

**ATTACHMENT (2)**

---

**Non-Proprietary -- Calculation No. CA04894, Revision No. 0,  
“Calculation of Vertical Bolt Pull-out Loads Due to Horizontal Seismic  
Loading of 1g for Calvert Cliffs Units 1 and 2”**

---

## WESTINGHOUSE NON-PROPRIETARY CLASS 3



## ABB Combustion Engineering Nuclear Operations

## Document Distribution/Approval

|                            |   |                         |   |
|----------------------------|---|-------------------------|---|
| Project Number: 2009325    |   | Originator: M.J. Guidos | Initials: <i>MJG</i>  |
| Project Name: BGE MNSA     |   |                         |   |
| Document Number:           | B1-NOME-CALC-0119   | Rev: 0                  | Quality Record?<br><input type="checkbox"/> No <input checked="" type="checkbox"/> Yes (See note below)   |
| Document Title:            | Calculation of Vertical Bolt Pull-Out Loads due to Horizontal Seismic Loading of 1 g for Calvert Cliffs Units 1 & 2 |                         |   |
|                            |   |                         | Quality Record Retention Period (see QP 17.1):<br><input checked="" type="checkbox"/> Lifetime <input type="checkbox"/> 3 years <input type="checkbox"/> 10 years |
| Transmittal Reason: Review |   |                         |   |
| Reference:                 |   |                         |   |

| Name                 | Title       | CEP Code         | Approval Requested  | Enc                      | Signature           | Date    |
|----------------------|-------------|------------------|---|--------------------------|---------------------|---------|
| J.T. McGarry         | PM          | 9481-1934        | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> | <i>J.T. McGarry</i> | 12/7/99 |
| A.P. Wivagg          | IR          | 9481-1934        | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> | <i>A.P. Wivagg</i>  | 12-1-99 |
| K.V. Margotta        |             | 9481-1934        | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> |                     |         |
| NOME file (2 copies) |             |                  | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | <input type="checkbox"/> |                     |         |
| <i>J. BURGER</i>     | <i>SUPV</i> | <i>9481-1934</i> | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | <input type="checkbox"/> | <i>J. Burger</i>    | 12/7/99 |
|                      |             |                  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | <input type="checkbox"/> |                     |         |
|                      |             |                  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | <input type="checkbox"/> |                     |         |
|                      |             |                  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | <input type="checkbox"/> |                     |         |
|                      |             |                  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | <input type="checkbox"/> |                     |         |
|                      |             |                  | <input type="checkbox"/> Yes <input type="checkbox"/> No            | <input type="checkbox"/> |                     |         |

|                               |
|-------------------------------|
| Comments: **QA forms attached |
|                               |
|                               |
|                               |
|                               |
|                               |
|                               |
|                               |
|                               |
|                               |

Note: This form must include the attached document when designated a Quality Record.

## Design Analysis Title Page

Title: Calculation of Vertical Bolt Pull-Out Loads due to Horizontal Seismic Loading of 1 g for Calvert Cliffs Units 1 & 2

Document Number: B1-NOME-CALC-0119 Revision Number: 00

**Quality Class:**

☒ QC-1 (Safety-Related)      ☐ QC-2 (Not Safety-Related)      ☐ QC-3 (Not Safety-Related)

**1. Approval of Completed Analysis**

This Design Analysis is complete and verified. Management authorizes the use of its results.

|   | Printed Name  | Signature                | Date    |
|---|---------------|--------------------------|---------|
| Cognizant Engineer(s)                           | M. J. Guidos  | <i>Michael J. Guidos</i> | 12/1/99 |
| Mentor <input checked="" type="checkbox"/> None |               |                          |         |
| Independent Reviewer(s)                         | A.P. Wivagg   | <i>A.P. Wivagg</i>       | 12-1-99 |
| Management Approval                             | J. T. McGarry | <i>J. T. McGarry</i>     | 12/7/99 |
|   | J.M. BURGER   | <i>J.M. Burger</i>       | 12/7/99 |

**2. Package Contents** (this section may be completed after Management approval):

|                            |    |       |
|----------------------------|----|-------|
| Total pages in Calculation | 39 | Pages |
| Pages in Appendix A        | 18 | Pages |
| B                          | 7  | Pages |
| Total page count           | 64 | Pages |

Total number of sheets of microfiche: ☒ None      Number of sheets

**Note:** CD-ROM Files are Not Applicable to this Analysis.

Other attachments (specify): \_\_\_\_\_

**3. Distribution:**

E. D. Boland (NOME File)

B. Boya (QA - 2 Copies)



B1-NOME-CALC-0119

00

Calculation Number

Rev.

2 of 39

Page Number

**Record of Revisions**

| <u>No.</u> | <u>Date</u> | <u>Pages Involved</u> | <u>Prepared By</u> | <u>Approved By</u>          |
|------------|-------------|-----------------------|--------------------|-----------------------------|
| 00         | 12/2/99     | All, Original Issue   | M.J. Guidos        | J.T. McGarry<br>A.P. Wivagg |



B1-NOME-CALC-0119

00

Calculation Number

Rev.

3 of 39

Page Number

### Table of Contents

| <u>Section</u> | <u>Title</u>                             | <u>Page</u> |
|----------------|--|-------------|
| 1.0            | Objective                                | 5           |
| 2.0            | Analytical Techniques (Method)           | 5           |
| 3.0            | References                               | 6           |
| 4.0            | Assessment Of Significant Design Changes | 7           |
| 5.0            | Design Input                             | 7           |
| 6.0            | Hot Leg RTD (HLR) MNSA                   | 8           |
| 6.1            | Calculation of Overturning Moment        |             |
| 6.2            | Calculation of Pullout Force             |             |
| 7.0            | Hot Leg PDT/ Sampling (HLPS) MNSA        | 12          |
| 7.1            | Calculation of Overturning Moment        |             |
| 7.2            | Calculation of Pullout Force             |             |
| 8.0            | Upper Pressurizer (UP) MNSA              | 16          |
| 8.1            | Calculation of Overturning Moment        |             |
| 8.2            | Calculation of Pullout Force             |             |
| 9.0            | Side Pressurizer (SP) MNSA               | 20          |
| 9.1            | Calculation of Overturning Moment        |             |
| 9.2            | Calculation of Pullout Force             |             |
| 10.0           | Bottom Pressurizer (BP) MNSA             | 24          |
| 10.1           | Calculation of Overturning Moment        |             |
| 10.2           | Calculation of Pullout Force             |             |
| 11.0           | Heater Sleeve (HS) MNSA                  | 28          |
| 11.1           | Calculation of Overturning Moment        |             |
| 11.2           | Calculation of Pullout Force             |             |
| 12.0           | Conclusion                               | 32          |



B1-NOME-CALC-0119

00

Calculation Number

Rev.

4 of 39

Page Number

### List of Figures

| <u>No.</u> | <u>Title</u>   | <u>Page</u> |
|------------|--|-------------|
| 1          | Hot Leg RTD Mechanical Nozzle Seal Assembly          | 8           |
| 2          | Hot Leg PDT/Sampling Mechanical Nozzle Seal Assembly | 12          |
| 3          | Upper Pressurizer Mechanical Nozzle Seal Assembly    | 16          |
| 4          | Side Pressurizer RTD Mechanical Nozzle Seal Assembly | 20          |
| 5          | Bottom Pressurizer Mechanical Nozzle Seal Assembly   | 24          |
| 6          | Heater Sleeve Mechanical Nozzle Seal Assembly        | 28          |

### List of Tables

| <u>No.</u> | <u>Title</u>                                | <u>Page</u> |
|------------|---|-------------|
| 1          | Hot Leg RTD MNSA Component Weights          | 33          |
| 2          | Hot Leg PDT/Sampling MNSA Component Weights | 34          |
| 3          | Upper Pressurizer MNSA Component Weights    | 35          |
| 4          | Side Pressurizer MNSA Component Weights     | 36          |
| 5          | Bottom Pressurizer MNSA Component Weights   | 37          |
| 6          | Heater Sleeve MNSA Component Weights        | 38          |

### List of Appendices

| <u>Section</u> | <u>Title</u>                               | <u>Page</u> |
|----------------|--|-------------|
| A              | Volumes of MNSA Components from Tables 1-6 | A1          |
| B              | Q.A. DOCUMENTATION                         | B1          |



## 1.0 Objective

The objective of this calculation is to analyze the overturning moment in the MNSA resulting from an applied 1 g seismic loading for Calvert Cliffs Units 1 and 2. The following MNSAs are included:

- 1) Hot Leg RTD (Reference 3.3),
- 2) Hot Leg PDT/Sampling (Reference 3.4),
- 3) Upper Pressurizer (Reference 3.6),
- 4) Bottom Pressurizer (Reference 3.8),
- 5) Side Pressurizer RTD (Reference 3.7), and
- 6) Heater Sleeve (Reference 3.5)

When the MNSA is subjected to a seismic load, the increase in load reacts against the preload in the Hex Head Bolts, causing loss of sealing pressure and similarly, reduction of the MNSA's anti-ejection capability. Based on the resulting overturning moment, the load required to offset the preload in the bolts is then calculated. This information is used in Reference for comparison to the qualified Bottom Pressurizer MNSA design in Reference 3.1.

## 2.0 Analytical Techniques (Method)

Hand calculations based on the principles of mechanical design are used to calculate the overturning moments and the resulting pull-out force acting to offset the preload in the four Hex Head Bolts of the MNSAs.

Abbreviations used in this calculation are as follows:

|        |                                   |
|--------|-----------------------------------|
| MNSA - | Mechanical Nozzle Seal Assembly   |
| RTD -  | Resistor Temperature Detector     |
| PDT -  | Pressure Differential Transmitter |
| BP -   | Bottom Pressurizer                |
| UP -   | Upper Pressurizer                 |
| HLR -  | Hot Leg RTD                       |
| HLPS - | Hot Leg PDT/Sampling              |
| HS -   | Heater Sleeve                     |



### 3.0 References

NOTE: For all referenced drawings, latest revisions apply unless otherwise noted.

- 3.1 ABB Engineering Report No. B-NOME-ER-0133, Rev. 00, "Design Evaluation of MNSA for Various Applications at Calvert Cliffs Units 1 & 2."
- 3.2 Rolex Company National Disc Spring Division, Cat. No. 0299, p/n SAI-115159.
- 3.3 ABB CENP Drawing No. E-MNSABGE-228-001, "Hot Leg RTD Mechanical Nozzle Seal Assembly."
- 3.4 ABB CENP Drawing No. E-MNSABGE-228-002, "Hot Leg PDT/Sampling MNSA."
- 3.5 ABB CENP Drawing No. E-MNSABGE-228-003, "Heater Sleeve Mechanical Nozzle Seal Assembly."
- 3.6 ABB CENP Drawing No. E-MNSABGE-228-005, "Upper Pressurizer Mechanical Nozzle Seal Assembly."
- 3.7 ABB CENP Drawing No. E-MNSABGE-228-006, "Side Pressurizer RTD Mechanical Nozzle Seal Assembly."
- 3.8 ABB CENP Drawing No. E-MNSABGE-228-007, "Bottom Pressurizer Mechanical Nozzle Seal Assembly."
- 3.9 ABB CENP Drawing No. E-MNSA-228-004, "Mechanical Nozzle Seal Assembly Details."
- 3.10 ABB CENP Drawing No. E-MNSA-228-013, "Mechanical Nozzle Seal Assembly Details."
- 3.11 ABB CENP Drawing No. E-MNSA-228-020, "Mechanical Nozzle Seal Assembly Details."
- 3.12 ABB CENP Drawing No. E-MNSA-228-021, "Mechanical Nozzle Seal Details."
- 3.13 Mechanics of Materials, McGraw-Hill, 1981.
- 3.14 Machinery's Handbook, Industrial Press Inc., 1996.





B1-NOME-CALC-0119

00

Calculation Number

Rev.

7 of 39

Page Number

#### 4.0 **Assessment of Significant Design Changes**

This calculation evaluates the six MNSA designs for Calvert Cliffs which are based on previous designs of MNSA clamps for San Onofre Units 2 & 3 and Palo Verde Units 1, 2 & 3.

#### 5.0 **Design Input**

This calculation uses the references of Section 3.0 as design inputs.



B1-NOME-CALC-0119

00

Calculation Number

Rev.

8 of 39

Page Number

**6.0 Hot Leg RTD (HLR) MNSA**

**6.1 Calculation of Overturning Moment**



B1-NOME-CALC-0119

00

Calculation Number

Rev.

9 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

10 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

11 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

12 of 39

Page Number

**7.0 Hot Leg PDT/Sampling (HLPS) MNSA**

**7.1 Calculation of Overturning Moment**



B1-NOME-CALC-0119

00

Calculation Number

Rev.

13 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

14 of 39

Page Number





B1-NOME-CALC-0119

00

Calculation Number

Rev.

15 of 39

Page Number

7.1.2.1

Overturning Moment of HLPS MNSA Lower Assembly



B1-NOME-CALC-0119

00

Calculation Number

Rev.

16 of 39

Page Number

## 8.0 Upper Pressurizer (UP) MNSA

### 8.1 Calculation of Overturning Moment



B1-NOME-CALC-0119

00

Calculation Number

Rev.

17 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

18 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

19 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

20 of 39

Page Number

**9.0 Side Pressurizer (SP) RTD MNSA**

**9.1 Calculation of Overturning Moment**



B1-NOME-CALC-0119

00

Calculation Number

Rev.

21 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

22 of 39

Page Number





B1-NOME-CALC-0119

00

Calculation Number

Rev.

23 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

24 of 39

Page Number

## 10.0 Bottom Pressurizer (BP) MNSA

### 10.1 Calculation of Overturning Moment



B1-NOME-CALC-0119

00

Calculation Number

Rev.

25 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

26 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

27 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

28 of 39

Page Number

## 11.0 Heater Sleeve (HS) MNSA

### 11.1 Calculation of Overturning Moment



B1-NOME-CALC-0119

00

Calculation Number

Rev.

29 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

30 of 39

Page Number





B1-NOME-CALC-0119

00

Calculation Number

Rev.

31 of 39

Page Number



B1-NOME-CALC-0119

00

Calculation Number

Rev.

32 of 39

Page Number

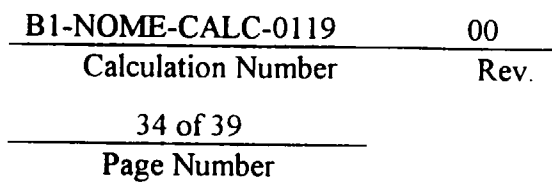
**12.0**    **Conclusion**



00

Rev.

Page Number



**TABLE 2: Hot Leg PDT/Sampling MNSA (E-MNSABGE-228-002-01, Assy) Component Weights**

**TABLE 3: Upper Pressurizer MNSA (E-MNSABGE-228-005-01, Assy) Component Weights**



00

Rev.

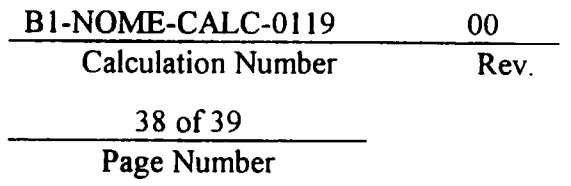
Page Number



00

Rev.

Page Number



**TABLE 6: Heater Sleeve MNSA (E-MNSABGE-228-003-01, Assy) Component Weights <sup>(7)</sup>**





B1-NOME-CALC-0119

00

Calculation Number

Rev.

39 of 39

Page Number

Notes:

GENERAL:

**APPENDIX A: VOLUMES OF MNSA COMPONENTS**  
**FROM TABLES 1-6**







































**APPENDIX B:**  
**QA DOCUMENTATION**

[

]













