ORGANIZATION: QUADREX CORPORATION
CAMPBELL, CALIFORNIA

REPORT NO.: 99900512/83-01	INSPECTION DATE(S) 1/10-13/83	INSPECTION ON-SITE HOURS: 27

CORRESPONDENCE ADDRESS: Quadrex Corporation
ATTN: Dr. L. P. Bupp
Senior Vice President, Corporate Services
1700 Dell Avenue
Campbell, CA 95008

ORGANIZATIONAL CONTACT: Mr. C. D. Roady, Manager, Corporate QA
TELEPHONE NUMBER: (405) 370-4377

PRINCIPAL PRODUCT: Engineering Consultants

NUCLEAR INDUSTRY ACTIVITY: The Quadrex Corporation has approximately 713 employees of which 5% are assigned to safety-related activities.

ASSIGNED INSPECTOR: R. H. Brickley 3/21/83
R. H. Brickley, Reactor Systems Section (RSS) Date

OTHER INSPECTOR(S):

APPROVED BY: C. J. Hale 3/21/83
C. J. Hale, Chief, RSS Date

INSPECTION BASES AND SCOPE:

A. BASES: 10 CFR Part 50, Appendix B and 10 CFR Part 21.

B. SCOPE: Status of previous inspection findings and the following: (1) a request from the NRC Office of Inspection and Enforcment concerning a Control Data Corporation report of an error they identified in the computer program PIPERUP, and (2) a report to NRC Region IV by Rockwell International concerning errors they had identified in the computer program NUPIPE.

PLANT SITE APPLICABILITY:

Not Identified

DESIGNATED ORIGINAL
Certified By Rheanne Clark

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99900512 PDR

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A. VIOLATIONS:

None

B. NONCONFORMANCES:

Quadrex Corporation failed to meet their commitment date of May 15, 1982, for the completion of an audit of computer program verification activities as stated in their letter to the NRC Region IV office dated March 19, 1982. The actual completion date was October 6, 1982.

C. UNRESOLVED ITEMS:

None

D. STATUS OF PREVIOUS INSPECTION FINDINGS:

1. (Closed) Nonconformance (82-01): Neither the Quadrex Corporation QA program nor its implementing procedures require that the design process and verification procedure be reviewed and modified as necessary when a significant design change is necessary because of incorrect design as required by Section 9 of ANSI N45.2.11.

   The inspector verified the corrective actions and preventive measures committed in the Quadrex Corporation letter dated March 9, 1982; i.e., Quality Assurance Procedures QAP-307, "Design Verification and Independent Design Review," and QAP-308, "Design Document Change Control," were revised and issued on March 31, 1982, for implementation on May 1, 1982.

2. (Closed) Nonconformance (82-01): The records of attendance at QA indoctrination sessions did not provide evidence that two members of procurement and one member of engineering had received QA indoctrination.

   The inspector verified the corrective actions and preventive measures committed in the Quadrex Corporation letters dated March 19 and April 29, 1982; i.e., QA and project indoctrination sessions were conducted and QAP-201, "Quality Assurance and Project Indoctrination," was revised and issued on March 31, 1982, for implementation on April 5, 1982.

3. (Closed) Nonconformance (82-01): Annual audits of QA engineering and computer program verification activities were not conducted during 1981.

   The inspector verified the corrective actions and preventive measures committed in the Quadrex Corporation letter dated March 19, 1982; i.e., QAP-1001, "Internal Audits," was revised and issued on March 31, 1982, for implementation on May 1, 1982, and the audit of QA engineering was completed by May 15, 1982. However, the audit of computer program verification activities was not completed until October 6, 1982. Since the March 19, 1982, letter committed to a completion date of May 15, 1982, this is considered a nonconformance (see B. above).

4. (Closed) Nonconformance (82-01): The response to a quality audit finding was not submitted by the required date nor was an extension requested as required by Section 4.1.5 of QAP-1003, "Audit Reporting, Followup and Closeout."

   The inspector verified the corrective actions and preventive measures committed in the Quadrex Corporation letters dated March 19 and April 29, 1982; i.e., a request for extension of time was received and QAP-1003 was revised and issued on March 31, 1982, for implementation on April 5, 1982.

5. (Closed) Unresolved Item (82-01): Section 4.4 of QAP-309, "Verification and Control of Digital Computer Programs," needed clarification concerning errors detected in a computer program that may have an effect on analyses that have utilized the uncorrected version of the program.

   The procedure was revised to require the cognizant Practice Manager(s) or designee(s) to determine the effect on completed work of any errors detected in engineering computer programs and initiate appropriate corrective action.

6. (Closed) Unresolved Item (82-01): Section 4.4 of QAP-902, "Reporting of Defects and Nonconformances (10 CFR Part 21)," does not require that the responsible officer document his reasons for disapproving the decision to report an item to the NRC nor does it require that this documentation be returned to the original evaluators for reconsideration.

   Revision 4 of QAP-904 requires the responsible officer to implement the recommendations of the evaluators.

7. (Closed) Unresolved Item (82-01): Section 3.0 of QAP-906, "Stop Work Action," needs clarification in that it does not specifically state that the Manager, Quality Assurance Engineering, has the authority to issue a stop work order, nor that the President and Senior Vice President, Corporate Services, have override authority.

   QAP-906 has been revised to specify that the Manager, Quality Assurance Engineering, has the authority to initiate stop-work action and that the President and Senior Vice President, Corporate Services, have override authority.

E. OTHER FINDINGS OR COMMENTS:

1. Error in the Computer Program PIPERUP - This item concerns a 10 CFR Part 21 report by Control Data Corporation (CDC) to the Office of Inspection and Enforcement (IE) regarding an error in the computer program PIPERUP that may have been used by CDC customers to perform nonlinear analysis on safety-related piping systems subject to postulated ruptures. The error reported was that arrays were not internally initialized resulting in the possibility of starting program execution with nonzero values in memory which would produce erroneous results. The erroneous results can occur only when multiple analyses are executed in the same job stream without initializing the arrays prior to each analysis.

   The initial inspection of this problem at CDC (Report No. 99900532/82-01) disclosed that the situation occurred when an analyst ran multiple problems back-to-back without reinitializing the arrays prior to each problem run. Discussions with cognizant Quadrex management personnel disclosed that the running of multiple problems back-to-back is not a normal practice. Reportedly, attendees at Quadrex conducted training sessions are cautioned about this method of operation. No other cases similar to this have been reported to Quadrex on this program or on NUPIPE. However, Quadrex management committed to include a precautionary statement regarding this matter in the next revision of the User Manual for PIPERUP and NUPIPE. (The same condition could occur in running NUPIPE or any other program.)

   Based on the results of this and the previous inspection, the inspector concluded that: (1) this was an isolated case, (2) it occurred as a result of an abnormal operating method, and (3) it did not result from an error in the PIPERUP program, but an error in its use.

2. Errors in the Computer Program NUPIPE - This item concerns a report by Rockwell International to the NRC Region IV office regarding "errors" they had identified in the computer program NUPIPE. The areas wherein "errors" were identified were: (1) NUPIPE assumes there is no weld mismatch for girth-butt weld joints with wall thicknesses greater than 3/16 inch; (2) for Class 2, Class 3, and B31.1 analyses, NUPIPE uses the room temperature Young's modulus for all flexibility calculations; (3) for Class 2 and Class 3 analysis, the "cold" modulus of elasticity is used in the thermal expansion analysis and no adjustment on thermal expansion stresses is used; (4) for Class 1 analysis, the method for adjusting thermal expansion stresses in the Class 1 piping is incorrect; (5) conventional modeling procedures could result in underprediction of stresses in tee and branch connections; and (6) there are no provisions for specifying dynamic subcycles for response spectrum earthquake loadings.

The inspector examined the records maintained on this item consisting of: (1) correspondence between Quadrex and Rockwell International, (2) the NUPIPE User Manual (two revisions), (3) calculations, and (4) NRC/consultant correspondence regarding benchmark verification of NUPIPE.

The examination of Quadrex records, discussions with cognizant personnel, and review of applicable versions of the ASME Code disclosed: (1) NUPIPE provides input features for cases of weld mismatch via cards TEE, AHAND, BHAND, and CHAND (Ref. User Manual pages 2-22 and 2-23); in addition, the indices/factors used are printed out with each run; (2) the Winter 1975 Code Addenda allows calculations for the expansion stress to be based on the modulus of elasticity at room temperature and does not specify a modulus for seismic analysis; (3) the Winter 1975 Code Addenda allows the use of the "cold" modulus in thermal expansion analysis and does not specify that an adjustment be made to thermal expansion stresses; (4) the Code requires that flexibility calculations be based on the hot modulus which NUPIPE uses and that the expansion stress be multiplied by the cold-to-hot modulus ratio without specifying how it is to be applied (NUPIPE multiplies the moment range by the largest value of the ratio); (5) the user of NUPIPE establishes the modeling procedure and is responsbile for implementing Article NB3687.4 of the Code; and (6) NUPIPE superimposes earthquake moment effects to obtain the worst moment range in the highest stress cycles which is included with other worst terms in equation 11 of NB3653.2.

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Based on the above information, the inspector concluded that the identified "errors" resulted from: (1) differing opinions (Rockwell versus Quadrex) on Code interpretation and modeling procedures, and (2) between differences in the Rockwell version of NUPIPE (1.4) and the current version (1.6.1). It should be noted that the majority of the identified "errors" related to user techniques while the remaining dealt with Code calculational methods. A comparison between the current version of NUPIPE (1.6.1) and the 1975 edition and the Summer 1979 Addenda of the Code indicated that the NUPIPE methodology followed Code requirements. Additionally, there was no evidence available at Quadrex to indicate that the Rockwell version of NUPIPE (1.4) had been or was updated to reflect subsequent changes in the ASME Code nor that Quadrex was contractually required to notify Rockwell of subsequent revisions of NUPIPE. The Rockwell version of NUPIPE is based on the 1974 edition of the Code through the Winter 1978 Addenda with the exception that the reducer element Class 1 stress indices reflect the Winter 1975 Addenda. The current version of NUPIPE is based on the Summer 1975 edition or Summer 1979 Addenda.

Inspector R.H. Brickley

Scope/Module Computer Program NUPIPE

DOCUMENTS EXAMINED

Docket No. 99900512
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1	2	TITLE/SUBJECT	3	4
1	7	Quadrex to Rockwell - Response to reported errors (JRH-82-3) (COC)	10/20/82	—
2	8	USER MANUAL - NUPIPE/TRHEAT Piping Analysis Programs	—	H
3	8	User Man. QUAD-6-82-001 (NUPIPE Users Manual)	3/25/82	0
4	8	Calc - Rockwell Ltr #82ESG-5728, Quadrex Response - Item 7	10/15/82	—
5	7	NRC → Quad (Benchmark Verification of the Quadrex Computer Code NUPIPE-II)	12/14/79	—
6	7	BNL → Quad requesting review & run of new benchmarks prob.	4/5/82	—

Document Types:
1. Drawing
2. Specification
3. Procedure
4. QA Manual
5. Purchas Order
6. Internal Memo
7. Letter
8. Other (Specify-if necessary)

Columns:
1. Sequential Item Number
2. Type of Document
3. Date of Document
4. Revision (If applicable

Inspector T. H. Brickley

Scope/Module Status of Previous Inspection Findings

DOCUMENTS EXAMINED

Docket No. ~~99905/2~~
Report No. 83-01
Page 1 of 2

1	2	TITLE/SUBJECT	3	4
1	3	QAP-307 (Design Verification and Independent Design Review)	5/1/82	2
2	3	QAP-308 (Design Document Change Control)	3/1/82	2
3	4	QA Program Procedures Manual - Table of Contents	3/31/82	2
4	8	Training Course - Quadrex QA Program/CPSES Proj. Plan Indoctrin	2/1/82	—
5	8	Same as item 4	2/24/82	—
6	8	Same as item 4	2/25/82	—
7	8	Training Course - QA Indoctrination	3/30/82	—
8	8	Same as item 7	3/31/82	—
9	8	Same as item 7	4/21/82	—
10	8	same as item 7 for: Tulsa, Pittsburgh, Gainesville,	5/3-12/82	—
11	3	QAP-201 (Quality Assurance and Project Indoctrination)	4/5/82	2
12	8	File for Audit C-82-01 (QA Engineering) Conducted 3/23-25/82	—	—
13	8	File for Audit C-82-04 (Verification & Control of Digital Computer Prog) Cond.	—	—
14	8	File for Audit C-82-05 (Verification & Control of Digital Computer Prog) Cond 10/1-4/82	—	—
15	3	QAP-1001 (Internal Audits)	5/1/82	3
16	6	Request for Extension of Response Action Time of QA Audit 81-12	2/4/82	—
17	8	~~81-12~~ QAF-81-12-01 - Status Accepted 3/5/82	10/2/82	0

Document Types:
1. Drawing
2. Specification
3. Procedure
4. QA Manual
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Scope/Module Status of Previous Inspection Findings

DOCUMENTS EXAMINED

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1	2	TITLE/SUBJECT	3	4
18	3	QAP-1003 (Audit Reporting, Followup and Closeout)	4/5/82	3
19	3	QAP-309 (Verification & Control of Digital Computer Programs)	5/1/82	2
20	3	QAP-904 (Reporting Defects & Noncompliances (per 10CFR21))	5/1/82 10/1/82	3 4
21	0	QAP-906 (Stop Work Action)	5/1/82	2

Document Types:
1. Drawing
2. Specification
3. Procedure
4. QA Manual
5. Purchas Order
6. Internal Memo
7. Letter
8. Other (Specify-if necessary)

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4. Revision (If applicabl

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Scope/Module Computer Program PIPERUP

DOCUMENTS EXAMINED

Docket No. 99900572
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1	2	TITLE/SUBJECT	3	4
1	3	QAP-310 (Software Quality Assurance Planning)	5/10/82	1
2	3	QAP-309 (Verification & Control of Digital Computer Programs)	5/1/82	2
3	3	QAP-107 (Activity-Control and Technical Documents)	11/30/81	1
4	7	CDC Ltr to NRC reporting error condition in PIPERUP	5/27/82	—
5	7	CDC ltr to S&W reporting error condition in PIPERUP	5/26/82	—
6	7	CDC Ltr to NRC providing additional information-PIPERUP	6/15/82	—
7	7	Quadrex to CDC - Resolution of PIPERUP	7/26/82	—
8	8	CDC-PRTHRUST/PIPERUP User Information Manual 84000220G	undated	—
9				

Document Types:
1. Drawing
2. Specification
3. Procedure
4. QA Manual
5. Purchas Order
6. Internal Memo
7. Letter
8. Other (Specify-if necessary)

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4. Revision (If applicable

PERSONS CONTACTED

Company QUADREX

Dates 1/10-14/83

Docket/Report No. 99900512/83-01

Inspector R. H. Brickley

NAME(Please Print)	TITLE(Please Print)	ORGANIZATION(Please Print)
J R Narsallo	Manager Nuclear Pkg Support	Quadrex PPSD
C. D. ROADY	Manager, Corp. QA	Quadrex Corp. Quality Assurance
Michael Referna	Engineer, NUPIPE Dev.	Quadrex Corp. PPSD

QUADREX

MEETING ATTENDANCE

SUBJECT: NRC - Preinspection Meeting DATE 1/10/83

LOCATION: Campbell Office Quadrex Corp

NAME	COMPANY/ORGANIZATION	TITLE
C.D. Ready	Quadrex / Corp. QA	Manager Corp. QA.
R.H. Brickley	US NRC-RIV	Reactor Engineer
R. Reddy	Quadrex	Manager - QA Engineering
JR Nardella	Quadrex PNSJD	Manager Nuclear Development
J.L. Wray	Quadrex / Computer Syst	V.P.
L. P. Bupp	Quadrex / Sr. Vice President,	Corporate Services
A.F. Kitz	Quadrex / VP Engrg	
G.E Krauter	Quadrex	Mgr, Proj Mgt Systems
Ronald Naymark	Quadrex	VP, Plant Piping & Supports Systems Division

ATTENDANCE LIST

COMPANY: QUADREX DOCKET NO. 99900512
83-01

Date: 1/13/83 ☐ Pre-Inspection Conference ☒ Post Inspection Conference

NAME (Please Print)	TITLE (Please Print)	ORGANIZATION (Please Print)
T. H. BRICKLEY	REACTOR ENGINEER	NRC - REGION IV
R. REDDY	MANAGER, QA ENGINEERING	QUADREX.
JR Nardoll	Manager Nuclear Development	Quadrex Corp
D. P. MUNSON	Manager, Structural Technology	Quadrex Piping
G. E. KRAUTER	MGR, PROJ MGT SYST (ENG)	QUAD. ENG.
J. L. Wray	V.P. Computer Systems & Ops	Quadrex
H. R. BOOTH	SR. CONS. - CORP QA	CORP. QA
L. P. BUPP	Sr. Vice President	Corporate Services
C. D. ROADY	Manager Corp QA	Quadrex Corp.