



ORGANIZATION: TECHNOLOGY FOR ENERGY CORPORATION  
KNOXVILLE, TENNESSEE

REPORT NO.: 99900844/85-01	INSPECTION DATE(S): 7/22-25/85	INSPECTION ON-SITE HOURS: 58
CORRESPONDENCE ADDRESS: Technology for Energy Corporation ATTN: Dr. J. E. Mott Senior Vice President 10770 Dutchtown Road Knoxville, Tennessee 37922		
ORGANIZATIONAL CONTACT: Mr. Steven Mott, QA/QC Manager TELEPHONE NUMBER: (615) 966-5856		
PRINCIPAL PRODUCT: Valve flow and loose parts monitoring systems.  NUCLEAR INDUSTRY ACTIVITY: 80%		
ASSIGNED INSPECTOR:  for N. J. Miegel, Reactive Inspection Section (RIS)		10/24/85 Date
OTHER INSPECTOR(S): L. Vaughan, Program Coordination Section K. Parkinson, BNL Consultant		
APPROVED BY:  E. W. Merschhoff, Chief, RIS, Vendor Program Branch		10/24/85 Date
INSPECTION BASES AND SCOPE:  A. BASES: 10 CFR Part 21, 10 CFR Part 50, Appendix B.  B. SCOPE: Review the implementation of the Technology for Energy Corporation (TEC) quality assurance program and TEC's methods for qualifying and determining the qualified life of their safety relief valve (SRV) acoustical monitoring systems.		
PLANT SITE APPLICABILITY: Browns Ferry 1, 2, 3 (50-259/260/296); Clinton (50-461/462); Watts Bar (50-390/391); Sequoyah (50-327/328); Bellefonte (50-438/439); Turkey Point (50-250/251); St. Lucie (50-335/389); Susquehanna (continued on the next page)		

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PLANT SITE APPLICABILITY: (continued)

(50-387/388); WNP2 (50-397); Zimmer (50-358/359); Midland (50-329/330); Palo Verde (50-528/529/530/592/593); Rancho Seco (50-312); D.C. Cook (50-315/316); Calvert Cliffs (50-317/318); Indian Point 2 (50-247); Pilgrim (50-293/471/472); San Onofre (50-206/361/362); Davis Besse (50-346); Diablo Canyon (50-275); Ft. Calhoun (50-285/548); Catawba (50-413/414); Oconee (50-269/270/287); McGuire (50-369/370); Indian Point 3 (50-286); Trojan (50-344).

A. VIOLATIONS:

None.

B. NONCONFORMANCES:

1. Contrary to Criterion V of 10 CFR 50 Appendix B and Section 2.0, paragraph 2.3.3 of the Technology for Energy Corporation (TEC) Quality Assurance Manual (QAM):
  - a. The preparation of a QA plan within 30 days after the issuance of the Project Order Number (PON) was not accomplished for Projects 30433, 30571, and 30649.
  - b. The QA plan for project 30649 was not signed by the Project Quality Assurance Administrator (PQAA), nor could approval of the QA plan by the Corporate Quality Assurance Manager (CQAM) be verified.
2. Contrary to Criterion VII of 10 CFR 50 Appendix B; Section 7.0, paragraph 7.2.2.1, and Section 18.0, paragraph 18.1.5 of the TEC QAM; three vendors on the Qualified Vendor List (QVL) had not been audited and evaluated.
3. Contrary to Criterion IX of 10 CFR 50 Appendix B; and Section 9.0, paragraph 9.2.3 of the TEC QAM, objective evidence was not documented to substantiate the training, experience, and/or recertification of NDE (liquid penetrant) Level II and III personnel.
4. Contrary to Criterion X of 10 CFR 50 Appendix B and Project Plan and Quality Assurance Plan, Revision 0, Section 4.0, PQAA Surveillance, the performance of required surveillances could not be verified.
5. Contrary to Criterion XII of 10 CFR 50 Appendix B and Section 12.0, paragraph 12.1.3.2 of the TEC QAM:

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- a. No procedure or schedule had been established for the calibration of the crimping devices.
  - b. Three crimper tools did not have calibration due date stickers (crimpers #A018, #A022, and #753-011).
6. Contrary to Criterion XV of 10 CFR 50 Appendix B and Section 15.0, paragraph 15.1.4 of the TEC QAM, numerous items in the QC hold area were not tagged with nonconforming material tags.
7. Contrary to Criterion XVII of 10 CFR 50 Appendix B and TEC Procedure for Certification and Qualification of Technical Personnel, CP-101, Revision 0:
  - a. Completed Personnel Certification Records, TEC Form PCR, could not be verified for five (5) Instrumentation/Electronics Test Specialists.
  - b. The required four (4) years of related technical experience for three (3) Instrumentation/Electronics Test Specialists and six (6) months of OJT under a Level II or III Technician/Specialist for four (4) Instrumentation/Electronics Test Specialists could not be verified.
8. Contrary to Criterion XVIII of 10 CFR 50 Appendix B and Section 18.0, paragraphs 18.1.2 and 18.1.3, of the TEC QAM:
  - a. Internal audit schedules for the years 1981 through 1985 were revised even though the QAM does not make provisions for changing established schedules.
  - b. No objective evidence was available to verify that audits 81-3, 82-2, 3, 4, 83-6, and 84-4 were either completed, completed as scheduled, or completed during the appropriate calendar year.

C. UNRESOLVED ITEMS:

1. Criterion II of 10 CFR Part 50, Appendix B, states, in part: "... Activities affecting quality shall be accomplished under suitably controlled conditions. Controlled conditions include the use of appropriate equipment; suitable environmental conditions for accomplishing the activity, such as adequate cleanliness; and assurance that all prerequisites for the given activity have been satisfied."

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Contrary to the above, the NRC inspectors found the manufacturing/assembly area at TEC to be in an extreme state of disarray. It was not possible to verify that material control was being maintained, however at the time of this inspection there were no orders for the commercial nuclear power industry being assembled. TEC had recently consolidated its operations and some of the disorder may be attributed to the move. Nevertheless, in and around the manufacturing area, excess and old equipment, miscellaneous parts, tools and publications as well as open tool chests and drawers were observed.

D. OTHER FINDINGS AND COMMENTS:

1. Project Review

TEC Quality Assurance Manual, Section 2.3.3, "Responsibilities and Requirements for a QA Plan," requires preparation of a QA Plan no later than 30 days after issuance of the PON. Since the QA Plan implements the TEC QA Manual on specific projects, the QA plans for three (3) recently completed projects for nuclear stations (found below) were examined to verify implementation of the TEC Quality Assurance Manual. The following TEC projects were reviewed:

<u>Project No.</u>	<u>System</u>
30433	River Bend Valve Flow Monitoring System
30571	V.C. Summer Valve Flow Monitoring System
30649	Comanche Peak Main Steam Safety Valve Position Indication Instrumentation System

<u>Project No.</u>	<u>PON Date</u>	<u>QA Plan Date</u>	<u>Section 2.3.3 Compliance</u>
30433	11/28/83	10/18/84	No
30571	6/22/84	9/4/84	No
30649	12/14/84	2/4/84	No

The system test records for each project were reviewed and verified. The system test records provided traceability to system components, test instruments, and the technicians performing the tests. The recorded test results were verified to be within the specified tolerances. A certificate of inspection and conformance/compliance was issued for each of the projects. These certificates certified conformance with the TEC Quality Control Manual and the customer's specifications.

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Nonconformance B.1.a was identified during this area of the inspection.

2. QA Plan Management

The QA plans for Projects 30433, 30571, and 30649 were examined to verify compliance with TEC QAM Section 2.3.3, "Responsibilities and Requirements for a QA Plan." The following observations were noted:

<u>Project No.</u>	<u>QA Plan Content</u>	<u>PQAA Signature</u>	<u>Project Manager Approval</u>	<u>CQAM Approval</u>
30433	Sat	Yes	Yes	Yes
30571	Sat	Yes	Yes	Yes
30649	Sat	No	Yes	No

Project 30649 QA Plan was not prepared and signed by the PQAA. There was no objective evidence that the CQAM approved the QA Plan for Project 30649.

Nonconformance B.1.b was identified during this area of the inspection.

3. Surveillances

Project 30571 QA Plan, Revision 0, Section 4.0, "PQAA Surveillance," committed the PQAA to making random surveillances of the project and documenting these surveillances in accordance with the TEC QA Manual, Section TEC-QA-18.2. The PQAA Surveillance Report Log was examined to verify compliance with the QA Plan requirement. No objective evidence verified that surveillances were conducted on Project 30571.

Nonconformance B.4 was identified during this area of the inspection.

4. Instrumentation/Electronic Test Specialist Certification

TEC Procedure, CP-101, Revision 0, dated January 14, 1981, "Procedure for Certification and Qualification of Technical Personnel," requires completion of a Certification Evaluation, TEC Form PCR, and a Personnel Certification Evaluation Records, TEC Form PCR, and Attachment C specifies the specific qualification/certification requirements for Instrumentation/Electronic Test Specialists. The records of five (5) specialists were examined for objective evidence

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to verify compliance with CP-101 requirements. Except for one specialist, the certification records did not contain objective evidence that justified the certifications granted in accordance with CP-101.

Nonconformances B.7.a and B.7.b were identified during this area of the inspection.

5. TEC 914-1 VFM Module Generic Failure Problem

The TEC 914-1 VFM (Valve Flow Monitor) module was identified as possibly having a generic failure problem. The 914-1 VFM module failed to reset (i.e., indicate an actual no flow condition) after properly indicating flow through a valve. This problem was identified by the Tennessee Valley Authority Browns Ferry Nuclear Plant. The initial TEC response classified the reported 914-1 module failure as "a mode of failure and not an operating characteristic for a normal TEC 914." Continued investigation by Browns Ferry and TEC identified additional TEC 914-1 VFM modules that also failed to reset after indicating valve flow. Approximately 8% to 10% of the 914-1 modules tested demonstrated the failure mode. TEC investigation, analysis, and testing of the 914-1 module identified the U5 component as causing the failures. The U5 component is a Texas Instrument chip (TL490CN). TEC testing has revealed that approximately 8% to 10% of the Texas Instrument chips (TL490CN) exhibit a "latch-up" characteristic when a high level/saturating signal is applied. The "latch-up" characteristic is not a designed characteristic for the TL490CN. Since the TEC 914-1 VFM module was manufactured with a component having inherent characteristics that circumvent the module design, a generic problem exists. TEC appropriately reported the 914-1 VFM module problem in accordance with 10 CFR 21. The Texas Instrument TL490CN Analog Level Detector inherent characteristic to "latch-up" presents a potential generic problem in other nuclear industry equipment utilizing the TL490CN.

6. TEC 914-1 VFM Qualified Life and Failure Rate

TEC documents 517-TR-03, "Final Qualification Test Report of VFM System," Revision 2, dated 12/81, and 517-TR-02, "Reliability Predictions for the TEC VFM System," Revision 0, dated 5/21/81, reported the methodology that TEC employed to determine VFM



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qualified life and mean-time-between-failure rate. TEC calculates the predicted mean-time-between-failure rate for the TEC 914-1 VFM module by use of a mathematical model contained in MIL-HDBK 217C (4/9/79). This model prescribes various formulas for calculating failure rates for specific types of components (i.e., resistors, capacitors, transistors, etc.) and accounts for various conditions of use such as voltage, current, temperature, shock, etc. A summation of the individual component failure rates is used to derive a mean-time-between-failure rate of 2.85 years for the 914-1 VFM module.

The qualified life for the 914-1 VFM module was determined using the Arrhenius Model which provides a means for establishing a qualified life for a component through accelerated aging in an oven. The Arrhenius Model correlates the number of hours of testing at an elevated temperature that will cause the same aging effect as would occur through normal aging at a normal temperature (e.g., if the Arrhenius Model identifies one hour at 100°C as equivalent to one year of aging at 25°C, then the component can have a one year qualified life at 25°C by demonstrating satisfactory performance following exposure to a 100°C environment one hour). TEC has qualified the 914-1 VFM module for five years qualified life through the accelerated aging.

These methods used to determine the TEC 914-1 mean-time-between-failure rate and qualified life are valid engineering methodologies.

7. Plant Tour

A tour of the TEC plant facilities was conducted to evaluate manufacturing and storage conditions and activities. The following conditions were noted: production activity was low with two (2) workers assembling electronic modules, four (4) workers assembling strain measuring equipment and one (1) worker painting small metal enclosures. The office and work spaces were disorderly and dirty: excess equipment from cancelled orders; old unused equipment; and miscellaneous parts, tools, wiring, equipment, publications, etc. were throughout the facility. The metal fabrication facility was extremely dirty and the shipping/receiving space was almost impassable.

8. Internal Audits

Section 18.0 of the TEC QAM; internal audit reports for 1981, 1982, 1983, and 1984; and TEC Management audits for 1983 and 1984 were reviewed. Training and qualification records for all lead auditors

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were also reviewed. Sufficient objective evidence, such as the auditors hand written notes, were available for all of the audit reports examined. The TEC QAM required that internal audits be performed each calendar year per an established schedule. It was the inspectors' observation that the schedule was revised when internal audits were not completed by the scheduled date. The TEC QAM does not include provisions for revising the internal audit schedule.

Nonconformances B.8.a and B.8.b were identified during this area of the inspection.

9. Calibration of Measuring and Test Equipment

Section XII "Control of Measuring and Testing Equipment" and calibration records testing and measuring equipment used to test and manufacture the 914 module and 1414 Valve Flow Monitor System (crimpers, oscilloscope, digital multimeters, sinewave generators, frequency counters, and amplifier) were reviewed. Seventeen measuring and test equipment calibration records were reviewed (7 calibration records were for crimpers). There were no procedures written for the control and maintenance of crimping tools. Three crimping tools were found in worker drawers without a calibration due sticker, all three were identified as 'Class II' (which means they were required to be calibrated, however one of these crimpers also had a sticker which stated "Calibration Not Required"). A new system to control the issuance, maintenance and calibration of crimpers was started in October 1984. The system called for blue tags to be attached to the calibration certification when a crimper was checked out for use. Four (4) of these crimper calibration certification records did not have a blue tag attached but were found in the work/assembly area.

Nonconformances B.5.a and B.5.b were identified during this area of the inspection.

10. Nonconforming Material

Section 15.0 of the TEC QAM and QCP-6100, Revision A "Processing of Nonconformance Reports" were reviewed. The Nonconformance Report Log and Nonconforming Reports (NCRs) 1001-1040 were also reviewed. A tour of the Quality Control (QC) Hold Area found numerous miscellaneous and unmarked items; such as spools of



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wire, a dolly, a broken wooden crate, seven large boxes, and file cabinets with drawers ajar in the hold area. Access to the QC hold area is restricted. Entry is gained only through the TEC lab inspection room.

Nonconformance B.6 was identified during this area of the inspection.

11. 10 CFR Part 21

TEC's procedures for complying with 10 CFR Part 21 were reviewed, and the posting of 10 CFR Part 21 and TEC's Part 21 procedures was verified. Section 206 of the Energy Reorganization Act of 1974 was not posted. The NRC inspector provided the TEC QA/QC manager with a copy of Section 206 which was posted immediately. TEC's Part 21 procedures were adequate and in compliance with the requirements of Part 21.

12. Documentation Review

a. Qualification of Vendors

Section VII, "Control of Purchased Material, Equipment, and Services," of TEC QAM, 24 purchase orders, vendor audit/evaluation/survey reports and auditor qualification records were reviewed. TEC procures all material/equipment as commercial grade and "DEDICATES" the completed monitoring system as safety related through testing. The Qualified Vendors List (QVL) dated 10/15/84, listed 14 vendors. Only one of the 14 was a supplier of equipment, the remainder were calibration and testing services. Four QVL vendors' audit/qualification folders were reviewed. Three of the four vendors had not been audited nor evaluated within the required time period (TEC's QAM Section 18.1.5 states audits shall be conducted at least once during the contract or annually).

b. Personnel Qualification and Certification

Section IX, "Control of Special Processes" and personnel qualification/certification records were reviewed for the period covering December 1980 to the present (July 1985). TEC's QAM Section 9.0 requires that NDE personnel be qualified and certified to the requirements of SNT-TC-1A or the ASME B&PV Code, as applicable. Three NDE personnel

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qualification and certification records were examined (two Level II and one Level III). None of these records contained any evidence of the training or experience obtained for these three individuals. The Level III had qualified both Level IIs to Penetrant Testing, however, the records showed that the Level III was a Level II for UT, PT, and MT in December 1980 with another company. He was made a Level III in February 1985, but there were no records of training and continuous work experience between 1980 and 1985. He was not recertified by SNT-TC-1A at the end of three (3) years, therefore he should have lost his certification. Both Level II personnel were given two (2) exams, one for Level I and the other for Level II in LPT on the same day 6/25/85.

Nonconformances B.2 and B.3 were identified during this area of the inspection.

E. PERSONS CONTACTED:

- \*M. Knott, PQAA, TEC
- \*S. Mott, QA/QC Manager, TEC
- \*B. Hunter, Manager, Product Design Department, TEC
- \*J. Primeaux, Manager, Engineer, TEC
- R. A. Hedrick, President, TEC
- \*J. E. Mott, Senior QA Counselor, TEC
- L. Holt, QA, TEC
- J. Pierce, Calibration Specialist, TEC

\*Attended exit meeting

F. DOCUMENTS EXAMINED:

1. Revision E, dated 1/31/84, Quality Assurance Manual - Technology for Energy Corp., TEC's Part 21 procedures.
2. TEC's Part 21 procedures.
3. Internal Audit Reports 1981-1985.
4. Management Audit Reports.
5. Internal Audit Schedules 1981-1985.
6. Training/Qualification records to audit for three employees.

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7. QCP-6100, Revision A, Processing of Nonconformance Reports.
8. QC Document, Nonconformance Report Log (Open NCRs).
9. QC Document, dated 5/15/85-7/10/85, 24 closed nonconformance reports.
10. Document No. 1414-TR-OL, Appendix I.
11. Document No. 517-TK-03, Revision 2, December 1981, Final Qualification Test Report for Environmental and Seismic Testing of the TEC Valve Flow Monitoring System.
12. QC Document, TEC Lead Auditor's Training Course.
13. 19 POs from 15 different vendors, dated 1981-1985.
14. 3 receiving Inspection Reports, Document Nos. 1332, 4624, 7157, dated 1981-1983.
15. 4 test procedures for the 914-1 assemblies for River Bend, TUGCO, V. C. Summer, Browns Ferry.
16. 7 drawings of parts, components and/or models of the valve flow monitoring system.
17. TEC Qualified Vendors List, dated 10/15/84.
18. TEC lead auditor's Training Course, dated 3/19/80.
19. Incoming Inspection Procedure, Document No. QCP-4100, Revision B, dated 4/29/85.
20. Procedure for Certification of Inspection, Examination, Test & Calibration Personnel, Document No. CP-101, Revision 1, dated 12/12/84.
21. Valve Flow Monitoring System TEC Model 1414-7(4), dated 7/85.
22. Inspector's Certification, Document No. TEC Form PCE, dated 4/16/84.
23. 2 letters re: Possible Safety Hazard & Quality Deviation, dated 7/19/85.

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24. 3 POs to TEC for Valve Flow Monitoring Systems (TUGCO, V. C. Summer, River Bend), dated 1983-1984.
25. QA Plans for V. C. Summer, River Bend, dated 1984.
26. 2 Tech Manuals for the Valve Flow Monitoring Systems.
27. 2 Procedures re: testing instructions for the valve flow monitoring systems, Document Nos. QCT P-053 and QCTP-022, dated 1985.
28. 2 VFM System Test Reports - River Bend, Document No. QCTP-022, dated 11/14/84.
29. Final Qualification Test Report & Reliability Predictions for TEC VFM, Document No. 517-TR-03102, dated 1981.
30. Miscellaneous Documents (internal memos, C of Cs, Certificates of Inspection & Conformance/Compliance, in process routing sheets, etc.).