September 1, 1993

Docket Nos. 50-390
and 50-391

APPLICANT: Tennessee Valley Authority (TVA)

FACILITY: Watts Bar Nuclear Plant, Units 1 and 2

SUBJECT: MEETING SUMMARY - AUGUST 3, 1993 MEETING TO DISCUSS CONCERNS RELATED TO USE OF U-BOLTS (TAC M79718 and M80345)

REFERENCE: Meeting notice by P. S. Tam, July 20, 1993; revised July 28, 1993

On August 3, 1993, NRC and TVA representatives met at NRC headquarters in Rockville, Maryland, to discuss technical concerns related to TVA's use of U-bolts as part of Watts Bar's piping supports. The staff's concerns originated during the Integrated Design Inspection (see Inspection Report 50-390/92-201) in July and August of 1992. As a result, TVA submitted additional information by letters dated September 21, October 13, December 22, 1992, and April 8, and June 21, 1993; in addition, TVA and the staff met on March 2, 1993 (see meeting summary dated March 11, 1993).

Enclosure 1 is the list of meeting participants. TVA presented technical information as delineated in the handout (Enclosure 2). The U-bolt review is ongoing under the TAC numbers shown above. No commitments were made, and no interim review results were provided by the staff in the meeting.

Original signed by

Peter S. Tam, Senior Project Manager
Project Directorate II-4
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Enclosures:
1. Participant list
2. TVA's handout

cc w/enclosures:
See next page

OFFICE	PDII-4/LA	PDII-4/PM	EMEB:SC	PDII-4/D
NAME	BClayton	PTam	TChan	FHebdon
DATE	9/1/93	9/1/93	9/1/93	9/2/93

DOCUMENT NAME: UBOLTMTG

Memo 4

D/01 1/1

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ENCLOSURE 1

LIST OF PARTICIPANTS

WATTS BAR UNIT 1 MEETING TO DISCUSS U-BOLTS

August 3, 1993

Name	Affiliation
James G. Adair	TVA/Civil Engineering
Terence Chan	NRC/NRR/Mechanical Engineering Branch
Michael Glasman	NRC/Watts Bar Resident Inspector
John Fair	NRC/NRR/Mechanical Engineering Branch
Fred Hebdon	NRC/NRR/PDII-4
James Norberg	NRC/NRR/Mechanical Engineering Branch
Per Svenssons	R. L. Cloud & Associates (TVA contractor)
Peter Tam	NRC/NRR/Project Directorate II-4
H. Lee Williams	TVA/Civil Engineering

Distribution w/enclosures 1 and 2

Docket File	
NRC & Local PDRs	
WBN Rdg. File	
E. Merschoff	RII
M. Glasman	RII
P. Tam	

Distribution w/enclosure 1

T. Murley/F. Miraglia	12-G-18
J. Partlow	12-G-18
S. Varga	
G. Lainas	
F. Hebdon	
B. Clayton	
E. Jordan	MNBB-3701
T. Chan	7-E-23
J. Fair	7-E-23
J. Norberg	7-E-23
OGC	15-B-18
ACRS(10)	

Enclosure 2

NRC MEETING - U-BOLTS
Watts Bar NPP

OUTLINE

- OVERVIEW/BACKGROUND
- OVERALL SYSTEM REVIEWS
- ADDRESS - SIFs
  - LOCAL PIPE DEFLECTION
  - SYSTEM STABILITY
- MARGIN REVIEW
- DISCUSSION

Meeting Objectives

- Insure complete understanding of Program, Issues
- Outline Current "Big Picture" In Terms of:
  - System Stability
    - Qualitative and Quantitative System Evaluation
  - Local Piping Stresses
    - Existing EQ 9, 10 Stresses in Piping
  - Support Deflection
    - Relationship of Global to Local Pipe Support Deflections

- Reach Technical Agreement on Next Step

Overview

- Under-torqued U-Bolt Support Found at WBN

- Engineered Program Developed to Address Key Aspects of Stability, Local Pipe Stress, Support Deflection Limits

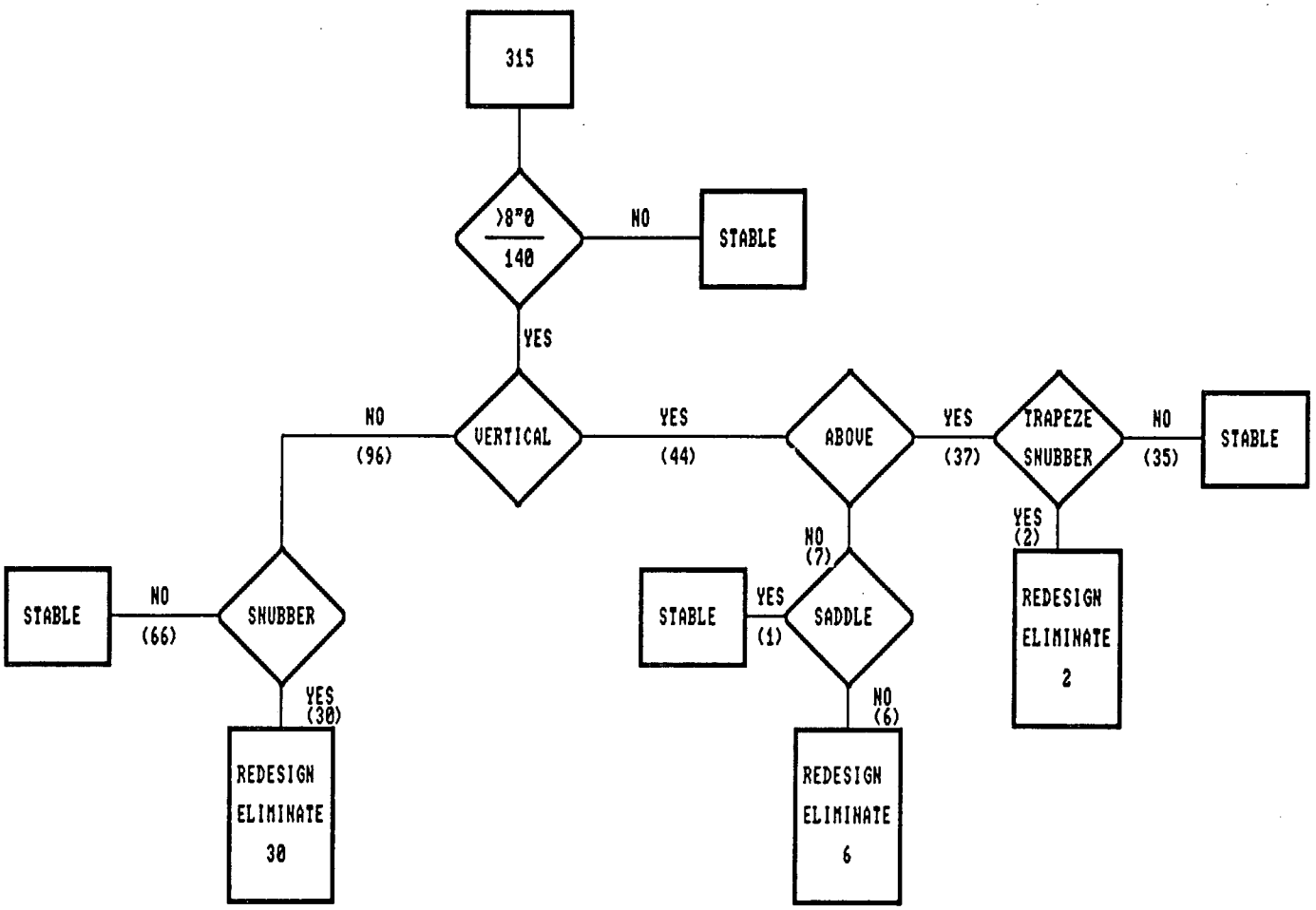
- Four Submittals Made to Date to Outline Programs, Address Questions

- U-Bolt Population

  - Original U-Bolt Population 339
  - Alternate Design 24
  - Belleville Washers Added 315
  - Changed to High St. Bolts 46

- Recent TVA Actions: Reassessed issue to focus on stability enhancements - horizontal snubber, vertical from floor, trapeze snubber

U-BOLT STABILITY REASSESSMENT



CONSIDERATIONS

1. STRUTS PROVIDE INCREASED STABILITY OVER SNUBBERS
2. FOR VERTICAL U-BOLTS, SUPPORTS ABOVE ARE INHERENTLY MORE STABLE THAN FROM BELOW
3. FOR VERTICAL U-BOLTS WITH SUPPORTS ABOVE, STRUTS ARE MORE STABLE THAN SNUBBERS
4. FOR HORIZONTAL U-BOLTS, STRUTS ARE INHERENTLY MORE STABLE ARRANGEMENT THAN SNUBBERS
5. SADDLES IN COMBINATION WITH PRELOADED U-BOLT PROVIDE ADDITIONAL STABILITY
6. WBN U-BOLT UPGRADE HAS PROVIDED FOR OVERALL COVERAGE FOR DESIGN CONSIDERATIONS

* BELLEVILLE WASHERS ADDED FOR MAINTENANCE OF PRELOAD
* VERIFIED BY INSITU TESTS
* SEE ADDITIONAL SHEETS 3 THRU 8

Issue: Local Pipe Stress

- **STANDARDS**

  - Development of P_c based on ASME III Section NB 3228.1

  - Representative stresses included in P_c evaluation to address primary and secondary effects

  - Shakedown; i.e., continuing deformation (per NB 3228.1) shown by analysis not to occur

- **CONSERVATISMS**

  - Upper bound limited to 2/3 P_c

  - Normal/Upset Code Limit 2/3 P_c applied to all loads including faulted

  - Limit load based on unconfined pipe section (local stiffening not used)

- **CONSIDERATIONS**

  - Vast majority of existing Equation 9/10 stress interactions are low (94% less than 40% of allowable)

  - Table II-1 submitted to show P_c coincident stresses representative, SIF's removed to be consistent

  - Few exceedances of P_c coincident stresses if Equation 9 & 10 are combined (with SIF's included)

Issue:Potential For Local Deformations

- **STANDARDS**

  - Piping and support analysis decoupled, consistent with common practice

  - All pipe supports for 1/8" deflection in loading direction

  - Sway angle for trapeze supports kept to < 5°

  - Local pipe deformation not part of support deflection check (consistent with other types of supports)

- **CONSERVATISMS**

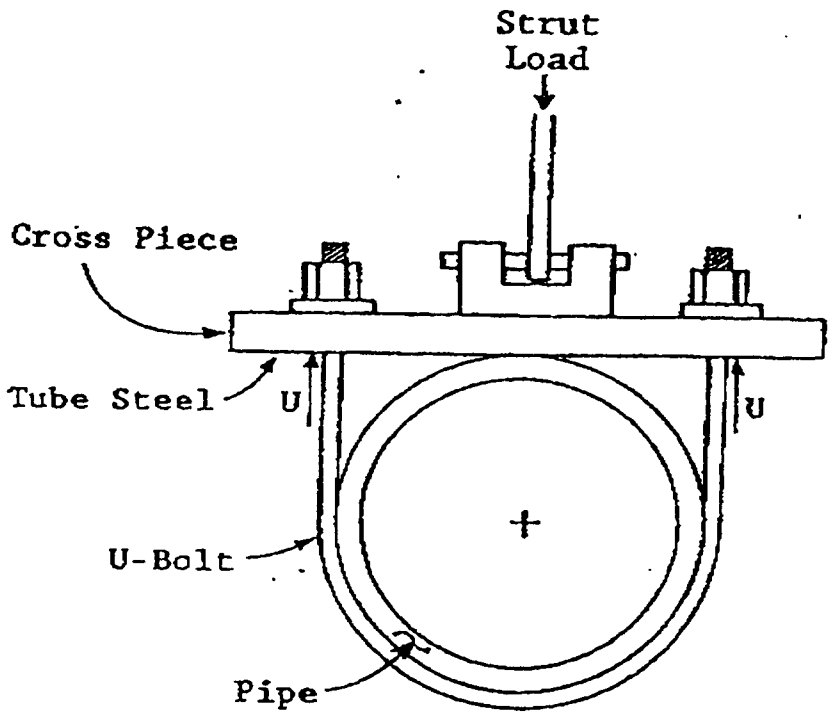
  - Methodology addresses loads for each U-Bolt location

  - Significant margin between minimum preload for stability and maximum preload for local pipe stress

- **CONSIDERATIONS**

  - Belleville washers added to provide positive assurance that preload is maintained

  - All support locations meet FSAR criteria for deflection



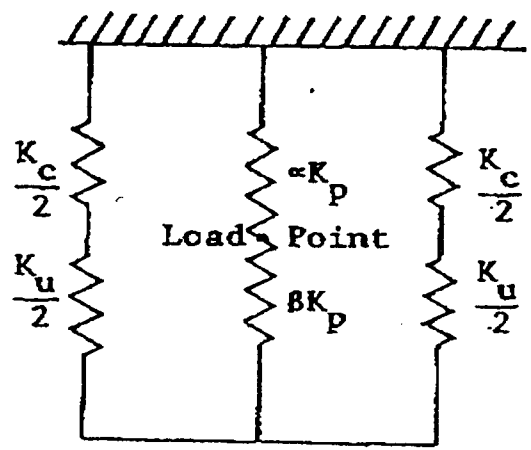


Figure 4.2 Mathematical Model of the U-Bolt / Pipe Assembly

Overall System Review

- **Purpose:**

  Review each Iso with U-Bolt to ensure overall piping system functionality

- Qualitative assessment by Senior Structural Engineers for each U-Bolt Application

  - Applied to all cases

  - Considered U-Bolt non-functional for seismic, margins in surrounding hangers reviewed

- Qualitative Assessment Performed on "Worst Case" Configurations

  - Three iso's with U-Bolt in ~~conservative~~ CONSECUTIVE locations

  - Reanalyzed with U-Bolt not providing seismic restraint

- **Results:**

  Piping met Operability Stress Limits for all cases.

Conservatisms in U-bolt Methodology

. Local pipe stress/deformation

- Allowable contact force on pipe based on Limit Load analysis of unconfined pipe section
- Normal/Upset Code limit (2/3 Pc) applied to all loads, including Faulted
- Primary load limit applied to all primary and secondary load effects
- Comprehensive Limit Load analysis includes local effects and representative global effects.

. Stability

- Comprehensive design methodology considers loads and parameters for each U-bolt
- Significant margin between minimun preload required for stability and maximum preload allowed for local pipe stress
- Belleville washers provide positive assurance that preload maintained

SUMMARY AND CONCLUSIONS

* Conservative design procedure implemented to address U-bolt stability and code issues

* Design inhancement developed to further assure long term stability (belleville washers)

* Each U-bolt support individually evaluated,modified if necessary,all pretensioned (some U-bolts removed as result)

* In-situ confirmation stability tests conducted on a sample to further assure compliance

* Seek resolution to issues outstanding