevance to safety considerations. For some work, re-examinations were performed:

- (1) Contract 213, Pittsburgh Des Moines, Containment vessel. Sixty one-foot-long areas of weld were subject to reverification magnetic particle re-examination.

Sixty radiographs were re-reviewed, including weld quality and film quality considerations.

- (2) Contract 213A, Pittsburgh Des Moines, Containment structures. A previous program had identified radiograph discrepancies, and all PDM radiographs were re-reviewed by PDM. Areas that showed film quality problems were re-radiographed.

Also, PDM had conducted a major documentation review and work reinspection program which resulted in much rework and new final inspections, including NDE.

- (3) Contract 220, Johnson Controls Inc., Instrumentation. Sixty welds were subjected to re-examination by liquid penetrant method.
- (4) Contract 233, B. F. Shaw, Spray Pond Piping. Thirty-five welds were re-examined by the magnetic particle method.
- (5) Contract 218, Fischbach/Lord, Electrical Installations. No re-examinations were performed, since the original magnetic particle examinations performed by the contractor have since been deemed superfluous to applicable Code requirements and not critical to the quality of conduit and cable tray support installations. The Engineer has revised the specification accordingly.
- (6) Contract 205, Control-X, Embedded Drain line piping. No re-examinations were performed, since all lines are non-critical in nature, not pressure-retaining, and are embedded in concrete and thus not assessible.
- (7) Contract 206A/210, Bostrom Bergen, Fuel pool liners. No re-examinations were performed, since the welds are not critical for structural integrity of the fuel pool (the liner acts simply as a leak proof membrane, and minor leakage can be detected and accommodated via the leak chase system behind each submersed weld seam. The Supply System also considered that the seams are inaccessible for re-examinations because they are currently filled with water (Although the NRC inspector did not

concur with this assessment, he did agree that the significance of the structure did not appear to warrant a re-examination effort.)

- (8) Contract 215 and others, Northwest Industrial X-Ray, Inc. (Serviced several contractors onsite, liquid penetrant, magnetic particle and radiograph methods. Performed radiography only for the 215 contract). All radiographs of the 215 contractor were reviewed under a special program which was closely monitored by NRC.

No liquid penetrant nor magnetic particle re-examinations were performed. The Supply System considered that the liquid penetrant, magnetic particle, and ultrasonic tests performed under the preservice inspection (PSI) program provided independent third-party data to affirm acceptability of ASME Class I piping greater than one-inch in diameter and certain ECCS and Main Steam Class II pipe welds greater than four-inches in diameter. As a result of this PSI program, the report mentions that many welds were turned back to construction to resolve surface indications identified by liquid penetrant tests, noting that the majority of these required only cosmetic blending (as opposed to repairs). The Supply System considered that the results of this program were sufficient to conclude the general acceptability of NDE work by the NIX contractor.

The inspector challenged the conclusion based upon NRC finding 50-397/79-18-02 and a September 25, 1981, WPPSS Corrective Action Request CAR-1003; these suggested that some NIX liquid penetrant examination work had failed to identify rejectable indications. However, for CAR-1003, there was indication (on an associated Request For NDE Inspection No. 6254) that this may have been due to workers having "cleaned welds" prior to the second examination, possibly introducing scratches or uncovering inclusions which would appear as new indications found by the PSI program (NRC Item 50-397/79-18-03). This appears to have resulted from surface preparation activities following initial completion and NDE of the weld by the erection contractor. The licensee provided additional data relating to the PSI program scope, and findings which clearly demonstrated that the PSI program results support adequacy of NIX penetrant testing. The licensee's rationale and conclusions appeared reasonable.

As a result of the various re-examinations and reviews summarized above, the reverification group identified some isolated discrepancies. Evaluation of these indicated no significant impact on a conclusion that the site nondestructive testing activities met Code and specification requirements.

For NDE performed by offsite vendors, the Supply System reviewed NDE related documentation, and considered NRC Bulletins and Circulars for any indication of problems with particular vendors. For site re-examination candidates, the Supply System considered only those

suppliers which did not have an ASME approved or NRC reviewed quality assurance program. In this category were:

- (1) Contracts 31A and 32CD, cranes. No re-examinations were performed, since specification requirements for NDE were limited to crane hooks. Such examinations were performed onsite after load tests, and will be routinely repeated during plant operations.
- (2) Contract 90, Leckenby Company, Pipe Whip Restraints. A program of 100 percent re-examination and repair was conducted for these items after July 1980.
- (3) Contract 215 Supplier, Associated Piping and Engineering. The Supply System reviewed radiographs for 1682 welds, in response to NRC Bulletin 82-01.

The Supply System concluded that the nondestructive examinations performed prior to July 1980 were performed competently and in accordance with the established code requirements. The NDE final report appears to provide a reasonable basis for this conclusion. The licensee reverification effort in this area appears to meet the requirements of the NRC request under 10 CFR 50.54(f). The inspector identified no items of noncompliance or deviations.

c. Painting Contract (219/234 - OBC)

The O. B. Cannon and Sons (OBC) coatings contractor had performed coating work within the containment vessel drywell and the wetwell prior to July 1980. The reverification report demonstrates that the contractor had reviewed his work scope, prior material and work records, prior deficiency reports, generic problem areas identified by the licensee, and provided a plan and criteria for reinspection of completed work. The report includes correspondence and Bechtel review results which summarize the following corrective actions:

(1) Drywell Contract 219:

Preliminary inspections identified a number of damaged areas in the drywell coatings. Much of this was due to rework activities on steel structures within the drywell. A complete reinspection of the containment wall, floor, structural steel, sacrificial shield wall and the reactor pressure vessel pedestal was accomplished. As a result, the 95 percent of previous coatings were reported removed (principally by sandblasting) and a new coating applied under new work procedures. The inspector had observed these sandblasting and recoating activities during routine inspection activities in 1983.

(2) Wetwell Contract 234:

Work completed prior to July 1980 included residual heat removal system lines (RHR) and initial surface preparation of

the interior of the pedestal for the reactor pressure vessel. Due to construction damage, the RHR lines were 100 percent recoated using new procedures. The pedestal interior was 100 percent reinspected as part of the preparations for application of the finish coatings. Deficiencies identified during the inspections were corrected before subsequent coats were applied.

d. Personnel Qualifications

The NRC June 17, 1980, inquiry proposed that the licensee plans for review of completed safety-related work should consider if there were instances in which improperly qualified personnel performed and inspected work. The Supply System July 17, 1980, reply indicated that the record reviews would include review of personnel (welding/NDE/QC/Engineering) qualifications to determine whether they were qualified. This commitment was adjusted in the fifth progress report (July 1, 1981) which included the Quality Verification Program Plan (procedure QVI-01, Revision 0). This approach was reviewed and acceptable to the NRC regional office, and was reiterated in the August 9, 1982, eleventh progress report, and the April 18, 1983, Supply System letter to NRC. The NRC concurrence with Supply System adjusted commitments was documented in the August 8, 1983, transmitted NRC inspection report number 50-397/83-27.

The records review of the various contractors were to include verification of qualifications of welding, nondestructive examination (NDE), and quality control personnel in accordance with standards and procedures governing such qualifications. The inspector noted incorporation of such review requirements in the detailed programs for the various active contractors, and had verified implementation of such record reviews for the mechanical and instrumentation contractors. Additionally, the Quality Reverification Program Report (section on personnel qualifications) included analyses of prior audit findings and reverification inspection findings to assess general adequacy of non-engineer qualifications programs for the contractors. The report identifies that, where discrepancies were previously identified, corrective actions were taken to resolve quality concerns.

For engineer qualifications, the Supply System recognized the absence of regulatory standards and the ambiguity of resumes as a basis for assessing abilities for specific work assignment. The licensee established a review approach which would assess the general performance of the engineering activities through sampling of various design change documents handled by the engineering staffs. The Quality Reverification Program personnel qualifications report summarizes the review approach and results:

The design control procedures in effect during the contract performance period were checked for each of twenty contractors; for each contractor the engineering personnel did not have the authority to disseminate technical information affecting permanent plant work

without first obtaining review and/or approval from the architect engineer (Burns and Roe, Inc.). This confirmed existence of an independent technical review for those contractors which did have some design responsibilities.

The Burns and Roe quality assurance program was confirmed to have included 98 formal internal engineering technical audits since November 1972. Additionally, offsite Burns and Roe engineers conducted five special design reviews of selected systems. Also, in 1977, the Supply System initiated system design reviews of 32 systems, and in 1982-1983 conducted Design Verification Program reviews of three systems. Such audits and reviews are credited with having assisted management in assessing staff performance and qualifications.

The various modes of effecting design modifications were identified and governing procedures confirmed as having provisions for checking and review.

Three reverification program reviews were conducted to examine:

- (1) The engineering decisions made by Burns and Roe engineers to resolve 348 of the 3096 nonconformance reports which had been referred to Burns and Roe for disposition prior to July 1980. This review was conducted by Supply System engineers.
- (2) The engineering decisions made by Burns and Roe engineers to reply to 40 requests for information (RFI) from contractors prior to July 1980. This review was conducted by Supply System engineers.
- (3) The engineering decisions made by Burns and Roe engineers to respond to 270 design change related documents (seven different types) issued prior to July 1980, for prepurchased or inactive category contracts. This review was conducted by Burns and Roe engineers after July 1980.

The results of these reviews did not reveal any unacceptable engineering actions. In some cases, the documented basis for decisions was unclear, but clarifications and analyses demonstrated the engineering decisions to have been valid. The Supply System reverification analyst concludes that there have been no significant findings concerning technical adequacy and the competency and qualifications of the participants proven.

The inspector took note of this report as a reasonable effort to identify any significant personnel qualifications problem with engineering.

The inspector previously (since July 1980) noted that Burns and Roe incorporated resume verification into their engineering hiring practices, and a Supply System uniform hiring policy was implemented to assure that contract (job shop) engineers are obtained from contractors who verify resumes. This appears to provide some

verification of information used by engineering managers during early stages of working with new staff members.

The inspector noted that piping and supports stress calculations will be verified with as-built conditions and electrical supports design bases have been verified by a third party contractor. The various specification and procedure reviews conducted as part of work restart resulted in additional engineering review of design bases (especially codes and standards requirements). Component rework and redesign activities have introduced additional reviews of prior engineering calculations and decisions. Various NRC initiated reviews, such as fire protection, human factors, cable separation reviews, and three-mile island issues, have resulted in prior engineering being revisited by additional reviewers. All of these activities tend to mitigate the reliance of significant design on any single individual whose competence might be in question.

The licensee effort on the personnel qualifications task appears reasonable and in accordance with commitments to NRC. No deviations were identified.

e. Generic Problem Areas

As the Supply System work restart task forces (now designated as RCSW) completed their review of contractor procedures in 1981, they compiled lists of items for consideration during the subsequent activities of reverification of prior work (RVP). These were provided to Bechtel via individual letters. Bechtel compiled a 75 page package of significant items, consisting mostly of NRC prior inspection findings, plus some matters which were reported to NRC under 10 CFR 50.55(e). These were coupled with an index and matrix of contractor applicability, and provided to contractors for consideration in their reverification programs. It was also used by Bechtel to upgrade work procedures.

An NRC regional office team identified (NRC inspection report 50-397/83-10 paragraph 3.f) that not all the items generated by the RCSW task forces had been translated into specific reverification items. It appeared that only those which involved NRC inspection findings, or which were so significant as to warrant reporting under 10 CFR 50.55(e) were considered. However, the licensee correctly pointed out that reverification program record reviews and visual reinspections have been performed using procedures which had been upgraded by the RCSW effort and thus inherently incorporated the RCSW comments (e.g., limitations on weld weave).

The inspector particularly examined the specific RCSW item mentioned by the regional office review team, which involved intergranular corrosion test data for a weld procedure. The comment stated that "Intergranular corrosion test does not address location of weld metal, base metal and HAZ" (heat affected zone). This implied that test data should have been recorded for each of the three mentioned areas. However, this was a misinterpretation of the applicable specification number 220-17A requirement that simply describes the

scope of the test specimen "The corrosion test specimen shall include weld metal, heat affected zone, and base metal." Neither the specification, nor the test procedure (ASTM-A262 Practice E) require recording data specific to each area. The intent was clearly confirmed with the Burns and Roe November 10, 1980, approval of an amendment to the relevant intergranular corrosion test report which simply added the statement "Weld deposit, heat-affected zone, and parent metal examined." Original data on the report clearly showed that weld metal and heat affected zone had been examined.

The comment also stated that "Two of the four locations were found to be unsatisfactory." This does not refer to the aforementioned three locations (weld metal, base metal, HAZ). The test report (Durkee Testing Laboratories H-1837) shows the locations as at or between tack welds on the corrosion specimen. The specific unsatisfactory designation on the test report for one weld procedure of the instrument contractor has no relevance to other contractors and was appropriately not included in the generic problem area list.

Most of the site contractors revised their procedures prior to submission to the RCSW team. More could have been done to obtain the benefit of those reviews as input to the reverification of prior work. However, no deviation from licensee commitments was identified.

4. Containment Penetration Stiffener Welds

NRC Inspection Report 50-397/83-29 (paragraph V-B.4.(3)) describes an observation by inspectors of the Construction Appraisal Team (CAT). It notes that the as-installed fillet welds, on certain stiffener plates of containment penetrations, had cross-sections less than the size shown on design drawings. The CAT suggested that such undersized fillet welds on containment penetration stiffeners appeared to be a generic problem for similar type penetrations.

The licensee's resolution of this observation was documented in an August 15, 1983 letter to NRC (G02-83-732), Program IV Page 2 of 9. This described that a 100 percent reinspection was conducted of all such configurations installed by the contractor involved (PDM contract number 213), and all conditions documented and evaluated by the engineer for adequacy to meet design loads. In every case the as-found condition was determined to be adequate.

The inspector examined the documentation (nonconformance reports and attachments) for the specific penetrations that were identified by the CAT (penetrations X-3, X-11A and X-50; NCR's 21810, 21808 and 21806). In each case the NCR includes an as-built sketch showing actual weld sizes for the various stiffener plates for each penetration. The engineer's conclusion of acceptability was noted.

The plant reverification program (Prepurchased and Inactive Contracts segment) considered the above items in the overall evaluation of the 213-contract. That program also considered the 93 nonconformance reports (NCR's), 28 corrective action reports (CAR's), 93 shop surveillance

reports and results of the NRC vendor inspection activities at the Pittsburgh-Des Moines (contract 213) shops. The final contract quality assurance documentation review results were also considered, including their significance. This activity was in accordance with the commitments to NRC in reply to the NRC inquiry under 10 CFR 50.54(f) in June 1980. The consideration of the CAT findings were as committed in NRC inspection report number 50-397/83-27 paragraph 3.h.

No items of noncompliance were identified.

5. Errors In Cable Pull Slips

The NRC Construction Appraisal Team (CAT) inspectors described errors in the computer generated pull slips, in paragraph II.B.3.a of NRC Inspection Report 50-397/83-29. The CAT inspectors considered the errors to be isolated and non-repetitive in nature, as noted in Appendix A of the July 26, 1983, transmittal letter of the CAT report. The specific errors noted were to be corrected as necessary by the licensee under his tracking list for CAT specific items (noted in NRC Inspection Report 50-397/83-38 paragraph 4.)

Since the CAT report infers that a computer system had been providing incorrect installation instructions to the field, the resident inspector inquired further into the details of the items identified by the CAT and their generic implications. The results revealed that the errors were not associated with the Engineer's computer generated cable routing lists, but rather were a result of the contractor's field engineer oversights.

The Engineer's computer printed cable schedule includes definition of cable routing through nodes. The contractor's field engineers used this cable schedule (Drawing E551, consisting of hundreds of pages of listings), along with other pertinent technical directions (in accordance with procedure CP/QAP-404 part VI-A.1) to prepare hand-written typed cable pull slips for use by field personnel. As part of this process, the procedure also required the contractor field engineers to verify all drawings for continuity of raceway between "From" and "To" locations, including visual inspection in the field to confirm feasibility of installation. The field engineers then entered the node numbers, as specified on the cable schedule, onto the individual pull slips. As the installation of the cable proceeded, entries were made on the pull slip to identify achievement of each of the nodes.

The CAT identified two cases (cables ASL73-9038 and 2PRM-114) where the field engineers had missed transcribing a node from the cable schedule onto the pull slip. These were inconsequential in that the nodes were in-line in continuous runs of raceway of an individual color coded electrical division.

The CAT identified one case (cable 2PRM-114) where the installing crew made an obvious typographical error in recording the in-line node series (...4033 3436 2666...) rather than the hand written field engineer specified series (...4033 3466 2666...).

The CAT identified one case (cable 2M8BA-0018) where the cable schedule and pull slips did not include node number 8063. The licensee has subsequently clarified that this is a node on a vertical riser adjacent to horizontal runs of raceway, and such nodes are not included in the cable schedule unless the cable is actually routed into the riser. (Questions relating to proximity of risers to horizontal tray have been addressed under NRC item 397/83-38-14).

The CAT also identified one case (cable ASM7-9090) where the cable pull slip showed the cable passing through wall penetration sleeve P2043-9C, whereas the actual installation was through P2043-10B. The specific sleeves are not specified in the cable schedule and were the option of the installing contractor, limited by divisional separation criteria. As the trays or conduit approach each side of the wall, they are in divisional groups, as are the penetration sleeve groups. The physical configuration is such that local selections within the penetration group could vary reasonably (Some limitations are presented in procedure CP/QAP-404 part V.F.4). Routing to a sleeve in another divisional group would be clearly visible and questionable. The CAT did not identify such a discrepancy.

The above details appear to support the CAT conclusions and do not suggest faulty installation nor a compromise in cable separation criteria in the as-installed cable routings.

No items of noncompliance or deviations were identified.

6. Incorrect Quotation of NRC Inspector

The resident inspector examined the affidavit of an ex-employee of the architect-engineer (S. Sandler dated October 13, 1983) which had been submitted to NRC in conjunction with a petition regarding the construction permit and operating license. It recited various technical issues which had previously been resolved by the Supply System and verified by NRC inspectors; it presented perceptions of these matters and incorrect interpretations of NRC regulations; it attributed certain statements (inaccurately) to the NRC resident inspector, implying existence of a problem which had not been addressed to the satisfaction of NRC inspectors. This is addressed here for record clarification purposes.

Specifically, the affidavit claimed that the NRC inspector stated that "checking qualifications of engineering personnel onsite was still a problem as late as November 1982." This was an incorrect rephrasing or misinterpretation.

The NRC has been interested in qualifications of engineering personnel in terms of verification of resumes, especially for contract (job shop) personnel. This has been addressed in NRC inspection reports 50-397/81-01, 81-08 and 81-10, and was being tracked under item numbers 397/81-01-09 and 81-01-01. At the time of the ex-employee's call in November 1982, the inspector had not yet completed his review of the licensee records regarding this item. The ex-employee apparently interpreted this to mean that the NRC considered engineer qualifications

to be inadequate, thus supporting his perception of what qualifications were required and not met.

The inspector conducted his review in December 1982 and found the matter acceptable (NRC inspection report 397/82-29). This matter related to the apparent absence of provisions to verify resumes, and did not involve any identified problems with engineer qualifications on the WNP-2 project, nor any noncompliance with NRC regulations.

7. High Pressure Core Spray Pump Start Failure

The inspector observed Loss-Of-Power Test Number 4 at 3:30 a.m. November 28, 1983. This involved disconnect of the backup power supply and then trip of the startup power source, with subsequent introduction of a loss-of-coolant accident signal. Diesel generators started and connected to the safety-related buses and ECCS pumps started with exception of the high pressure core spray pump (HPCS). Subsequent licensee investigation showed that secondary undervoltage contacts, functioning as prescribed by design schematic drawings, prevented the HPCS circuit breaker from closing. These contacts were installed as a result of finding number PFR-HPCS-51 of the Design Verification Program, which had identified that original design had not incorporated the secondary undervoltage provision of FSAR Section 8.3.1.1.1 Amendment 26. The revised design was provided with General Electric Company concurrence via FDDR-KK1-1214 Revision 2, Document VPF-3390-28(5)-2 sheet 5 Revision 1, dated September 21, 1983.

The licensee has now revised the design to include additional circuit relay contacts as a final fix to assure proper start of the pump. Basis for the change included verification tests to confirm the cause of the failure of the pump to start following the change, the loss-of-power test Number 4 was repeated, (evening of November 28, 1983) with acceptable results, including proper start of the HPCS pump.

The inspector interviewed the Supply System engineer who had participated in the Design Verification Program review of this system. The engineer affirmed that he had been consulted regarding the final fix for the design error, and displayed documentation confirming that General Electric Company engineers had been consulted. The design fix was accomplished in one day, and documentation of the problem and GE concurrence were initiated subsequent to the installation of hardware and completion of the preoperational test.

The nature of the design error was such that failure of the pump to start was dependent upon the timing of the LOCA signal following the loss-of-power event. It was conceivable that preoperational testing would not have revealed the deficiency if the LOCA signal were introduced quickly. The licensee notified the NRC Region V office of this matter November 30, 1983, as a significant construction deficiency, under 10 CFR 50.55(e).

No items of noncompliance were identified.

8. Licensee Actions On Previous NRC Inspection Findings

With the approach of the licensee's target fuel load date, the licensee staff had emphasized efforts to address previous NRC inspection findings. On October 31, 1983, the licensee advised the inspector that all construction related prior NRC findings, including those of the Construction Appraisal Team (CAT), had been addressed and resolved to the satisfaction of the Bechtel and Supply System quality assurance department's management. For each such item, Bechtel had prepared a package of information which described the problem, an assessment of root cause, and specific and generic corrective actions taken (including measures to prevent recurrence). Bechtel also included pertinent excerpts from procedures or records which demonstrated implementation of the corrective actions. The approach for all items, regardless of nature, included response commensurate with what would be expected for NRC issued items of noncompliance.

The inspector examined these packages, plus additional records, and interviewed personnel and examined hardware as necessary to substantiate implementation of satisfactory corrective measures.

For some items the NRC Office of Nuclear Reactor Regulation has been conducting a technical evaluation of the findings and the licensee's engineering analyses. Those reviews have not yet been fully completed for consideration by the inspector to resolve the issues; however, the progress on those issues has been such as to indicate substantial concurrence with the licensee's positions.

Prior findings examined by the inspector this period consisted of the following:

- a. (Closed) General Follow-up Item 50-397/80-08: Group of 40 items were to be incorporated into general corrective action program development.

An NRC escalated enforcement action was issued to the Supply System June 17, 1980, which required project wide corrective actions. Subsequent to this, and during final phases of the in-process investigation documented in NRC Investigation Report 50-397/80-08, the Region V inspection staff identified 40 items which should be considered in the development and implementation of the corrective action programs. Some of these items were also identified by NRC as specific follow-up or unresolved, items (e.g., 80-08-18, 80-08-20, 80-08-33 and 80-10-01). The Supply System compiled these items into a transmittal to the mechanical contractor (October 3, 1980) during the development of corrective action programs and procedures. It requested specific attention to the items, including bi-weekly reports on status. Such reports were submitted and noted by the resident inspector as part of the objective evidence of the Supply System and contractor efforts to develop corrective action plans.

In November 1983, following completion of the Quality Reverification Program final report, the inspector requested the Supply System project quality assurance manager to provide a tabulation of the

interim positions and the final corrective actions taken for each of the items. The requested tabulation showed that the corrective actions had consisted of actions specific to the particular issues (including generic reviews where warranted), incorporation of the matters into the final as-built program or other documentation review or hardware inspection programs, and/or consideration of the items for procedural controls for new work. The licensee actions in all cases appeared appropriate to the circumstances.

The inspector identified no items of noncompliance or deviations.

- b. (Closed) Follow-up Item 50-397/79-16-05: Piping weld profile relationship to piping minimum wall thickness criteria.

The original item, and associated follow-up (documented in NRC Inspection Reports 50-397/80-01 and 80-04) described three issues. The resolution of these matters is described in NRC Inspection Report 50-397/83-27 paragraph 4.2, in which the following questions had not been completely addressed, but which are resolved as described below:

- (1) Item 4.1.(1)(2) - The Bechtel Quality Assurance group visually examined weld MS-547-3-FW-3 and accepted the condition. The NRC inspector examined the weld and two adjacent piping weld transitions. For the additional two welds (MS-549-2.3-A and MS-547-2-B) Bechtel and Bestco staff (under observation of the NRC inspector) made profilometer measurements of the pipe-to-weld transitions and ultrasonic thickness measurements along the transition area. These were plotted to graphically show the exterior and interior profiles across the weld region. These were convincing evidence of compliance with ASME Code requirements for weld joint alignment. The results have been documented on Bestco NDE reports numbers N-403 and N-404. This item is resolved.
- (2) Item 4.a.(1)(b) - Evidence of repair of weld MS-547-2-1 appears on completed nonconformance report number 2259. This item is resolved.
- (3) Item 4.a.(3)(a) - Of 187 weld ends evaluated by the engineer, nine initially were questionable, four of these being accepted based upon values not exceeding .006-inches and five accepted due to them being vendor welds. The inspector questioned the basis for accepting the five vendor welds. That basis included consideration of these welds involving butt-welds (not socket welds); the vendor piping was schedule 80 versus schedule 160 piping selected for field connection to it, and erroneous application of schedule 160 thickness criteria to the ultrasonic measurements of the vendor pipe stubs (the wall thickness apparently met the schedule 80 criteria). Thus the Engineer concluded that "correct acceptance criteria was not applied" to the vendor welds. This item is resolved.

- (4) Item 4.a(3)(b) - With resolution of questions on the specific vendor welds, questions of generic implications are resolved.

c. (Closed) Follow-up Item 50-397/80-08-21: Pipe wall thinning issues appeared to have received insufficient management attention.

This item has been summarized in NRC Inspection Report Number 50-397/83-35 paragraph 5.B. Licensee actions were identified as acceptable, with exception of specific matters for which objective evidence of resolution had not been provided to the inspector during his review. Research by the licensee has recovered documents which address these remaining questions as follows:

- (1) Item 6.B.(1) - Weld preparation counterboring. Bechtel quality control procedures P-1.10 and W-1.00 require inspection of grinding areas on piping for possible wall thinning. A non-specific reference (in fitup inspection of W-1.00) also calls for assuring "surfaces and edges to be welded are properly prepared." After weld completion the Bechtel procedures call for checks of surface contour. The procedures appear commensurate with those described to NRC for the previous contractor. Other aspects of this matter have previously been addressed in NRC Inspection Reports Number 50-397/79-18, 83-27 and 82-28. Project specification 215-15B and Bechtel procedure SWP-P-P-2 consider evaluation of surface conditions and wall thickness considerations for pre-service inspection activities. This item is resolved.
- (2) Item 6.B.(2) - Corrosion allowance. The Engineer did not seek specific concurrence from the NSSS supplier for redefined corrosion allowances. GE Specification 22A3095AD Appendix III paragraphs 1-1 and 5-6-3 identify that included values of corrosion allowances are only "recommendations" where the pipe lines involved are in systems for which design responsibility has been contracted to others (as in the case of main steam lines outside containment isolation valves). This item is resolved.
- (3) Item 6.B.(3)(a) - Pitting. Pitting observed in piping was described in Burns and Roe Corrective Action Report CAR-1468 on August 1, 1980; this challenged the validity of ultrasonic tests conducted by the pipe manufacturer Associated Piping Engineering. Evaluations and examinations by the Engineer are documented in nonconformance report NCR-215-5997, engineering directive PED-W-215-M-3804, letter BRWP-F-81-1753, Supply System memorandum EMN-RAM-80-23, and Technical Report Pipe Wall Thinning Study LPLS and HPCS Systems (CM Transmittal 80-9). The studies conclude that the piping contained pits subject to purchaser rejection under ASME-SA-106 Part 20.4, but that the owner did not elect to reject the piping. The pits cover large areas but have subsequently been found to not encroach on the design wall thickness. Sufficient surface area has been ultrasonically verified to provide confidence to the licensee for other locations on the pipe. This item is closed.

- (4) Item 6.B.(3)(6) - Pitting. Nonconformance report NCR-215-5997 describes that AP&E pipes have shop bends but no record of the ultrasonic wall thickness reports required by AP&E's bending procedure. The engineer has clarified that the provisions of ASME Section III NBS-4223.1 alternate rules have been used to accept the absence of these records. The required calculations include recognition of, and are based upon, the lowest measured thin spot in the piping sampled. This item is resolved.
- (5) Item 6.B.(5)(a) - Gouge on pipe spool LPCS-4472-1. The licensee has now located the corrective action documentation (NOPE-58 dated February 24, 1983) which demonstrates that the defect has been repaired and checked for minimum wall thickness criteria. This item is resolved.
- (6) Item 6.B.(5)(b) - Liquid penetrant and magnetic particle examinations. Nondestructive examination (NDE) reports indicated that some surface blending (grinding) had been done to remove NDE indications, but there were no supplemental records to indicate if subsequent ultrasonic wall thinning checks had been made. The NDE reports were, however, signed as acceptable after the blending.

A Bechtel search of the final record packages, which have been reviewed by the intensive WBG documentation review program, did not identify any such ultrasonic test records. The licensee staff believes that the quality control inspector and NDE examiner final visual checks probably showed little removal of base material and thus no need for ultrasonic thickness testing. Bechtel had planned to fully resolve questions on this matter by making thickness measurements on the areas in question, but the piping was found to be wrapped and buried in its final underground location. The inspector concurred that the matter in question does not appear sufficiently significant to uncover the piping for examination. This item is resolved.

- d. (Closed) Follow-up Item 50-397/81-01-08): Control of quality Class 1/Class 2 interfaces during construction.

The mechanical contractor (WBG) had encountered minor problems during work restart in 1981, relating to control of quality Class 2 work which interfaced with quality Class 1 installations, and with handling of quality Class 1 items (valves) which had been cut-out and placed in the warehouse for re-use. The Bechtel quality assurance procedures did not appear to include any specific instructions to avoid the problems experienced by WBG.

Bechtel quality assurance management did not consider that specific instructions were necessary, and on October 20, 1982, documented their rationale in memorandum CDH-82-10-2677 (which was provided to the inspector as the basis for the Bechtel inaction). This memorandum stated that recurrence of the WBG problem within the Bechtel Organization "is an abstraction and addressing specifically what controls (prevent) a recurrence is an improbable question." It

emphasizes that "quality control inspection is not a 100 percent activity" (the Bechtel program utilizes a quality control inspector surveillance function for some work activities.) The inspector had no examples of these problems having occurred in Bechtel work activities, nor any worker complaints related to these.

No items of noncompliance were identified.

A change notice to Bechtel procedure GWP/P-4 revision 6 (PCN-GWP/P-4-4 dated December 20, 1982) includes a requirement for complete receipt inspection for re-issued or re-stocked material. Also, an August 1983 revision II to Bechtel work procedure SWP/P-P-2 does now provide for field engineering inspection for returning valves to stock. Also, Bechtel procedure SWP/P-P-6 revision 6 addresses requirements for as-built documentation (inspection by field engineers) of the completed and quality control accepted pipe support installations. It requires identification of "additional loads" (e.g., attachments), for assuring availability of associated quality records and evaluation by the engineer. This matter is closed.

- e. (Closed) Unresolved Item 50-397/82-18-04: Nondestructive examination personnel concerns.

The current site contractor (BESTCO) for nondestructive examination (NDE) work was under Bechtel administration. The contractor's personnel had various concerns, including how to document examination discrepancies which materialized outside the specific zone of interest. This specific question was resolved by the personnel placing descriptive notations in the "Comments" portion of the NDE report. (The general question of BESTCO personnel concerns was previously addressed, and noted as resolved, in NRC Inspection Report 50-397/82-29).

During October and November 1983, the inspector interviewed Bechtel quality control staff and management relative to the program conducted October 1983 to review all of the BESTCO NDE reports which had been generated under Bechtel administration. All notations were investigated to assess the noted conditions. Piping insulation was removed when necessary. The Bechtel staff stated that re-examination, exploration by grinding, final re-examination and referrals to the engineer for evaluation have been conducted.

The Bechtel follow-through on this item is noted above, and described here as an update on this matter, which was previously closed.

- f. (Closed) Noncompliance Item 50-397/83-14-02: Improper downgrade of pipe support quality classification.

The engineer had issued design changes which classified certain containment isolation valve piping supports as quality Class II, which was an improper downgrade from quality Class I requirements.

Licensee actions were described in letters to NRC dated July 8 and July 29, 1983. The inspector examined these actions as described in NRC inspection report number 50-397/83-41 paragraph 4.g. Additional licensee actions, including additional sampling and evaluation of findings, were described in letters to NRC dated September 12 and November 21, 1983. The licensee actions and conclusions appeared reasonable and responsive to the issues.

The licensee had committed to examine some quality Class II design changes for disciplines other than piping (e.g., electrical). The inspector examined the quality control inspection records for the cables associated with a PED (215-E-2165) selected randomly from Attachment II of the September 12, 1983 letter. This included review of drawings E537-sheet 12F, E545-1A and E694 and conduit inspection record for cable/conduit BRWGE-9707-1. The records substantiated the comments in the letter, i.e., drawings were used in conjunction with engineering changes (PED's) which thus assured that Quality Class I installation verification was achieved.

The inspector also considered the implications of the significant construction deficiency report to NRC dated October 27, 1983 (G02-83-977), which discussed corrective actions for a condition where cables routed to Class IE equipment were identified and terminated as non-class IE. Generic corrective action was taken for this matter as described in the licensee's report. The above reviews, and the cable separation reinspection programs, provide additional assurance of the application of quality verification activities to electrical items which may have been the subject of design change actions. This matter is closed.

g. (Closed) Noncompliance Item 50-397/83-14-03: Improper concrete repairs.

Observed conditions of concrete patches indicated that repairs had been inadequate to retain their integrity or had been placed without full regard to applicable requirements. This matter has been further reviewed by NRC as described in NRC Inspection Reports 50-397/83-22, 83-36, 83-38 and 83-53. The licensee has addressed the NRC questions in this area as described in previous reports. An outstanding item was the pending engineer evaluation and disposition of the 11 identified patches which exhibited hollow-character sounds at some points.

The engineer has examined each patch and evaluated the original nonconformance report data and the design for the location in question to ascertain if the patch was cosmetic or structurally significant. One patch, which contained a crack, was excavated to sound concrete; it was found to involve less than 10 percent of the column cross-section and was deemed insignificant. During removal, the patch reportedly did not exhibit voids. The hollow-character sound was attributed to some lack of bonding at the edge of the patch or at the reinforcing steel. The engineer deemed the discrepancies insignificant relative to the strength of the

structure, and instructed the construction manager that further inspection/sounding of other known patches was not warranted.

At the request of the inspector, the engineer reconsidered the population of NCR's. The engineer's actions are recorded in a Burns and Roe letter to WPPSS (BRWP-f-83-8462, dated November 28, 1983). Of the 104 NCR's for patches, the engineer deemed 18 as cosmetic in nature; these were not considered further. Bechtel quality assurance staff attempted to examine the remaining 86, and found 42 inaccessible due to paint covering the area or other interference. Where the patch location was clearly identified, the painted surfaces were examined for signs of cracks. Of the 44 accessible patches there were questions raised relative to 16. These were examined by the Burns and Roe lead structural engineer, and included the original 11 of 17 previously questioned. The engineer attributed the minor cracks to patch shrinkage effects and considered all conditions acceptable. This item is closed.

- h. (Closed) Follow-up Item 50-397/83-14-04: Reinspection of concrete under the quality reverification program.

The site reverification program did not include reinspection of concrete, but relied upon a review of documentation to ascertain adequacy of prior work. The NRC identification of an unsound concrete patch (item 50-397/83-14-03) suggested further consideration of this approach.

The licensee has reconsidered the practicality of various approaches to reinspect cast in place reinforced concrete and reaffirmed that little meaningful reinspection could be accomplished, short of destructive examinations. The licensee has also considered the findings of the NRC Construction Assessment Team, and the excavations which were made in support of that effort. Also, the licensee has consolidated the concrete review effort for the fifteen contractors which were involved on the site over eight years. The report of this review shows that the specifications and procedures for each contractor were reviewed for technical adequacy and degree of control of work. Also 1025 nonconformance reports were reviewed and categorized to assess trends and corrective actions prescribed by the engineer for each contractor. The report emphasized critical review of deficiency documents.

The report concluded that the specifications issued by the architect-engineer for all the major contractors incorporated the principal standards of the American Society for Testing Materials (ASTM) and American Concrete Institute (ACI), which are the key standards groups referenced in the Final Safety Analysis Report. It concluded that contractor work procedures were generally responsive to specification requirements, with some exceptions, as demonstrated by procedure approval correspondence with the Engineer.

The deficiency document reviewed showed the usual types of work discrepancies expected in major concrete work (omission and misplacement of steel, rock pockets, voids, formwork

out-of-tolerance, curing temperature deviations, etc.) The numbers of such reports and the documented Engineer decisions to rework/repair/accept-as-is (over 70 percent were rework) are presented to illustrate that the quality assurance program was functioning to identify and correct discrepancies in in-process and final work.

The report notes the concrete excavations made in several areas of the plant to examine reinforcing steel in response to some CAT issues, and a plant-wide grout core-drilling program to ascertain strength of as-cast material. It concludes that additional excavations for purposes of general reverification are not warranted.

The reverification program appears to have adequately addressed the issue of hardware oriented reinspection of concrete, notwithstanding other considerations which may arise with the ongoing NRC review of reinforcing steel spacing discrepancies. This item is closed.

- i. (Closed) Unresolved Item 50-397/83-38-06: Assess implications of NRC construction appraisal team findings regarding bolting and fasteners, relative to quality reverification program.

The Supply System quality reverification program report (Volume I, Book I, Part 8.0) describes that CAT inspection items were compared to RVP items to identify identical or similar items reinspected and nature of the findings. It describes that generally similar findings were identified by both programs. Some tabulations were included and analyzed to determine if the CAT findings undermine¹ the validity of the reverification program conclusions. The data appears to support the findings of the reverification program.

A separate review was conducted for the specific items of fasteners and bolting. It confirmed that the CAT findings were not an indication of inadequate reverification program scope, based upon the fact that the prescribed scope included only installations completed and accepted by quality control prior to July 1980, as follows:

- a. Motors and pump coupling and relief valve bolts/nuts were incomplete and transferred to Bechtel as work-to-go, and not final accepted prior to July 1980. Reverification inspection results would not have been indicative of the adequacy of the prior contractor's work. The results did indicate a weakness in the Bechtel program, which has been addressed in the licensee's response to NRC item 50-397/83-38-04.
- b. Cable trays had not been final inspected and accepted prior to July 1980; these were completed under the contracts program of improved procedures/specifications, which had been considered to be adequate for future work. The specific issue of cable tray bolting material has been addressed by the licensee in

response to NRC item 50-397/83-38-04 and has been determined to be a minor discrepancy of no structural significance.

- c. Battery racks were excluded from the reverification program because they had been turned over to the startup organization, which had subsequently reworked them after July 1980. This work by the startup organization has been subject of NRC action and has been addressed by licensee response to NRC items 50-397/81-18-04, 81-18-05 and 83-38-13. In addition, the specific questions regarding the battery racks has been further addressed through September 14, 1983, engineering direction (PED-S218-E-C234) which prescribes complete replacement of the batteries and racks.

The inspector identified no items of noncompliance or deviations. This matter is closed.

- j. (Closed) Unresolved Item 50-397/83-38-11: Design drawings not conforming with design calculations.

An NRC Construction Appraisal Team (CAT) inspector identified that a design drawing S-709, and the as-installed condition, did not reflect the number and spacing of shear stirrups for concrete beam number 2B11, as were indicated by the supporting design calculations. The CAT inspector questioned the general adequacy of the design drawings to properly reflect design calculation requirements (NRC Inspection Report 50-397/83-29 page V-5).

Subsequent review of data showed the CAT inspector's concern to be unfounded. The CAT inspector had examined a calculation sheet dated April 4, 1974, by the design engineer, and April 18, 1974 by the design checker. This was sheet 9-of-15 of the calculation set (page 63 of change notice PCN-531). The sheet showed that the designer had made the following calculations to determine the required area of steel for stirrups (shear ties):

- a. Using two #5 Grade 40 stirrups at 7-inch spacing as a trial design, the calculated required steel area was 1.06 square inches. The available area would be 1.24 square inches, for the four legs of two #5 stirrups (0.31 square inches per leg).
- b. Using two #5 Grade 40 stirrups at 6-inch spacing as second iteration, the calculated required steel area was 1.00 square inches. The available area would again be 1.24 square inches. The designer chose two #5 Grade 40 stirrups at 7-inch spacing.
- c. Using one #6 Grade 60 stirrup at 6-inch spacing, the checker found the calculated required steel area to be 0.66 square inches. The available area would be .88 square inches, for the two legs of one #6 stirrup (0.44 square inches per leg). The checker proposed one #6 Grade 60 stirrup at 6-inch spacing.

The checker presented a table of his recommendations for ten beams, including beam 2B11, in an April 19, 1974, "Summary Of Revised and

New Beams," sheet 15-of-15 of the calculation set (page 69 of the PCN-531). However, the checker was obliged to resolve his recommendations with the designer. This "Summary" sheet showed that the resolution for beam 2B11 was to select a design of two #5 Grade 40 stirrups at 8-inch spacing. The recalculation for this was not documented. However, it may be inferred that a factor of 8/7 was applied to the equations/calculation of "a" above to yield a required steel area of $8/7 \times 1.06 = 1.21$ square inches, which compares closely with the 1.24 square inches available from the four legs of the two #5 stirrups.

The resolution notation on the "Summary" sheet is proper and correct and reflects the data on drawing S-709 and the installed condition. The resident inspector considers that the failure to document the very simple confirmatory calculation is trivial, and an insufficient basis to conclude any general, (or specific), failure to translate design calculations into design drawings. This matter is closed.

- k. (Closed) Unresolved Item 50-397/83-38-12: Erroneous nonconformance report dispositions.

An NRC Construction Appraisal Team (CAT) inspector identified errors in the calculation details supporting the engineering disposition action for three of six nonconformance reports. It also appeared that existence of conditions allowed under inspection criteria of procedure QVI-09 may not have been considered in such calculations (NRC inspection report 50-397/83-29 page V-10 and V-11).

The lead structural engineer demonstrated that, in each case, the error was in the conservative direction, i.e., values were used which presumed stress levels larger than actual or load capacities smaller than actual. The factor-of-safety in each case was between 2 and 24, such that the checker of the calculations may reasonably have used independent order-of-magnitude estimates to confirm the adequacy of the design decision (without repeating the details of the individual original calculations).

Additionally, the structural engineering group identified all 27 civil/structural reverification program nonconformance reports and checked the calculations for each of the engineering decisions involved. Some of the original engineering decisions were clearly based (acceptably) on ball-park estimates of loads involved (e.g., in assessing the required weld size to support a beam end connection, the engineer assumed a loading equal to the designer's handbook maximum allowable loading for such a beam, even though the beam was actually loaded to much less). The recheck of these calculations or estimates were done with actual loads and formal calculations. The criteria of QVI-09 were considered (1/16-inch undersize welds) and conservative assumptions were used (e.g., where weld local defect or undersize was noted, the entire weld was assumed absent). With such calculations, safety factors of between 2 and 10 were found.

In addition to the files for nonconformance reports identified by the CAT inspector, the resident inspector randomly selected two of the 27 structural reverification nonconformance reports; he examined the files for NCR-21529 and NCR-21528, which illustrated the above points. Although the CAT findings indicated that the engineering checking process may have been ineffective in assuring proper disposition of structural nonconformance reports, subsequent review by the resident inspector indicated that unacceptable conditions had not been missed by the checkers. The additional review of all structural nonconformance reports fully resolved the question of application of QVI-09. This matter is closed.

1. (Closed) Unresolved Item 50-397/83-38-16: Review of Bechtel Field engineer dispositions of as-built deviations on large bore pipe supports.

The NRC Construction Assessment Team identified cases where the Bechtel field engineers had improperly dispositioned discrepancies identified on as-built drawings. A program was planned to review engineer dispositions for small bore piping supports. NRC Inspection Report 50-397/83-29 paragraph III.3.c describes the CAT concern that large bore piping supports also appear to deserve review.

The large bore piping supports have been subject to re-review of the as-built measurements which are of importance to the designer. Such categories of measurements have been clarified by Burns and Roe via Engineer direction PED-215-H-W-851, dated July 22, 1983. Also, the reference criteria for tolerances, drawing H-501, has been clarified by PED-215-H-W941 and W949. The application of these criteria in the re-review process had been audited over a four day period by Bechtel corporate office engineers, who had examined 35 large bore and 60 small bore pipe support as-built drawing packages. This August 15-19 effort was summarized in a September 2, 1983, Bechtel internal memorandum (L-Shipley to T-Bostrum).

The inspector also examined the Bechtel action on the discrepancies identified in the NRC CAT inspection report 50-397/83-29 Table III-6. Each item had been addressed fully. This matter is closed.

- m. (Closed) Unresolved Item 50-397/83-38-17: The location of pipe whip restraints were specified on structural design drawings, however, the locations are not referenced to the location of associated piping runs. The piping as-built program did not include verification of pipe whip locations relative to piping.

The Supply System described the program for assuring proper location of pipe whip restraints in Item E of the attachment "Status of Actions Taken" of the August 15, 1983, reply to NRC (G02-83-732). The architect engineer has completed measurements of locations of all pipe whip restraints and reconciliation with design calculations. The evaluation considered pipe-stability calculations and peak dynamic loads on pipe whip restraints, as described in the

engineer's summary letter to the Supply System (BRWP-RO-83-481 dated November 22, 1983). This matter is closed.

7. Management Meeting

The inspector met with the licensee's representatives (denoted in paragraph 1) on December 2, 1983, to discuss the results of the inspection efforts and to receive a status report on the preoperational test program.