ENCLOSURE 1
ATTACHMENT 14

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 261
EXTENDED POWER UPRATE
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

PBNP-994-21-09, REVISION 0, HELB RECONSTITUTION PROGRAM
TASK 09 - GOTHIC MODELS

20 pages follow

## Table of Contents

## 1. Purpose

The purpose of Task 09 of the High Energy Line Break (HELB) Reconstitution Program as defined in Design Input (DI) 1 is to establish the GOTHIC models to be used for analyses of HELBs in the Primary Auxiliary Building (PAB) of the Point Beach Nuclear Plant (PBNP). The starting point for these models is the base case that is documented in DI 2.

Note that GOTHIC models of the PAB for HELB analyses are required for both pressure and temperature limiting cases. Even though the nature of these cases is slightly different, a single base case model was developed that is appropriate for both types of analyses. Also, it should be noted that this PAB model has been extended to encompass more refined modeling of the Turbine Building (TB), since HELBs must also be considered in the TB as seen in DI 3.

## 2. Design Input

The Design Input (DI) used in this analysis consists of the following:

1. AES Project Plan PBNP-994-21-01 "Project Plan for HELB Reconstitution Program" December 18, 2007.
2. AES Calculation 2005-0051 Rev. 0, "Primary Auxiliary Building GOTHIC Model".
3. AES Calculation PBNP-994-21-06 Rev. 0, "HELB Reconstitution Program - Task 6 – Break & Crack Size/Location Selection".
4. Turbine Building Comparison (Copy included in Attachment B.1).
5. Elevations of the Piping Centerlines for the Various Breaks in the Façade (Copy included in Attachment B.2).
6. Calculation of the Total Free Volume of the Façades (Copy included in Attachment B.3).
7. E-mail from Erich Ziller to Charles Agan August 06, 2008, "Requested information for HELB Gothic" (Copy included in Attachment B.4).
8. AES Calculation ENG-CS-169 Rev.0, "Turbine Building HELB Surface Areas & Flow Paths".
9. Final Safety Analysis Report, Revision 6/07

## 3. Assumptions

1. Deleted.

2. Data from GOTHIC models for plants that are similar to PBNP has been scaled to fill in data that was not readily available at the time this calculation was prepared. This assumption is primarily used for the Turbine Building. The sources of these models are included in the DI list in Section 2 above.
3. Deleted.
4. Connections that represent the pressure relief in the facades are represented by flow paths (FPs) from the façade to a pressure boundary condition (BC). The pressures in these boundary conditions are established by performing sensitivity studies on that pressure to determine the value that yields a flow that is close to 0.0 when running the null transient with these vent paths open. The null transient represents the conditions in the PAB during normal operating conditions. Thus, the desired BC pressure corresponds to having equilibrium conditions prior to the initiation of the HELB event.
5. The following assumptions have been made concerning the dimensions of the Containments, Refueling Water Storage Tank (RWST), Reactor Water Makeup Tank (RWMT), Blow Down Evaporator (BDE), and Gas Stripper Building (GSB) that are inside the facades. The first three are vessels assumed to be right circular cylinders, and the area and OD of the RWMT are assumed to be the same as that of the RWST. The horizontal cross sections of the DBE and GSB are assumed to be square. The bottom elevations of the last three are assumed to be the same as for the RWST which is 8 ft. 10% of the free volume is assumed to be occupied by other equipment in the facades based on a similar assumption used in DI 2.
6. The volume hydraulic diameters for the façade sub-volumes, which are vertical layers within the façade, are $4*V_{free}/S_w$ where $V_{free}$ is the total free volume and $S_w$ is the corresponding wetted surface area. The same expression is used for the TB volumes except that the gross dimensions are used.
7. For subdivided volumes, the free volumes are defined by the porosities. Thus no blockage or cell face variations are defined. (A cell is a region within the subdivided volume.) Also, default values are used for the turbulent and laminar leakage parameters, and cell face slip was ignored, since the cells are relatively large.
8. The forward and reverse form loss coefficients for added flow paths are assumed to be 1.5 based on assuming sharp edged entrances and exits (see Reference 2) unless otherwise noted in Attachment A.
9. The double doors that connect Rooms 272 and 273 (HVAC Equipment Rooms) to Rooms 524 and 596 (facades) are assumed to open; however, reverse flow from the facades into the HVAC Equipment Rooms is not allowed based on DI 7 which states that these doors

swing into the facades. The gaps for these doors are assumed to be open under all conditions.

10. The heights of the ends of a vertical FP are assumed to be 0.1 ft since these connections represent openings in the horizontal plane. The location of the lower end is at the top of the lower volume, and the location of the upper end is at the bottom of the upper volume.
11. Based on DI 7, there are nine roof top ventilators on each façade each of which are assumed to be tubes having an area of 6 $ft^2$ and an ID = 3.0 ft.
12. The inertia lengths for the band vent paths for the facades are assumed to be from the horizontal geometric centers to the corners.
13. Friction is ignored in all vent FPs in the facades since the flow within the facades passes through relatively unimpeded. (See Figure 1.2-6 of DI 9.)
14. All the flow paths that allow communication between the regions below and above the operating floor in the Turbine Building are represented by a single FP with an assumed area of 6000 $ft^2$ which is assumed to be a square. For breaks above the operating floor metal panels blow off and the environment does not propagate to the lower level. For breaks in the lower level the propagation to the upper floor is less severe than that for break in the upper floor.
15. The basement floor and the operating floor of the TB are 12" concrete, and all of the steel is ¼" steel. All of the outer surfaces (Floor, Roof, and Siding) of the TB are insulated.
16. The roof and siding materials of the TB are assumed to be the same as that of the PAB.
17. The Turbine Hall volume and Facade peak pressure is limited to 0.5 psig due to metal blow-off wall panels coming off. Therefore, the accuracy of the TB and Facade volume is not significant in determining the peak pressure. It only changes the time at which the panels come off.

## 4. Acceptance Criteria

There are no acceptance criteria associated with the analyses documented in this calculation.

## 5. Software

The version of GOTHIC Version 7.2a(QA) (Reference 1) as provided to AES by FP&L Energy was used for the these analyses.

## 6. Methodology

The methodology consisted of the following steps:

1. The base case GOTHIC model that is documented in DI 2 which is primarily designed to perform ventilation analyses was reviewed to determine changes that were necessary for the PAB HELB analyses.
2. The changes identified under Step 1 above were then implemented starting with the DI 2 model to develop the base case for the HELB analyses as described in Attachment A.

## 7. Analysis

The review of the DI 2 GOTHIC model for the PAB identified that there were two major areas of that model that required refinement. These areas are the facades and the Turbine Building, since DI 3 identifies that there are limiting HELBs in these two areas that require analyses. The DI 2 model included these areas, but they were treated in a cursory manner, since they do not have a significant impact on the ventilation analyses.

The information from DI 4 through 8 along with the assumptions given in Section 3 was used to calculate the parameters associated with these refinements as given in Attachment A.

## 8. Conclusions

This calculation documents the development of the base case GOTHIC model for the PBNP PAB that may be used as the basis to analyze the pressure and temperature limiting HELBs. Benchmarking will be done in Task 13 of the High Energy Line Break (HELB) Reconstitution Program.

## 9. References

1. AES Verification File GOTHIC Software Version 7.2a (QA) dated 2/20/08 including "GOTHIC CONTAINMENT ANALYSIS PACKAGE USER MANUAL Version 7.2a(QA) January 2006", NAI 8907-02 Rev 17".
2. Crane Technical Paper No. 410, Flow of Fluids.

## Attachment A

### Development of the PAB HELB Base Case

As noted in Section 7, the base case of the PAB HELB analyses consists of changes to the DI 2 base case. These changes consisted mainly of refinements in facades and the Turbine Building.

### A.1 Volume Parameters

A.1.1 Façade Model Changes

The Unit 1 and 2 facades are represented by Volumes 125 and 124 and are denoted as Rooms 524 and 596, respectively. Based on DI 6, their respectively total free volumes are 1,282,000 and 1,257,000 ft$^3$. Based on DI 5, there are three HELBs in the facades that require analyses, and DI 7 suggests that these volumes be divided into three layers. Thus the lumped volumes in the DI 2 model were replaced by sub-divided volumes with three vertical zones. DI 6 gives the total dimensions as: X = 145 ft, Y = 132 ft, and Z = 150 ft. However, based on DI 7, the bottom elevation and height of the facades were set to 6.5 and 152.5 ft, respectively. The grids that define the horizontal planes that divide these into the three vertically stacked sub-volumes are taken at elevations of ≈ 39 and ≈ 86 ft, so that the corresponding distances from the bottom are Z ≈ 32.5 and ≈ 79.5 ft. The actual Z dimensions are listed below. The X-Y plane is not subdivided. Using the data in DI 6 and 7, the following free volumes which define the porosities and hydraulic diameters for the sub-volumes for each façade are obtained. In these calculations, the elevations at which the horizontal planes are defined have been chosen as 6.5, 39, 86, and 159 ft based on DI 7. Refer to Assumption 5 concerning the dimensions the Containments, RWST, RWMT, BDE, and GSB. In the following calculation, the conversion factor 0.134 ft$^3$/gal is used for consistency with DI 6.

| Vessel | Volume (ft$^3$) | Area (ft$^2$) | Height (ft) | Bottom Elevation (ft) |
|---|---|---|---|---|
| Containment | ***1,379,280*** | 9852 | 140 | 6.5 |
| RWST | 40,200 | ***558.33*** | 72 | 8.0 |
| RWMT | 13,400 | ***558.33*** | ***24*** | ***8.0*** |
| BDE | 28,900 | 507 | 57 | ***8.0*** |
| GSB | 26,400 | 574 | 46 | ***8.0*** |

Note that parameters shown in ***bold italics*** have been inferred based on Assumption 5, and all others were obtained directly from DI 6 and 7.

Based on Assumption 5, the areas for the Containment and RWST yield respective diameters of 112 and 26.7 ft, and the areas of the DBE and GSB yield respective horizontal lengths of 22.5 and 24.0 ft.

A.1.1.1 Unit 1 Façade (Room 524 and Volume 125)
The Z grid locations are: 0, 32.9034, 79.7158, and 152.5 ft.

A.1.1.1.1 Elevation 6.5 to 39 ft. (Volume 125s1)
Blocked Volume

| | | | |
|---|---|---|---|
| Containment Volume | = 9852*(39-6.5) | = | 320,190 |
| RWST Volume | = 558.33*(39-8) | = | 17,308 |
| RWMT Volume | = 2*558.33*(32-8) | = | 26,800 |
| Total | | = | 364,298 |
| Total Volume | = 145*132*(39-6.5) | = | 622,050 |
| Total Blocked Volume | | = | -364,298 |
| Free Volume | | = | 257,752 $ft^3$ |

The porosity is 0.9*(257,752/622,050) = 0.3729
The wetted surface areas are:

| | | | |
|---|---|---|---|
| Horizontal at Elevation 6.5 ft | = 145*132 – 9852 – 3*558.33 | = | 7,613 |
| at Elevation 32 ft | = 2*558.33 | = | 1,117 |
| Vertical | = 2*(145+132)(39-6.5) | = | 18,005 |
| | 2*π*26.7*(39-8) | = | 2,600 |
| | π*112*(39-6.5) | = | 11,435 |
| Total | | = | 44,796 $ft^2$ |

Based on Assumption 6, the hydraulic diameter is $4*V_{free}/S_w$ = 4*257,752/44,796 = 23.02 ft.

A.1.1.1.2 Elevation 39 to 86 ft. (Volume 125s2)
Blocked Volume

| | | | |
|---|---|---|---|
| Containment Volume | = 9852*(86-39) | = | 463,044 |
| RWST Volume | = 558.33*(80-39) | = | 22,892 |
| Total | | = | 485,936 |
| Total Volume | = 145*132*(86-39) | = | 899,580 |
| Total Blocked Volume | | = | -485,936 |

Free Volume = 413,644 ft$^3$
The porosity is 0.9*(413,644/899,580) = 0.4138
The wetted surface areas are:
Horizontal at Elevation 80 ft = 558
Vertical = 2*(145+132)(86-39) = 26,038
π*26.7*(80-39) = 3,439
π*112*(86-39) = 16,537
Total = 46,572 ft$^2$
The hydraulic diameter is = 4*413,644/46,572 = 36.53 ft.

A.1.1.1.3 Elevation 86 to 159 ft. (Volume 125s3)
Blocked Volume
Containment Volume = 9852*(146.5-86) = 596,046
Total = 596,046
Total Volume = 145*132*(159-86) = 1,397,220
Total Blocked Volume = -596,046
Free Volume = 801,174 ft$^3$
The porosity is 0.9*(801,174/1,397,220) = 0.5161
The wetted surface areas are:
Horizontal at Elevation 146.5 ft = 9,582
at Elevation 159 ft = 145*132 = 19,140
Vertical = 2*(145+132)(159-86) = 40,442
π*112*(159-86) = 21,287
Total = 90,721 ft$^2$
The hydraulic diameter is = 4*801,174/90,721 = 35.32 ft.

A.1.1.1.4 Total Free Volume in the Model
The total Unit 1 Façade free volume in the model is 1,325,313 ft$^3$.

A.1.1.2 Unit 2 Façade (Room 596 and Volume 124)
The Z grid locations are: 0, 32.7974, 79.5410, and 152.5 ft.

A.1.1.2.1 Elevation 6.5 to 39 ft. (Volume 124s1)
Blocked Volume
Containment Volume = 9852*(39-6.5) = 320,190
RWST Volume = 558.33*(39-8) = 17,308

BDE Volume = 507*(39-8) = 15,717
GSB Volume = 574*(39-8) = 17,794
Total = 371,009
Total Volume = 145*132*(39-6.5) = 622,050
Total Blocked Volume = -371,009
Free Volume = 251,041 $ft^3$
The porosity is 0.9*(251,041/622,050) = 0.3632
The wetted surface areas are:
Horizontal at Elevation 6.5 ft = 145*132–9852–558-507-574 = 7,649
Vertical = 2*(145+132)(39-6.5) = 18,005
4*22.5(39-8) = 2,790
4*24*(39-8) = 2,976
π*26.7*(39-8) = 2,600
π*112*(39-6.5) = 11,435
Total = 45,455 $ft^2$
The hydraulic diameter is = 4*251,041/45,455 = 22.09 ft.

A.1.1.2.2 Elevation 39 to 86 ft. (Volume 124s2)
Blocked Volume
Containment Volume = 9852*(86-39) = 463,044
RWST Volume = 558.33*(80-39) = 22,892
DBE Volume = 507*(65-39) = 13,182
GSB Volume = 574*(54-39) = 8,610
Total = 507,728
Total Volume = 145*132*(86-39) = 899,580
Total Blocked Volume = -507,728
Free Volume = 391,852 $ft^3$
The porosity is 0.9*(391,852/899,580) = 0.3920
The wetted surface areas are:
Horizontal at Elevation 54 ft = 574
at Elevation 65 ft = 507
at Elevation 80 ft = 558
Vertical = 2*(145+132)(86-39) = 26,038
4*22.5(65-39) = 2,340
4*24*(54-39) = 1,440
π*26.7*(80-39) = 3,439

π*112*(86-39) = 16,537
Total = 51,433 $ft^2$
The hydraulic diameter is = 4*391,852/51,433 = 30.47 ft.

A.1.1.2.3 Elevation 86 to 159 ft. (Volume 124s3)
Blocked Volume
Containment Volume = 9852*(146.5-86) = 596,046
Total = 596,046
Total Volume = 145*132*(159-86) = 1,397,220
Total Blocked Volume = -596,046
Free Volume = 801,174 $ft^3$
The porosity is 0.9*(801,174/1,397,220) = 0.5161
The wetted surface areas are:
Horizontal at Elevation 146.5 ft = 9,582
at Elevation 159 ft = 145*132 = 19,140
Vertical = 2*(145+132)(159-86) = 40,442
π*112*(159-86) = 21,287
Total = 90,721 $ft^2$
The hydraulic diameter is = 4*801,174/90,721 = 35.32 ft.

A.1.1.2.4 Total Free Volume in the Model
The total Unit 2 Façade free volume in the model is 1,299,660 $ft^3$.

**A.1.2 Turbine Building Model Changes**

The entire TB is represented by a single lumped volume in the DI 2 base case which is Volume 126. Instead of modifying this volume, two new volumes were added which are Volume 133 and 134 that represent the volumes below and above the Turbine Deck (Operating Floor), respectively. The PB PAB model of the TB relies heavily on Assumption 2 along with DI 4.

The net free volumes are taken directly from DI 4 and are 2.025 and 3.931 $Mft^3$, respectively. The respective bottom elevations are 8 and 44 ft, and the respective heights are 36 and 65 ft as given in DI 4. The total TB gross volume is 7.007 $Mft^3$ from DI 4, and the corresponding gross surface area is:
A = 4*(542*128) + 2*[109*(542+128)] = 0.424 $Mft^2$.

The overall hydraulic diameter based on these gross dimensions as stated in Assumption 6 is 4*7.007/0.424 = 66.1 ft and is used for both volumes.

### A.2 Flow Path Parameters

A.2.1 Façade Model Changes

The double doors that connect Rooms 272 and 273 (HVAC Equipment Rooms) to Rooms 524 and 596 (facades) are represented in the DI 2 base case model with FPs 600 through 605. These six FPs are two groups of three each with the first three representing the Unit 1 door. Each group of three consists of two vertically stacked FPs and the door gap that spans the door height. In the DI 2 model, all of these FPs were blocked closed, since they had very large forward and reverse loss coefficients. Following Assumption 9, the only changes that were made consisted of setting the forward loss coefficients to 1.5 for all of them and setting the reverse loss coefficients to 1.5 for the two that represented the gaps.

DI 7 identifies that there are three sets of pressure relief flow paths for each of the facades. These FPs are the roof vents and the band vents at the 70 and 112 ft elevations. The following table lists the FPs that were added to the model that represent these vents along with their Volumes A and B, the latter of which are pressure boundary conditions.

| FP Number | Description | Volume A | Volume B |
|---|---|---|---|
| 628 | U1Roof Vent | 125s3 | 136P |
| 629 | U2 Roof Vent | 124s3 | 137P |
| 630 | U1 112 ft Band | 125s3 | 138P |
| 631 | U2 112 ft Band | 124s3 | 139P |
| 632 | U1 70 ft Band | 125s2 | 140P |
| 633 | U2 70 ft Band | 124s2 | 141P |

The bottom elevations and heights (Assumption 10) are listed in the following table.

| FP Number | Volume A Elevation (ft) | Volume A Height (ft) | Volume B Elevation (ft) | Volume B Height (ft) |
|---|---|---|---|---|
| 628 | 158.9 | 0.1 | 158.9 | 0.1 |
| 629 | 158.9 | 0.1 | 158.9 | 0.1 |
| 630 | 112.0 | 0.583 | 112.0 | 0.583 |
| 631 | 112.0 | 0.583 | 112.0 | 0.583 |
| 632 | 70.0 | 0.583 | 70.0 | 0.583 |
| 633 | 70.0 | 0.583 | 70.0 | 0.583 |

The areas of these FPs are:
Roof Vent: A (FP 628 and 629) = 9*6 = 54.0 $ft^2$ (See Assumption 11)
112 ft Band A (FP 630 and 631) = 321.5 $ft^2$
70 ft band A (FP 632 and 633) = 176.5 $ft^2$

The hydraulic diameters of these FPs are:
Roof Vent Dh (FP 628 and 629) = ID = 3.0 ft (See Assumption 11)
112 ft Band Dh (FP 630 and 631) ≈ 2*H = 2*0.583 = 1.17 ft
70 ft band Dh (FP 632 and 633) ≈ 2*H = 2*0.583 = 1.17 ft

The inertia lengths of these FPs are based on Assumption 12 and are:
Roof Vent L (FP 628 and 629) = (159-86)/2 = 36.5 ft
112 ft Band L (FP 630 and 631) = $\sqrt{(145/2)^2+(132/2)^2}$ = 98.0 ft
70 ft band L (FP 632 and 633) = $\sqrt{(145/2)^2+(132/2)^2}$ = 98.0 ft

The friction lengths of these FPs are 0.0 based on Assumption 13, and the forward and reverse loss coefficients are 1.5 based on Assumption 8.

A.2.1 Turbine Building Model Changes

FP 634 was added to represent all of the flow paths that allow communication between the regions below and above the operating floor which is at Elevation 44. Assumption 10 is used to set the bottom elevations and the heights which are shown in the following table. Volume A = 133 and Volume B = 134.

| FP Number | Volume A Elevation (ft) | Volume A Height (ft) | Volume B Elevation (ft) | Volume B Height (ft) |
|---|---|---|---|---|
| 634 | 43.9 | 0.1 | 44.0 | 0.1 |

The area is 6000 $ft^2$ based on Assumption 14. The hydraulic diameter is based on assuming a square, so $Dh = \sqrt{A} = \sqrt{6000} \approx 80$ ft. The inertia length is (36+65)/2 = 50.5 ft.

The friction length of 0.0 is based on Assumption 13, and the forward and reverse loss coefficients are 1.5 based on Assumption 8.

### A.3 Thermal Conductor Parameters

Thermal conductors were added to the Turbine Building volumes based on DI 8 as follows. The DI 8 Turbine Building data is for the Prairie Island Plant which has four stacked vertical regions. The lowest region (Condenser Pit) from Elevation 668'-9" to 696' is ignored. The second and third regions are equivalent to the PBNP TB region below the operating floor and the fourth region, to the PBNP TB region above the operating floor. The added thermal conductors are listed in the following table.

| Conductor No. | Description | Volume A | Volume B | Orientation |
|---|---|---|---|---|
| 761 | TB Ground Floor | 133 | 133 | I |
| 762 | TB Lower Siding | 133 | 133 | I |
| 763 | TB Lower Steel | 133 | 133 | I |
| 764 | TB Deck | 133 | 133 | X |
| 765 | TB Roof | 133 | 133 | I |
| 766 | TB Lower Siding | 133 | 133 | I |
| 767 | TB Lower Steel | 133 | 133 | I |

The TB foot print has an area of (542*128) = 69,376 ft2. A conservative value of 65,000 $ft^2$ is used for the concrete ground floor, and 69,400 $ft^2$ is used for the roof. A conservative value of 60,000 $ft^2$ is used for the operating floor which takes into consideration the assumed 6,000 $ft^2$ FP between the lower and upper regions of the TB. The siding areas are:

Below Operating Floor = 2*(542+128)*(44-8) = 48,240 $ft^2$ (16,300)

Above Operating Floor = 2*(542+128)*(109-44) = 87,100 $ft^2$ (56,900) where the conservative values in the parentheses are based in the DI 8 data and are the values used in the model.

From DI 8, the total metal surfaces for the PI TB equivalent regions below and above the operating floor are 264,906 and 262,041 ft$^2$, respectively. Thus, after eliminating corresponding siding from those areas, conservative steel areas of 244,000 and 122,600 ft$^2$ are used in the PB model.

The following table lists the heat transfer coefficient (HTC) types and thermal conductor types based on Assumptions 15 and 16.

| Conductor No. | Volume A HTC | Volume B HTC | Conductor Type |
|---|---|---|---|
| 761 | 1 | 4 | 3 |
| 762 | 3 | 4 | 27 |
| 763 | 3 | 3 | 48 |
| 764 | 2 | 1 | 3 |
| 765 | 2 | 4 | 26 |
| 766 | 3 | 4 | 27 |
| 767 | 3 | 3 | 48 |

The initial temperatures are set to 85F.

### A.4 Boundary Condition Parameters

The following table lists the new boundary conditions along with the pressures that were obtained using Assumption 4.

| BC No. | Description | Pressure (psia) |
|---|---|---|
| 136P | U1Roof Vent | 14.2757 |
| 137P | U2 Roof Vent | 14.2757 |
| 138P | U1 112 ft Band | 14.2986 |
| 139P | U2 112 ft Band | 14.2986 |
| 140P | U1 70 ft Band | 14.3192 |
| 141P | U2 70 ft Band | 14.3192 |

**A.5 Run Control Parameters**

A second time domain was added which is identical to the first except that the DT Ratio is set to 1.0 and the End Time set to 100.0 sec.

**A.6 Volume Initial Conditions**

The initial conditions in all control volumes are 14.375 psia pressure, 90 F temperature, and 37% relative humidity with the exception of the following volumes.

| Volume Number | Pressure, psia | Temperature, F | Relative Humidity, % |
|---|---|---|---|
| 21s | 14.375 | 91.5 | 37 |
| 25s | 14.375 | 91.5 | 37 |
| 42s | 14.375 | 99.5 | 37 |
| 47s | 14.375 | 104.5 | 37 |
| 58s | 14.375 | 91.5 | 37 |
| 64s | 14.375 | 90 | 37 |
| 82 | 14.7 | 95 | 37 |
| 88 | 14.7 | 95 | 37 |
| 103 | 14.375 | 94.5 | 37 |

# Attachment B

## Copies of Design Input

This attachment contains copies of some of the Design Inputs that are listed in Section 2 and were used for the development of the PAB HELB base case.

## B.1 Design Input 4

Turbine Building Comparison

Based on Column Row Spacing

| | Length | Width | Height | Cond Pit | Gross |
|---|---|---|---|---|---|
| Prairie Island Nuclear Generation Plant | | | | | |
| PINGP | 440’ | 126’ | 107 (695-802) | 0.300 | 6.232 |
| Kewaunee Power Station | | | | | |
| KPS | 227.5 | 130 | 108 (586-694) | 0.000 | 3.194 |
| Point Beach Nuclear Plant | | | | | |
| PBNP | 542 | 128 | 101 (8-109) | 0.000 | 7.007 |

Based on Other Documents

| | Gross | Net | Source |
|---|---|---|---|
| PINGP | 6.519 | 5.636 (86.5%) | Calculation ENG-ME-268 |
| KPS | 2.885 | 2.800 (97.1%) | USAR Appendix 10A Figure |
| PBNP | 7.007 | 5.956 (85.0%) | Estimated |

Vertical Distribution

| | Net Above Operating Floor | Net Below Operating Floor | |
|---|---|---|---|
| PINGP | 3.733 (66.2%) | 1.903 | Calculation ENG-ME-268 |

| | | | |
|---|---|---|---|
| KPS | 2.000 (71.4%) | 0.800 | USAR Appendix 10A Figure |
| PBNP | 3.931 (66.0%) | 2.025 | Estimated |

### B.2 Design Input 5

The following elevations are the piping centerlines for the various breaks in the Facade:

MS 88'-0"
MS to AFWPT 88'-0" and 81'-10"
FW 61'-8" and 48'-0"
CD 47'-4" and 16'-11"
SB 34'-0" and 15'-0"

Based on the elevations we have chosen for the three compartments, the limiting breaks in each compartment would be:

Top MS
Middle MS to AFWPT
Bottom SB

### B.3 Design Input 6

Purpose

This calculation is to determine the total free volume of each façade building.

References and Design Inputs

- Calc. No.: PBNP-994-18-M01
  - U-1/U-2 total Façade area
  - U-1/U-2 Containment area
  - U-1/U-2 RWST area
  - U-1 RWMT
  - U-2 Blow Down Evaporation Room area
  - U-2 Gas Stripper Building

Assumptions

- Rough estimation: volume of relevant structures rounded to nearest thousand cubic feet
- Façade and Containment of U-1= Façade and Containment of U-2
- 100,000 gallon capacity of RWMT

- 300,000 gallon capacity of RWST
- 10% of total displacement subtracted to account for additional equipment inside Façade

Methodology

- Each unit's excess volume calculated separately according to individual layout
- Computed volumes based on areas calculated in referenced document and known height of structures in question

Calculation

- Free volume of U-1= [Façade – Containment –RWST –(RWMT x2)] x 0.9

  = [(145' x 132' x 150') – (9852 $ft^2$ x 140') – (300,000 gal x 0.134 $ft^3$/gal) – (2 x 100,000 x 0.134 $ft^3$/gal)] x 0.9

  = (2,871,000 $ft^3$ – 1,379,000 $ft^3$ -40,000 $ft^3$ -27,000 $ft^3$) x 0.9

  =1,282,000 $ft^3$

- Free volume of U-2 = [Façade –Containment –RWST –BDE –GSB] x 0.9

  = [2,871,000 $ft^3$ -1,379,000 $ft^3$ – 40,000 $ft^3$ - (57' x 507 $ft^2$) – (46' x 574 $ft^2$)] x 0.9

  =1,257,000 $ft^3$

Conclusion

- The estimated free volume of the U-1 Façade is 1,282,000 $ft^3$
- The estimated free volume of the U-2 Façade is 1,257,000 $ft^3$

## B.4 Design Input 7

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**From:** ZILLER, ERICH [mailto:ERICH.ZILLER@fpl.com]
**Sent:** Wednesday, August 06, 2008 12:38 PM
**To:** Agan, Charles E.
**Cc:** Reiff, Mark; KRUKOWSKI, ROBERT
**Subject:** Requested information for HELB Gothic

Charles,

Bob and I did an in-plant tour to gather the information you requested. We included a roof top tour which allowed us to inspect the facade walls for possible additional vent points to atmosphere. We are delighted to report a 7" wide (0.583') bleed point which extends partially around the facades at about the 70' elevation---a total of 302.6 feet. A second 7" wide (0.583') bleed point at approximately the 112' elevation extends entirely around the facades a net distance of 551.5' after subtracting one 2.5' wide door. The partial lower band of 176.51 ft2 + the upper band of 321.52 ft2 = 498 ft2/facade, this in addition to the nine roof top ventilators on top each façade that you were already advised of. Note that the top of the facade roofs at their highest point is 160' pitched down to their four outer edges at 158' 6". Considerable air flow was noted exiting the facades from the higher elevation bleed points where we could physically access it.

We discussed your slicing the façade into three layers and how to best do this. We came up with the following suggestion:

6.5' to 39' – this would encompass P-51 & P-52, SGA & B Blowdown pene at ele 34' and piping upstream of the recovery heat exchangers. It would also encompass most but not all of the Blowdown Recovery HEX Condensate Return line piping which leaves the HEX's on Unit 1 at ~16' 11" rising to 46' 8" elevation and on Unit 2 leaves at ~17' 6" and rising to the 48' elevation.

39' to 86' – this would encompass P-4 & P-3 the Main Feed Line "A" & "B" penetrations, piping, and outside containment check valves. The Main Feed line penetrations are at elevations 61' 6" & 48' elevations respectively.

86' to 159' – this would encompass P-1 & P-2 the Main Steam Line "A" & "B" 88' ele penetrations, piping, four SG Safety valves, atmospheric steam dumps, steam driven auxiliary feedwater pump first off steam supply valves, Main Steam Isolation valves 1(2) 2018 & 2017 and their position indication switches which are at ~90' elevation. (At PBNP either MSIV leaving full open causes a trip of that unit's main turbine)

The top of the RWST's is at ~ 80' ele which is quite close to the A Main Steam Lines of both units. There are no pipe restraints or hangers above the top of the RWST's in either façade so pipe whip may be of concern. The bottom of the RWST's is on elevation 8'. Both 1(2) LI-971 & 973 are contained in insulated boxes with 1/8" metal banding keeping them closed; the RWST level transmitters are all at elevation 9' 9".

The cross over steam dump discharge piping terminates ~ 8' above the 66' fan room roofs at ~ 117' elevation. Each fan room has four discharge lines with a 7.9166' (7' 11") circumference. The gap from the discharge line OD to the ID of the drip pans is .2083' or (2.5"). The OD of the discharge line is 2.5199' and the ID of the drip tray is 2.5199' + (2 X .2083') = 2.9365'. Subtracting the circular area of the discharge line OD from the circular area of the drip tray ID results in 1.785 ft2/cross over steam dump discharge line. Also of interest is that there is a constant strong draft leaving the 66' ele fan rooms 272 & 273 via the four roof discharge lines which is easily felt by hand. You were previously provided information on a vent path via vacuum breakers to each purge exhaust fan suction (2/unit), through the fan discharge plenum to the purge exhaust stacks which penetrate the façade roofs ending at ~ the 166' elevation. The limiting factor for this relief path is the physical size of the vacuum breakers since the discharge ducting is much larger. Note that the 66' ele double doors of interest from rooms 272 & 273 swing into the facades and that both doors have all closure latches and upper & lower door frame and floor pins removed.

Hopefully the above information will facilitate your improving the Gothic model of the facades, and and rooms 272 & 273.

Erich Ziller & Bob Krukowski