RAS 14362

Eval 330592-27-27

Purpose:
The purpose of this Tech Eval is to document representative thickness of the Drywell Vessel based on inspection and associated calculations.

This information will be provided to Structural Integrity Associates as input in the development of a Finite Element Model of the Oyster Creek Drywell Vessel (Contract Number 1002562, Requisition Number 846565). As such, the intent per this Tech Eval is to define representative thicknesses based on the 2006 Refueling Outage ultrasonic thickness measurements to obtain a realistic picture of the margins that currently exist for the Oyster Creek drywell.

This Tech Eval has been performed in accordance with CC-AA-309-101 Revision 8.

This Tech Eval is classified as Safety Related "Q"

A HU-AA-1212 review has been performed of this technical product. Based on a Medium Consequence Factor (Possibility of a Regulatory Open Item) and three Process and Human Performance Risk Factors, the Risk Rank was determined to be "1". Therefore, Independent Review in accordance CC-AA-309-101, revision 8 is acceptable.

Assumptions

1 The purpose of this Tech Eval is to provide representative thicknesses for each region and elevation. Oyster Creek Engineering has developed several calculations that demonstrate that the inspection data meets acceptance criteria (References 1, 2, 3, and 5). However, in many cases the UT data is treated conservatively when compared to the acceptance criteria. This conservative treatment results in assumed vessel thicknesses that are thinner and more widespread (i.e., bigger surface area) than is actually in the field. This approach is proper and acceptable for the referenced documents since their purpose is to demonstrate all acceptance criterion is met.

The purpose of this Tech Eval, however is to provide realistic representative thickness of a region. These representative thicknesses will be design input to calculations that will demonstrate that both existing margins and the margins that will exist at the end of the period of extended operation are acceptable.

Therefore, the results based on these representative thickness values will be more accurate.

The intent of this Tech Eval is to define representative thicknesses based on the actual ultrasonic measurements taken from inside the drywell. The UT measurements taken from outside the drywell are less representative since these measurements purposely concentrated on thin local areas (less than 2 ½" in diameter) and due to the surface preparations needed to obtain accurate external UT reading.

Template = SECY-028

SECY-02

Methodology

1) For regions other than the sandbed, a representative value will be chosen based on the thinnest average grids values from the monitoring program and associated calculations and that have been provided to the regulator in various presentations and submittals and, therefore, is part of the public record. These values may be values documented for past inspections, rather than the most recent value for that region. Although this remains conservative (selecting the thinnest average value), the variability in the data is not as significant as in the sandbed region and the values used are consistent with those previously provided to regulatory organizations.

2) Since the existing margin in the sandbed region is smaller, more representative general thickness values will be determined based on the following:

   a) As noted in the assumptions, internal grid measurements will be used as the basis for the representative thickness. These measurements are considered to be the most accurate since the coating on the inside surface of the drywell was removed for the measurements and a protective grease coating is applied after measurements are taken (to eliminate the possibility of internal surface corrosion). The average internal grid measurements were used as the primary indicator of the representative general thickness of each bay. However, other data sources were used to verify or augment the applicable values for each of the bays. These other sources of data were the external data, pictures of the external surfaces of the sandbed, and the trench data in bays 15 and 17. Augmentation of the grid data is described in the sections 2b through 2h.

   b) The external individual UT readings were deliberate attempts to identify the thinnest local areas less than 2 ½" inches in diameter in each bay. Therefore, using these values (only) to define representative general thicknesses is not appropriate. However, the external data was used to define locally thin areas that are thinner than 0.736" (see item 3 below) and that will be included in the analysis model.

   c) The measurement data makes it evident that the wall loss experienced while the sand was present did not encompass the entire sandbed region from elevation 8'11" to 12' 3" since the regions were either not completely filled with sand or not completely filled with water. Pictures taken in 1992 of the external shell surface (after sand removal) confirmed the presence of a "transition" line at approximate elevation 11'. Above this "transition" line the thickness of the vessel is close to nominal wall thickness and below the line are areas that exhibit wall loss due to the corrosion. Therefore, the general wall thickness of each sandbed bay has been divided into two areas; above and below elevation 11' 0". This will reduce the conservatism that would be introduced by assuming the entire bay thickness is equivalent to an average of the external readings or the average of the internal grids readings.

d) Where the internal grid measurements were clearly not representative of the corrosion on the shell in that bay, representative measurement from adjacent bays were utilized to provide a representative general thickness. Bay 1 is the prime example of the use of this methodology. Visual and photographic observations of Bay 1 and Bay 19 indicate these to be two of the most heavily corroded bays. External UT reading in Bay 1 confirms the presence of corrosion. Yet, the internal Grid UT examination in Bay 1 would indicate near nominal thickness. Since some of the external readings occur above elevation 11' 0", it was concluded that corrosion for the whole bay should be assumed. Therefore, the values from the adjacent corroded bay (Bay 19) were deemed to be more representative for Bay 1 than the internal grid value.

e) Where the trenches were cut out of the drywell floor (elevation 10' 3") allowing UT measurements from inside the Drywell in large areas, these measurements were used to determine the general thickness of these bays (Bays 5 and 17). The trench UT data consists of hundreds of individual UT readings over a large area, rather than only 49 readings or less over smaller regions. Therefore, the results of these inspections are concluded to be representative of the general thickness of these two bays.

f) Where the internal data indicates a "transition" line through the grid, the average of the lower reading were used to define that particular bay general thickness below elevation 11'.

g) In one case (bay 15) there were no internal grid or external individual data available below elevation 11'. Therefore, an average of the two adjacent bays was used. The basis for this approach is the assumption that there is a general wall thickness gradient between the two adjacent bays that would adequately represent the general thickness of the bay between them.

h) For bays 9, 15, and 17 (above elevation 11') there are multiple internal grids. Therefore in these bays, the weighted average of the multiple grids were calculated by summing the total number of valid thickness readings and dividing by the total number of valid readings.

3) In several bays of the sandbed region there are locally thin areas that are thinner than 0.736" and are confined to areas no larger than 36" by 36". These areas will be input to the model as defined locally thin circular areas. These areas were selected directly from calculation C-1302-187-5320-024 revision 2. To facilitate computer modeling of the locally thinned areas, larger circular areas were overlaid over the thin square areas identified in calculation C-1302-187-5320-024 revision 2. The circular areas completely capture the square areas. This introduces a small amount of conservatism since the area of the circles exceeds the area of the squares. Although conservative, this is not expected to significantly impact the overall results obtained from the analysis.

Detail Evaluation:

Regions other than the Sandbed

Region	Elevations	Value in mils	References
Cylindrical Region	**71' 6" to 93'**	**604**	1) Oyster Creek License Renewal ACRS 1/18/07 Presentations Slide 14 (reference 3) 2) 1994 average grid value for grid 9-20 Calculation C-1302-187-5320-037 Revision 3 appendix 7 page A7-20 of 29 (reference 4)
Knuckle Region	**65' 2 7/8" to 71' 6"**	**2530**	1) Oyster Creek License Renewal ACRS 1/18/07 Presentations Slide 14 (reference 3) 2) 2006 average grid value for bay 9 Calculation C-1302-187-5320-037 Revision 3 page 11 of 48 (reference 4)
Upper Spherical Region	**50' 11/18" to 65' 2 7/8"**	**676**	1) Oyster Creek License Renewal ACRS 1/18/07 Presentations Slide 14 (reference 3) 2) 1994 average grid value for grid 13 -32 - Calculation C-1302-187-5320-037 Revision 3 appendix 5 page A5-23 of 38 (reference 4)
Middle Spherical Region	**37' 3" to 50' 11/18"**	**678**	1) Oyster Creek License Renewal ACRS 1/18/07 Presentations Slide 14 (reference 3) 2) 2006 average grid value for grid 13-31 - Calculation C-1302-187-5320-037 Revision 3 appendix 3 page A3-24 of 36 (reference 4)
Lower Spherical Region	**To 23' 6 7/8" to 37' 3"**	**1160**	1) Oyster Creek License Renewal ACRS 1/18/07 Presentations Slide 14 (reference 3) 2) 2006 average grid value for bay 19- Calculation C-1302-187-5320-037 Revision 3 page 11 of 48 (reference 4)
Embedded Region (1154 Nominal Thickness)	**6' 7" below 8' 11"**	**1113**	1) Oyster Creek License Renewal ACRS 1/18/07 Presentations Slide 124 (reference 3) 2) Tech Eval 00546049-07, Attachment 7 page 1 of 2 "Water Found in Drywell Bay 5 – UT Data Evaluation
Embedded Region (676 Nominal Thickness)	**Below 6' 7"**	**636**	1) Tech Eval 00546049-07, page 8 of 10 "Water Found in Drywell Bay 5 – UT Data Evaluation

Sandbed Region

BAY	Above Elevation 11'-0" (mils)	Basis	Below Elevation 11'-0" (mils)	Basis
1	826	Same value as used for Bay 19 (adjacent bay)	826	Same value as used for Bay 19 (adjacent bay)
3	1180	Internal grid average (single grid) Ref. 2 page 7	950	Numerical average thickness between Bays 1 & 5
5	1185	Internal grid average (single grid) Ref. 2 page 7	1074	Average of internal trench data points (six 49 point grids). Refer to page 5 of 10 of A2152754 E09
7	1133	Internal grid average (single grid) Ref. 2 page 7	1034	Numerical average thickness between Bays 5 & 9
9	1074	Weighted average of two internal grids (49 point and 7 point) Ref. 2 page 6 and 7	993	Smaller of the two internal grid averages (49 point grid) Ref. 2 page 6
11	860	Average of two internal grids (both 49 point) Ref. 2 page 6	860	Average of two internal grids (both 49 point) Ref. 2 page 6
13	907	Average of two internal grids (both 49 point; 7 point grid data not used) Ref. 2 page 6 and 7	907	Average of three internal grids (both 49 point; 7 point grid data not used) Ref. 2 page 6 and 7
15	1062	Weighted average of two internal grids (49 point and 7 point) – Ref. 2 page 6 and 7	935	Numerical average thickness between Bays 13 & 17
17	863	Weighted average of the bottom of internal grid 17A (28 points) and internal grid 17D (49 points). – Ref. 2 page 6 Data for grid 17/19 not used.	963	Average of internal trench data points (six 49 point grids). Refer to page 6 of 10 on Tech Eval A2152754 E09
19	826	Average of three internal grids (all 49 points) – Ref. 2 page 6	826	Average of three internal grids (all 49 points) – Ref. 2 page 6

Locally Thin Areas

See Attachment 1

Conclusion:

The attached table provides representative thicknesses of the Drywell Vessel based on 2006 inspection and other past inspections. These values shall be used as general thickness values for the associated region.

OYSTER CREEK DRYWELL THICKNESSES FOR USE IN BASE CASE ANALYSIS		
LOCATION		THICKNESS (mils)
Cylindrical Region		604
Knuckle Region		2530
Upper Spherical Region		676
Middle Spherical Region		678
Lower Spherical Region (Note 1)		1160
Embedded Region (1154 Nominal Thickness)		1113
Embedded Region (676 Nominal Thickness)		636
SANDBED REGION		
BAY	Above Elevation 11'-0" (mils)	Below Elevation 11'-0" (mils)
1	826	826
3	1180	950
5	1185	1074
7	1133	1034
9	1074	993
11	860	860
13	907	907
15	1062	935
17	863	963
19	826	826

In addition since there are several locally thin areas in the sandbed. Specific thin area shall be modeled per Attachment 1.

Reference:

1) Calculation C-1302-187-5320-024 Revision 2
2) Calculation C-1302-187-5320-041 Revision 0
3) Calculation C-1302-187-5320-037 Revision 3
4) Oyster Creek License Renewal ACRS 1/18/07 Presentation
5) Tech Eval 00546049-07, "Water Found in Drywell Bay 5 – UT Data Evaluation

Attachments

Attachment 1 – Sketches showing locally thin area. (5 pages)

Prepared By – Peter Tamburro 4/20/07

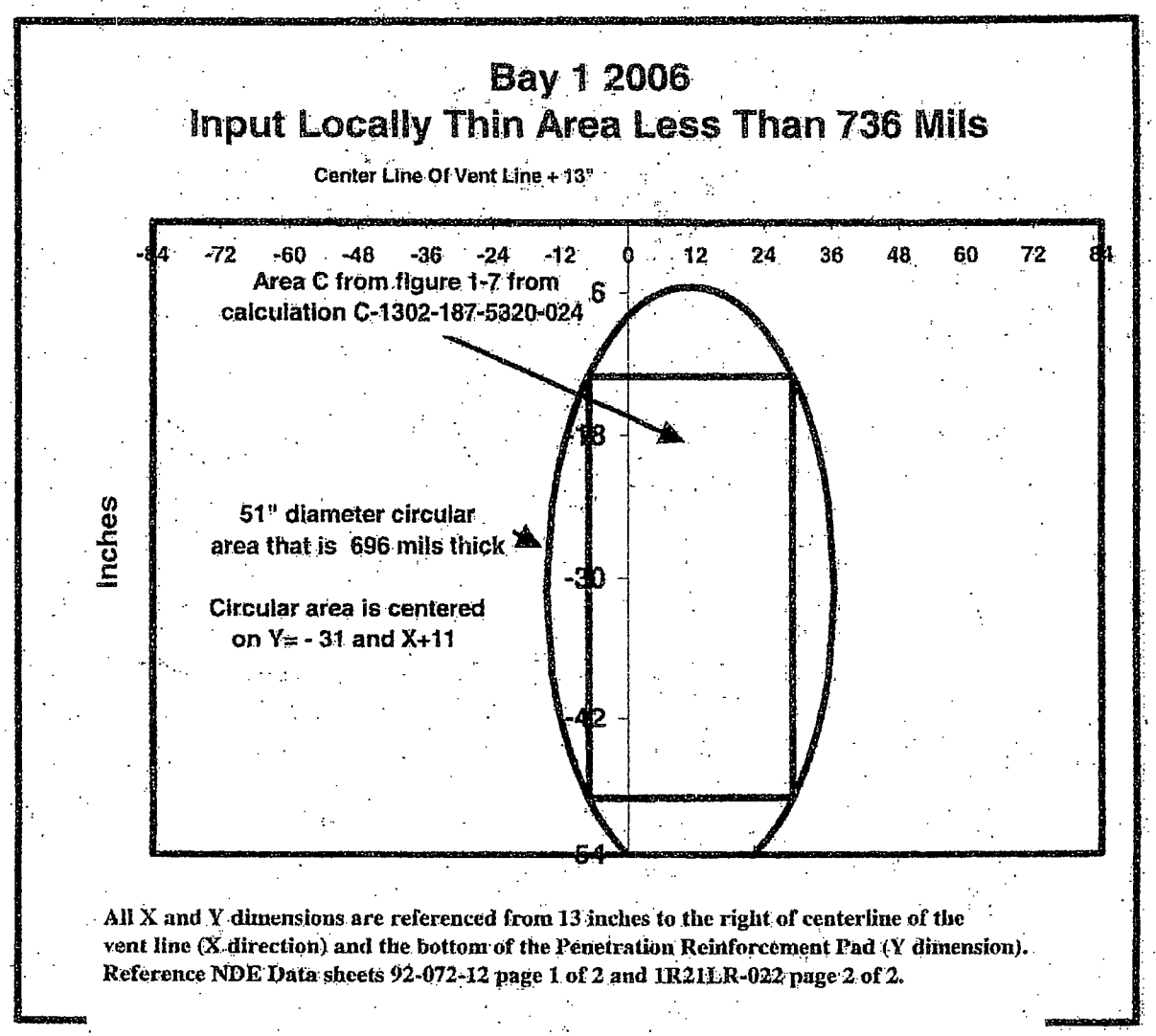
Independent Review:

The Independent Review has been completed in accordance with ER-AA-309-101. I have independently verified and agreed with the methodology, inputs, and results of this Technical Evaluation. All of my comments were answered and incorporated as appropriate.

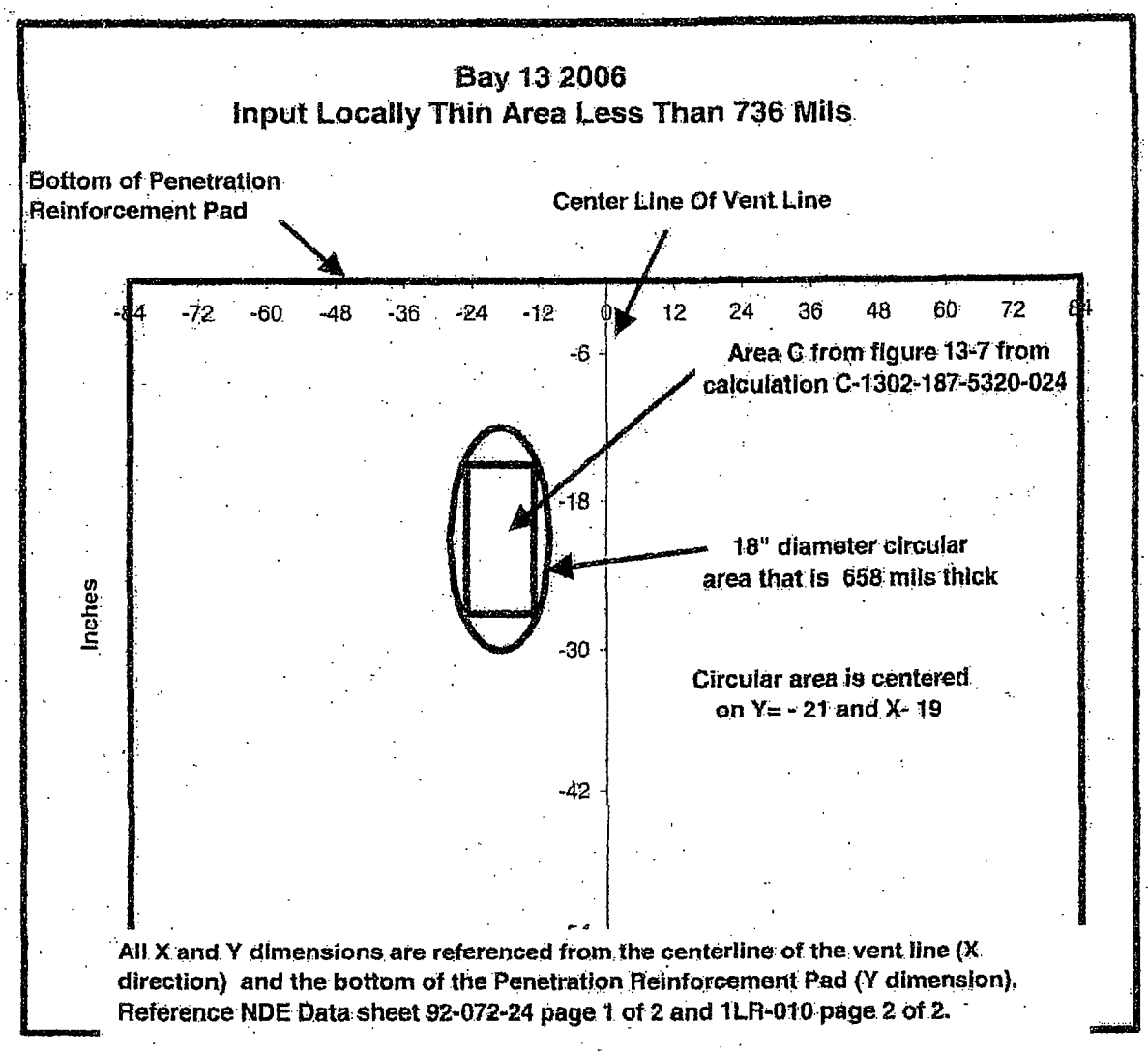
Independently Reviewed By: David P. Olszewski Date: 4/20/2007 4/20/07

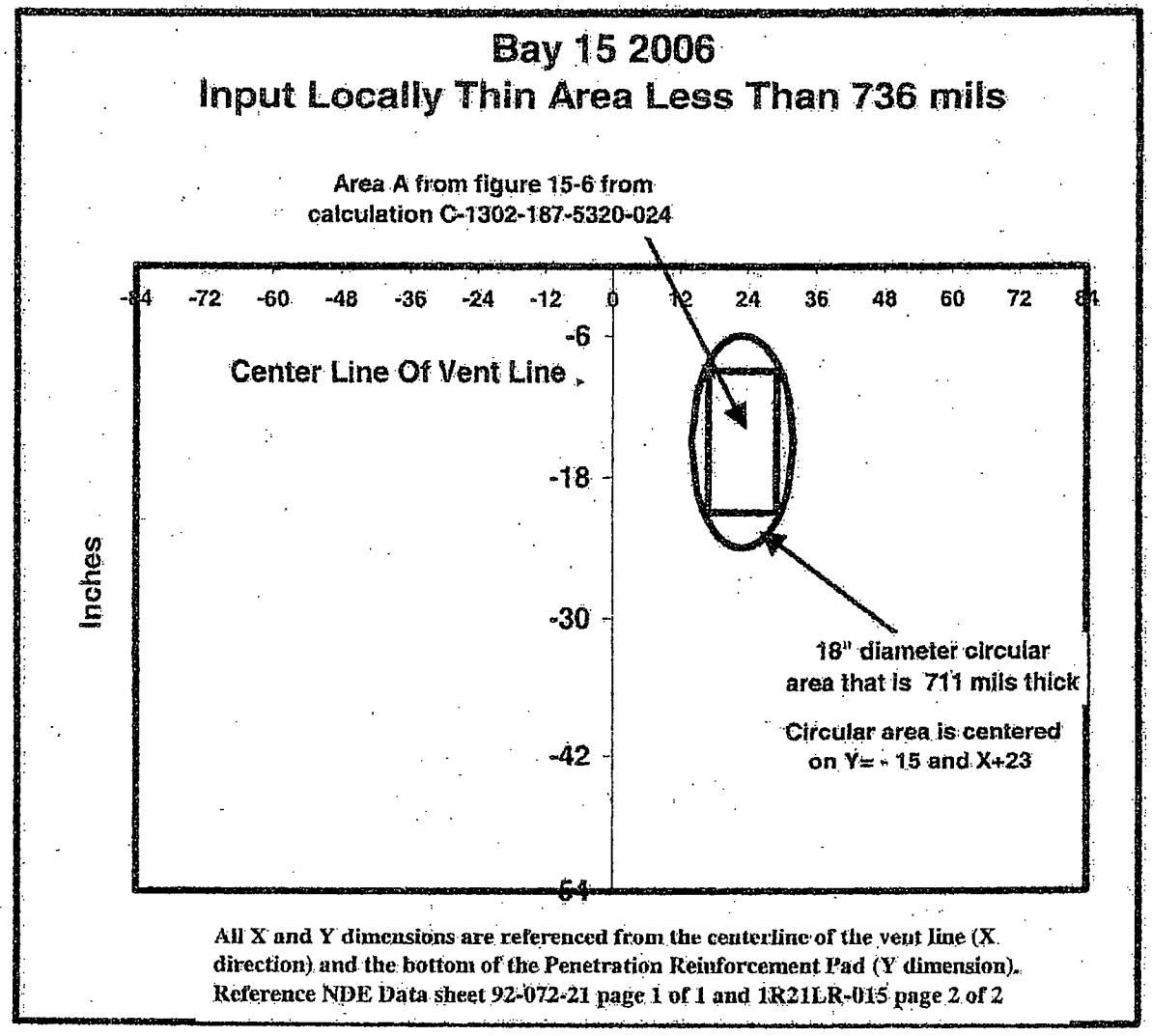
Manager's Comments: The preparer and reviewer are qualified to perform this task. This data is being prepared, reviewed and approved to verify the inputs to be used to complete the drywell shell analysis project. Therefore, the HU-AA-1212 risk rank of 1 is appropriate and the existing process reviews are acceptable.

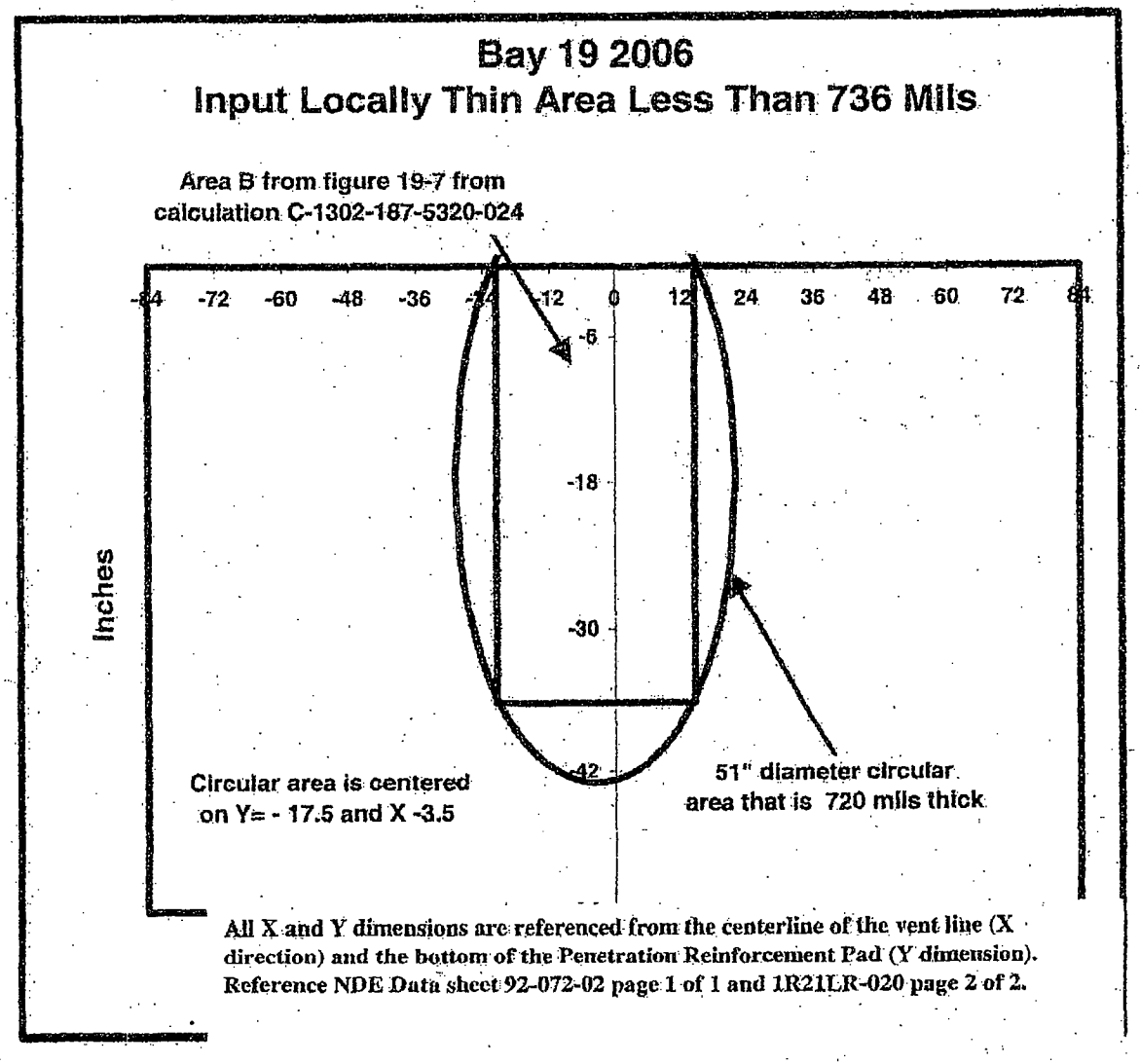
Manager Approval: F. H. Ray 4/20/2007. F. H. Ray 4/20/07

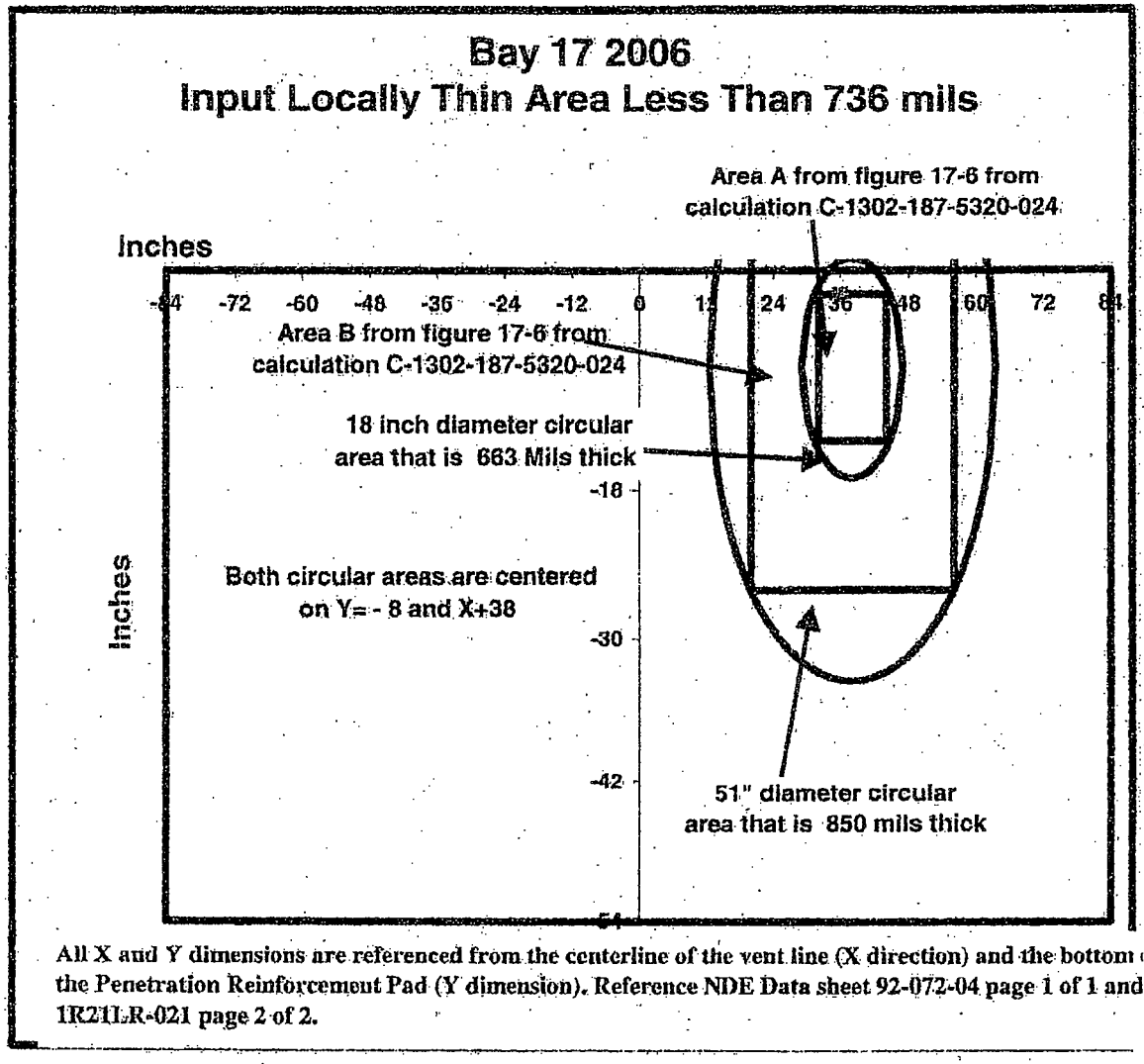


All X and Y dimensions are referenced from 13 inches to the right of centerline of the vent line (X direction) and the bottom of the Penetration Reinforcement Pad (Y dimension). Reference NDE Data sheets 92-072-12 page 1 of 2 and 1R21LR-022 page 2 of 2.


Bay 13 2006
Input Locally Thin Area Less Than 736 Mils
Bottom of Penetration Reinforcement Pad
Center Line Of Vent Line
-84 -72 -60 -48 -36 -24 -12 0 12 24 36 48 60 72 84
-6
-18
-30
-42
Inches
Area C from figure 13-7 from calculation C-1302-187-5320-024
18" diameter circular area that is 658 mils thick
Circular area is centered on Y= - 21 and X- 19
All X and Y dimensions are referenced from the centerline of the vent line (X direction) and the bottom of the Penetration Reinforcement Pad (Y dimension).
Reference NDE Data sheet 92-072-24 page 1 of 2 and 1LR-010 page 2 of 2.


Bay 15 2006
Input Locally Thin Area Less Than 736 mils
Area A from figure 15-6 from calculation C-1302-187-5320-024
-84 -72 -60 -48 -36 -24 -12 0 12 24 36 48 60 72 84
-6
-18
-30
-42
-54
Inches
Center Line Of Vent Line
18" diameter circular area that is 711 mils thick
Circular area is centered on Y= - 15 and X+23
All X and Y dimensions are referenced from the centerline of the vent line (X direction) and the bottom of the Penetration Reinforcement Pad (Y dimension).
Reference NDE Data sheet 92-072-21 page 1 of 1 and 1R21LR-015 page 2 of 2


Bay 19 2006
Input Locally Thin Area Less Than 736 Mils
Area B from figure 19-7 from calculation C-1302-187-5320-024
-72
-60
-48
-36
-12
0
12
24
36
48
60
72
-6
-18
-30
-42
Inches
Circular area is centered on Y= - 17.5 and X -3.5
51" diameter circular area that is 720 mils thick
All X and Y dimensions are referenced from the centerline of the vent line (X direction) and the bottom of the Penetration Reinforcement Pad (Y dimension).
Reference NDE Data sheet 92-072-02 page 1 of 1 and 1R21LR-020 page 2 of 2.



All X and Y dimensions are referenced from the centerline of the vent line (X direction) and the bottom of the Penetration Reinforcement Pad (Y dimension). Reference NDE Data sheet 92-072-04 page 1 of 1 and 1R21LR-021 page 2 of 2.