ORGANIZATION: TELEDYNE ENGINEERING SERVICES
WALTHAM, MASSACHUSETTS

REPORT NO.: 99900513/85-01	INSPECTION DATE(S): 1/7-11/85	INSPECTION ON-SITE HOURS: 62

CORRESPONDENCE ADDRESS: Teledyne Engineering Services
ATTN: Mr. F. C. Bailey
President
130 Second Avenue
Waltham, Massachusetts 02254

ORGANIZATIONAL CONTACT: Mr. A. E. Johnson, QA Manager
TELEPHONE NUMBER: (617) 890-3350

PRINCIPAL PRODUCT: Engineering and consulting services

NUCLEAR INDUSTRY ACTIVITY: Approximately 90% of Teledyne Engineering Services (TES) staff at Waltham, Massachusetts, facility is involved in nuclear activities.

ASSIGNED INSPECTOR: R. P. McIntyre — 6/19/85
R. P. McIntyre, Special Projects Inspection Sect. — Date

OTHER INSPECTOR(S): M. Russell (EG&G)

APPROVED BY: John W Craig — 6/19/85
John Craig, Chief, Special Project Inspection Section — Date

INSPECTION BASES AND SCOPE:

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

B. SCOPE: The purpose of this inspection was to review the following items: (1) program verification of Teledyne Engineering Services (TES) owned computer code TMRSAP, (2) computer program error handling procedures, and (3) pipe support design calculations.

PLANT SITE APPLICABILITY: Watts Bar (50-390, 50-391)

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REPORT NO.: 99900513/85-01	INSPECTION RESULTS:	PAGE 2 of 4

A. VIOLATIONS:

None

B. NONCONFORMANCES:

1. Contrary to Section 5.1 of Project QA Program for TES project 6235C and Section 6.0 of Impell procedure WBNP-001 Rev 0., Watts Bar pipe support calculations 62-2CVC-R168 and 62-2CVC-R253 did not include documented justification for the omission of the effects of forces and moments due to pipe movements on the sizing of welded plate attachments, nor was there any documentation of qualification by engineering judgement.

2. Contrary to Section 3.1 and 3.7 of the TES Quality Assurance Manual, a vertical friction force was incorrectly applied at Node 9 of the GTSTRUDL model for Watts Bar Pipe Support calculation 62-2CVC-R42, TES project 6235C. Additionally, there was no documentation of this error with respect to structural adequacy of the support.

C. UNRESOLVED ITEMS

None

D. OTHER FINDINGS OR COMMENTS

1. Computer Program Verification: The development and verification of the computer program TMRSAP, which is used by TES in the design of safety-related items was reviewed during this inspection. Technical Engineering Procedures TEP-1-005, Application Computer Program Development, was reviewed and utilized throughout the inspection of TMRSAP.

   The computer code TMRSAP, which was developed internally by TES, is used for static and dynamic analysis of linear piping systems. It employs a finite element solution technique with a library consisting of curved and straight pipe elements, and a boundry element for simulation of pipe restraints. TMRSAP provides capability for analysis of such static loading as deadweight, thermal, and pressure elongation loadings. Capabilities for dynamic analysis include response spectrum and time history (both modal and direct) analysis. Solution methods include Gaussian elimination for static solutions, and determinant search or subspace iteration for the modal dynamic solutions. Direct integration is performed with the Wilson-O-method.

TES verified TMRSAP by a comparison of the output of 22 verification problem solutions with either the results of hand calculations or the output of other computer codes (STARDYNE, EPIPE, ANSYS, AND ADLPIPE). During this inspection all verification problems were reviewed. Although the verification of this code was done according to a general design control procedure (Section 3.0 of the TES Quality Assurance Manual), it was found to meet the requirements of the latest TES procedure controlling computer code verification (TEP-1-005), with one exception. The exception was that the source code listing and computation outputs were not included in the verification manual. However, the computation output includes a source code listing that was clearly identified in the verification manual and was readily available at the TES office. No violations or nonconformances were identified during this part of the inspection.

2. Computer Program Error Handling Procedures:

The procedures for handling computer program errors are covered in Section 14.0, Error Reporting, TEP-1-005 Rev 1. TEP-1-005 was revised 12/19/84 to include error reporting procedures as well as a Computer Program Error Notification and Disposition Report form, which is completed for all reported computer program errors. If it is determined that a program error can impact current or previous analyses, then a Computer Program Error Project Disposition Report form must be completed. An investigation by TES project is initiated to search for and correct any current or previous analyses affected by the error.

Since the procedures for error reporting were recently put into effect, the NRC inspector was unable to track a code error through the new system. TES has received a large number of computer code error reports from computer service bureaus, Control Data Corporation and United Information Services. TES is in the process of performing an investigation of the errors for the computer program ANSYS which have the potential to impact past analyses. The search and disposition of these errors on past and present TES projects may be reviewed during a future NRC inspection. No violations or nonconformances were identified during this part of the inspection.

3. Pipe Support Design Calculations:

TES is a sub-contractor to Impell and provides services for the design and analysis of certain pipe supports for the Watts Bar Nuclear Power

Plant. Impell has the overall contract with the Tennessee Valley Authority (TVA). TES will provide support analysis packages and support drawings to Impell for the systems within their scope of the contract.

During this inspection a sample of pipe Watts Bar Pipe support drawings and design calculations for the Chemical Volume and Control System (CVCS) were chosen for a detailed review. The review included verification of compliance to TVA Pipe Support Design Procedures, Impell Engineering Proceaures for Pipe Support Designs, TES Project 6235C QA program requirements and applicable design codes and criteria. The inspectors reviewed the correctness of the numerical calculations related to support member stress, member deflections, weld design, base plate analysis, and concrete anchor bolt analysis. Additionally, computerized input and output for computer programs such as GTSTRUDL and BASEPLATE II was reviewed. The inspector also examined the appropriateness of references and applicability of assumptions used in these programs.

Within this area of the inspection, two nonconformances were identified (see Section B, items 1 and 2 above). These items are discussed below.

Impell Engineering Procedure for Pipe Support Design (WBNP-001) explicitly states that when engineering judgement is used as a means of qualification for a portion of a calculation, it should be documented and justified in the calculation package. When reviewing pipe support calculations 62-2CVC-R168 and 62-2CVC-R253, TES project 6235C, the NRC inspector found instances where engineering judgement was being utilized but not documented. These calculations did not include forces and moments resulting from piping movement when sizing the welds for the attachment of rigid sway struts to a bolted base plate and an embedded plate. This was confirmed during interviews with the project engineer on the Watts Bar Project.

A vertical friction force was incorrectly applied at Node 9 of the GTSTRUDL model for a welded frame in the calculation of pipe support 62-2CVC-R42. It should have been applied at Node 5 of the model. Since there was already a horizontal load at Node 5, the error resulted in lower stress for the member incorporating Node 5. However, the loading conditions on the frame were low and the total ratio of calculated stress to allowable stress was well below the ASME code limit of 1.0 for combined stresses. Therefore, this input error will not affect the structural adequacy of this support.

PERSONS CONTACTED

Company TELEDYNE ENGR SERVICES Dates 1/7/85

Docket/Report No. 99900513/85-01 Inspector R. McINTYRE

ENTRANCE MEETING. Page 1 of 1

NAME(Please Print)	TITLE(Please Print)	ORGANIZATION(Please Print)
M I Russell	NRC consultant	EG&G Idaho, Inc.
ALDIE E. JOHNSON JR.	V P & Q.A MGR	TELEDYNE ENGR SERV.
James A Flaherty	V.P.	Teledyne Engineering Services
Fred C Bowles	Consultant	" " "
DONALD MESSINGER	QA. SUPERVISOR	TELEDYNE ENG. SERVICES
DONALD F. LANDERS	EXEC. V.P.	TELEDYNE ENG. SERVICES

PERSONS CONTACTED

Company TELEDYNE ENGINEERING SERVICES Dates 1/11/85

Docket/Report No. 99900513/85-01 Inspector R MCINTYRE

EXIT MEETING

NAME(Please Print)	TITLE(Please Print)	ORGANIZATION(Please Print)
Mark Russell	NRC consultant	EG&G Idaho
James A. Flaherty	Vice President	TES
DONALD F. CANDERS	EXEC. VICE PRES	TES
R+I Berks	Principal Engineer	TES
ALDIE E. JOHNSON JR.	QA. MGR.	TES
FRED FOLEY	PRESIDENT	TES

PERSONS CONTACTED

Company TELEDYNE ENGINEERING SERVICES

Dates 11/7-11/85

Docket/Report No. 99900513/85-01

Inspector R McINTYRE/M. RUSSELL

NAME(Please Print)	TITLE(Please Print)	ORGANIZATION(Please Print)
R.H. Berks	Principle Engineer	Teledyne Engineering Services
M.C. RICHARD	PROJECT ENGINEER	TELEDYNE ENG SERVICES
MIKE MORAN	PROJECT ENGINEER	" " "
ALDIE E. JOHNSON JR.	Q.A. MGR.	" " "

INSPECTOR: R McINTYRE

SCOPE:

DOCUMENTS EXAMINED

DOCKET NO. 99900513

REPORT NO. 85-01

ITEM NO.	*TYPE OF DOCUMENT	DOCUMENT NO.	REV.	DATE	DOCUMENT TITLE/SUBJECT
1	QAM	—	1	4/1/83	TELEDYNE ENGR SERVICES / QUALITY ASSUR MANUAL
2	QPCN	1004		12/19/84	QUALITY PROGRAM CHANGE NOTICE TO SECTION 3.0 OF QAM / DESIGN CONTROL
3	QAM	SECT 3.0	0	4/83	DESIGN CONTROL
4	EAM	VOLUME 1	7	—	ENGINEERING ASSURANCE MANUAL
5	PROC	TEP-1-005	1	12/4/84	TECHNICAL ENGINEERING PROCEDURE / APPLICATION Computer Program DEVELOPMENT
6	LTR	—	—	11/2/84	CONTROL DATA CORP TO TELEDYNE ENGR SERVICE (TES) / ERROR REPORTS FOR 5 COMPUTER PROGRAMS
7	INM	—	—	6/1/83	TO ALL ENGR PERSONNEL / ERROR IN computer Program STAAD III
8	INM	—	—	12/14/84	ANSYS ERROR NOTICES
9	INM	—	—	12/27/84	REVIEW OF ANSYS ERROR NOTICES
10	RPT			11/02/84	SOFTWARE CDC PROBLEM REPORT / ANSYS COMPUTER CODE.

*TYPE OF DOCUMENT

DWG - DRAWING
SPEC - SPECIFICATION
PROC - PROCEDURE
QAM - QA MANUAL
P.O. - PURCHASE ORDER

INM - INTERNAL MEMO
LTR - LETTER
OTH - OTHER
EAM - ENGR ASSURANCE MAN.
RPT - REPORT

INSPECTOR: R McINTYRE

SCOPE:

DOCUMENTS EXAMINED

DOCKET NO. 99900513

REPORT NO. 85-01

ITEM NO.	*TYPE OF DOCUMENT	DOCUMENT NO.	REV.	DATE	DOCUMENT TITLE/SUBJECT
11	PQAP	6235C	1	11/30/84	PROJECT QA PROGRAM / DESIGN AND ANALYSIS OF PIPE SUPPORTS FOR WATTS BAR NUCLEAR POWER PLANT.
12	DWG	62-2CVC-R253	902	—	CVCS PIPE SUPPORT DRAWING / WATTS BAR NUC PLANT (WBNP)
13	CALC	62-2CVC-R253	902	1/5/85	PIPE SUPPORT CALCULATION / CHEMICAL VOLUME AND CONTROL SYSTEM.
14	MAN	PSDM A621021	1	—	TVA PIPE SUPPORT DESIGN MANUAL / WATTS BAR ANALYSIS AND SUPPORT GROUP
15	PROC	EP-1-034	0	11/9/84	ENGINEERING PROCEDURE FOR PROJECT 6235C / SUPPLEMENTAL SUPPORT ANALYSIS PROCEDURE.
16	OTH	47B406-566	1	9/8/82	TVA CVCS SYSTEM SUPPORT LOADS TABLE
17	PRO	WBNP-001	0	11/1/84	ENGINEERING PROCEDURE FOR PIPE SUPPORT DESIGN
18	DWG	62-2CVC-R168	901		PIPE SUPPORT DRAWING / CVCS
19	OTH	PG-003	0	11/1/84	PROJECT GUIDE / PROJ NO 6235C / DISTRIBUTION OF WBNP-001 ENGR PROC FOR PIPE SUPPORT DESIGN

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DOCUMENTS EXAMINED

INSPECTOR: M J Russell

SCOPE:

DOCKET NO. 99900213/85-01

REPORT NO. 85-01

PAGE 1 OF 1

ITEM NO.	*TYPE OF DOCUMENT	DOCUMENT NO.	REV.	DATE	DOCUMENT TITLE/SUBJECT
1	QAM	none	3	4/1/83	Teledyne Engineering Services / Quality Assurance Manual
2	Proc	TEP-2	2	9/2/81	Teledyne Engineering Services / Technical Engineering Procedure
3	VM	TR-5872-3	0	10/83	TMRSAP Verification Manual
4	CUM	TR-5872-1	0	10/83	TMRSAP Users Manual
5	A	62-2CVC-R168/N3-62-26A	0	11/21/84	Support Analysis
6	Proc	6235C	1	11/30/84	Project QA Program
7	DM	A62102.10	1	5/18/82	TVA Pipe Support Design Manual (vols 2 & 3)
8	PROC	EP-1-034	0	11/9/84	Supplemental Support Analysis Procedures
9	A	62-2CVC-R41	1	1/8/85	Document Design Calc's For Support 62-2CVC-R41
10	Proc	WBNP-001	0	9/28/84	Engineering Procedure For Pipe Support Design (IMPELL)
11	Dwg	47W406-367	0	12/20/84	System N3-62-36A Pen X-14 Static Thrml & Seismic Anal of CVCS Seal Water Piping.

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DM - Design Manual