

TELEDYNE  
ENGINEERING SERVICES

130 SECOND AVENUE

WALTHAM MASSACHUSETTS 02254

(617) 890-3350 TWX (710) 324-7580

October 27, 1982  
5599-18

Mr. Robert J. Shovlin  
Assistant Project Director - Susquehanna  
Pennsylvania Power and Light Company  
Two North Ninth Street  
Allentown, Pennsylvania 18101

Subject: Addendum to TES Final Report TR-5599-3, Independent Design  
Review - Susquehanna Steam Electric Station

Dear Mr. Shovlin:

Enclosed are six copies of the subject report. We have also forwarded  
copies to the following parties in accordance with your instructions.

Mr. A. Schwencer  
U. S. Nuclear Regulatory Commission  
7920 Norfolk Avenue  
Bethesda, Maryland 20014

Mr. Robert Perch (To Be Opened by Addressee Only)  
U. S. Nuclear Regulatory Commission  
7920 Norfolk Avenue  
Bethesda, Maryland 20014

Mr. J. B. Violette (4 copies)  
Bechtel Power Corporation  
P. O. Box 3965, 50 Beale Street  
San Francisco, California 94119

If you have any questions please do not hesitate to contact me.

Very truly yours,

TELEDYNE ENGINEERING SERVICES

*Donald F. Landers*

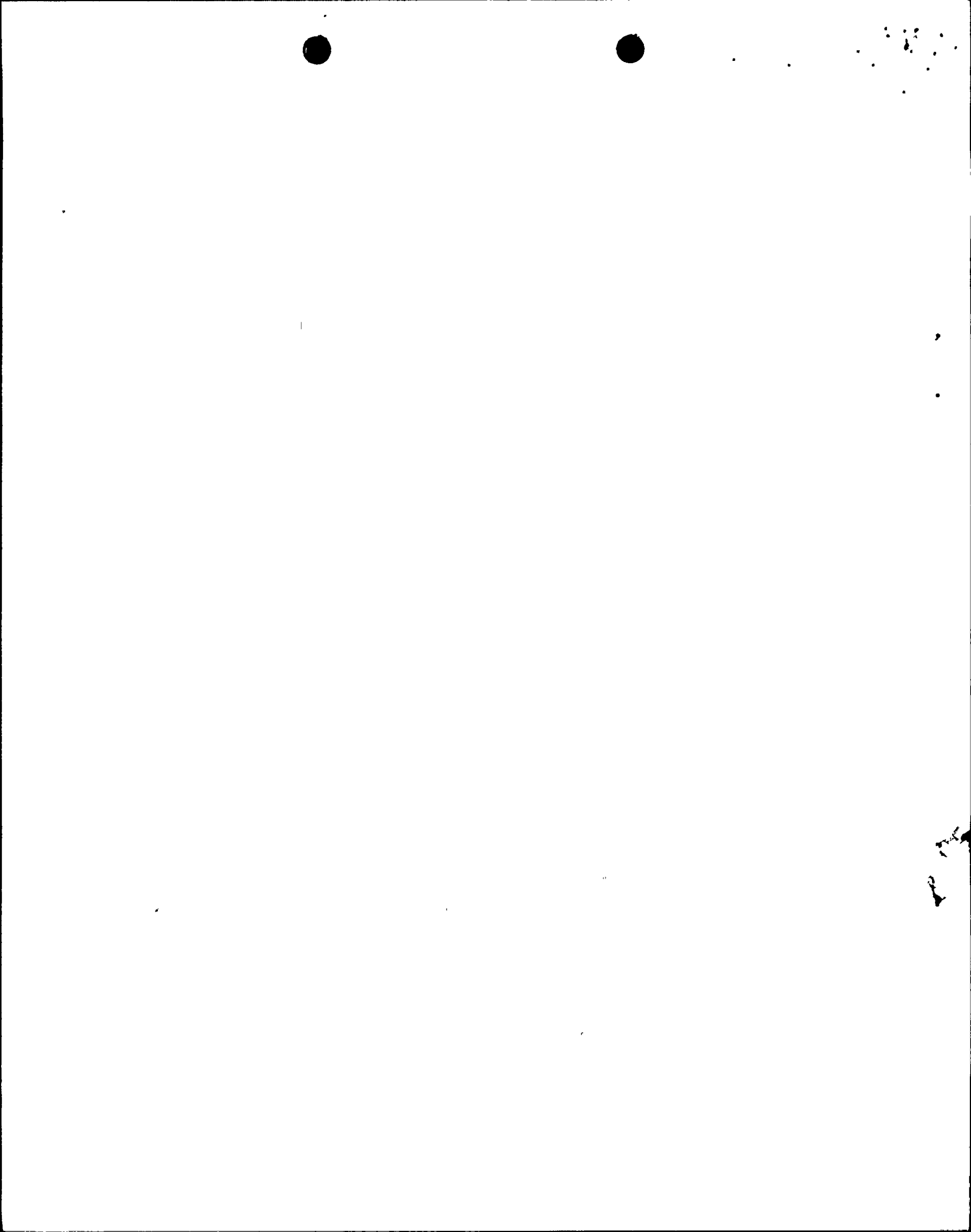
Donald F. Landers  
Senior Vice-President

DFL/1h

Enclosures

cc: R. A. Enos (TES)  
J. A. Flaherty (TES)  
J. W. Hanson (TES)  
J. W. McBrine (TES)  
S. D. Wharton (TES)  
D. Messinger (TES)  
E. A. Solla (TES)  
P. R. Kommineni (TES)  
TES Document Control

~~8211010070~~



PENNSYLVANIA POWER AND LIGHT COMPANY  
TWO NORTH NINTH STREET  
ALLENTOWN, PENNSYLVANIA 18101

TECHNICAL REPORT TR-5599-3

ADDENDUM TO  
FINAL REPORT

INDEPENDENT DESIGN REVIEW  
SUSQUEHANNA STEAM ELECTRIC STATION

OCTOBER 27, 1982

TELEDYNE ENGINEERING SERVICES

130 SECOND AVENUE  
WALTHAM, MASSACHUSETTS 02254  
617-890-3350

AND NOT  
DESIGNATED  
821101.0070

Technical Report  
TR-5599-4

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        Objectives and Procedures Manual



## 1.0 INTRODUCTION

This report is submitted to serve two purposes. The first is to close out the two findings defined in the TES Final Report Number TR-5599-3 dated August 22, 1982 (Reference 1). The second is to act as an Executive Summary to the Independent Design Review performed by TES on the Susquehanna Steam Electric Station.

## 2.0 CLOSING OF FINDINGS

The following discussion presents the details behind the closing of Findings by TES.

### 2.1 Finding Number 1

This Finding was closed by Letter Number 5599-17, dated October 19, 1982, which is attached in Appendix 1.

The basis of Finding Number 1 was that the Design Specification categorization of plant operating conditions was not proper. In Bechtel Design Specification 8856-M-175, Revision 5, the transient condition "Loss of Feedwater Pumps, Main Steam Isolation Valves Closed" is classified as an Emergency Condition. Based on the requirements of ASME, BPVC Section III (Code) this classification precludes this event from consideration in the fatigue evaluation. However, the Code in Paragraph NB-3113.3 requires that an event classified as an Emergency Condition:

"shall not cause more than 25 stress cycles having an  $S_a$  value greater than that for  $10^6$  cycles from the applicable fatigue design curves of Figures I-9.0."

This event, "Loss of FW Pumps MSIV Closed" is specified as occurring ten times. For each occurrence, three step changes in temperature from 546F to 40F and one step change in temperature from 546F to 100F is specified. Additionally recovery from 40F to 546F at various times is also specified. Based on the specified conditions, more than 25 stress cycles having an  $S_a$  value greater than that for  $10^6$  cycles from the applicable fatigue curves will occur. This event will have a significant impact on the fatigue life of components and must be considered in the fatigue evaluation. This can only be accomplished by classifying the event as an Upset Condition.

The information submitted by Bechtel in Reference 3 addressed the impact of the "Loss of Feedwater Pumps, MSIV Closed" transient on the Fatigue Usage Factor for the Main Feedwater System. Further, a study was done that determined the fatigue effect on all other Class 1 systems was negligible. A summary of that information follows:

<u>System</u>	<u>Usage Factor</u>	
	<u>Stress Report</u>	<u>Study</u>
Feedwater	0.8993	0.9494
Core Spray	0.8975	0.8985
RPV Drain	0.3576	0.3576
Standby Liquid Control	0.4332	0.4383
RCIC	0.6146	0.6151
HPCI	0.8290	0.8295
Head Vent	0.6021	0.6027
Head Spray	0.7956	0.7957
MSIV Drain	0.0384	0.0393

It is important to understand that the TES position on this Finding has always been that a safety concern did not exist. In fact, TES pointed out at two NRC staff meetings that our experience in analyzing

Class 1 BWR systems indicated that the requirements of the ASME, BPVC Section III would be met considering this event as an Upset Operating Condition. TES needed documentation from Bechtel verifying this position. That has been submitted in Reference 3.

Finding Number 1 has been addressed to the satisfaction of TES and is therefore revised to an Observation.

## 2.2 Finding Number 2

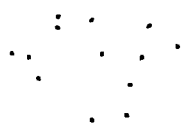
This Finding is related to the reconciliation process of as-built supports and results from the fact that further calculations were required by Bechtel to resolve as-built geometries for the Main Feedwater System. The following is a summary of the Finding as detailed in Reference 1.

Finding Number 2 (Phase 1 Finding Numbers 7, 9 and 10, and Observation Numbers 3, 4, 5, 6, 7 and 9)

A significant number of comments have been generated on the support design process. Most of these comments are related to reconciliation of as-built geometry by the support designer. The concern is basically associated with acceptability of the as-built support. Two major items (Finding Nos. 7 and 10) have been responded to by Bechtel in this Phase 2 portion of the review but they only tend to support that the process did not work.

The response to Phase 1 Finding No. 7 indicates that the pipe support reviewer and checker determine whether a relocated support was a significant enough change to warrant a Civil department review. In the case of the specific support of concern no Civil review is apparent. However, there is a new plate required in the as-built design which is the





responsibility of the Civil department. The support design group calculations indicate that the plate will be handled by the Civil group and the Civil calculations do not address the plate since they do not know the support is located on it without having the as-built geometry forwarded to them. In the final Bechtel submittal the plate has been analyzed by the Civil department as a result of the TES findings.

The response to Phase 1 Finding No. 10 indicates that the weld at the shield wall is acceptable after reducing the conservatism in the original analysis and performing a detailed computer solution of the support. It is apparent that this weld was not acceptable by inspection as originally stated by Bechtel.

Responses to Finding Number 9 and the Observations listed under this Finding were reviewed and in some cases indicate the Observation could have been closed if sufficient detail was provided in the Bechtel reconciliation process. During the August 10, 1982 meeting at TES, Bechtel indicated that group meetings and training sessions were held to explain procedures used in the reconciliation process. Further, the reviewer checks each item and determines acceptability and even crosses each item off that he judges is acceptable on a check print. None of this information is retained by Bechtel nor is there any record maintained of meetings or training sessions for this purpose.

In response to this Finding, PP&L undertook a review of the reconciliation process for an additional 20 supports on systems other than the feedwater system. That review indicated that one anchor would require extensive reanalysis. Essentially, the as-built anchor had approximately one-fourth of the as-designed weld length. As a result of this, PP&L elected to go to a sample of 400 supports. The breakdown of that sample is as follows:

Composition of Sample

<u>Type</u>	<u>Population</u>	<u>Sample</u>
Snubbers	25%	11%
Springs	15%	3%
Rigid Supports	54%	75%
Anchors	<u>6%</u>	<u>11%</u>
	100%	100%

The sample concentrated more heavily on rigid supports and anchors because the IDR Finding and the original PP&L sample indicated that these were the most critical type supports with respect to reconciliation.

A detailed procedure for the review of the 400 supports was developed by PP&L and reviewed by TES. A copy of that procedure is attached in Appendix 2. A TES observer was present at the Bechtel offices in San Francisco during the major part of this review related to Categorization. Our observation of that process included spot-checking of supports to determine if TES agreed with the categorization. TES concluded that the process as defined by PP&L and reviewed by TES was being carried out successfully and that the personnel involved in Categorization were allowed to reach decisions independently. Based on this, TES determined that a review of all Category III supports would be sufficient to reach our conclusion. Our review of 80 supports designated as Category III results in the following:

1. The original reconciliation process indicates weaknesses in the area of acceptance of as-built designs. This is primarily related to those supports that were reconciled based on engineering judgment. This is based on the fact that 14 supports required extensive reanalysis to determine adequacy and 40 supports required some simple recalculation. Extensive analysis includes detail computer analysis of the



support and/or reanalysis of the piping system to reduce loading conservatisms.

2. The categorization of 89 items in Category III was very conservative. It is TES' opinion that approximately one-half of these supports should have been Category II.
3. All supports other than anchors have been demonstrated to be adequate by the PP&L review and the Bechtel responses, including reanalysis. TES has sufficient evidence to remove these from further consideration.
4. A reconciliation problem related to weld capacity still exists for anchors. A program acceptable to TES has been presented in Section 3.0. Acceptance of this program by PP&L would satisfy Finding Number 2 of the IDR.

### **3.0 ANCHOR RECONCILIATION PROGRAM**

In order for TES to remove Finding Number 2, the following program must be accepted by PP&L.

#### **3.1 Definition of Anchor**

An anchor is defined as any support that provides rotational as well as translational restraint to the piping system. One direction of rotational restraint is sufficient for a support to be categorized as an anchor. Anchors which are part of containment (flued heads) and anchors at equipment (pumps, vessels, etc.) are specifically excluded from this program. Essentially, this program is limited to intermediate anchors which use structural steel to provide restraint.

### 3.2 Program Division

The program should be divided into two phases, as follows:

1. Phase 1 - anchors inside containment.
2. Phase 2 - anchors outside containment.

The reason for this division is that TES feels the plant should be allowed to operate once the anchors inside containment have been reconciled. This is because the earthquake event (OBE or SSE) is a significant load for all anchors and, for the short time needed to reconcile anchors outside containment, the event probability should be very low.

### 3.3 Program Details

All anchors shall be subjected to the categorization process defined in Appendix 2. Those anchors which are placed in Category I and/or II will be acceptable by definition. For those anchors placed in Category III only analysis comparable to the as-designed analysis is allowable for reconciliation. If reconciliation cannot be reached in this manner the anchor will be modified to reflect as-designed. Where interference or access does not permit this approach, modifications to the anchor may be made which do not reflect as-designed but do provide the same design margin. It is noted that analysis techniques beyond those used in the original anchor design are not to be used to provide the design margin.

### 4.0 PROGRAM MONITORING

TES' review of the implementation of the PP&L program for reconciliation of the 400 support sample was quite extensive. Based on this

review, our confidence in the PP&L personnel involved and PP&L's commitment to this program, we feel there is no further need for TES participation.

## 5.0 CONCLUSIONS

The Independent Design Review performed on the Main Feedwater system at the Susquehanna Steam Electric Station was quite extensive in scope. This review provided TES with a detailed understanding of the following:

- 5.1 FSAR commitments,
- 5.2 Quality Assurance procedures, process and implementation,
- 5.3 Design procedures, process and implementation,
- 5.4 As-built configuration,
- 5.5 Reconciliation of as-built geometries versus as-designed, and
- 5.6 Implementation of FSAR commitments.

Based on the results of our Independent Design Review, it is TES' opinion that, upon completion of the program outlined in Section 3.0 of this report, the commitments of the FSAR have been complied with for the Susquehanna Steam Electric Station.

## 6.0 REFERENCES

- 6.1 TES Final Report TR-5599-3, "Independent Design Review - Susquehanna Steam Electric Station", dated August 23, 1982.
- 6.2 PP&L Letter Number ER100450, PLA-1328, dated October 4, 1982, from N. W. Curtis (PP&L) to A. Schwencer (USNRC).
- 6.3 Bechtel Letter Number 0176565, dated September 24, 1982, from E. B. Poser (Bechtel) to R. Enos (TES).

Technical Report  
TR-5599-4

APPENDIX 1

TES LETTER NUMBER 5599-17



October 19, 1982  
5599-17

Mr. Robert J. Shovlin  
Assistant Project Director - Susquehanna  
Pennsylvania Power and Light Company  
Two North Ninth Street  
Allentown, Pennsylvania 18101

Subject: TES Independent Design Review - Susquehanna Steam Electric  
Generating Station

References: (1) PP&L Letter ER 100450 dated October 4, 1982  
(2) Bechtel response to Phase 2, Finding No. 1 (Identifi-  
cation No. 0176565) dated September 24, 1982

Dear Mr. Shovlin:

Attached are six copies of this letter. We have also forwarded copies  
to the following parties in accordance with your instructions.

Mr. A. Schwencer  
U. S. Nuclear Regulatory Commission  
7920 Norfolk Avenue  
Bethesda, Maryland 20014

Mr. Robert Perch (To Be Opened by Addressee Only)  
U. S. Nuclear Regulatory Commission  
7920 Norfolk Avenue  
Bethesda, Maryland 20014

Mr. J. B. Violette (4 copies)  
Bechtel Power Corporation  
P. O. Box 3965, 50 Beale Street  
San Francisco, California 94119

This letter is submitted as a preliminary reaction to References (1) and  
(2) responses to Phase 2, Finding No. 1, of the TES Final Report. This  
item will be addressed in greater detail in an Addendum to the TES Final  
Report. It is anticipated that the Addendum will be submitted upon com-  
pletion of a review by TES of the Support Reconciliation Report being  
prepared by PP&L in response to Phase 2, Finding No. 2.

The basis of Finding No. 1 is that the Design Specification categorization  
of plant operating conditions is not proper. This is specifically  
related to "Loss of Feedwater Pumps, MSIV Closed" being classified as an

Mr. Shovlin, PP&L  
5599-17  
October 19, 1982  
Page 2

Emergency Condition. References (1) and (2) indicate that the inclusion of this transient in the Upset Condition category does not violate Code fatigue criteria. Further, a study of other systems indicates that this transient is less severe and would have negligible effect on fatigue usage factors for those systems.

TES has stated at two meetings with the NRC staff that our experience in analyzing BWR piping systems indicates that the results obtained by Bechtel could be expected and no safety concerns existed. Based on this knowledge, TES requested that sufficient documentation be presented to indicate that Bechtel reaches the same conclusion when this transient is considered as an Upset Condition. This documentation was presented in Reference (2).

It is apparent that the definition of Finding as used by TES in the IDR of Susquehanna is being misunderstood. A Finding does not necessarily mean that a safety concern exists. TES feels that any concerns resulting from Phase 2, Finding No. 1, with respect to safety should be eliminated. Based on the above, Phase 2, Finding No. 1, should be changed to an Observation that has been sufficiently addressed by PP&L.

If you have any questions concerning this please do not hesitate to contact me.

Very truly yours,

TELEDYNE ENGINEERING SERVICES

*Donald F. Landers*

Donald F. Landers  
Senior Vice-President

DFL/lh

cc: R. A. Enos (TES)  
D. Messinger (TES)  
TES Document Control

Technical Report  
TR-5599-4

APPENDIX 2

AS-BUILT RECONCILIATION PROGRAM REVIEW  
OBJECTIVES AND PROCEDURES MANUAL

Revision 0 10/9/82

Revision 1 10/9/82 WJR RVP

Revision 2 10/12/82 DS RVP

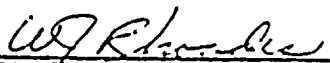
AS-BUILT RECONCILIATION PROGRAM REVIEW

OBJECTIVES AND PROCEDURES MANUAL

SUSQUEHANNA STEAM ELECTRIC STATION

PENNSYLVANIA POWER & LIGHT COMPANY

  
R. V. Parekh - Bechtel

  
W. J. Rhoades - P. P. & L.

INTRODUCTION

It has been concluded by PP&L that additional review of the As-Built Reconciliation Program is necessary. The purpose of this review is to provide a very high confidence level to PP&L and the NRC that there exist no unsafe piping supports in the Susquehanna Steam Electric Station.

Accordingly, PP&L has selected a sample size of five hundred (500) seismic category one supports to be reviewed. This sample size provides us with the high degree of confidence we require. However, after we have reviewed several hundred supports, this sample size may be adjusted upwards or downwards depending on the results of the survey at that time.

Selection of the supports to be reviewed will be made by PP&L representatives. It is intended that the sample selected be random with respect to systems but skewed in favor of anchors, rigid and operationally active snubbers with less consideration towards dead weight type supports. A complete list of those supports selected will be documented in the final report.

DEFINITIONS

The following are the definitions of the categories of differences between the as-built and engineering drawings.

CATEGORY I: Are those differences which are considered insignificant, such as slight variation in dimensions.

CATEGORY II: Are those differences which may be of concern but upon further investigation are considered acceptable. The investigation, however, may be by engineering judgement or by simply referring to the as-designed calculation and noting what the requirements or actual stresses are.

CATEGORY III: Are those differences which are of concern and require further evaluation. The evaluation would require an additional analysis or a more detailed analysis of the original calculation.

REJECT: Reject is defined by PP&L as any support that, in the judgement of PP&L, requires a field hardware modification.



## ORGANIZATION

This program is organized into three primary task groups plus a documentation retrieval group. Task group one will perform the function of comparing and clearly identifying all differences between the final "as-built" and the engineering analyzed support drawing. Group two will perform the judgements and determine to which category each item, highlighted by Group one, is to be put and document that category. Group three will take those Category III which require resolution and perform the necessary calculations or additional research work to verify acceptability of the support. If field walkdown for review of specific support is required it will be made and documented by the PP&L Resident Engineering.



## DOCUMENTATION RETRIEVAL

### STEPS:

1. Check Pipe Support list against DOCRET to note the latest Engineering revision. (DOCRET is the log of engineering revisions issued and is generated from microfilm cards and was in existence at the time of as-built reconciliation.)

2. Copy of Engineering revision
  - a. Retrieve copy
  - b. Make 1 copy
  - c. To be filed in binder later
  
3. Copy of the latest as-built from the ABR (As-Built Reconciliation) binder
  - a. Check revision in binder reconciliation sheet
  - b. Locate as-built P.S. detail in the ABR. Check to ensure that the sticker is signed-off by Engineering.
  - c. Put marker in the ABR binder
  - d. Sign-out out card
  - e. Make 1 copy
  - f. File back where marker was
  - g. Sign-out ABR out-card.

GROUP 1

Comparison of Engineering and As-Built Pipe Support Details

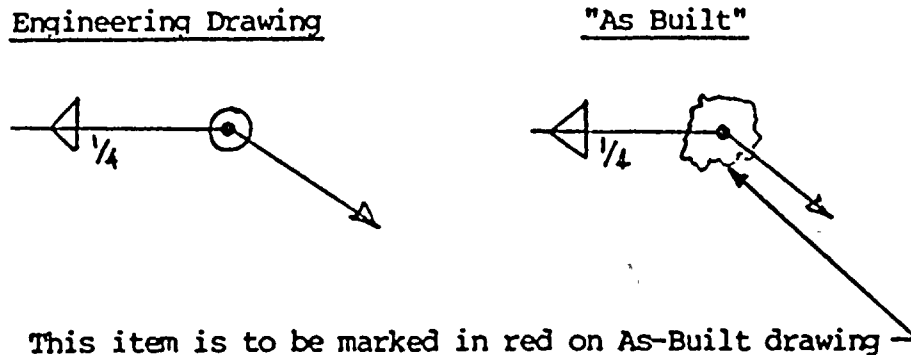
(Yellow-out Process):

1. Obtain copy of Engineering and as-built P.S. revision
2. Yellow-out all items that are identical on both Engineering and as-built pipe support detail.
3. Items not identical to the Engineering revision should be circled in red.

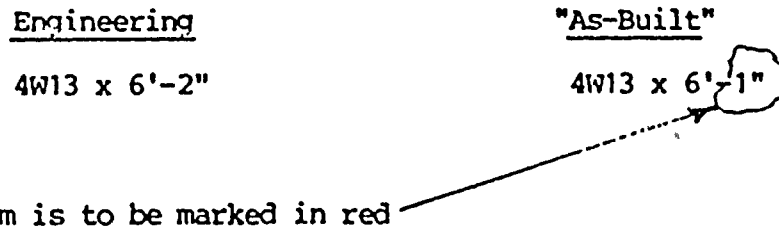


4. Identify items that are not identified on either of the drawings by a circle in green with an asterisk mark.

It is to be emphasized that no judgements are to be made by Group one personnel and that all differences, no matter how trivial they may appear, are to be marked in red or green. The following example is an illustration of this requirement:



Bill of Materials



5. Fill out the cover sheet completely
6. Package cover sheet, Engineering revision and yellowed-out as-built P.S. detail.
7. All packages returned to group one task coordinator for PP&L review.

GROUP 2Review and Disposition of Differences Between Engineering and As-Built Drawings

1. Ensure that Group One Cover Sheet has been properly signed off prior to performing any reviews.
2. Record each difference on the prescribed sheet (attached).
3. Categorize each difference as Category I, II, III as described in Definitions Section.
4. Resolutions:

Category I differences are those that are insignificant such as slight variation in dimensions and thus, are acceptable by definition.

Category II differences are those that are acceptable by engineering judgement or reference to original calculations. For example, the design called for a 6" diameter pipe having a wall thickness of 3/8". The as-built shows a 6" x 6" x 1/4" thick square structural tube is used instead. This may be acceptable by engineering judgement by comparing the area and section modules of them in relation to the imposed load. Another example is the design has called for a 3/8" fillet weld all around a member. The as-built shows 5/16" fillet weld is used instead. By referring to the original calculation, it is noted that a 1/4" fillet weld is required and thus is acceptable.

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(Note: The original calculations are QA documents and, as such, are considered valid and acceptable design basis calculations. Therefore, there would be no need to re-review the original calculations and would be beyond the scope of this task).

Category III differences are those that require additional calculations to resolve the difference between the as-designed and as-built. You should search the As-Built Reconciliation (ABR) book to see if there exist calculations that address each Category III difference. When there are no ABR calculations for an item or the calculations are not satisfactory, you should identify that additional calculations are required prior to acceptance or sign off. Please print your name and your team leader's name on the first sheet for identification purposes prior to submitting them to your team leader. When additional calculations are required, the necessary calculations will be performed by Group III and provided to you. If additional calculations are needed to resolve the difference(s), no matter how simple a calculation, you are requested not to make them yourself. This is because of two (2) reasons. First, the the calculations need to be verified in accordance with established procedures and be documented. Second, the Group III function is to make these calculations and they are available to do so. After you

2

are provided with the calculations the package will be considered complete if you concur with the calculations and all Category III differences have been addressed. If not, a resolution for them will be required. If there is an inpass, PP&L shall determine the final resolution for them. If rejects are identified (see definition) because hardware changes are required they would be identified and signed off. Needless to say, if there are no Category III differences, the "As-Built Reconciliation Judgement Verification" form shall be signed off based on acceptance of Category I and II differences, if any.

5. Items that need Field verification or clarification due to drawing ambiguity, clarity should be identified and brought to Team Leader's attention for resolution.
6. Forward package to PP&L representative for review and concurrence.

### GROUP 3

#### Performance of Additional Calculations to Justify Adequacy of the Differences Designated as Category III by Group II

1. Generate calculations per PERM as necessary to validate the differences and the as-built condition to the extent feasible.  
All packages forwarded to Group 3 require individualized disposition

to assure support adequacy. Once you receive a package identify what must be done, notify PP&L of your intended action, and proceed.

If a calculation needs to be run, proceed immediately and, once appropriate calculations are complete, attach them to the completed package, sign the cover sheet and forward them to PP&L. If field checking of an item is required, notify PP&L and they will make arrangements for PP&L Resident Engineering group to make necessary checks. If any support cannot be resolved by additional calculations, notify PP&L immediately.

| △  
2

FINAL DOCUMENTATION:

1. A sample selection of the Final Documentation Package will be made by PP&L to assure the following:
  - a. As-Built Reconciliation Judgement Verification sheet completely filled in.
  - b. Copies of yellow-out cover sheets filled in.
  - c. Copies of Engineering revision and as-built P.S. detail (yellow-out copy)
  - d. Calculations as applicable, and when generated by Group 3 for each pipe support.

LIST OF ATTACHMENTS:

1. Sample signoff sheet for Group 1
2. Sample As-Built Reconciliation Judgement Verification Signoff sheet for Group 2.















**AS-BUILT RECONCILIATION PROGRAM REVIEW**  
**SUSQUEHANNA STEAM ELECTRIC STATION**

UNIT - 1

CATEGORY III RESPONSE FORM

ABR CALC.

SUPPORT No. \_\_\_\_\_ SEQUENCE No. \_\_\_\_\_

ENG. DWG. REV. \_\_\_\_\_ AS-BUILT REV. \_\_\_\_\_

FCI \_\_\_\_\_ SYSTEM. \_\_\_\_\_

ABR CALC. REVISION REQUIRED:      YES      NO  
        

RESPONSE: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

RESPONSE BY. \_\_\_\_\_

DATE. \_\_\_\_\_

APPROVED BY \_\_\_\_\_

DATE. \_\_\_\_\_



NOV 9 1982

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G. Knighton

E. Adensam

\*R. Vollmer

\*R. Mattson

\*S. Hanauer

\*H. Thompson

\*Attorney, OELD

E. L. Jordan, DEQA:IE

J. M. Taylor, DRP:IE

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E. Christenbury, OELD

J. Scinto, OELD

\*A. Bennette

