NRR-PMDAPEm Resource

From: Lashley, Phil H. [phlashley@firstenergycorp.com]
Sent: Wednesday, July 22, 2015 11:31 AM
To: Wyman, Stephen
Cc: DiFrancesco, Nicholas; Devlin-Gill, Stephanie; Lentz, Thomas A. (Licensing); Nevins, Kathleen J.
Subject: [External_Sender] RE: Davis Besse ESEP Clarification Questions
Attachments: DBNPS ESEP Clarification Question Response.pdf

Responses to the Davis-Besse ESEP clarification questions are included in the attachment to this email.

Respectfully,

Phil H. Lashley
Fleet Licensing Supervisor
Cell: (330) 696-7208
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Mail Stop: A-WAC-B1

From: Wyman, Stephen [mailto:Stephen.Wyman@nrc.gov]
Sent: Wednesday, July 01, 2015 5:39 PM
To: Lashley, Phil H.
Cc: DiFrancesco, Nicholas; Devlin-Gill, Stephanie
Subject: Davis Besse ESEP Clarification Questions

Mr. Lashley,

As part of the NRC review of the Davis Besse ESEP report, the staff would appreciate clarification on the following technical items:

> The following clarification questions are raised in the context of the NRC evaluation of the ESEP submittals only and licensees' responses will be reviewed by NRC staff only to the extent the use of this information affects the elements and outcomes of the ESEP evaluation. As many licensees have used information from their ongoing SPRA analyses, the current review will not evaluate methods or results as they pertain to the SPRA. They will be reviewed later at the time of SPRA review.

1. The licensee did not state whether the walkdown personnel were trained in seismic walkdown. Please confirm that the walkdowns were conducted by trained engineers that successfully completed the Seismic Qualification Utility Group (SQUG) Walkdown Screening and Seismic Evaluation Training Course in accordance with the guidance document.

2. ESEP Report Section 6.6 states that "Attachment B tabulates the HCLPF values for all components on the ESEL." Attachment A, the ESEL, contains 382 items on 19 pages. Attachment B contains 11 pages of HCLPF values, with no cross reference back to the ESEL Table items. There appears to be fewer items in the HCLPF Table than items in the ESEL. Please confirm that the HCLPF Table only includes the ESEL items that Attachment A identifies as "Screened In". For clarification, provide a roadmap from the ESEL Table (Attachment A) to the HCLPF Table (Attachment B).
3. Section 3.1.5 of the ESEP Report states:"Critical indicators and recorders are typically physically located on panels/cabinets and are included as separate components; however, seismic evaluation of the instrument indication may be included in the panel/cabinet seismic evaluation (rule-of-the-box)."

Section 6.1 of the ESEP Report states "A number of components on the ESEL are breakers and switches that are housed in a "parent" component, such as a motor control center (MCC) or switchgear. For the purpose of this evaluation, calculations are not explicitly performed for these housed components. Instead, their HCLPF is assigned based on the parent component."

The information provided in both paragraphs is not clear. Please provide a more detailed description of both approaches, how they are different, when would each approach be applied, and examples for both approaches to show how the HCLPF values of the devices were determined, including consideration of cabinet amplification, if applicable. Also, describe whether any of these devices are sensitive to vibration as are relays and other devices with contacts, and if so, how they were evaluated. Lastly, if the qualification of the devices is based on the cabinet/panel they are housed in, which have been previously qualified as part of an equipment class ("parent" component), how is it known/confirmed that the parent component normally contains the particular device.

4. Section 5.2 of the ESEP Report states the following: "Subsequent equipment HCLPF calculations and fragility evaluations are based on the conservative deterministic failure margin (CDFM) approach. In accordance with EPRI 1019200 [10] "Seismic Fragility Applications Guide Update," the seismic analyses are performed using BE structure stiffness, mass and damping characteristics, and the BE subsurface Vs profile compatible with the expected seismic shear strains. The resulting ISRS approximately represent the 84th percentile response suitable for use in the CDFM calculations."

   Section 4 of the Seismic Evaluation Guidance, Augmented Approach (EPRI 3002000704) allows the development of ISRS calculated from new SSI models. The guidance document indicates that: EPRI 1025287 (SPID) and the ASME/ANS PRA Standard give guidance on acceptable methods to compute both the GMRS and the associated ISRS. Table 6-5 in the SPID document, under the SFR-C6 entry, indicates that ASME/ANS PRA Standard (Addendums A and B) requires consideration of the variation of soil properties (Vs profile). Also, the SFR-C5 entry indicates that if the median-centered response analysis is performed, the evaluation should estimate the median response (i.e., structural loads and ISRS) and variability in the response using established methods.

   Based on EPRI 1019200, which was referenced by the ESEP Reports, parameter variation should be incorporated into SSI analyses in order to characterize the uncertainty in the SSI demands. EPRI 1019200 indicates that the SSI analyses in ASCE 4 be followed, which require that SSI evaluations include lower bound and upper bound soil profiles to account for parameter variation in SSI. EPRI 1019200 also indicates that for the structural model, the best estimate (median) and uncertainty variation in the frequency should be considered.

   Therefore, please describe how parameter variation is incorporated into the SSI analyses for the structural model and subsurface while using only the best estimate (BE) structure stiffness, mass and damping characteristics, and the BE subsurface Vs profile. Related to the above discussion, if only the BE is used for the structural model and soil profile, explain how the ISRS would approximately represent the 84th percentile response, as stated in the ESEP report.

5. Section 6.4 of the ESEP Reports states that all HCLPF calculations were performed using the CDFM methodology. However, Appendix B provides information for βC, βR, and βU, which would indicate that fragility analyses have been performed.

   The licensee is requested to confirm that only the CDFM methodology has been used for HCLPF calculations, or to identify that fragility analysis has also been used to estimate HCLPF capacity. If fragility analyses have also been used, then include a description of the fragility analyses methods used, and describe the procedure used to estimate HCLPF capacity from the fragility data.

An email response will likely be sufficient to support the ESEP report review, however, please be aware that your email response will be made publicly available in ADAMS. A response around July 22, if practicable, would be greatly appreciated to support the planned review schedule.

Please let me or Nick DiFrancesco (at 301-415-1115) know if you would like to schedule a clarification call or have any questions and concerns.

Thanks,
Steve

Stephen M. Wyman
USNRC/NRR/JLD/HMB
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Hearing Identifier: NRR_PMDA
Email Number: 2265

Mail Envelope Properties (CY1PR0501MB15472BA3AD40F80DC34ED75ABD830)

Subject: [External_Sender] RE: Davis Besse ESEP Clarification Questions
Sent Date: 7/22/2015 11:31:03 AM
Received Date: 7/22/2015 11:32:23 AM
From: Lashley, Phil H.

Created By: phlashley@firstenergycorp.com

Recipients:
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Tracking Status: None

Post Office: CY1PR0501MB1547.namprd05.prod.outlook.com

Files	**Size**	**Date & Time**
MESSAGE	7716	7/22/2015 11:32:23 AM
DBNPS ESEP Clarification Question Response.pdf		1525903

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

3562533-R-001
Revision 0

Response to Davis-Besse Nuclear Power Station Expedited Seismic Evaluation Process Report Clarification Questions

July 14, 2015

Prepared for:

FENOC

FirstEnergy Nuclear Operating Company

ABSG Consulting Inc. • 300 Commerce Drive, Suite 200 • Irvine, California 92602

3562533-R-001
Revision 0

Response to Davis-Besse Nuclear Power Station Expedited Seismic Evaluation Process Report Clarification Questions

July 14, 2015

Prepared by:

ABSG Consulting Inc.

Prepared for:

FirstEnergy Nuclear Operating Company
Davis-Besse Nuclear Power Station
5501 Ohio 2
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APPROVALS

Report Name: Response to Davis-Besse Nuclear Power Station Expedited Seismic Evaluation Process (ESEP) Report Clarification Questions

Date: July 14, 2015

Revision No.: Revision 0

Approval by the responsible manager signifies that the document is complete, all required reviews are complete, and the document is released for use.

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07/14/2015
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7/15/15
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FENOC Approver:
Jon Hook
Manager, Design Engineering
7/16/15
Date

Table of Revisions

Revision No.	Date	Description of Revision
0	July 14, 2015	Original Issue

Nuclear Regulatory Commission e-mail from Stephen Wyman to Phil Lashley dated July 1, 2015.

Clarification Question #1

The licensee did not state whether the walkdown personnel were trained in seismic walkdown. Please confirm that the walkdowns were conducted by trained engineers that successfully completed the Seismic Qualification Utility Group (SQUG) Walkdown Screening and Seismic Evaluation Training Course in accordance with the guidance document.

FENOC Response

The walkdown team for ESEP components consisted of Mr. Eddie Guerra, P.E., Mr. Brian Lucarelli, and Mr. John Reddington, P.E. As discussed in Section 6.3.2 of the ESEP Report, recent seismic probabilistic risk assessment (SPRA) walkdowns were credited for some components on the ESEL. The SPRA walkdown team consisted of Mr. Guerra, Mr. Lucarelli, Mr. Jason Dimaria, P.E., and Mr. Bradley Yagla. Additionally, Mr. Farzin Beigi, P.E., provided support and expert input to the walkdown teams throughout the full extent of the plant walkdowns as well as post-walkdown discussions.

All six of these individuals are trained engineers that have successfully completed the SQUG Walkdown Screening and Seismic Evaluation Training Course or equivalent training. Resumes and SQUG certificates for these individuals are provided in Attachment 1.

Clarification Question #2

ESEP Report Section 6.6 states that "Attachment B tabulates the HCLPF values for all components on the ESEL." Attachment A, the ESEL, contains 382 items on 19 pages. Attachment B contains 11 pages of high confidence, low probability of failure (HCLPF) values, with no cross reference back to the ESEL table items. There appears to be fewer items in the HCLPF table than items in the ESEL. Please confirm that the HCLPF table only includes the ESEL items that Attachment A identifies as "Screened In". For clarification, provide a roadmap from the ESEL table (Attachment A) to the HCLPF table (Attachment B).

FENOC Response

Based on the guidance in EPRI 3002000704, 382 items were identified as potential ESEL items. Following the Electric Power Research Institute (EPRI) screening process, described in Section 3.1 of the ESEP Report, 109 of these items were screened out. The final ESEL contains 273 screened in components. Attachment A of the ESEP report summarizes and documents this screening process, and Attachment B of the ESEP report presents HCLPF values only for the screened in items.

For clarification, Attachment 2 of this response provides the Attachment B HCLPF table with an additional column identifying the ESEL item number to provide a roadmap to the ESEL table in Attachment A of the ESEP report.

Clarification Question #3

Section 3.1.5 of the ESEP Report states: "Critical indicators and recorders are typically physically located on panels/cabinets and are included as separate components; however, seismic evaluation of the instrument indication may be included in the panel/cabinet seismic evaluation (rule-of-the-box)."

Section 6.1 of the ESEP Report states "A number of components on the ESEL are breakers and switches that are housed in a "parent" component, such as a motor control center (MCC) or switchgear. For the purpose of this evaluation, calculations are not explicitly performed for these housed components. Instead, their HCLPF is assigned based on the parent component."

The information provided in both paragraphs is not clear. Please provide a more detailed description of both approaches, how they are different, when would each approach be applied, and examples for both approaches to show how the HCLPF values of the devices were determined, including consideration of cabinet amplification, if applicable. Also, describe whether any of these devices are sensitive to vibration as are relays and other devices with contacts, and if so, how they were evaluated. Lastly, if the qualification of the devices is based on the cabinet/panel they are housed in, which have been previously qualified as part of an equipment class ("parent" component), how is it known/confirmed that the parent component normally contains the particular device.

FENOC Response

The above referenced sections of the ESEP Report describe the approach to the rule-of-the-box. Section 3.1.5 states that indicators and recorders are listed on the ESEL as distinct items, but that their seismic evaluation is based on the evaluation of the "parent" component. Section 6.1 reiterates that when an ESEL item is identified to be mounted on a parent component, the HCLPF of the parent component is assigned to the item.

All the HCLPF calculations are based on the guidance provided in EPRI TR-1002988 and EPRI TR-1019200, in which a generic capacity of 1.8g or use of GERS is endorsed for functional capacity. The anchorage capacity for the parent component is also evaluated. The HCLPF developed for the parent component is assigned as the HCLPF value to all ESEL components housed therein, as documented in Attachment B of the ESEP report.

Plant's component management system was utilized to locate all "housed-in" components on the ESEL. All "housed-in" components were subsequently walked down as part of the "parent" component. For example, HPI Converters FYHP3C1 and FYHP3C2 (ESEL Items 201 and 202) were walked down to confirm their location and mounting inside Cabinet C3628 (ESEL Item 205). These components are therefore assigned the HCLPF of C3628. Similarly, a walkdown confirmed that Motor MP42-1 (ESEL Item 325) is mounted on Decay Heat Pump P42-1 (ESEL Item 324). As the HCLPF calculation for P42-1 considers everything within the boundary of the skid, MP42-1 is assigned the HCLPF of P42-1.

As stated in Section 6.5 of the ESEP Report, there are no relays included in the Davis-Besse Nuclear Power Station ESEL. Therefore no specific evaluations for devices sensitive to vibration were performed.

Clarification Question #4

Section 5.2 of the ESEP Report states the following:

> *Subsequent equipment HCLPF calculations and fragility evaluations are based on the conservative deterministic failure margin (CDFM) approach. In accordance with EPRI 1019200 [10] "Seismic Fragility Applications Guide Update," the seismic analyses are performed using BE structure stiffness, mass and damping characteristics, and the BE subsurface Vs profile compatible with the expected seismic shear strains. The resulting ISRS approximately represent the 84th percentile response suitable for use in the CDFM calculations.*

Section 4 of the Seismic Evaluation Guidance, Augmented Approach (EPRI 3002000704) allows the development of ISRS calculated from new soil structure interaction (SSI) models. The guidance document indicates that: EPRI 1025287 (SPID) and the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) probabilistic risk assessment (PRA) Standard give guidance on acceptable methods to compute both the ground motion response spectra and the associated in-structure response spectra (ISRS). Table 6-5 in the SPID document, under the SFR-C6 entry, indicates that ASME/ANS PRA Standard (Addendums A and B) requires consideration of the variation of soil properties (Vs profile). Also, the SFR-C5 entry indicates that if the median-centered response analysis is performed, the evaluation should estimate the median response (i.e., structural loads and ISRS) and variability in the response using established methods.

Based on EPRI 1019200, which was referenced by the ESEP Reports, parameter variation should be incorporated into SSI analyses in order to characterize the uncertainty in the SSI demands. EPRI 1019200 indicates that the SSI analyses in ASCE 4 be followed, which require that SSI evaluations include lower bound and upper bound soil profiles to account for parameter variation in SSI. EPRI 1019200 also indicates that for the structural model, the best estimate (median) and uncertainty variation in the frequency should be considered.

Therefore, please describe how parameter variation is incorporated into the SSI analyses for the structural model and subsurface while using only the best estimate (BE) structure stiffness, mass and damping characteristics, and the BE subsurface Vs profile. Related to the above discussion, if only the BE is used for the structural model and soil profile, explain how the ISRS would approximately represent the 84^{th} percentile response, as stated in the ESEP report.

FENOC Response

The recommended guidelines (EPRI 1019200) are used to obtain a deterministic response for the given shape of the foundation input response spectrum, and using best estimate structure and soil stiffness and conservative estimate of median damping. This response approximates the 84^{th} percentile relative to the statistical distribution that would result from say a set of 30 calculations randomly varying stiffness and damping parameters and using a set of 30 time histories. The deterministic response is suitable for use in the CDFM calculation of fragilities of plant SSCs.

EPRI 1019200 further states that the SSI analysis should address best estimate + parameter variation, and that the peak shifting should be used instead of peak broadening recommended in ASCE 4-98. However, the reported analysis uses only the result from the BE soil column (stiffness and damping), and median structure stiffness and damping. The effects of variability of the soil column stiffness and damping are considered using the approach in EPRI NP-6041. This approach estimates the upper and lower bound SSI frequencies based on the fixed base frequency, the best estimate SSI frequency and a CV factor in the soil column stiffness. Considering the depth to rock and the overlying basal gravel and engineered fill, the upper and lower bound SSI frequencies are estimated to be in the range of ± 15% of the best estimate SSI frequency.

Therefore, the upper and lower bound seismic responses are not expected to be significantly different from the best estimate response. Nevertheless, the variability in the SSI stiffness is accommodated in the CDFM method for calculating fragilities by peak shifting of at least ± 20%.

Clarification Question #5

Section 6.4 of the ESEP Reports states that all HCLPF calculations were performed using the CDFM methodology. However, Appendix B provides information for β_C, β_R, and β_U, which would indicate that fragility analyses have been performed.

The licensee is requested to confirm that only the CDFM methodology has been used for HCLPF calculations, or to identify that fragility analysis has also been used to estimate HCLPF capacity. If fragility analyses have also been used, then include a description of the fragility analyses methods used, and describe the procedure used to estimate HCLPF capacity from the fragility data.

FENOC Response

CDFM methodology has been used for all calculations as stated in Section 6.4 of the ESEP Report. The use of the word "fragility" in this context refers to the hybrid approach for fragilities where the HCLPF capacity is calculated first using CDFM methodology and the median capacity is then determined with an assumed composite variability (β_C). The hybrid approach to fragilities and the associated variabilities are described in Section 6.4.1 of EPRI 1025287. It is noted that reporting the median capacity is not required for the ESEP, and are only provided as additional information.

Attachment 1.
Walkdown Team Member Resumes

ABS Consulting

FARZIN R. BEIGI, P.E.

PROFESSIONAL HISTORY

ABSG Consulting Inc., Oakland, California, Senior Consultant, 2004–Present
Technical Manager, 2001–2004

EQE International, Inc., California, Principal Engineer, 1990–2001

TENERA L.P., Berkeley, California, Project Manager, 1982–1990

PROFESSIONAL EXPERIENCE

Mr. Beigi has more than 32 years of professional structural and civil engineering experience. As a Senior Consultant for ABS Consulting, Mr. Beigi provides project management and structural engineering services, primarily for seismic evaluation projects. He has extensive experience in the areas of seismic evaluation of structures, equipment, piping, seismic criteria development, and structural analysis and design. Selected project accomplishments include the following:

- Currently Mr. Beigi is managing the seismic portion of the seismic PRA project for FirstEnergy Nuclear Operating Company's four nuclear reactors at Davis-Besse Nuclear Power Station, Perry Nuclear Power Plant, and Beaver Valley Power Station Units 1 and 2. This project involves modelling of structures, generation of response spectra within those structures, walkdowns of all components on the PRA list and performing seismic fragility evaluations for selected equipment and structures.
- Most recently, Mr. Beigi has been involved in performing seismic and wind fragility analyses of equipment and structures at Gösgen Nuclear Power Plant in Switzerland, Lungmen Nuclear Power Plant in Taiwan, Oconee Nuclear Station in U.S., Point Lepreau Nuclear Plant in Canada, Beznau Nuclear Power Plant in Switzerland, Olkiluoto Nuclear Power Plant in Finland, and Neckarwestheim Nuclear Power Station in Germany.
- Provided new MOV seismic qualification (weak link) reports, for North Anna, Surry, and Kewaunee nuclear plants to maximize the valve structural thrust capacity by eliminating conservatisms found in existing qualification reports and previously used criteria.
- At Salem Nuclear Power Plant, Mr. Beigi developed design verification criteria for seismic adequacy of heating, ventilation, and air conditioning (HVAC) duct systems. He also performed field verification of as-installed HVAC systems and provided engineering evaluations documenting seismic adequacy of these systems, which included dynamic analyses of selected worst-case bounding samples.

ABS Consulting

FARZIN R. BEIGI, P.E.

- Mr. Beigi has participated in several piping adequacy verification programs for nuclear power plants. At Watts Bar and Bellefonte Nuclear Plants, he was involved in the development of walkdown and evaluation criteria for seismic evaluation of small bore piping and participated in plant walkdowns and performed piping stress analyses. At Oconee Nuclear Station, Mr. Beigi was involved in developing screening and evaluation criteria for seismic adequacy verification of service water piping system and performed walkdown evaluations as well as piping stress analyses. At Browns Ferry Nuclear Plant, Mr. Beigi was involved in the assessment of seismic interaction evaluation program for large and small bore piping systems.
- Mr. Beigi performed a study for the structural adequacy of bridge cranes at Department of Energy's (DOE) Paducah Gaseous Diffusion Plant utilizing Drain-2DX non-linear structural program. The study focused on the vulnerabilities of these cranes as demonstrated in the past earthquakes.
- Mr. Beigi has generated simplified models of structures for facilities at Los Alamos National Lab and Cooper Nuclear Station for use in development of building response spectra considering the effects of soil-structure-interactions.
- Mr. Beigi has participated as a Seismic Capability Engineer in resolution of the U.S. Nuclear Regulatory Commission's Unresolved Safety Issue A-46 (i.e., Seismic Qualification of Equipment) and has performed Seismic Margin Assessment at the Browns Ferry Nuclear Power Plant (Tennessee Valley Authority [TVA]), Oconee Nuclear Plant (Duke Power Co.), Duane Arnold Energy Center (Iowa Electric Company), Calvert Cliffs Nuclear Power Plant (Baltimore Gas and Electric), Robinson Nuclear Power Plant (Carolina Power & Light), and Bruce Power Plant (British Energy – Ontario, Canada). He has performed extensive fragility studies of the equipment and components in the switchyard at the Oconee Nuclear Power Plant.
- Mr. Beigi has developed standards for design of distributive systems to be utilized in the new generation of light water reactor power plants. These standards are based on the seismic experience database, testing results, and analytical methods.
- Mr. Beigi managed EQE's on-site office at the Tennessee Valley Authority Watts Bar Nuclear Power Plant. His responsibilities included staff supervision and technical oversight for closure of seismic systems interaction issues in support of the Watts Bar start-up schedule. Interaction issues that related to qualification for Category I piping systems and other plant features included seismic and thermal proximity issues, structural failure and falling of non-seismic Category I commodities, flexibility of piping systems crossing between adjacent building structures, and seismic-induced spray and flooding concerns. Mr. Beigi utilized seismic experience data coupled with analytical methods to address these seismic issues.
- As a principal engineer, Mr. Beigi conducted the seismic qualification of electrical raceway supports at the Watts Bar Plant. The qualification method involved in-plant walkdown screening evaluations and bounding analysis of critical case samples. The acceptance criteria for the bounding analyses utilized ductility-based criteria to ensure consistent design margins. Mr. Beigi also provided conceptual design

modifications and assisted in the assessment of the constructability of these modifications. Mr. Beigi utilized similar methods for qualification of HVAC ducts and supports at Watts Bar, and assisted criteria and procedures development for HVAC ducting, cable trays, conduit and supports at the TVA Bellefonte nuclear power plant.

- Mr. Beigi also has extensive experience utilizing finite element computer codes in performing design and analysis of heavy industrial structures, systems, and components. At the Texas Utility Comanche Peak Nuclear Power Plant, Mr. Beigi administered and scheduled individuals to execute design reviews of cable tray supports; evaluated generic design criteria for the design and construction of nuclear power plant systems and components and authored engineering evaluations documenting these reviews.

Mr. Beigi has also been involved in a number of seismic risk assessment and equipment strengthening programs for high tech industry, biotech industry, petrochemical plants, refineries, and other industrial facilities. Selected project accomplishments include:

- Most recently performed Seismic Qualification of Critical Equipment for the Standby Diesel Power Plants Serving Fort Greely, and Clear Air Force Station, Alaska. Projects also included design of seismic restraints for the equipment and design of seismic supports for conduit, cable tray, duct, and piping systems. Both facilities are designated by the Department of Defense as a Seismic User Group Four (SUG-IV) facility. Seismic qualification of equipment and interconnections (conduit, duct and piping) involved a combination of stress computations, compilation of shake table data and the application of experience data from past earthquakes. Substantial cost savings were achieved by maximum application of the experience data procedures for seismic qualification.
- Assessment of earthquake risk for Genentech, Inc., in South San Francisco, California. The risk assessments included damage to building structures and their contents, damage to regional utilities required for Genentech operation, and estimates of the period of business interruption following a major earthquake. Provided recommendations for building or equipment upgrades or emergency procedures, with comparisons of the cost benefit of the risk reduction versus the cost of implementing the upgrade. Project included identification of equipment and piping systems that were vulnerable under seismic loading and design of retrofit for those components as well as providing construction management for installation phase of the project.
- Fault-tree model and analysis of critical utility systems serving Space Systems/Loral, a satellite production facility, in Palo Alto, California.
- Seismic evaluation and design of retrofits for equipment, tools and process piping as well as clean room ceilings and raised floors at UMC FABs in Taiwan.
- For LDS Church headquartered in Utah, performed seismic vulnerability assessment and ranked over 1,200 buildings of miscellaneous construction types for the purpose of retrofit prioritization.

- Seismic evaluation and design of retrofits for clean room ceilings at Intel facilities in Hillsborough, Oregon.
- Assessment of programmable logic controls as part of year 2000 (Y2K) turn over evaluation at an automatic canning facility in Stanislaus, California.
- Seismic evaluation and design of retrofits for equipment and steel storage tanks at the Colgate-Palmolive plant in Cali, Colombia.
- Design of seismic anchorage for equipment and fiberglass tanks at the AMP facilities in Shizouka, Japan.
- Evaluation and design of seismic retrofits for heavy equipment, and piping systems at Raychem facilities in Redwood City and Menlo Park, California.
- Assessment of the seismic adequacy of equipment, structures and storage tanks at the Borden Chemical Plant in Fremont, California.
- Design of seismic bracing for fire protection and chilled water piping systems at the Goldman Sachs facilities in Tokyo, Japan.
- Design of seismic retrofits for low rise concrete and steel buildings and design of equipment strengthening schemes at AVON Products Co. in Japan.
- Managed the design and construction of seismic retrofits for production equipment and storage tanks at Coca Cola Co. in Japan.
- Seismic evaluation and design of retrofit for equipment, piping and structures at the UDS AVON Refinery located in Richmond, California.
- Seismic assessment and peer review of the IBM Plaza Building, a 31-story high rise building located in the Philippines.
- Seismic evaluation and conceptual retrofit design for the headquarters building of the San Francisco Fire Department.
- Equipment strengthening and detailed retrofit design for the Bank of America Building in San Francisco.
- Equipment strengthening and detailed retrofit design for Sutro Tower in San Francisco.
- Equipment strengthening and detailed retrofit design for Pacific Gas & Electric substations in the San Francisco, California, area.
- Seismic evaluations and loss estimates (damage and business interruption) for numerous facilities in Japan, including Baxter Pharmaceuticals, NCR Japan Ltd., and Somar Corporation.
- Seismic evaluation of concrete and steel buildings at St. Joseph Hospital in Stockton, California, in accordance with the guidelines provided in FEMA 178.

EDUCATION

B.S., Civil Engineering, San Francisco State University, San Francisco, California, 1982

ABS Consulting

FARZIN R. BEIGI, P.E.

REGISTRATION

Professional Engineer: California
Seismic Qualification Utilities Group Certified Seismic Capability Engineer
Training on Near-Term Task Force Recommendation 2.3 – Plant Seismic Walkdowns

AFFILIATIONS

American Society of Civil Engineers, Professional Member

SELECTED PUBLICATIONS

Wakefield, D., F. Beigi, and R. Fine, "An Approach to Seismic PRA SSC Screening," 2015 International Topical Meeting on Probabilistic Safety Assessment and Analysis (PSA 2015), Sun Valley, Idaho, 2015.

Richner, M. Sener Tinic, M. Ravindra, R. Campbell, F. Beigi, and A. Asfura, "Insights Gained from the Beznau Seismic PSA Including Level 2 Considerations," 2008 International Topical Meeting on Probabilistic Safety Assessment and Analysis (PSA 2008), Knoxville, Tennessee, 2008.

Klapp, U., F. R. Beigi, W. Tong, A. Strohm, and W. Schwarz, "Seismic PSA of Neckarwestheim 1 Nuclear Power Plant," 19th International Conference on Structural Mechanics in Reactor Technology (SMiRT 19), Toronto, Canada, August 12–17, 2007.

Asfura, A. P., F. R. Beigi, and B. N. Sumodobila, "Dynamic Analysis of Large Steel Tanks," 17th International Conference on Structural Mechanics in Reactor Technology (SMiRT 17), Prague, Czech Republic, August 17–22, 2003.

"Seismic Evaluation Guidelines for HVAC Duct and Damper Systems," EPRI Technical Report 1007896, published by the Electric Power Research Institute, April 2003.

Arros, J., and F. Beigi, "Seismic Design of HVAC Ducts based on Experienced Data," Current Issues Related to Nuclear Plant Structures, Equipment and Piping, proceedings of the 6th Symposium, published by North Carolina State University, Florida, December 1996.

Beigi, F. R., and J. O. Dizon, "Application of Seismic Experience Based Criteria for Safety Related HVAC Duct System Evaluation," Fifth DOE Natural Phenomenon Hazards Mitigation Symposium, Denver, Colorado, November 13–14, 1995.

Beigi, F. R., and D. R. Denton, "Evaluation of Bridge Cranes Using Earthquake Experience Data," presented at Fifth DOE Natural Phenomenon Hazards Mitigation Symposium, Denver, Colorado, November 13–14, 1995.

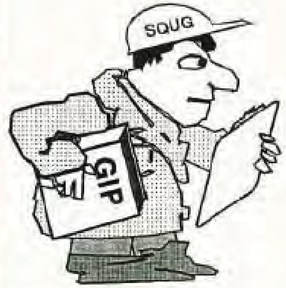
SQUG

Certificate of Achievement

This is to Certify that

Farzin R. Beigi

has Completed the SQUG Walkdown Screening and Seismic Evaluation Training Course Held May 3-7, 1993



David A. Freed, MPR Associates
SQUG Training Coordinator

Neil P. Smith, Commonwealth Edison
SQUG Chairman

Robert P. Kassawara, EPRI
SQUG Program Manager

279 Dorchester Rd, Akron Ohio 44313
Phone 330-612-9579
E-mail jereddington@gmail.com

John E. Reddington

Work Experience

March 2013 to Present: **CJR Engineering** and **Rolls-Royce**

Consultant: Technical lead on seismic PRA for several units; assist in fire PRA; work on Small Modular Reactor initial PRA.

January 2007 to March 2013: **First Energy, FENOC**

Principal Consultant, Probabilistic Risk Analysis: Technical lead for seismic PRA for FENOC fleet; SQUG qualified- performed oversight of NRC's 50.54f task 2.3 and 2.1. mentor to junior and co-op engineers Lead fire PRA for the Davis-Besse fire PRA, including contractor oversight and coordination; specialization in HRA, including operations interface, model integration, dependency analysis and PWROG HRA Subcommittee; participant in several fire PRA peer reviews and one seismic PRA peer review.

August 2004- January 2007:

Principal Programs Engineer, Fleet office Akron, OH: responsible for the fire protection program for the FENOC fleet

August 2003 to August 2004: Davis Besse Nuclear Station Oak Harbor, OH

Training Manager: Responsible for direction and implementation of site's accredited training programs. Heavily involved with high intensity training required to get Davis Besse back on line following a two year outage replacing the reactor head.

January 2001 to August 2003 : Davis Besse Nuclear Station Oak Harbor, OH

Supervisor Quality Assurance Oversight for Maintenance:
Responsible for value added assessments based on performance as well as compliance. Ensure industry best practices are used as standards for performance in maintenance, outage planning, and scheduling.

1996 to January 2001,
Superintendent Mechanical Maintenance
Manage the short and long term direction of the Mechanical and Services Maintenance Departments. Responsible for 80 to 90 person department with a budget between 7 and 15 million dollars a year. Direct the planning, engineering, and field maintenance activities. Direct oversight of outage preparations and implementation. One year assignment working with Technical Skills Training preparing for accreditation.

1993 – 1996

Shift Manager

Act as the on-shift representative of the Plant Manager. Responsible for providing continuous management support for all Station activities to ensure safe and efficient plant operation. Establish short term objectives for plant control and provide recommendations to the Shift Supervisor. Monitor core reactivity and thermal hydraulic performance, containment isolation capability, and plant radiological conditions during transients and advise the operating crew on the actions required to maintain adequate shutdown margin, core cooling capability, and minimize radiological releases.

1991 – 1993

Senior System and Maintenance Engineer

Provide Operations with system specific technical expertise. Responsible for maintaining and optimizing the extraction steam and feedwater heaters, the fuel handling equipment and all station cranes.

Acted as **Fuel Handling Director** during refueling outages. Responsibilities Included maintaining the safe and analyzed core configuration, directing operation personnel on fuel moves, directing maintenance personnel on equipment repair and preventative maintenance.

1986 – 1991

Senior Design Engineer and Senior Reactor Operator student

Activities included modification design work and plant representative on the Seismic Qualification Utilities Group and the Seismic Issues subcommittee. Licensed as a Senior Reactor Operator following extensive classroom, simulator, shift training, and Nuclear Regulatory Commission examination.

1984 – 1986 **Sargent & Lundy Engineers** Chicago, IL

Senior Structural Engineer

Responsible for a design team of engineers for the steel design and layout to support the addition of three baghouses on a coal fired plant in Texas. Investigated and prepared both remedial and long term solutions to structural problems associated with a hot side precipitator.

1980 – 1984

Structural Engineer

Responsible for steel and concrete design and analysis for LaSalle and Fermi Nuclear Power plants. Performed vibrational load and stability analysis for numerous piping systems. Member of the on-site team of engineers responsbile for timely in-place modifications to the plant structure at LaSalle.

1979 – 1980 Wagner Martin Mechanical Contractors Richmond, IN

Engineer/Project Manager

Responsible for sprinkler system design through approval by appropriate underwriter. Estimator and Project Manager on numerous mechanical projects up to 1.8 million dollars.

Education	1975 - 1979	Purdue University	West Lafayette, IN
	Bachelor of Science in Civil Engineering		
	1990- 1995	University of Cincinnati	Cincinnati, OH
	Master of Science in Nuclear Engineering		

Professional Memberships

Professional Engineer, State of Illinois, 1984

Professional Engineer, State of Ohio, 1986

Senior Reactor Operator, Davis Besse Nuclear Power Plant, 1990

Qualified Lead Auditor, 2003

Seismic Qualification Utility Group- SQUG qualified

EPRI

Certificate of Achievement

This is to Certify that

John E. Reddington

*has Completed the Trial SQUG A46 Walkdown
Screening and Seismic Evaluation Training Course
Held November 20-25, 1987*

Richard G. Starck II, MPR Associates, Inc.
Training Coordinator

Robert P. Kassawara, EPRI
Program Manager

RIZZO ASSOCIATES

Eddie M. Guerra, P.E.

Senior Structural Engineer

Years Experience
5

Level
6

Education

M. Eng., Structural Engineering, Lehigh University, Bethlehem, PA – May 2010

B.S., Civil Engineering, University of Puerto Rico, Mayaguez, PR – Dec. 2008

Professional Registrations

Professional Engineer: Puerto Rico – 2013 (PE24153)

SQUG Certified Seismic Capability Engineer

Professional Affiliations

American Society of Civil Engineers (ASCE)

American Society of Mechanical Engineers (ASME)

Network for Earthquake and Engineering Simulation (NEES)

Society of Hispanic Professional Engineers (SHPE) (Vice-President, Western Pennsylvania Region)

Honors and Awards

2010 Recipient of the Thornton Tomasetti Foundation Scholarship

Golden Key International Honor Society

Tau Beta Pi Engineering Honor Society

Dean's List University of Puerto Rico

Academic Activities

Adjunct Professor, Department of Mathematics, Community College of Allegheny County

Guest Speaker - "Challenges for a New Generation of Structural Engineers," Department of Civil and Environmental Engineering, Lehigh University.

Skill Areas:

Seismic Engineering	Fragility Analysis
Seismic PRA	Finite Element Analysis
Ductile Steel Design	Advanced Structural Analysis
Soil-Structure Interaction	Project Management
Reinforced Concrete Design	Structural Steel Design
Wind Aerodynamics	Impact Engineering
Seismic Walkdowns	Nuclear Safety Systems

Mr. Ed M. Guerra has served as a Senior Structural Engineer for RIZZO Associates (RIZZO) in the fields of seismic engineering, wind dynamics, impact engineering, and design of steel and concrete structures. Mr. Guerra has been involved in several Seismic, Wind and Aircraft Impact Risk Assessments for nuclear plants, both in the US and international. As part of his Seismic PRA experience, Mr. Guerra has been involved in all supporting aspects of the project, including SEL development, Seismic Walkdowns, Building Dynamic Analysis, SSI Analysis, Fragility Analysis of Equipment, Relays and Structures and External Peer Reviews. Mr. Guerra has also worked closely with systems modelers and PRA analysts especially throughout the iterative process of identifying and reevaluating top contributors to the plant risk level.

Mr. Guerra has performed fragility evaluations and seismic walkdowns in support of 2.3 and 2.1 NTTF Programs for several NPPs in the US. Recently, Mr. Guerra has been appointed to the Joint Committee on Nuclear Risk Management (JCNRM) as a contributor for part 5 "Requirements for Seismic Events At-Power PRA" of the ASME/ANS PRA Standard. His main areas of interest in Seismic PRA are the effects of structural and soil non-linearity on components, wave-propagation effects on structures, the correlation of PRA failure modes and structural failure mechanisms, and smart data management and logistics. Mr. Guerra is SQUG-certified and has completed the EPRI-sponsored Seismic PRA training. He is an active participant of EPRI Workshops currently held to provide lessons learned to US utilities currently undergoing Seismic PRAs.

Watts Bar NPP Seismic PRA

Tennessee Valley Authority|
Rhea County, Tennessee
12/2014 – 01/2015

Mr. Guerra performed seismic fragility evaluations for Air Handling Units, Condensers and Cooler Units in support of Watts Bar Seismic PRA. In reference to EPRI 103959 and EPRI 6041, Mr. Guerra developed fragility parameters for functional and structural failure modes based on available test data and seismic qualifications for each of the aforementioned groups of equipment. The resulting fragility parameters, including potential spatial interactions, were used as input to the PRA model for subsequent risk quantification.

Computer Skills

STAAD Pro, SASSI, PC-SPEC, ANSYS, AutoCAD, SAP2000, RAM, Mathcad, and Microsoft Project

Publications

Guerra, Eddie M., Impact Analysis of a Self-Centered Steel Concentrically Braced Frame," NEES Consortium, May-July 2007

Languages

English, Spanish

Tornado Screening Walkdowns for Genkai Units 3 & 4

Scientech | Kyushu Electric Power Company | Genkai, Japan

07/2014 – 08/2014

Mr. Guerra performed tornado walkdowns for Genkai Units 3 and 4 in order to identify and assess the effect of tornado-borne missiles against safety-related structures. During the 3-day walkdown period, the walkdown team focused on three main aspects: confirming that a sample of previously identified missiles comply with the findings documented in previous inspection reports, identifying and record detailed information for vulnerable critical targets, and recording detailed design characteristics and dimensions of critical potential missiles. The information collected by the team of walkdown engineers was subsequently used to reduce the number of potential missiles within the specified radius for Units 3 and 4. In addition, the walkdown team assessed the condition of existing counter measures as well as provided expert opinion on alternate countermeasures to sustain tornado effects.

Perry NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Perry, Ohio

08/2012 – Present

Mr. Guerra serves as the Senior Project Engineer for the calculation of Seismic Fragilities for mechanical and electrical equipment in support of the Seismic PRA for the plant. In his role as a structural analyst, Mr. Guerra has implemented both FA and CDFM methodologies in order to develop fragility curves for components to be credited in the plant logic model. In addition to mechanical and electrical equipment as defined in the EPRI 21 Classes, Mr. Guerra is performing fragility analyses for NSSS components and plant distributions systems. Parameters necessary for the development of fragility curves are being calculated following EPRI guidelines including EPRI 103959, EPRI 6041, EPRI 1002988 and the EPRI Update 1019200. Results from the Seismic PRA will comply with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendation.

As Senior Project Engineer he engaged in performing seismic fragilities for reinforced concrete shear walls in support of the Seismic PRA for the plant. Mr. Guerra has implemented the use of SAP2000 models and Mathcad calculations in order to evaluate the shear walls seismic capacity and their associated building structural responses. Fragility curves for shear walls were developed based on median, HCLPF and variability parameters estimated from EPRI guidelines. Shear wall fragilities associated with the plant's safety-related buildings have been incorporated into the plant logic model for quantification of CDF contribution.

Mr. Guerra served as the Project Engineering Associate for the Seismic Walkdowns of the Perry Nuclear Power Plant in support of its Seismic PRA and 2.1 NTTF Fukushima Resolution. Mr. Guerra was part of the team of Seismic Walkdown Engineers responsible for the walkdown of electrical and mechanical components as well as piping and electrical distribution systems. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. Inclusion rules, or caveats, as depicted in EPRI 6041 and EPRI 5223, were implemented when performing the walkdowns in order to reduce the level of detailed fragility calculations to be subsequently performed. Successful completion of plant walkdowns led to the reduction in the number of systems and components to be evaluated as part of the fragility calculation effort.

Mr. Guerra also served as the Project Engineering Associate for the Seismic Walkdowns of the Perry Nuclear Power Plant in support of the 2.3 NTTF Fukushima Resolution. As part of the 2.3 Walkdowns, Mr. Guerra performed visual inspections in order to identify un-analyzed, non-conforming, and degraded conditions related to Systems, Structures, and Components. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. The Seismic Walkdown Team adhered to the EPRI 2.3 NTTF Guidance in order to identify Potentially Adverse Seismic Conditions and efficiently implement the plant's Licensing Basis Evaluation and Corrective Action Program.

Mr. Guerra has served as the point of contact between systems modelers and PRA analysts especially throughout the iterative process of identifying and refining top contributors to the plant risk level. The objective of this iterative process was to refine seismic fragilities to assess unintended conservatism in the fragility parameters to subsequently achieve an acceptable risk level quantified in terms of CDF or LERF.

Mr. Guerra participated in the Peer Review of the PNPP Seismic PRA in support of the work related to walkdowns, building evaluations and equipment fragilities. As part of the PNPP Peer Review, Mr. Guerra engaged in the direct response of comments from peer reviewers as well as technical discussions regarding compliance with the ASME Standard.

Beaver Valley Unit 1 NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Shippingport, Pennsylvania

09/2012 – Present

Mr. Guerra serves as the Senior Project Engineer for the calculation of Seismic Fragilities for mechanical and electrical equipment in support of the Seismic PRA for the plant. In his role as a structural analyst, Mr. Guerra has implemented both FA and CDFM methodologies in order to develop fragility curves for components to be credited in the plant logic model. In addition to mechanical and electrical equipment as defined in the EPRI 21 Classes, Mr. Guerra is performing fragility analyses for NSSS components and plant distributions systems. Parameters necessary for the development of fragility curves are being calculated following EPRI guidelines including EPRI 103959, EPRI 6041, EPRI 1002988, and the EPRI Update 1019200. Results from the Seismic PRA will comply with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendation.

As Project Engineer he engaged in performing seismic fragilities for reinforced concrete shear walls in support of the Seismic PRA for the plant. Mr. Guerra has implemented the use of SAP2000 models and Mathcad calculations in order to evaluate the shear walls seismic capacity and their associated building structural responses. Fragility curves for shear walls were developed based on median, HCLPF and variability parameters estimated from EPRI guidelines. Shear wall fragilities associated with the plant's safety-related buildings have been incorporated into the plant logic model for quantification of CDF contribution.

Mr. Guerra served as the Project Engineering Associate for the Seismic Walkdowns of the Beaver Valley Unit 1 Nuclear Power Station in support of its Seismic PRA and 2.1 NTTF Fukushima Resolution. He was part of the team of Seismic Walkdown Engineers responsible for the walkdown of electrical and mechanical components as well as piping and electrical distribution systems. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. Inclusion rules, or caveats, as depicted in EPRI 6041 and EPRI 5223, were implemented when performing the walkdowns in order to reduce the level of detailed fragility calculations to be subsequently performed. Successful completion of plant walkdowns led to the reduction in the number of systems and components to be evaluated as part of the fragility calculation effort.

He also served as the Project Engineering Associate for the Seismic Walkdowns of the Beaver Valley Unit 1 Nuclear Power Station in support of the 2.3 NTTF Fukushima Resolution. As part of the 2.3 Walkdowns, Mr. Guerra performed visual inspections in order to identify un-analyzed, non-conforming, and degraded conditions related to Systems, Structures, and Components. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. The Seismic Walkdown Team adhered to the EPRI 2.3 NTTF Guidance in order to identify Potentially Adverse Seismic Conditions and efficiently implement the plant's Licensing Basis Evaluation and Corrective Action Program.

Mr. Guerra has served as the point of contact between systems modelers and PRA analysts especially throughout the iterative process of identifying and refining top contributors to the plant risk level. The objective of this iterative process was to refine seismic fragilities to assess unintended conservatism in the fragility parameters to subsequently achieve an acceptable risk level quantified in terms of CDF or LERF.

Mr. Guerra participated in the Peer Review of the BVPS-1 Seismic PRA in support of the work related to walkdowns, building evaluations and equipment fragilities. As part of the BVPS-1 Peer Review, Mr. Guerra engaged in the direct response of comments from peer reviewers as well as technical discussions regarding compliance with the ASME Standard.

Beaver Valley Unit 2 NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Shippingport, Pennsylvania

09/2012 – Present

Mr. Guerra serves as the Senior Project Engineer for the calculation of Seismic Fragilities for mechanical and electrical equipment in support of the Seismic PRA for the plant. In his role as a structural analyst, Mr. Guerra has implemented both FA and CDFM methodologies in order to develop fragility curves for components to be credited in the plant logic model. In addition to mechanical and electrical equipment as defined in the EPRI 21 Classes, Mr. Guerra is performing fragility analyses for NSSS components and plant distributions systems. Parameters necessary for the development of fragility curves are being calculated following EPRI guidelines including EPRI 103959, EPRI 6041, EPRI 1002988, and the EPRI Update 1019200. Results from the Seismic PRA will comply with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendation.

As Project Engineer he engaged in performing seismic fragilities for reinforced concrete shear walls in support of the Seismic PRA for the plant. Mr. Guerra has implemented the use of SAP2000 models and Mathcad calculations in order to evaluate the shear walls seismic capacity and their associated building structural responses. Fragility curves for shear walls were developed based on median, HCLPF and variability parameters estimated from EPRI guidelines. Shear wall fragilities associated with the plant's safety-related buildings have been incorporated into the plant logic model for quantification of CDF contribution.

In addition, Mr. Guerra served as the Project Engineer Associate for the Seismic Walkdowns of the Beaver Valley Unit 2 Nuclear Power Station in support of its Seismic PRA and 2.1 NTTF Fukushima Resolution. He was part of the team of Seismic Walkdown Engineers responsible for the walkdown of electrical and mechanical components as well as piping and electrical distribution systems. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. Inclusion rules, or caveats, as depicted in EPRI 6041 and EPRI 5223, were implemented when performing the walkdowns in order to reduce the level of detailed fragility calculations to be subsequently performed. Successful completion of plant walkdowns led to the reduction in the number of systems and components to be evaluated as part of the fragility calculation effort.

Mr. Guerra also served as the Project Engineer Associate for the Seismic Walkdowns of the Beaver Valley Unit 2 Nuclear Power Station in support of the 2.3 NTTF Fukushima Resolution. As part of the 2.3 Walkdowns, Mr. Guerra performed visual inspections in order to identify un-analyzed, non-conforming, and degraded conditions related to Systems, Structures, and Components. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. The Seismic Walkdown Team adhered to the EPRI 2.3 NTTF Guidance in order to identify Potentially Adverse Seismic Conditions and efficiently implement the plant's Licensing Basis Evaluation and Corrective Action Program.

Mr. Guerra has served as the point of contact between systems modelers and PRA analysts especially throughout the iterative process of identifying and refining top contributors to the plant risk level. The objective of this iterative process was to refine seismic fragilities to assess unintended conservatism in the fragility parameters to subsequently achieve an acceptable risk level quantified in terms of CDF or LERF.

Mr. Guerra participated in the Peer Review of the BVPS-2 Seismic PRA in support of the work related to walkdowns, building evaluations and equipment fragilities. As part of the BVPS-2 Peer Review, Mr. Guerra engaged in the direct response of comments from peer reviewers as well as technical discussions regarding compliance with the ASME Standard.

Davis-Besse NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Oak Harbor, Ohio

03/2012 – Present

Mr. Guerra serves as the Senior Project Engineer for the calculation of Seismic Fragilities for mechanical and electrical equipment in support of the Seismic PRA for the plant. In his role as a structural analyst, Mr. Guerra has implemented both FA and CDFM methodologies in order to develop fragility curves for components to be credited in the plant logic model. In addition to mechanical and electrical equipment as defined in the EPRI 21 Classes, Mr. Guerra is performing fragility analyses for NSSS components and plant distributions systems. Parameters necessary for the development of fragility curves are being calculated following EPRI guidelines including EPRI 103959, EPRI 6041, EPRI 1002988, and the EPRI Update 1019200. Results from the Seismic PRA will comply with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendation.

As Project Engineer he engaged in performing seismic fragilities for reinforced concrete shear walls in support of the Seismic PRA for the plant. Mr. Guerra has implemented the use of SAP2000 models and Mathcad calculations in order to evaluate the shear walls seismic capacity and their associated building structural responses. Fragility curves for shear walls were developed based on median, HCLPF and variability parameters estimated from EPRI guidelines. Shear wall fragilities associated with the plant's safety-related buildings have been incorporated into the plant logic model for quantification of CDF contribution.

Mr. Guerra served as the Project Engineering Associate for the Seismic Walkdowns of the Davis-Besse Nuclear Power Station in support of its Seismic PRA and 2.1 NTTF Fukushima Resolution. He was part of the team of Seismic Walkdown Engineers responsible for the walkdown of electrical and mechanical components as well as piping and electrical distribution systems. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. Inclusion rules, or caveats, as depicted in EPRI 6041 and EPRI 5223, were implemented when performing the walkdowns in order to reduce the level of detailed fragility calculations to be subsequently performed. Successful completion of plant walkdowns led to the reduction in the number of systems and components to be evaluated as part of the fragility calculation effort.

In addition, he served as the Project Engineering Associate for the Seismic Walkdowns of the Davis-Besse Nuclear Power Station in support of the 2.3 NTTF Fukushima Resolution. As part of the 2.3 Walkdowns, Mr. Guerra performed visual inspections in order to identify un-analyzed, non-conforming, and degraded conditions related to Systems, Structures, and Components. Mr. Guerra implemented the use of computer tablets to expedite the data management process prior, during and after the walkdowns. The Seismic Walkdown Team adhered to the EPRI 2.3 NTTF Guidance in order to identify Potentially Adverse Seismic Conditions and efficiently implement the plant's Licensing Basis Evaluation and Corrective Action Program.

Mr. Guerra, as a Project Engineering Associate, engaged in the Soil-Structure Interaction Analysis for the Davis-Besse Auxiliary Building. Mr. Guerra developed FE computer models for the Auxiliary Building using AutoCAD, ANSYS, and SAP2000. Mr. Guerra then performed both fixed-base and Soil-Structure Interaction Analyses of the Auxiliary Building using SAP2000 and SASSI programs. Input ground motion was derived from the Site-Specific Seismic-Hazard Analysis performed in support of the Seismic PRA. Seismic input was defined at the Reactor Foundation Level and subsequently, In-Structure Response Spectra, or ISRS, were developed at several floor elevations of the Auxiliary Building. The final plots for ISRS at varying locations in the structure were used as the median-centered seismic demand for the fragility analysis of structures and equipment in the Auxiliary Building.

He also served as the Project Engineering Associate engaged in a seismic analysis of the Auxiliary Building-Area 7 of the Davis Besse Nuclear Power Station. As part the analysis, Mr. Guerra was responsible for developing Finite Element and Stick Models using ANSYS and SAP2000. Mr. Guerra developed graphical In-Structure Response Spectra comparisons denoting the dynamic responses arising from both Stick and FE models subjected to the same ground input motion. Results of the analysis provided the basis for validating the use of existing IPEEE stick models for the seismic re-evaluation of plant structures to support the SPRA and the NTTF 2.1 submittals.

Mr. Guerra has served as the point of contact between systems modelers and PRA analysts especially throughout the iterative process of identifying and refining top contributors to the plant risk level. The objective of this iterative process was to refine seismic fragilities to assess unintended conservatism in the fragility parameters to subsequently achieve an acceptable risk level quantified in terms of CDF or LERF.

Mr. Guerra participated in the Peer Review of the DBNPS Seismic PRA in support of the work related to walkdowns, building evaluations and equipment fragilities. As part of the DBNPS Peer Review, Mr. Guerra engaged in the direct response of comments from peer reviewers as well as technical discussions regarding compliance with the ASME Standard.

Duane Arnold NPP – Seismic & Wind Qualification of Louvered Panel Modules

Duane Arnold | Cedar Rapids, Iowa

01/2012 – 03/2012

Mr. Guerra, Project Engineer Associate, assisted with the qualification of a tornado Louvered Panel Module assembly for a Chiller Unit Enclosure to be erected for the Duane Arnold Nuclear Power Plant. The extent of the qualification included the assessment of tornado wind loading effects, impact effects of air-borne missiles, seismic loading and inner-structure ventilation criteria. In addition to the performed linear elastic analyses, the qualification process included the application of plastic design and energy balance concepts in order to assess impact effects and inner-structure ventilation criteria respectively.

Y-Loop Testing Facility Inspection of Shenyang Turbo Machinery

Shenyang Turbo Machinery | Shenyang, P. R. of China

11/2011 – 12/2011

Mr. Guerra, Engineer Associate II, was part of the team in charge of performing the inspection of the Y-Loop Testing Facility for the Cooling System of the AP1000 Nuclear Power Plant. The inspection procedures focused primarily on welded connections, steel structural members and bolted connections. Final recommendations were provided which led to the approval of the design and installation of the Y-Loop Testing Facility Steel Structure.

Koeberg NPP Seismic Evaluation

ESKOM | Cape Town, South Africa

09/2011 – 11/2011

Mr. Guerra, Engineer Associate II, performed the structural assessment of reinforced concrete shear walls in the Koeberg NPP subjected to the effects from Aircraft Impact Loading. Semi-empirical relations associated to perfectly plastic collisions were implemented for the evaluation of local, global and secondary effects resulting from a missile impact on concrete walls. Results from the analysis provided the basis for risk informed assessments in relation to Aircraft Impact on Koeberg's Safety-Related Structures.

Mr. Guerra served as the Engineer Associate II for the calculation of Seismic Fragilities for mechanical and structural components in support of the Seismic Margin Assessment of the Koeberg Nuclear Power Plant. In his role as a structural analyst, Mr. Guerra implemented CDFM methodologies in order to determine seismic fragilities for components falling within the Review Level Earthquake screening threshold. Parameters necessary for the development of seismic fragilities were calculated following EPRI guidelines including EPRI 103959, EPRI 6041, and EPRI 1002988. Results from the seismic evaluation of screened-in components were implemented as the basis for more detailed analyses and minor modifications.

Mr. Guerra, Engineer Associate II, was part of the Seismic Walkdown Team responsible for the walkdown of electrical and mechanical components as well as piping and electrical distribution systems in support of the SMA for the Koeberg NPP. Mr. Guerra followed GIP walkdown guidelines in order to determine if components and systems were below the Review Level Earthquake margin level. Successful completion of plant walkdowns led to the reduction in the number of systems and components to be evaluated as part of the fragility calculation effort.

Santa Isabel Wind Turbine Tower Analysis and Design Revision

Siemens | Santa Isabel, Puerto Rico

10/2010 – 09/2011

Mr. Guerra, Engineer Associate I, was in charge of the analysis and design revision of a wind turbine tower to be constructed in Santa Isabel, Puerto Rico. He developed design criteria based on local building code requirements and the International Electro technical Commission (IEC) provisions for wind turbine design. The analysis encompassed the suitability of the tower against regional extreme seismic and wind demands.

General Electric Peer Review for Mechanical Equipment Qualification

General Electric | Chilca, Peru

06/2010 – 09/2011

Mr. Guerra, Engineer Associate I, provided structural revision services for General Electric Power and Water Division regarding the seismic qualification of electrical equipment to be installed in the Fenix Power Plant located in Chilca, Peru. Equipment and surrounding structures were verified following Peruvian structural standards.

Potash Fertilizer Plant Seismic Analysis

Rivers Consulting | Province of Mendoza, Argentina

06/2010 – 08/2011

Mr. Guerra, Engineer Associate I, assisted in the analysis and design revision of a Potash Fertilizer Plant to be constructed in the Mendoza Province, Argentina. He performed dynamic analysis and structural design revision of the main steel structure by complying with Local Argentinean Structural Codes.

Structural Analysis of Steel Floor Framing System

Curtiss-Wright | Cheswick, Pennsylvania

05/2011 – 06/2011

Mr. Guerra, Engineer Associate I, performed a structural analysis addressing the structural adequacy of a steel floor framing system in order to sustain heavy equipment weights. Structural revision included computer modeling of the steel framing and revision of code criteria involving both Chinese and American steel shape properties.

AP1000 HVAC Duct System Seismic Qualification

SSM | Westinghouse Electric Company, LLC | Pittsburgh, Pennsylvania

10/2010 – 05/2011

Mr. Guerra, Engineer Associate I, was part of the team responsible for the seismic qualification of the AP1000 HVAC Duct System project. He performed structural dynamic analysis of all mayor steel platforms inside steel containment vessel; investigated the interaction of steel vessel and HVAC system displacements due to normal operational and severe thermal effects; and performed finite element modeling of HVAC access doors under static equivalent seismic loads. Mr. Guerra followed AISC, ASCE and SMACNA standards for the qualification of steel duct supports.

SQUG

Certificate of Achievement

This is to Certify that

Eddie M. Guerra

has Completed the SQUG Walkdown Screening
and Seismic Evaluation Training Course
June 11-15, 2012
Glen Allen, Virginia

Paul D. Baughman, ARES Corporation
SQUG Instructor

Divakar Bhargava, Dominion Generation
SQUG Chairman

Brian A. Lucarelli, E.I.T.

Engineering Associate

Years Experience
5

Level
5

Education
B.S., Civil Engineering, University of Pittsburgh, Pittsburgh, PA – December 2009

B.S., Mathematics, Waynesburg University, Waynesburg, PA - December 2009

Professional Certifications
Engineer-in-Training – PA
ET013562

Continuing Education
SQUG Walkdown Screening and Seismic Evaluation Training Course, August 2012

Short Course on Computational Geotechnics and Dynamics, August 2011.

ASDSO Estimating Permeability Webinar, December 2010.

Computer Skills
SAP2000, PLAXIS, SEEP/W, SLOPE/W, THERM, AutoCAD, ArcGIS, Phase[2], Slide, MathCAD

Professional Affiliations
American Concrete Institute (ACI)

ACI Committee 207 (Mass Concrete) – Associate Member

American Society of Civil Engineers (ASCE)

Engineers Without Borders (EWB)

Skill Areas:

- Seismic Fragility Evaluations
- Seismic Walkdown Inspection
- Soil Mechanics
- Roller Compacted Concrete
- Construction Materials Testing
- Quality Assurance

Mr. Lucarelli has experience in seismic walkdown inspections of operating nuclear plants and seismic fragility evaluations of structures, systems, and components. He has attended the 5-day SQUG Walkdown Screening and Seismic Evaluation Training Course and has also provided support during peer reviews to the ASME/ANS PRA Standard.

Mr. Lucarelli also has experience in geotechnical modeling, structural modeling, and quality control in support of applications for proposed nuclear plants.

Watts Barr NPP Seismic Scoping Study

URS Consulting | TVA | Rhea County, Tennessee

3/2014 – 01/2015

As an Engineering Associate, Mr. Lucarelli has been engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities for the seismic PRA. As part of this effort, Mr. Lucarelli was part of the Seismic Walkdown Team. He was responsible to perform the NTTF 2.1 Seismic Walkdown and Equipment Screening and to perform walkdowns in support of the Expedited Seismic Evaluation Process (ESEP). Mr. Lucarelli also developed seismic fragilities for miscellaneous components such as the Polar Crane, Steel Containment Vessel Penetrations, and Control Room Ceiling.

Perry NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Perry, Ohio

6/2012 – Present

As an Engineering Associate, Mr. Lucarelli has been engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities for the seismic PRA. As part of this effort, Mr. Lucarelli was part of the Seismic Walkdown Team. He was responsible to perform the NTTF 2.1 Seismic Walkdown and Equipment Screening. He was also responsible to perform the NTTF 2.3 Seismic Walkdown and walkdowns in support of the Expedited Seismic Evaluation Process (ESEP). Mr. Lucarelli managed the development of equipment fragilities for PNPP and acted as the point of contact between the team of fragility analysts and the PRA analyst developing the logic model.

Mr. Lucarelli participated in the Peer Review of the PNPP Seismic PRA in support of the work related to walkdowns and equipment fragilities. As part of the PNPP Peer Review, Mr. Lucarelli engaged in the direct response of comments from peer reviewers as well as technical discussions regarding compliance with the ASME Standard.

Beaver Valley Unit 1 NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Shippingport, Pennsylvania

6/2012 – Present

As an Engineering Associate, Mr. Lucarelli has been engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities for the seismic PRA. As part of this effort, Mr. Lucarelli was part of the Seismic Walkdown Team and was responsible to perform the NTTF 2.1 Seismic Walkdown and Equipment Screening. Mr. Lucarelli performed walkdowns in support of the Expedited Seismic Evaluation Process (ESEP).

Beaver Valley Unit 2 NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Shippingport, Pennsylvania

6/2012 – Present

As an Engineering Associate, Mr. Lucarelli has been engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities for the seismic PRA. As part of this effort, Mr. Lucarelli was part of the Seismic Walkdown Team. He was responsible to perform the NTTF 2.1 Seismic Walkdown and Equipment Screening. He was also responsible to perform the NTTF 2.3 Seismic Walkdown. Mr. Lucarelli performed walkdowns in support of the Expedited Seismic Evaluation Process (ESEP).

Davis-Besse NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Oak Harbor, Ohio

6/2012 – Present

As an Engineering Associate, Mr. Lucarelli has been engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities for the seismic PRA. As part of this effort, Mr. Lucarelli was part of the Seismic Walkdown Team. He was responsible to perform the NTTF 2.1 Seismic Walkdown and Equipment Screening. He was also responsible to perform the NTTF 2.3 Seismic Walkdown. Mr. Lucarelli performed walkdowns in support of the Expedited Seismic Evaluation Process (ESEP).

Visaginas NPP Units 3 and 4

Visagino Atomine Elektrine UAB | Villnius, Lithuania

10/2012 – 12/2012

As an Engineering Associate, Mr. Lucarelli Evaluated cone penetration test (CPT) data to evaluate site uniformity, provide recommended elastic modulus values for geologic layers, and evaluate dissipation test results to determine the coefficient of consolidation for geologic layers.

Vogtle NPP Geotechnical Investigation

Westinghouse Electric Company | Burke County, Georgia

2/2012 – 7/2012

RIZZO conducted a settlement analysis to predict the total and differential settlements expected during construction of the Vogtle Units. Mr. Lucarelli was responsible for reviewing on-site heave and settlement data and the excavation sequence to calibrate the material properties in the settlement model. He was also responsible for creating a settlement model that implemented the expected AP1000 construction sequence and presenting the results in a report.

Levy County NPP Foundation Considerations

Sargent & Lundy/Progress Energy | Crystal River, Florida

1/2010 – 6/2012

Mr. Lucarelli has been extensively involved in the design and specification of the Roller Compacted Concrete (RCC) Bridging Mat that will support the Nuclear Island foundation. He authored numerous calculations and reports related to the work for this project, including responding to Requests for Additional Information from the NRC. He performed finite element analyses of the stresses within the Bridging Mat under static and dynamic loading conditions, evaluation of whether the stresses in the Bridging Mat met the applicable requirements of ACI 349 and ACI 318, and the determination of long-term settlement. As part of laboratory testing program for RCC, Mr. Lucarelli assisted in the evaluation, selection, and testing specification for the concrete materials to ensure they met the applicable ASTM material standards. He also authored the Work Plan and served as on-site quality control during laboratory testing of RCC block samples in direct tension and biaxial direct shear. His responsibilities included inspection of the testing being performed, control of documentation related to testing activities, and ensuring subcontractors fulfilled the requirements of RIZZO's NQA-1 Quality Assurance Program.

Blue Ridge Dam Rehab

Tennessee Valley Authority | Fannin County, Georgia

3/2012 – 4/2012

RIZZO conducted a deformation analysis of the downstream side of the Blue Ridge Dam to assess the observed movement in the Mechanically Stabilized Earth (MSE) wall. Mr. Lucarelli prepared a two dimensional finite element model of the dam, which included reviewing construction documentation and instrument readings to determine cross sectional dimensions and material properties.

Akkuyu NPP Site Investigation

WorleyParsons | Mersin Province, Turkey

9/2011 – 3/2012

RIZZO conducted a geotechnical and hydrogeological investigation of the proposed site for four Russian VVER-1200 reactors. This investigation entailed geotechnical and hydrogeological drilling and sampling, geophysical testing, and geologic mapping. Mr. Lucarelli served as on-site quality control for this project. His responsibilities included controlling all records generated on site, interfacing with TAEK (Turkish Regulatory Agency) auditors, and tracking nonconformance observed during the field investigation in accordance with RIZZO's NQA-1 Quality Assurance Program. Mr. Lucarelli also assisted in the preparation of the report summarizing the findings of the field investigation.

Calvert Cliffs NPP Unit 3

Unistar | Calvert County, Maryland

7/2011 – 1/2012

5/2010 – 11/2010

RIZZO completed a COLA-level design of the Ultimate Heat Sink Makeup Water Intake Structure at the Calvert Cliffs site. Mr. Lucarelli authored and checked calculations to determine the design loads, as prescribed by ASCE 7, to be used in a Finite Element model of the structure. Mr. Lucarelli was also responsible for ensuring that the design met the requirements of the Design Control Document.

Mr. Lucarelli also performed a settlement analysis for the Makeup Water Intake Structure.

Areva RAI Support Services for U.S. EPR Design Certification

AREVA

8/2011 – 9/2011 (10-4435)

Mr. Lucarelli assisted in the calculation of the subgrade modulus distribution for the foundation of the Nuclear Auxiliary Building (NAB) for the U.S. Evolutionary Power Reactor (U.S. EPR). This iterative process included modeling subsurface profiles in DAPSET to obtain a soil spring distribution under the basemat. The soil spring distribution was then modeled in GTSTRUDL as the basemat support.

C.W. Bill Young Regional Reservoir Forensic Investigation

Confidential Client | Tampa, Florida

2/2010 – 3/2010

RIZZO conducted a forensic investigation into the cause of soil-cement cracking on the reservoir's upstream slope. This investigation involved a thorough review of construction testing results and documentation to determine inputs for seepage and slope stability analyses. Mr. Lucarelli reviewed construction documentation and conducted quality control checks on the data used for the analyses. Mr. Lucarelli also prepared a number of drawings and figures that presented the results of the forensic investigation.

PREVIOUS EXPERIENCE

Aquaculture Development

Makili | Mali, Africa

9/2007 – 12/2009

As the project coordinator, his primary responsibilities included maintaining a project schedule, developing a budget for project implementation, and coordinating technical reviews of project documentation with a Technical Advisory Committee.

The University Of Pittsburgh Chapter Of Engineers Without Borders designed and constructed an aquaculture pond in rural Mali, Africa with a capacity of 3.6 million gallons. This pond is designed to maintain enough water through a prolonged dry season to allow for year-round cultivation of tilapia. As the project technical lead, Mr. Lucarelli was involved in developing conceptual design alternatives and planning two site assessment trips. These scope of these site assessment trips included topographic surveying, the installation of climate monitoring instrumentation, soil sampling and characterization, and laboratory soils testing.

Southwestern Pennsylvania Commission

Pittsburgh, Pennsylvania

05/2008 – 08/2008

As a transportation intern, Mr. Lucarelli analyzed data in support of various studies dealing with traffic forecasting, transit use, and highway use. He also completed fieldwork to assess the utilization of regional park-and-ride facilities.

SQUG

Presents this

Certificate of Achievement

To Certify That

Brian A. Lucarelli

has Completed the SQUG Walkdown Screening and Seismic Evaluation Training Course

Held August 20-24, 2012

Richard G. Starck II, MPR Associates, Inc.
SQUG Instructor

Paul D. Baughman, ARES Corporation
SQUG Instructor

Jason M. Dimaria, P.E.

Project Engineer

Years Experience
6

Level
4

Education
M.S., Civil Engineering, Wayne State University – 2008

B.S., Civil Engineering, Wayne State University – 2005, Cum Laude

B.A., Physics, Albion College – 2003

Professional Affiliations
American Society of Civil Engineers (ASCE), American Institute of Steel Construction (AISC), Member Structural Engineers Association of Michigan (SEAMi), Associate Member Chi Epsilon – Civil Engineering Honor Society

Professional Registration
Professional Engineer – P.E. – Michigan: License No. 6201059422

Software
RAM, STAAD.pro, Sap 2000, RISA 3D, RISA Floor, Math Cad, Auto Cad, REVIT, Hypermesh, Abaqus, ANSYS, TNO Diana, Nastran, MATLAB, MS Office Suite

Publications
Michigan Department of Transportation RC-1490 – Bridge Deck Corner Cracking on Skewed Structures
Sep. 2007, by Gongkang Fu, Jihang Feng, Jason Dimaria and Yizhou Zhuang, WSU

Skill Areas:

Steel Connection Design	Finite Element Analysis
Steel Framing Design	Existing Structure Evaluation
Reinforced Concrete Design	Constructability Design/Evaluation
Heavy Lift and Rigging Design	Advanced Structural Analysis
Response Spectra Analysis	Seismic Evaluation
Time History Analysis	Structural Dynamics
Monte Carlo Simulation	Fragility Analysis
Probabilistic Structural Analysis	HCLPF/CDFM Analysis
Concrete Design (ACI 318)	ACI 349

Mr. Dimaria is a Project Engineer with Paul C. Rizzo Associates, Inc. (RIZZO). He has developed an extensive background in industrial and commercial facilities. In addition to new designs, Mr. Dimaria has worked on the evaluation of existing structures for retrofit.

His experience includes 3D computer modeling of structures for static and dynamic analysis, response spectra analysis for mechanical, and wind vibrations or earthquakes. Mr. Dimaria also has experience modeling linear and non-linear finite element model stress evaluation of various structures and structural details.

Before joining RIZZO, Mr. Dimaria functioned as a Staff Engineer at Ruby+Associates Inc. in Farmington Hills, Michigan. His main areas of responsibility included structural steel building design, structural steel connection design, reinforced concrete design and constructability review. From this experience Mr. Dimaria has a unique perspective of structural systems and applies knowledge of constructability design to ensuring that the structure is able to be efficiently erected in the field.

In addition to his experience with steel and reinforced concrete design, Mr. Dimaria also has experience with heavy lift and rigging design.

Mr. Dimaria has completed the Seismic Qualification Utilities Group (SQUG) 5-Day 2.1 Seismic Walkdown Training Course. This training course includes certification of Near Term Task Force (NTTF) 2.3 Seismic Walkdown Training.

June 2013 – Present
CA01 Module Evaluation – Westinghouse, Pittsburgh, Pennsylvania:

Mr. Dimaria, as Project Engineer, is responsible for the review and implementation of corrective actions. He will also analyze any required updates to the structural drawings of the CA01 structure and assess the impact these updates will have on the analytical model.

November 2012 – Present
FERMI 2 NPP SPRA Upgrade Fragility Analysis – URS/DTE Energy Plant, Newport, Michigan:

Mr. Dimaria is engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities and the seismic PRA. As part of this effort, Mr. Dimaria is part of the team responsible for the

SPRA Walk downs to be performed in compliance with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendations.

April 2012 – Present
Perry NPP - Seismic Fragility Evaluation – FirstEnergy Nuclear Operating Company, Perry, Ohio:

Mr. Dimaria is engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities and the seismic PRA. As part of this effort, Mr. Dimaria is part of the team responsible for the SPRA Walk downs to be performed in compliance with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendations.

April 2012– Present
Beaver Valley Unit 1, NPP – Seismic Fragility Evaluation – FirstEnergy Nuclear Operating Company, Shippingport, PA:

Mr. Dimaria is engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities and the seismic PRA. As part of this effort, Mr. Dimaria is part of the team responsible for the SPRA walk downs to be performed in compliance with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendations.

April 2012– Present
Beaver Valley Unit 2 NPP – Seismic Fragility Evaluation – FirstEnergy Nuclear Operating Company, Shippingport, Pennsylvania:

Mr. Dimaria is engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities and the seismic PRA. As part of this effort, Mr. Dimaria is part of the team responsible for the SPRA Walk downs to be performed in compliance with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendations.

April 2012– Present
Davis-Besse NPP – Seismic Fragility Evaluation – FirstEnergy Nuclear Operating Company, NPP, Oak Harbor, Ohio:

Mr. Dimaria is engaged in performing seismic evaluations of plant structures and components in support of developing seismic fragilities and the seismic PRA. As part of this effort, Mr. Dimaria is part of the team responsible for the SPRA Walk downs to be performed in compliance with the ASME ANS RA-Sa-2009 Standard and the NTTF 2.1 Recommendations.

April 2009 – Present
AP1000 VCS Duct System Engineering Analysis and HVAC Design – SSM Industries:

Mr. Dimaria is a Project Engineer for this ongoing project. RIZZO is providing seismic design support for VCS Duct System for AP1000 Containment. Mr. Dimaria created several models to determine the reaction loads on different containment modules due to the duct runs associated with the VCS System inside the AP1000 Containment. The duct runs mainly conduct chilled air from the ring header to various lower regions of the containment space.

Mr. Dimaria performed mode-frequency analysis using the Global Models and extract frequencies and mode shapes for specific VCS duct segments by using STAAD.pro. The frequencies represent the combined frequency of the duct beams and supports. Mr. Dimaria also utilized MathCAD to calculate the composite fundamental Frequency of specific duct systems combining the Global Beam Model frequency, the panel frequency and the stiffener frequency. He demonstrated that the fundamental frequency is in excess of 33 Hz, which is the threshold frequency for ZPA associated with the support point ISRS.

The final analysis will evaluate the dynamic interaction of the duct systems with various miscellaneous platform structures which are used to support the duct runs inside containment. This analysis will develop composite modal frequencies that include the stiffness and mass of the platforms. The combined platforms and duct system will be analyzed using the appropriate spectral acceleration in the In-Structure Response Spectra (ISRS) at the locations where the platforms are attached.

August 2009 – Present
Geotechnical Evaluation of Layered Soils and Dynamic Analysis of STM Test Facility for AP1000 RC Pump – Shenyang Turbo-Machinery Corporation (STM):

Mr. Dimaria is a Project Engineer for this project. RIZZO is providing geotechnical, structural, and mechanical engineering services for the Shenyang Turbo-Machinery (STM) Company in mainland China. RIZZO is developing the design of a Test Loop Facility used for manufacturing the AP 1000 Reactor Cooling Pump. The design is similar to a design developed by RIZZO for a facility in the United States. Due to the multi-layered soils at the Chinese site and the low bearing capacity of several layers, RIZZO is developing a soil remediation plan for the facility. The excavation methodology plan will remove the weaker, saturated clay deposits directly below the mat and pit foundations that are settlement prone. These soils will be replaced with compacted, granular engineered fill. The dewatering of the site and the design of a deep, braced excavation for the pit construction is also part of the plan.

For this project Mr. Dimaria reviewed the Structural Steel Drawings and Details for completeness, accuracy and compliance with Chinese Steel Design and Welding Codes. Since the project involved the conversion from Rolled U.S. Steel Shapes to Chinese Welded Shapes, Mr. Dimaria Reviewed these alterations of the design, additionally the welding symbols used in China are different than those in the U.S. Mr. Dimaria reviewed the original U.S. Test Loop Drawings and ensured that the welding procedures and steel design used at the Chinese Test Loop facility were in compliance.

August 2011 – November 2011
Koeberg Nuclear Power Plant Seismic Evaluation, Cape Town, South Africa – ESCOM:

Mr. Dimaria was an Assistant Project Engineer for this project. RIZZO provided structural, and tsunami engineering services for this project along with Nuclear Structural Engineering of Johannesburg South Africa. For this project Mr. Dimaria was responsible for evaluating the capacities of structural and mechanical elements as part of an analysis of High Confidence Low Probability of Failure (HCLPF) study for the plant.

April 2011 – March 2012
Kallpa Seismic Calculation Review – POSCO:

Mr. Dimaria is an Assistant Project Engineer for this project. RIZZO is providing, structural analysis and design calculation peer review for the Combined Cycle Power Plant in Peru. Mr. Dimaria reviewed client calculations and drawings and provided comments to the originator to ensure consistency and proper structural design and analysis methodologies were employed on the project.

As part of the design review Mr. Dimaria was support field engineer for the inspection of the Kallpa Combined Cycle Power Plant to verify that the as built condition of the structures was in line with the design calculations and drawings reviewed and approved by RIZZO.

April 2011 – Present
Chilca Uno Seismic Calculation Review – POSCO:

Mr. Dimaria is a Project Engineer for this project. RIZZO is providing, structural analsis and design calculation peer review for the Combined Cycle Power Plant in Peru currently under construction. Mr. Dimaria reviewed client calculations and drawings and provided comments to the originator to ensure consistency and proper structural design and analysis methodologies were employed on the project.

As part of the design review Mr. Dimaria was lead field engineer for the inspection of the Chilca Uno Combined Cycle Power Plant to verify that the as built condition of the structures was in line with the design calculations and drawings reviewed and approved by RIZZO.

PREVIOUS EXPERIENCE:

December 2006 – June 2009
Staff Engineer II – Ruby Associates, Inc. Farmington Hills, Michigan:

- Developed innovative calculations for various engineering problems for time critical projects.
- Created and analyzed Finite Element models of complex structural systems.
- Developed computational spreadsheets to design structural elements more efficiently and with greater accuracy.
- Collaborated with engineering staff to provide solutions for structural problems. Coordinated efforts with clients and field personnel concerning problem solutions, development, and repair methods, including:
  - ***Revel Casino, Atlantic City, NJ –*** Connection design services for time critical project. Provided designs that enabled simplified detailing and reduced construction time in the field.
  - ***TXU – Oak Grove Electric Station, Robertson Co., TX –*** Review of existing structure connections for retro-fit. Critical role to improve the safety and long term viability of structure.
  - ***Downstream Casino and Resort, Quapaw, OK –*** Provided connection design services for $301 million casino and twelve story 222 room hotel tower. Maintained contact and quality control with detailer concerning problems that arose during detailing.
  - ***Horizontal Life Line Safety System Review –*** Provided technical field support and testing to ongoing research project for steel fabrication company regarding proprietary fall arrest system. Also provided engineering evaluation of various iron worker tie off methods.

May 2005 – December 2006
Graduate Research Assistant – Wayne State University, Detroit, Michigan:

- Worked with Michigan and Georgia DOT's on several original sensor instrumentation projects, maintained systems, and compiled data for computer analysis.
- Assumed leadership role on system design and field instrumentation, coordinated efforts with DOT's and contractors to keep project on schedule.
- Teaching Assistant – Worked with students as a teacher to mentor and improve understanding of design and analysis process.

SQUG

Presents this

Certificate of Achievement

To Certify That

Jason Dimaria

has Completed the SQUG Walkdown Screening and Seismic Evaluation Training Course

Held August 20-24, 2012

Richard G. Starck II, MPR Associates, Inc.
SQUG Instructor

Paul D. Baughman, ARES Corporation
SQUG Instructor

RIZZO ASSOCIATES

Bradley T. Yagla, E.I.T.

Engineering Associate

Years Experience
2

Level
3

Education
B.S. Civil & Environmental Engineering, University of Pittsburgh – Pittsburgh, Pennsylvania – 2012

Professional Certifications
Engineer-in-Training (EIT) – Pennsylvania

Computer Skills
STAAD.Pro, AutoCAD, Revit, RISA-3D, SAP2000, SASSI, MathCad

Skill Areas:

Structural Modeling	Structural Analysis
Nuclear Power Plants	Structures
Modular Construction	Pipe Supports
Embedment Plates	Seismic Walkdowns
Seismic Fragilities	SSI Dynamic Analysis

Mr. Yagla is an Engineering Associate with RIZZO Associates (RIZZO). Mr. Yagla has been involved primarily in the structural analysis of power generation structures.

RIZZO's senior staff have recently completed the Seismic 2-Day NTTF 2.3 Seismic Walkdown Training. This training is being disseminated to others on RIZZO's staff, including Mr. Yagla.

Perry NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Perry, Ohio

06/2012 – Present

Mr. Yagla, as an Engineering Associate, performed the following tasks in support of the Seismic Probabilistic Risk Assessment (SPRA) for the plant:

- Assessed existing seismic analyses of plant structures, systems, and components (SSCs).
- Developed Finite Element (FE) and Stick Models of plant structures for seismic analysis.
- Validated and verified FE models using 1-g push and modal analyses.
- Analyzed structure FE models for soil-structure interaction.
- Conducted in-plant seismic walkdowns of SSCs to identify potential failure modes.
- Performed fragility calculations for SSCs using probabilistic and deterministic approaches.
- Originated and checked calculations and reports pertaining to seismic walkdowns and fragilities.

Beaver Valley Unit 1 NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Shippingport, Pennsylvania

06/2012 – Present

Mr. Yagla, as an Engineering Associate, performed the following tasks in support of the Seismic Probabilistic Risk Assessment (SPRA) for the plant:

- Assessed existing seismic analyses of plant structures, systems, and components (SSCs).
- Developed Finite Element (FE) and Stick Models of plant structures for seismic analysis.
- Validated and verified FE models using 1-g push and modal analyses.
- Analyzed structure FE models for soil-structure interaction.
- Conducted in-plant seismic walkdowns of SSCs to identify potential failure modes.
- Performed fragility calculations for SSCs using probabilistic and deterministic approaches.
- Originated and checked calculations and reports pertaining to seismic walkdowns and fragilities.

Beaver Valley Unit 2 NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Shippingport, Pennsylvania

06/2012 – Present

Mr. Yagla, as an Engineering Associate, performed the following tasks in support of the Seismic Probabilistic Risk Assessment (SPRA) for the plant:

- Assessed existing seismic analyses of plant structures, systems, and components (SSCs).
- Developed Finite Element (FE) and Stick Models of plant structures for seismic analysis.
- Validated and verified FE models using 1-g push and modal analyses.
- Analyzed structure FE models for soil-structure interaction.
- Conducted in-plant seismic walkdowns of SSCs to identify potential failure modes.
- Performed fragility calculations for SSCs using probabilistic and deterministic approaches.
- Originated and checked calculations and reports pertaining to seismic walkdowns and fragilities.

Davis-Besse NPP Seismic PRA

ABS Consulting | FirstEnergy Nuclear Operating Company | Oak Harbor, Ohio

06/2012 – Present

Mr. Yagla, as an Engineering Associate, performed the following tasks in support of the Seismic Probabilistic Risk Assessment (SPRA) for the plant:

- Assessed existing seismic analyses of plant structures, systems, and components (SSCs).
- Developed Finite Element (FE) and Stick Models of plant structures for seismic analysis.
- Validated and verified FE models using 1-g push and modal analyses.
- Analyzed structure FE models for soil-structure interaction.
- Conducted in-plant seismic walkdowns of SSCs to identify potential failure modes.
- Performed fragility calculations for SSCs using probabilistic and deterministic approaches.
- Originated and checked calculations and reports pertaining to seismic walkdowns and fragilities.

PREVIOUS EXPERIENCE

Intern – Piping and Supports Integration

Westinghouse Electric Company | Cranberry Township, Pennsylvania

05/2011 – 08/2011

- Coordinated pipe support and embedment plate issue resolution for Embedment Project Team.
- Created and maintained a spreadsheet that tracked 800 issues from detection to resolution.
- Verified embedment plate issues were rectified in the AP1000 computer model using NavisWorks.
- Provided vital embedment information to critical China AP1000 Projects in Weekly deliverables.
- Presented qualitative and statistical issue – related data to management on a daily basis.

Intern – Modules and Construction Interface

Westinghouse Electric Company | Cranberry Township, Pennsylvania

05/2010 – 08/2010

- Provided input during formal design review for modular AP1000 Nuclear Power Plant Units.
- Developed process flowcharts for piping isometric drawing classification.
- Verified stress calculations for pipe hangers in mechanical modules.
- Located and documented discrepancies between AP1000 computer model and technical drawings.
- Participated in weekly Nuclear Technical and Human Performance training sessions.

Certificate of Attendance

This certifies that

Bradley Yagla

Attended the following Training Course:

"SQUG Walkdown Screening and Seismic Evaluation"

Presented by

Eddie M. Guerra

on

Thursday, November 29, 2012

PCR ENGINEERS/CONSULTANTS/CM

Eddie M. Guerra
Project Engineer

November 29, 2012

Attachment 2.
Tabulated HCLPF Values with ESEL ID

Tabulated HCLPF Values with ESEL ID

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
HV5301A	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	300
HV5301B	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	301
HV5301C	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	302
HV5301D	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	303
HV5301E	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	304
HV5301F	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	305
HV5301G	0.42	0.40	0.26	0.30	1.07	Block Wall	New Analysis	306
HV5301H	1.02	0.45	0.24	0.38	2.90	Functional	Analysis Qualification Data	307
SV5301	1.02	0.45	0.24	0.38	2.90	Functional	Assigned by Rule of the Box. Parent Component HV-5301E.	310
SV5301A	1.02	0.45	0.24	0.38	2.90	Functional	Assigned by Rule of the Box. Parent Component HV-5301E.	311
HV5443A	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	379
HV5443C	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	380
HV5261	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	375
HV5305	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	376

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
HV5305A	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	377
HV5305B	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	378
HV5361A	0.50	0.40	0.26	0.30	1.27	Block Wall	New Analysis	308
HV5361B	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	309
HV5597	0.57	0.45	0.24	0.38	1.62	Anchorage	Analysis Based on Existing Seismic Analysis	381
MV5443A	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5443A.	353
MV5443C	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5443C.	354
MV5261A	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5261.	297
MV5305	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5305.	280
MV5305A	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5305A.	278

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
MV5305B	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5305B.	279
MV5597	0.57	0.45	0.24	0.38	1.62	Anchorage	Assigned by Rule of the Box. Parent Component HV5597.	281
F15-3	1.26	0.35	0.24	0.26	2.85	Anchorage	New Analysis	158
E12B	1.06	0.40	0.24	0.32	2.70	Functional	GERS	253
E12F	1.06	0.40	0.26	0.30	2.69	Block Wall	New Analysis	256
YE1	1.06	0.40	0.24	0.32	2.70	Functional	GERS	258
BE1259	1.06	0.40	0.24	0.32	2.70	Functional	Assigned by Rule of the Box. Parent Component E12B.	257
BE1273	1.06	0.40	0.24	0.32	2.70	Functional	Assigned by Rule of the Box. Parent Component E12B.	254
BE1285	1.06	0.40	0.24	0.32	2.70	Functional	Assigned by Rule of the Box. Parent Component E12B.	275
BE1297	1.06	0.40	0.26	0.30	2.69	Block Wall	Assigned by Rule of the Box. Parent Component E12F.	255
BE1298	1.06	0.40	0.26	0.30	2.69	Block Wall	Assigned by Rule of the Box. Parent Component E12F.	268

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
BE1208A	1.06	0.40	0.26	0.30	2.69	Block Wall	Assigned by Rule of the Box. Parent Component E12F.	274
YE104	1.06	0.40	0.24	0.32	2.70	Functional	Assigned by Rule of the Box. Parent Component YE1.	284
F11A	0.26	0.40	0.24	0.32	0.67	Anchorage	New Analysis	212
BF1130	0.26	0.40	0.24	0.32	0.67	Anchorage	Assigned by Rule of the Box. Parent Component F11A.	317
BF1120	0.26	0.40	0.24	0.32	0.67	Anchorage	Assigned by Rule of the Box. Parent Component F11A.	211
E11E	0.29	0.40	0.24	0.32	0.73	Anchorage	New Analysis	374
YE2	0.29	0.40	0.24	0.32	0.73	Anchorage	New Analysis	262
BE1151	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component E11E.	246
BE1149	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component E11E.	295
YE208	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component YE2.	260

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
YE209	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component YE2.	361
YE210	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component YE2.	362
YE212	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component YE2.	363
YE2A	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component YE2.	259
YE2B	0.29	0.40	0.24	0.32	0.73	Anchorage	Assigned by Rule of the Box. Parent Component YE2.	261
E12E	0.68	0.40	0.24	0.32	1.73	Anchorage	New Analysis	252
BE1291	0.68	0.40	0.24	0.32	1.73	Anchorage	Assigned by Rule of the Box. Parent Component E12E.	251
BE1292	0.68	0.40	0.24	0.32	1.73	Anchorage	Assigned by Rule of the Box. Parent Component E12E.	348
E12A	1.15	0.40	0.24	0.32	2.92	Functional	GERS	216
D1_ED	1.15	0.40	0.24	0.32	2.92	Functional	GERS	373
E14	1.15	0.40	0.24	0.32	2.92	Functional	GERS	155

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
BE1201	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	291
BE1202	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	247
BE1208	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	273
BE1209	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	293
BE1216	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	292
BE1223	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	217
BE1226	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	343
BE1234	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	250

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
BE1240	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	276
BE1241	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E12A.	277
BE1401	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component E14.	154
D101	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	65
D103	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	74
D104	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	67
D131	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	68
D132	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	72

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
D134	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	75
D111	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	69
D112	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	70
D116	1.15	0.40	0.24	0.32	2.92	Functional	Assigned by Rule of the Box. Parent Component D1_ED.	71
E11D	0.32	0.40	0.24	0.32	0.81	Anchorage	New Analysis	242
BE1126	0.32	0.40	0.24	0.32	0.81	Anchorage	Assigned by Rule of the Box. Parent Component E11D.	320
BE1196	0.32	0.40	0.24	0.32	0.81	Anchorage	Assigned by Rule of the Box. Parent Component E11D.	240
E11A	0.49	0.40	0.24	0.32	1.24	Anchorage	New Analysis	239
E11B	0.49	0.40	0.24	0.32	1.24	Anchorage	New Analysis	241
E11C	0.49	0.40	0.24	0.32	1.24	Anchorage	New Analysis	244
BE1120	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11A.	237

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
BE1121	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11A.	323
BE1162	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11B.	213
BE1166	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11B.	238
BE1180	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11B.	243
BE1183	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11B.	316
BE1144	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11C.	294
BE1150	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11C.	245
BE1154	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11C.	360

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
BE1142	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component E11C.	163
E12C	0.42	0.40	0.24	0.32	1.06	Functional	GERS	249
EF12C	0.42	0.40	0.24	0.32	1.06	Functional	GERS	160
BE1284	0.42	0.40	0.24	0.32	1.06	Functional	Assigned by Rule of the Box. Parent Component E12C.	248
BEF124	0.42	0.40	0.24	0.32	1.06	Functional	Assigned by Rule of the Box. Parent Component EF12C.	159
BEF125	0.42	0.40	0.24	0.32	1.06	Functional	Assigned by Rule of the Box. Parent Component EF12C.	166
E1	0.70	0.40	0.24	0.32	1.77	Anchorage	New Analysis	230
BCE11	0.70	0.40	0.24	0.32	1.77	Anchorage	Assigned by Rule of the Box. Parent Component E1.	232
BE106	0.70	0.40	0.24	0.32	1.77	Anchorage	Assigned by Rule of the Box. Parent Component E1.	236
BE107	0.70	0.40	0.24	0.32	1.77	Anchorage	Assigned by Rule of the Box. Parent Component E1.	235

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
BE110	0.70	0.40	0.24	0.32	1.77	Anchorage	Assigned by Rule of the Box. Parent Component E1.	234
C1	0.38	0.40	0.24	0.32	0.97	Anchorage	New Analysis	367
ABDC1	0.38	0.40	0.24	0.32	0.97	Anchorage	Assigned by Rule of the Box. Parent Component C1.	364
AC110	0.38	0.40	0.24	0.32	0.97	Anchorage	Assigned by Rule of the Box. Parent Component C1.	365
AC112	0.38	0.40	0.24	0.32	0.97	Anchorage	Assigned by Rule of the Box. Parent Component C1.	326
AC113	0.38	0.40	0.24	0.32	0.97	Anchorage	Assigned by Rule of the Box. Parent Component C1.	340
AC1CE11	0.38	0.40	0.24	0.32	0.97	Anchorage	Assigned by Rule of the Box. Parent Component C1.	366
XCE1-1	0.43	0.40	0.24	0.32	1.08	Anchorage	New Analysis	368
P42-1	0.49	0.40	0.24	0.32	1.24	Anchorage	New Analysis	324
P43-1	0.49	0.40	0.24	0.32	1.24	Anchorage	New Analysis	335
MP42-1	0.49	0.40	0.24	0.32	1.24	Anchorage	Assigned by Rule of the Box. Parent Component P42-1.	325

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
P195-1	0.76	0.40	0.24	0.32	1.93	Anchorage	New Analysis	269
CC1467	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	338
SV1467	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component CC1467.	339
SS607	3.85	0.40	0.24	0.32	9.78	Functional	Analysis Based on Existing Seismic Analysis	14
SV607	3.85	0.40	0.24	0.32	9.78	Functional	Assigned by Rule of the Box. Parent Component SS607.	15
HP2C	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	197
DH1517	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	318
DH2733	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	321
MV1517	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component DH1517.	319
MV2733	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component DH2733.	322
SW1366	0.41	0.40	0.24	0.32	1.05	Functional	Analysis Based on Existing Seismic Analysis	161

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
CC5095	0.41	0.40	0.24	0.32	1.05	Functional	Analysis Based on Existing Seismic Analysis	341
MV1366	0.41	0.40	0.24	0.32	1.05	Functional	Assigned by Rule of the Box. Parent Component SW1366.	162
MV5095	0.41	0.40	0.24	0.32	1.05	Functional	Assigned by Rule of the Box. Parent Component CC5095.	342
MU3	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	22
MU38	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	17
SVMU3	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component MU3.	23
SVMU38	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component MU38.	18
SV4823	0.31	0.45	0.24	0.38	0.90	Functional	Earthquake Experience Data	298
SV4824	0.31	0.45	0.24	0.38	0.90	Functional	Earthquake Experience Data	299
DH11	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	312

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
DH12	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	313
CF1A	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	207
CF1B	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	208
MVDH11	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component DH11.	314
MVDH12	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component DH12.	315
MVCF1A	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component CF1A.	209
MVCF1B	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component CF1B.	210
SW1381	0.47	0.40	0.24	0.32	1.20	Functional	Earthquake Experience Data	165
C31-4	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component E42-4.	347

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
MC31-4	0.65	0.40	0.24	0.32	1.66	Functional	Assigned by Rule of the Box. Parent Component C31-4.	349
C71-1	0.92	0.40	0.24	0.32	2.34	Functional	Earthquake Experience Data	271
C75-1	0.75	0.40	0.26	0.30	1.90	Block Wall	New Analysis	352
C78-1	0.75	0.40	0.26	0.30	1.90	Block Wall	New Analysis	272
C21-1	0.39	0.45	0.24	0.38	1.12	Functional	Earthquake Experience Data	285
MC21-1	0.39	0.45	0.24	0.38	1.12	Functional	Assigned by Rule of the Box. Parent Component C21-1.	286
S61-1	0.22	0.45	0.24	0.38	0.63	Functional	Analysis Based on Existing Seismic Analysis	288
MS3311	0.22	0.45	0.24	0.38	0.63	Functional	Assigned by Rule of the Box. Parent Component S61-1.	290
MS61-1	0.22	0.45	0.24	0.38	0.63	Functional	Assigned by Rule of the Box. Parent Component S61-1.	289
E42-4	0.65	0.40	0.24	0.32	1.66	Functional	Earthquake Experience Data	346
S33-1	0.61	0.45	0.24	0.38	1.74	Functional	Earthquake Experience Data	287

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
MP43-1	0.61	0.45	0.24	0.38	1.74	Functional	Assigned by Rule of the Box. Parent Component S33-1.	336
C1-1	0.36	0.40	0.24	0.32	0.91	Functional	Earthquake Experience Data	157
E37-1	0.36	0.40	0.24	0.32	0.91	Functional	Assigned by Rule of the Box. Parent Component C1-1.	149
L5701	0.30	0.40	0.24	0.32	0.76	Functional	GERS	56
L57D1	0.30	0.40	0.24	0.32	0.76	Functional	GERS	57
Y1	0.82	0.40	0.24	0.32	2.08	Functional	GERS	103
Y3	0.82	0.40	0.24	0.32	2.08	Functional	GERS	105
D1P	0.82	0.40	0.24	0.32	2.08	Functional	GERS	84
D1N	0.82	0.40	0.24	0.32	2.08	Functional	GERS	94
Y1A	0.82	0.40	0.24	0.32	2.08	Functional	GERS	109
D1N01	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1N.	95
D1N03	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1N.	97
D1N04	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1N.	98

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
D1P01	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	85
D1P03	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	87
D1P07	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	89
D1P11	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	90
D1P13	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	91
D1P20	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	92
D1P24	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component D1P.	93
Y101	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component Y1.	107

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
Y108	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component Y1.	110
Y301	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component Y3.	115
Y101A	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component Y1A.	108
Y109A	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component Y1A.	111
YAR	0.82	0.40	0.24	0.32	2.08	Functional	GERS	76
YAU	0.82	0.40	0.24	0.32	2.08	Functional	GERS	82
YAR04	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component YAR.	77
YAR05	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component YAR.	78
YAR06	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component YAR.	79

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
YAU01	0.82	0.40	0.24	0.32	2.08	Functional	Assigned by Rule of the Box. Parent Component YAU.	83
1N	0.76	0.40	0.24	0.32	1.94	Functional	GERS	62
1P	0.76	0.40	0.24	0.32	1.94	Functional	GERS	61
DBC1N	0.65	0.40	0.24	0.32	1.64	Functional	GERS	219
DBC1P	0.65	0.40	0.24	0.32	1.64	Functional	GERS	218
DBC1NA	0.65	0.40	0.24	0.32	1.64	Functional	Assigned by Rule of the Box. Parent Component DBC1N.	222
BBC1NB	0.65	0.40	0.24	0.32	1.64	Functional	Assigned by Rule of the Box. Parent Component DBC1N.	223
DBC1PA	0.65	0.40	0.24	0.32	1.64	Functional	Assigned by Rule of the Box. Parent Component DBC1P.	224
BBC1PB	0.65	0.40	0.24	0.32	1.64	Functional	Assigned by Rule of the Box. Parent Component DBC1P.	225
YV1	0.95	0.40	0.24	0.32	2.42	Functional	GERS	99
YV3	0.95	0.40	0.24	0.32	2.42	Functional	GERS	101
YVA	0.95	0.40	0.24	0.32	2.42	Functional	GERS	81
LTSP9B3	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	33

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
FIS1422D	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	344
FTHP3C	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	200
TS-5261	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	296
TS5318	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	283
TS5443	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	358
TS-5597	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	282
TSH5421	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	350
TSL5421	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	351
TT5443	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	356
LSH 1128	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	267
LSL 1128	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	266
LT1525A	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	183

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
PT2000	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	181
PTRC2B4	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	43
TSH 1483	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	345
FTDH2B	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	332
LT2787	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	264
TT1356	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	153
PTSP12B1	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	31
TY5443	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	359
LTRC14-2	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	45
TESP11B1	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	26
TIC5443	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	357
TE-5443	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	355

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
TE-1356	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	151
TEIM07M	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	41
TE-RC3B5	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	38
TE-RC4B2	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	35
C3630	1.09	0.40	0.24	0.32	2.77	Anchorage	Earthquake Experience Data	47
LIRC14-2	1.09	0.40	0.24	0.32	2.77	Anchorage	Assigned by Rule of the Box. Parent Component C3630.	46
FYIHP3C1	1.09	0.40	0.24	0.32	2.77	Anchorage	Assigned by Rule of the Box. Parent Component C3630.	204
C5762	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	48
C5763	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	51
C5759	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	50
C5752	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	54

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
C5753	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	206
C5799	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	52
C5727	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	60
C5712	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	53
C5705	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	369
C5706	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	370
C5708	0.39	0.45	0.24	0.38	1.10	Functional	Earthquake Experience Data	371
PISP12B	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5708.	32
TTRC3B5	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5706.	37
TTRC4B2	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5706.	36

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
LISP9B1	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5712.	34
TDI4951	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5799.	40
TI4627	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5799.	39
HISRC2-1	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5705.	214
TTIM7M	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5763.	42
C5752E	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5752.	156
C5752F	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5752.	49
PY2000B	0.39	0.45	0.24	0.38	1.10	Functional	Assigned by Rule of the Box. Parent Component C5762.	178
C5716	0.42	0.45	0.24	0.38	1.19	Functional	Earthquake Experience Data	58

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
C5717	0.42	0.45	0.24	0.38	1.19	Functional	Earthquake Experience Data	59
C5720	0.42	0.45	0.24	0.38	1.19	Functional	Earthquake Experience Data	372
FYIHP3C	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	203
PI2000	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	179
PIRC2B4	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	44
LI1525A	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	184
TI1356	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	152
FYIDH2B	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	333
JY1525A	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	185

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
JY2000	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5716.	180
LI2787B	0.42	0.45	0.24	0.38	1.19	Functional	Assigned by Rule of the Box. Parent Component C5720.	265
C4601	0.28	0.40	0.24	0.32	0.71	Functional	Earthquake Experience Data	55
C3628	1.16	0.40	0.24	0.32	2.95	Functional	Earthquake Experience Data	205
FYHP3C1	1.16	0.40	0.24	0.32	2.95	Functional	Assigned by Rule of the Box. Parent Component C3628.	201
FYHP3C2	1.16	0.40	0.24	0.32	2.95	Functional	Assigned by Rule of the Box. Parent Component C3628.	202
C4607	0.27	0.40	0.24	0.32	0.67	Anchorage	New Analysis	215
C3019	0.50	0.40	0.24	0.32	1.27	Functional	Assigned based on Seismic Ruggedness	164
E22-1	0.30	0.40	0.24	0.32	0.76	Anchorage	Analysis Based on Existing Seismic Analysis	337
E27-1	0.40	0.35	0.24	0.26	0.90	Anchorage	Analysis Based on Existing Seismic Analysis	331
T10	0.34	0.35	0.24	0.26	0.77	Anchorage	New Analysis	182

Tabulated HCLPF Values with ESEL ID (Continued)

Equipment ID	HCLPF	β_C	β_R	β_U	A_m	Failure Mode	Fragility Method	ESEL Item #
T12	0.44	0.40	0.24	0.32	1.12	Anchorage	New Analysis	334
T46-1	0.57	0.40	0.24	0.32	1.45	Anchorage	New Analysis	263
T153-1	0.91	0.35	0.24	0.26	2.07	Anchorage	New Analysis	270

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