Aging Effects for Structures and Structural Components (Structural Tools), Revision 1

1002950

Final Report, August 2003

EPRI Project Manager
J. Carey

EPRI • 3412 Hillview Avenue, Palo Alto, California 94304 • PO Box 10412, Palo Alto, California 94303 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com

established at 500 ppm chloride or 1,500 ppm sulfates. The use of an appropriate cement type (e.g., ASTM C 150, Type II) and pozzolana (e.g., fly ash) also increase sulfate resistance [1].

Continued or frequent cyclic exposure to the following aggressive chemical environments is necessary for aggressive chemicals to cause significant concrete degradation:

- Acidic solutions with pH < 5.5
- Chloride solutions > 500 ppm
- Sulfate solutions > 1500 ppm

Nuclear power plants should assess their respective plant sites to determine if their above and below grade concrete structures and structural members are exposed to an environment below the chemical limits. If the concentrations of acid and aggressive chemicals are all below the threshold limits, aggressive chemicals is not an applicable aging mechanism for concrete structures and structural members at those power plant sites. If the concentrations of acid and aggressive chemicals are marginally above the threshold limits, and the structures are of quality concrete with satisfactory operating experience, then aggressive chemicals aging mechanism for the concrete structures and structural members may not be significant.

Since aggressive chemicals are contained at the plant sites, system leakage is possible that could cause the concrete to be exposed to chemicals beyond these limits. However, leaks are not expected to continue for the extensive periods required for degradation, and repairs would be completed prior to loss of intended function.

5.3.1.5 Corrosion of Embedded Steel and Steel Reinforcement

Corrosion is an electrochemical process that results in the formation of ferric oxide (rust). The corrosion products have a significantly greater volume than the original metal resulting in tensile stresses and spalling in the surrounding concrete. The high alkalinity (pH > 12.5) of concrete provides an environment around embedded steel and steel reinforcement which protects them from corrosion. If the pH is lowered (e.g., to 10 or less), corrosion may occur. However, the corrosion rate is still insignificant until a pH of 4.0 is reached. A reduction in pH can be caused by the leaching of alkaline products through cracks, the entry of acidic materials, or carbonation. Chlorides can be present in constituent materials of the original concrete mix (i.e., cement, aggregates, admixtures, and water), or they may be introduced environmentally. The severity of corrosion is influenced by the properties and type of cement and aggregates as well as the concrete moisture content.

The aging effects due to corrosion of embedded steel (e.g., inserts, embedded plates and channels) and steel reinforcement (rebar) are visible concrete degradation and steel corrosion. The presence of corrosion products on embedded steel subjects the concrete to tensile stress that eventually causes hairline cracking, rust staining, spalling, and more cracking. These actions will expose more embedded steel and steel reinforcement to a potentially corrosive environment and cause further deterioration in the concrete. A loss of bond between the concrete and embedded steel/steel reinforcement will eventually occur, along with a reduction in steel cross-section which can ultimately impair structural integrity.

The degree to which concrete will provide satisfactory protection for embedded steel reinforcement depends in most instances on the quality of the concrete and the depth of concrete cover over the steel. The permeability of the concrete is also a major factor affecting corrosion resistance. Concrete of low permeability contains less water under a given exposure and is more likely to have lower electrical conductivity and better resistance to corrosion. Such concrete also resists absorption of salts and their penetration into the embedded steel and provides a barrier to oxygen, an essential element of the corrosion process. Low water-to-cement ratios and adequate air entrainment increase resistance to water penetration and thereby provide greater resistance to corrosion [1].

Unlike embedded steel or steel reinforcement (rebar) that are protected by the surrounding concrete, steel pipe piles exposed to groundwater and soil conditions may be susceptible to corrosion. The concrete inside the pipe piles is not susceptible to degradation which could impair the ability of the concrete to perform its intended function since the strength capacity of the laterally constrained concrete is not sensitive to degradation of the structural member caused by aging. Corrosion of the steel pipe piles can be attributed to the nonuniform distribution of oxygen and groundwater along the surface of the piles.

As part of an industry study, M. Romanoff examined corrosion data from 43 piling installations and on that basis drew some general conclusions regarding the corrosion of driven steel piles [14, 15]. The examined test installations had pile depths of up to 136 feet and time of exposure varying from 7 to 50 years in a wide variety of soil conditions. The results indicate that the type and amount of corrosion observed on steel pilings driven into undisturbed natural soil, regardless of the soil characteristics and properties, is not sufficient to significantly affect the strength of pilings as load bearing structures. The data also indicate that undisturbed natural soils are so deficient in oxygen at levels a few feet below the surface, or below the water table, that steel piles are not appreciably affected by corrosion. Because pipe piles driven in undisturbed soils have been shown to be unaffected by corrosion and those driven in disturbed soil have experienced only minor to moderate corrosion, loss of material due to corrosion is not an applicable aging effect for pipe piles for the period of extended operation. Plain, reinforced-concrete piles or caissons in earth are generally considered permanent and are inherently durable unless the soil contains acids.

The concrete structures and structural members at nuclear power plants within the United States are designed and constructed in accordance with ACI and ASTM standards which provide a good quality, relatively high strength, dense, low permeability concrete that provides adequate concrete cover over the embedded steel. This is sufficient to preclude embedded steel corrosion for above grade exterior concrete not exposed to an aggressive environment. Note that if the concrete is degraded by other mechanisms, which reduce the protective cover of the steel reinforcement, corrosion may occur. Adequate management of the other aging effects will in effect manage the corrosion of embedded steel reinforcement.

Intake structures at ocean sites are constantly exposed to high chemical concentrations from the ocean water. Chlorides, either from atmospheric releases of industrial/chemical plants nearby or from saltwater, could gain access to steel through existing cracks in the concrete. For concrete structures that are regularly exposed to aggressive ions in solution (i.e. > 500 ppm chlorides) and which also have a ready supply of oxygen, corrosion of embedded steel is a potentially significant degradation mechanism and must be further evaluated. An aging management program may be credited for managing this aging effect.

Corrosion of embedded steel and steel reinforcement (rebar) is not significant for above grade concrete structures if the concrete is not exposed to an aggressive environment (pH < 11.5 or chlorides > 500ppm) for extended periods such as prolonged ponding or continuous sprays. However, even if an aggressive environment is present, corrosion of the embedded reinforcing steel may be prevented from causing significant age related degradation of the concrete if adequate design considerations have been implemented. These design considerations include the use of concrete having a low water-to-cement mix ratio (0.35 to 0.45) and adequate air entrainment (3 to 6%) which results in low permeability. Another design consideration includes providing sufficient reinforcement that minimizes crack development thereby preventing corrosion of the embedded steel and steel reinforcement (rebar) and degradation of the concrete [1].

If embedded steel or steel reinforcement (rebar) below grade is exposed to aggressive groundwater (pH < 5.5, chloride > 500 ppm and sulfate > 1500 ppm) for extended periods, age related degradation due to corrosion of the reinforcing steel should be considered a potentially significant aging mechanism. Examination in accordance with the implementation of IWL (containment) and management of inaccessible areas (examination of representative samples of below-grade concrete when excavating) should be considered and justified on a plant specific basis.

Each nuclear power plant should review its concrete structures and structural members to determine if they were designed and constructed in accordance with ACI and ASTM standards which provide a good quality, dense, low permeability concrete that provides adequate concrete cover over the embedded steel and steel reinforcement. Since good design and construction practices are sufficient to preclude embedded steel reinforcement corrosion in the absence of other aging mechanisms, corrosion of embedded steel and steel reinforcement would not be an applicable aging mechanism for nuclear power plant concrete structures and structural members so designed and constructed.

5.3.2 Cracking

Cracking may occur in concrete structures and structural members as general cracking, map cracking, hairline cracking, pitting, and erosion. These effects are the result of one or more of the following aging mechanisms: freeze-thaw, reaction with aggregates, shrinkage, settlement, elevated temperature, irradiation, and fatigue.

5.3.2.1 Freeze-Thaw

Based on the review in Section 5.3.1.1, repeated cycles of freezing and thawing may alter both the mechanical properties and physical form of the concrete, thus causing cracking of the concrete.

Freeze-thaw damage starts at the surface and is readily detected by surface inspections. Freeze-thaw damage is expected to be a local condition and by itself will not affect the strength

12/08/05 12:05:34
04/20/05 13:02:16

1A

GPU NUCLEAR	DOCUMENT NO. C-1302-187-310-037

TITLE Statistical Analysis Of Drywell Vessel Thickness Data Through September 2000

REV	SUMMARY OF CHANGE	APPROVAL	DATE
1	**Non-Substantive Change** Rev.1 updates the Coversheet Referenced Calculation Section with three additional references. In addition reference 3.22 on page 11 was corrected from C-1302-187-5300-028 to C-1302-187-5300-030. These changes correct or update references and are editorial and do not affect the calculation, the conclusions or results. Therefore the verification is unaffected.	Peter Tamburro [signature] [signature] Tom Quintenz	4/19/01 4-20-01
2	Revised to incorporate Program November 2004 UT Inspections. The Oyster Creek Drywell Vessel is required to be inspected every other refueling outage (every 4 years) per the requirements of FSAR Section 3.8.2.8. The following pages have been revised: 1, 2, 3, 4, 5, 6, 7, 8, 9, 28, 29, 30, 31, 32, 33, and 35. Also Attachments / Appendix 1 through 11 have been revised. Please Note on page 1 an editorial change was made after the Reviewer and Manager signed the page. The Editorial change was to change the calculation revision from Rev 1 to Rev. 2. This editorial change was communicated to both Howie Ray and Steve Leshnoff.	Peter Tamburro [signature] [signature] Howie Ray	4/20/05 6/10/05

N0036 (1/99)

AmerGen
A PECO Energy/British Energy Company

CALCULATION COVER SHEET
(Ref. EP-006)

PT

Subject	Calculation No.	Rev. No.	System Nos.	Sheet
Subject: Statistical Analysis of Drywell Vessel Thickness Data Through September 2000	C-1302-187-E310-037	~~0~~ PT 1	187	~~1~~ of 36 1B

1. Is this calculation within the scope of the GPUN Operational Quality Assurance Plan? (If YES, a verification is required unless the calculation is a non-substantive revision.) — X Yes ☐ No
2. Does this calculation contain assumptions / design inputs that require confirmation? (If YES, provide CAP or appropriate configuration control number(s)) (e.g., ECD, PFU, MD, PCR, etc.) ________ — ☐ Yes X No
3. Does this calculation require revision to any existing documents? (If yes, provide CAP or appropriate configuration control number(s)) ________ — ☐ Yes X No
4. Is this calculation performed as a design basis calculation? (If YES, identify design basis parameters.) (See Section 3.3) — ☐ Yes X No

Parameter: ________

Referenced Calculations and Safety Evaluations (See Section 4.3.1.3)	Rev. No.
1) Safety Evaluation SE-000243-002, "Drywell Steel Shell Plate Thickness Reduction at the Base Sand Cushion Entrenchment Region."	15
2) GPUN calculation C-1302-187-5300-005, Rev.0. "Statistical Analysis of Drywell Thickness Data Thru 12-31-88"	0
3) GPUN Calculation C-1302-187-5300-028, Rev.0. "OCDW Statistical Analysis of Drywell Thickness Data Thru September 1994" PT 5/19/05	0
4) GPUN Calculation C-1302-187-5300-~~028~~ 030, Rev.0. "Statistical Analysis of Drywell Thickness Data Thru September 1996"	0

Comments: Rev.1 updates the Coversheet Referenced Calculation Section with three additional references. In addition reference 3.22 on page 11 was corrected from C-1302-187-5300-028 to C-1302-187-5300-030. These changes correct or update references and editorial and do not affect the calculation, the conclusions or results. Therefore the verification is unaffected.

APPROVALS

Originator Peter Tamburro [signature]	Date 12/23/00
Verification Engineer/Reviewer Steve Leshnoff [signature]	Date 12/28/00
Section Manager Tom Quintenz [signature]	Date 3-26-01
Other Verification Engineer/Reviewer	Date
Other Verification Engineer/Reviewer	Date

AmerGen

CALCULATION VERIFICATION PLAN/SUMMARY SHEET

(Ref. EP-006)

Subject: Statistical Analysis of Drywell Vessel Thickness Data Through September 2000	Calculation No. C-1302-187-E310-037	Rev. No. 0	System Nos. 187	Sheet: 2 of 36

PLAN

Scope of Verification: Perform Verification in accordance with EP-006 Verify calculation inputs are corrected, methodology is consistent with previous calculations, assumptions consistent with previous calculations and reasonable and calculations are correct, and conclusions are accurate and reasonable.

Item No.	Method/Depth oF Verification Required	Req'd. Comp. Date
1	(Check Applicable Boxes) Design Review X Alternate Calculation ☐ Qualification Test ☐ Other ☐ (Specify below)	

Assigned Verification Engineer S.D. LESHNOFF

Other Verification Engineer

Section Manager (Sign) [signature] Date 12-23-00

SUMMARY

Summary of verification scope, methods, results and conclusions:

This calculation meticulously uses classical statistical methods for regression analysis that have been used previously to estimate OC drywell corrosion rates albeit in a different and more convenient format. The applicability of the regression model is determined appropriately and conservatively by using the "F"-test for significance in order to distinguish random variation from an actual physical trend. Each step in the statistical method is explained and applied clearly and correctly. All available historical data is included in the analysis. It is important to note that forward projection of corrosion captures a non-linear relationship between the mean corrosion rate and the 95% confidence limit.

The results correctly distinguish between data sets that show no corrosion from those that do. The conclusions as regards the impact of very low corrosion rates, where these exist, are clearly and correctly derived.

Based on this evaluation, the calculation is verified to be acceptable.

APPROVALS (Sign)

Assigned Verification Engineer S.D. Leshnoff	Date 12/28/00
Other Verification Engineer	Date

Use Additional Sheets if Necessary

AG5871 (1/99)

1. Purpose

The purpose of this calculation is to update the Drywell Thickness Analyses documented in reference 3.7, 3.8, and 3.11 through 3.22 by incorporating measurements taken in September 2000 (see Appendix 10) and November 2004 (Appendix 11).

Specific objectives of this calculation are:

1) Determine the September 2000 and November 2004 mean thickness at each monitored location
2) Statistically analyze the thickness measurements to determine if a corrosion rate exists at each location,
3) If a corrosion rate exists, provide a conservative projection to 2029.

This calculation does not evaluate the sand bed region. The corrosion in the sand bed region was eradicated in 1992 by removing sand. The external side of the Drywell Vessel in these regions was then coated. Follow-up inspections after 1992 (including September 2000 and November 2004) shows that the coating is good condition. Therefore thickness measurements of the sandbed region are not required.

This calculation does not use the same software that was used in earlier calculations. Previous calculations utilized the GPUN mainframe computer and the "SAS" mainframe software. The Oyster Creek Plant has been sold to AmerGen in the year 2000. The GPUN Main Frame will not be available to AmerGen after the year 2002. Also the "SAS" software is mainframe based and difficult to learn and maintain. An alternative PC based software, "MATHCAD", has been chosen to perform this calculation.

Although software has been changed the overall methodology, with minor exceptions, is the same as in previous calculation. The minor exceptions are the statistical tests that determine whether the data is normally distributed.

Also, since the GPUN Maine Frame Computer stored all program data, this calculation documents all data sets since the beginning of the program for each inspection location above the sandbed elevation.

PT 5/19/05

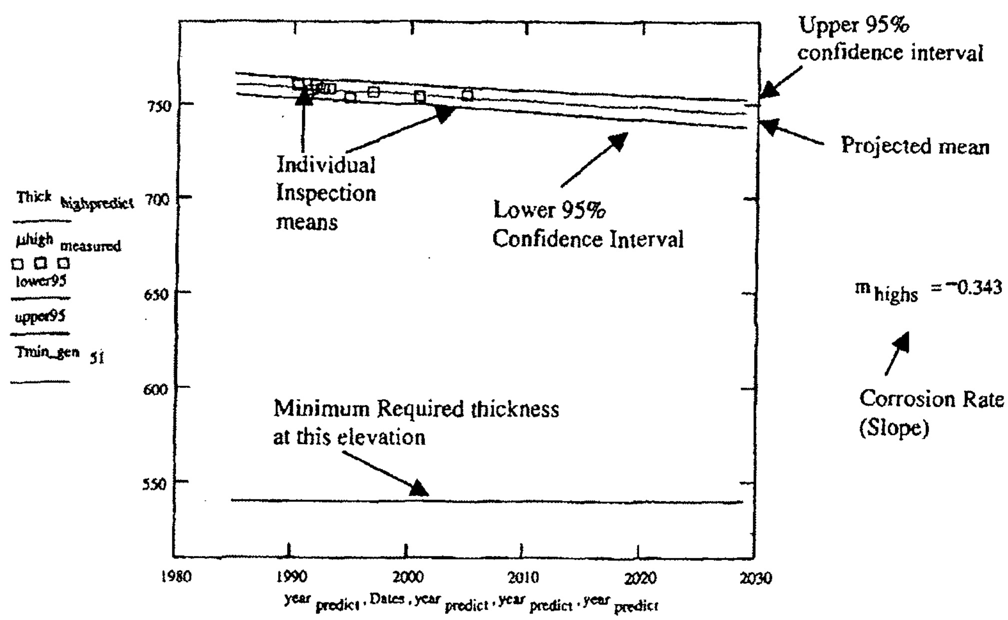
2.0 Summary of Results

2.1 Elevation 50' 2" through November 2004.

Bay	Area/ Location	Nov. 2004 Mean +/- Standard Error (mils)	No of Insp.	F-ratio	Mean of all Inspections +/- Standard Error (mils)	Corrosion Rate (Mils/ year)	Projected Lower 95% Confidence Thickness in 2029 (mils)	Min Required Thickness (mils)
5	D12	742.8+/- 1.9	12	0.25	744.6- +/-0.8	NA	NA	541
5	5 low	700.5 +/- 9.8	11	0.265	704.4 +/- 0.6	NA	NA	541
5	5 hi	755.6 +/- 1.4	11	1.030	NA	0.3	738.4	541
13	31 low	693.5 +/ -6.0	11	0.27	686.1+/- 1.3	NA	NA	541
13	31 hi	757.6 +/- 1.8	11	0.29	763.4 +/- 1.7	NA	NA	541
15	23 low	727.4 +/- 3.3	11	0.16	726.6 +/- 0.5	NA	NA	541
15	23 hi	757.3 +/- 1.3	11	1.05	NA	0.4	738.0	541

Since February 1990, eleven or more inspections have been performed on each of the four locations at this elevation. Two of these four locations are not experiencing corrosion. A portion of the third and fourth locations (Bay 5, area 5 and Bay 15 Area 13) may be experiencing minor corrosion rates of approximately 0.3 and 0.4 mils per year. These corrosion rates are very small. Projections based on these corrosion rates using the 95% lower confidence interval shows that these areas it will not corrode to less than the minimum required thickness by the year 2029. There is substantial margin, even when considering plant life extension (see the plots below).

Bay 5 Area 5 Thicker Subset Corrosion Projection



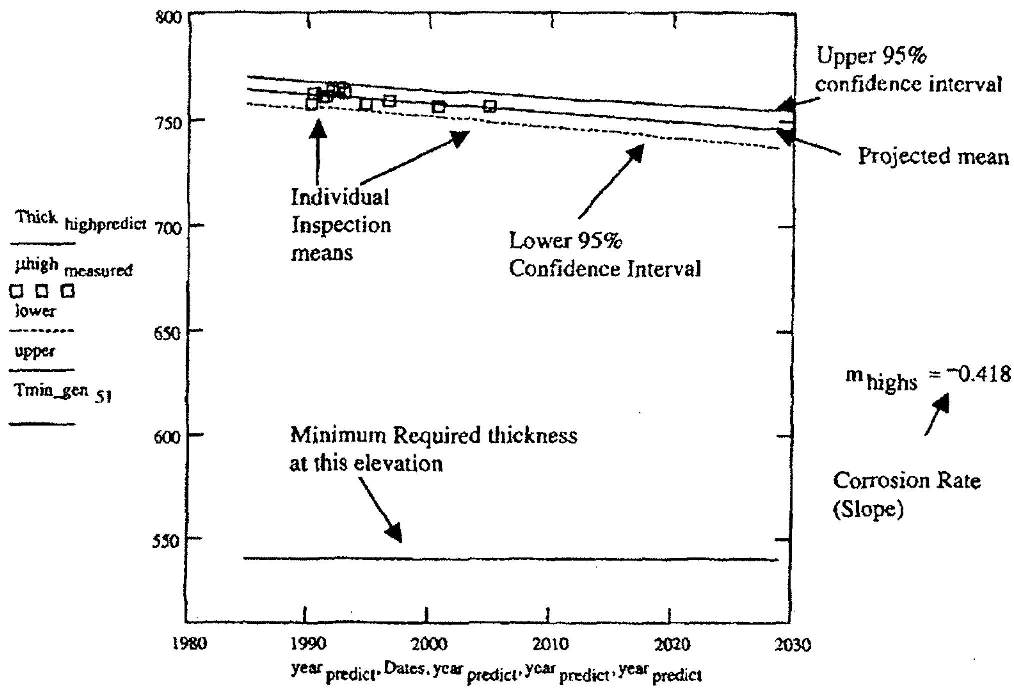
AmerGen CALCULATION SHEET

Preparer: Pete Tamburro 1/18/05

Subject:	Calculation No.	Rev. No.	System Nos.	Sheet
Statistical Analysis of Drywell Vessel Thickness Data	C-1302-187-E310-037	~~1~~ 2	187	5 of 35

OT 5/15/05

Bay 15 Area 23 Thicker Subset Corrosion Projection



Analysis of individual points within these four locations shows no ongoing corrosion except for two points. Bay 5 Location D12, point 9 may be experiencing a corrosion rate of 1.2 mils per year. Bay 15 Location 23, point 26 may be experiencing a corrosion rate of 1.3 mils per year. These corrosion rates are very small. Projection based on these corrosion rates using the 95% lower confidence interval shows that these points will not corrode to less than the minimum required thickness by the year 2029.

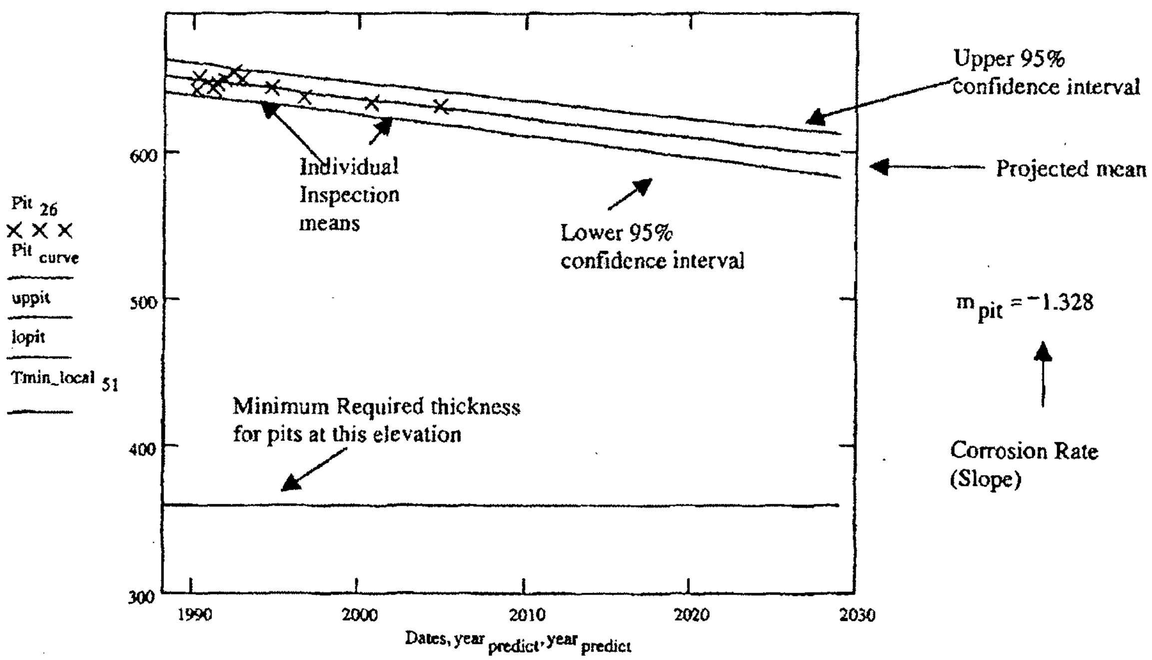
AmerGen **CALCULATION SHEET**

Preparer: Pete Tamburro 1/18/05

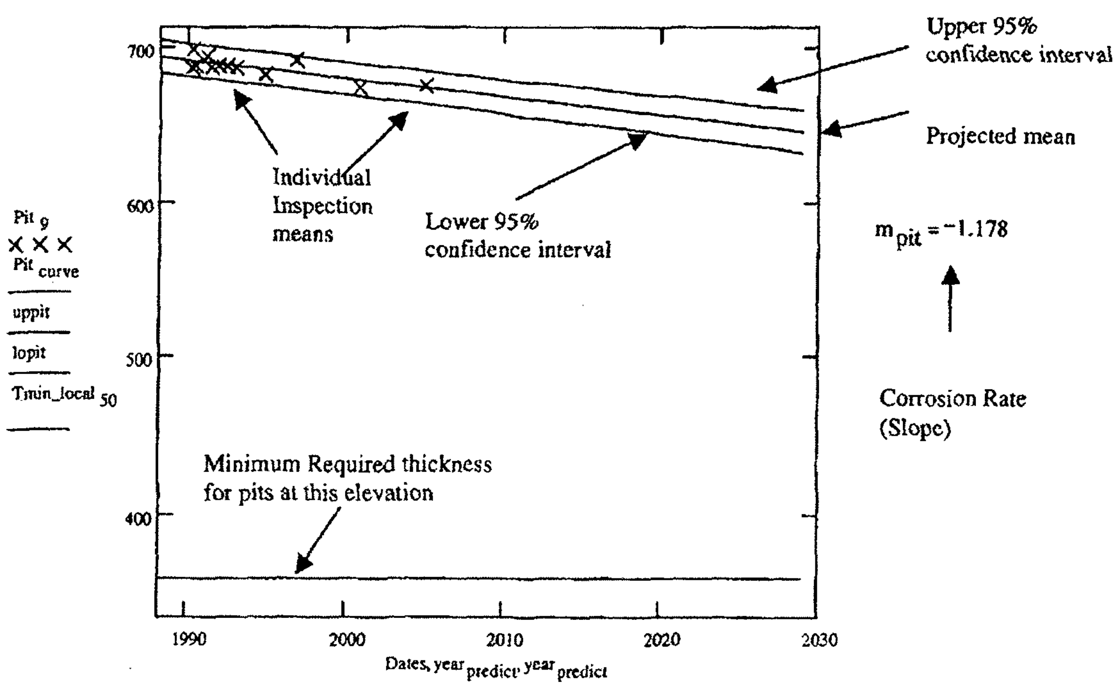
Subject:	Calculation No.	Rev. No.	System Nos.	Sheet
Statistical Analysis of Drywell Vessel Thickness Data	C-1302-187-E310-037	~~1~~ 2	187	6 of 35

PT 5/15/05

Bay 15 Area 23 Point 26 Corrosion Projection



Bay 5 Area D12 Point 9 Corrosion Projection

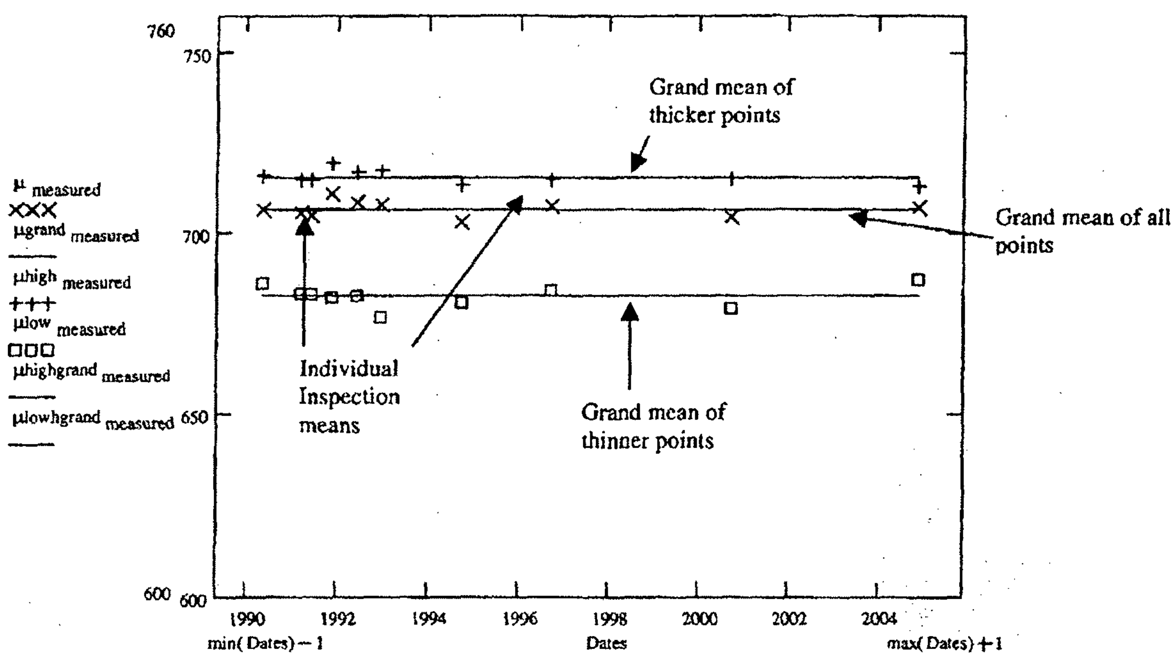


2.2 Elevation 51' 10" through November 2004.

Bay	Area/ Location	Nov. 2004 Mean +/- Standard Error (mils)	No of Insp.	F-ratio	Mean of all Inspections +/- Standard Error (mils)	Corrosion Rate (Mils/ year)	Projected Lower 95% Confidence Thickness in 2029(mils)	Min Required Thickness (mils)
13	32 low	687.2 +/-3.6	10	0.04	682.3 +/- 1.0	NA	NA	541
13	32 hi	713.1 +/-0.7	10	0.7	715.7 +/- 0.6	NA	NA	541

Since April 1990, ten inspections have been performed on one location at this elevation. The data indicates that this location is not experiencing corrosion (see the pot below).

Bay 13 Area 32



Analysis of local individual points within this location shows no ongoing corrosion.

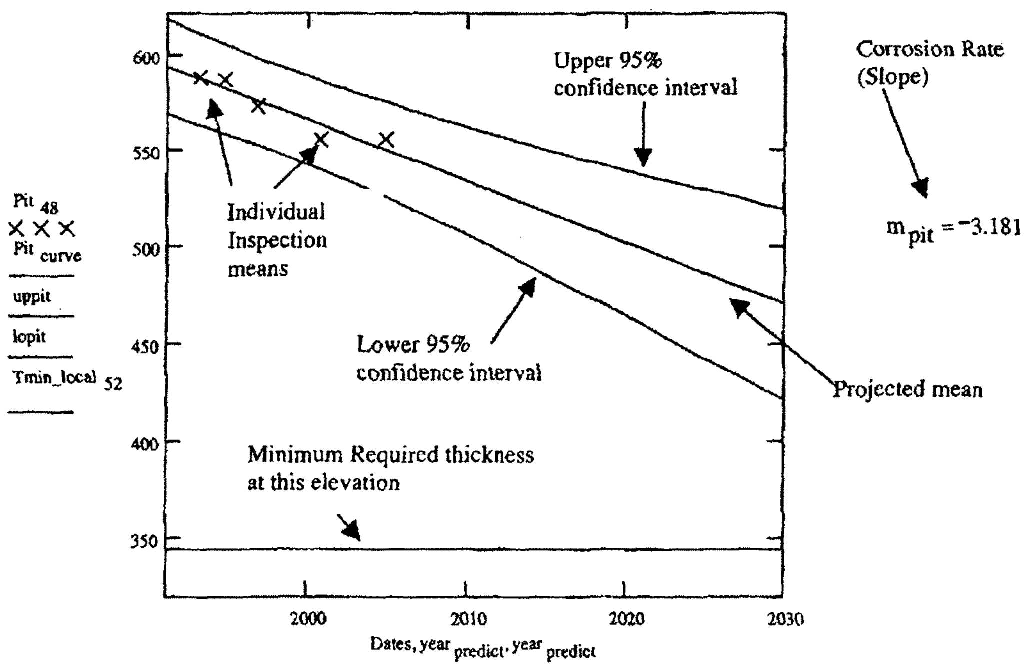
2.3 Elevation 60' 10" through November 2004.

Bay	Area/ Location	Nov. 2004 Mean +/- Standard Error (mils)	No of Insp.	F-ratio	Mean of all Inspections +/- Standard Error (mils)	Corrosion Rate (Mils/ year)	Projected Lower 95% Confidence Thickness in 2029(mils)	Min Required Thickness (mils)
1	5-22	692.8 +/- 1.3	5	0.15	694.9 +/- 4.2	NA	NA	518

Since December 1992, only five inspections have been performed on this one location. The data indicates that this location is not experiencing corrosion.

Analysis of individual points within this location shows that there may be ongoing corrosion at one point. Bay 1 location 5-22; point 48 may be experiencing a corrosion rate of 3.2 mils per year. This calculated rate, which is greater than all other calculated rates, may be due to the limited amount of inspections. The methodology and analysis results in greater rates, and confidence levels with less inspection information. Never-the-less projection based on this corrosion rates using the 95% lower confidence interval, which is significantly more conservative than at other locations show that this point will not corrode to less than the minimum required thickness by the year 2029.

Bay 1 Area 5-22 Point 48 Corrosion Projection



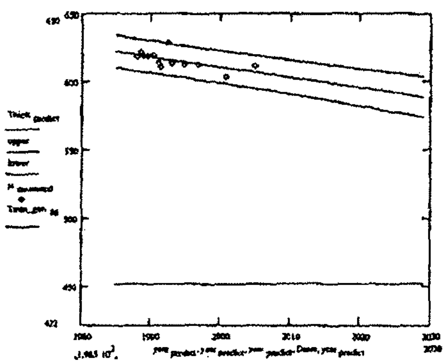
PT 5/15/05

2.4 Elevation 87' 5" through November 2004.

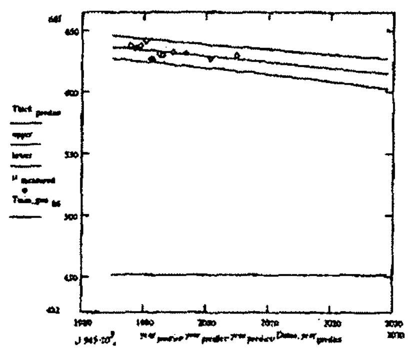
Bay	Area/ Location	Nov. 2004 Mean +/- Standard Error (mils)	No of Insp.	F-ratio	Mean of all Inspections +/- Standard Error (mils)	Corrosion Rate (Mils/ year)	Projected Lower 95% Confidence Thickness in 2029(mils)	Min Required Thickness (mils)
9	20	612.3 +/-2.0	13	1.38	NA	0.75	604.1	452
13	28	639.9 +/-1.9	13	0.22	638.8 +/- 1.2	NA	NA	452
15	31	630.2 +/-2.4	13	0.90	NA	0.49	615.3	452

Since November 1987, thirteen inspections have been performed on each of the three locations at this elevation. Two of the three locations may be experiencing corrosion. Bay 9, area 20 is experiencing minor a corrosion rate of approximately 0.75 mils per year. Bay 15 area 31 may be experiencing a corrosion rate of 0.49 mils per year. The F-ratio for this second location is 0.90, which is close to the threshold as to whether or not a rate exists. These corrosion rates are very small. Projections based on these corrosion rates using the 95% lower confidence interval shows that they will not corrode to less than the minimum required thickness by the year 2029.

Bay 9 Area 20 Corrosion Projection



Bay 15 Area 31 Corrosion Projection



Analysis of identified pits within these three locations shows no ongoing corrosion.

3.1 References

3.1 GPUN Safety Evaluation SE-000243-002, Rev. 14 "Drywell Steel Shell Plate Thickness Reduction at the Base Sand Cushion Entrenchment Region."

3.2 GPUN TDR 854, Rev. 0 "Drywell Corrosion Assessment"

3.3 GPUN TDR 851, Rev. 0 "Assessment of Oyster Creek Drywell Shell"

3.4 GPUN Installation Specification, IS-328227-004, Rev XX, "Functional Requirements for Drywell Containment Vessel Thickness Examination"

3.5 Applied Regression Analysis, 2nd Edition, N. R. Draper & H. Smith, John Wiley and Sons 1981

3.6 Statistical Concepts and Methods, G.K. Bhattacharyya & R.A. Johnson, John Wiley and Sons 1977

3.7 GPUN calculation C-1302-187-5300-005, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru 12-31-88"

3.8 GPUN TDR 948, Rev. 1 "Statistical Analysis of Drywell Thickness Data"

3.9 Experimental Statistics, Mary Gobbons Natrella, John Wiley & Sons, 1966 Reprint (National Bureau of Standards Handbook 91)

3.10 Fundamental Concepts in the Design of Experiments, Charles C Hicks, Saunders College Publishing, Fort Worth, 1982

3.11 GPUN Calculation C-1302-187-5300-008, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru 2-8-90"

3.12 GPUN Calculation C-1302-187-5300-011, Rev.1, "Statistical Analysis of Drywell Thickness Data Thru 4-24-90"

3.13 GPUN Calculation C-1302-187-5300-015, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru March 1991"

3.14 GPUN Calculation C-1302-187-5300-017, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru May 1991"

3.15 GPUN Calculation C-1302-187-5300-019, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru November 1991"

3.16 GPUN Calculation C-1302-187-5300-020, Rev.0, "OCDW Projected Thickness Data Thru 11/02/91"

3.17 GPUN Calculation C-1302-187-5300-021, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru May 1992"

3.18 GPUN Calculation C-1302-187-5300-022, Rev.0, "OCDW Projected Thickness Data Thru 5/31/92"

3.19 GPUN Calculation C-1302-187-5300-025, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru December 1992"

3.20 GPUN Calculation C-1302-187-5300-024, Rev.0, "OCDW Projected Thickness Data Thru 12/8/92"

3.21 GPUN Calculation C-1302-187-5300-028, Rev.0, "OCDW Statistical Analysis of Drywell Thickness Data Thru September 1994"

3.22 GPUN Calculation C-1302-187-5300-030, Rev.0, "Statistical Analysis of Drywell Thickness Data Thru September 1996"

3.23 Practical Statistics – "Mathcad Software Version 7.0 Reference Library, Published by Mathsoft, Inc. Cambridge

4.0 Assumptions

The statistical evaluation of the UT measurement data to determine the corrosion rate at each location is based on the following assumptions:

4.1 Characterization of the scattering of the data over each 6" by 6" grid is such that the thickness measurements are normally distributed. If the data is not normally distributed the grid is subdivide into normally distributed subdivisions.

4.2 Once the distribution of data is found to be close to normal, the mean value of the data points is the appropriate representation of the average condition.

4.3 A decrease in the mean value of the thickness over time is representative of the corrosion.

4.4 If corrosion does not exist, the mean value of the thickness will not vary with time except for random variations in the UT measurements

4.5 If corrosion is continuing at a constant rate, the mean thickness will decrease linearly with time. In this case, linear regression analysis can be used to fit the mean thickness values for a given zone to a straight line as a function of time. The corrosion rate is equal to the slope of the line.

PT 5/15/08

5.0 Design Inputs:

5.1 The minimum required thickness for the three elevations in which the data was collected in September 2000 and Nov. 2004 are documented below (reference 3.1).

Drywell Vessel Plate Elevations	Acceptable Mean Thickness	Local Acceptable Thickness
El. 23' to 50' 11-1/8"	0.541"	0.360"
El. 50' 11-1/8" to 65' 2-7/16"	0.518"	0.345"
El. 65' 2-7/16" to 94' 9"	0.452"	0.300"

5.2 Seven core sample approximately 2" in diameter were removed from the drywell vessel shell for analysis (reference 3.1). In these locations replacement plugs were installed. Five of these removed cores are in grid locations that are part of the monitoring program. Of these, 4 were in sandbed region, which are no longer monitored (reference 3.1). The remaining core was removed from the grid at elevation 50'2" bay 5 area D 12. The replacement plug is located over data points 13, 20, 25, 26, 27, 28, 33, 34, and 35. Therefore the UT data from these points are not included in the calculation.

5.3 Historical data sets were collected from previous calculations (references 3.7, and 3.11 through 3.22)

6.0 OVERALL APPROACH AND METHODOLOGY:

6.1 Definitions

6.1.1 A Normal Distribution has the following properties

- Characterized by a bell shaped curve centered on the mean.
- A value of that quantity is just as likely to lie above the mean as below it
- A value of that quantity is less likely to occur the farther it is from the mean
- Values to one side of the mean are of the same probability as values at the same distance on the other side of the mean

6.1.2 Mean thickness is the mean of valid points, which are normally, distributed from the most recent UT measurements at a location.

6.1.3 Variance is the mean of the square of the difference between each data point value and the mean of the population.

6.1.4 Standard Deviation is the square root of the variance.

6.1.5 Standard Error is the standard deviation divided by the square root of the number of data points. Used to measure the dispersion in the distribution.

6.1.6 Skewness measures the relative positions of the mean, medium and mode of a distribution. In general when the skewness is close to zero, the mean, medium and mode are centered on the distribution. The closer skewness is to zero the more symmetrical the distribution. Normal distributions have skewness, which approach zero.

6.1.7 Kurtosis measures the heaviness of a distribution tails. A normal distribution has a kurtosis, which approaches zero. PT 3/19/05

6.1.8 Linear Regression is a linear relationship between two variables. A line with a slope and an intercept with the vertical axis can characterize the linear relationship. In this case the linear relationship is between time (which is the independent variable) and corrosion (which is the dependent variable).

6.1.9 F-Ratio –

An F-Ratio less than 1.0 occurs when the amount of corrosion, which has occurred since the initial measurement, is less than the random variations in the measurements or fewer than four measurements have been taken. If the F ratio is less than 1.0, the computed corrosion rate does not reflect the actual corrosion rate but rather is provided to as a conservative projection (reference 2.22).

An "F" ratio of 1 or less indicates that the data trend is best explained by the grand mean of the data and the trend has no slope. The variability in the data is within the distribution profile for the data, which is normally distributed. Therefore a grand mean ($\mu grand_{actual}$) is best estimate of the thickness of the location.

An F-Ratio of greater than 1.0 occurs when the amount of corrosion that has occurred since the initial measurement is significant compared to the random variations, and four or more measurements have been taken. In these cases the computed corrosion rate more accurately reflects the actual corrosion rate, and there is a very low probability that the actual corrosion rate is zero. The greater the F-Ratio the lower the uncertainty in the corrosion rate (reference 2.22).

Where the F-Ratio of 1.0 or greater provides confidence in the historical corrosion rate, the F-Ratio should be 4 to 5 if the corrosion rate is to be used to predict the thickness in the future. To have a high degree of confidence in the predicted thickness, the ratio should be at least 8 or 9 (reference 3.22).

6.1.10 Grand mean - when the F-Ratio test is less than 1.0 and/or the slope is positive this is the grand mean of all data.

6.1.11 Corrosion Rate – With three or more data sets and the F-Ratio test greater than 1.0 this is the slope of the regression line.

6.1.12 Upper and Lower 95% Confidence Interval – The upper and lower corrosion rate range for which there is 95% confidence that the actual rate lies within.

6.2 The UT measurements within scope of this monitoring program are performed in accordance with ref. 3.4. This specification involves taking UT measurements using a template with 49 holes laid out on a 6" by 6" grid with 1" between centers on both axes. The first sets of measurements were made in 1987. All subsequent measurements are made in the same location within 1/8" (reference 3.4).

6.3 Each 49 point data set is evaluated for missing data. Invalid points are those that are declared invalid by the UT operator or are at plug locations.

6.3 Past calculations were reviewed to ensure that points that were considered pits are accurately trended and excluded from the calculation of the mean.

6.4 Data that is not normally distributed will be compared to previous calculations to determine if past data was also not normally distributed. In such cases the new data is divided into subsets with the same points as in past calculations.

6.5 Methodology

6.5.1 Test Matrix

To demonstrate the methodology a 49 member array will be generated using the Mathcad "rnorm" function. This function returns an array with a probability density which is normally distributed, where the size of the array ($No_{DataCells}$), the target mean (μ_{input}), and the target standard deviation (σ_{input}) are input.

The following will build a matrix of 49 points

$No_{DataCells} := 49 \qquad i := 0 .. No_{DataCells} - 1 \qquad count := 7$

The array "Cells" is generated by Mathcad with the target mean (μ_{input}) and standard deviation (σ_{input})

$\mu_{input} := 775 \qquad \sigma_{input} := 20 \qquad Cells := rnorm(No_{DataCells}, \mu_{input}, \sigma_{input})$

"Cells" is shown as a 7 by 7 matrix

$$Show_{matrix}(Cells, 7) = \begin{bmatrix} 766 & 761 & 766 & 756 & 741 & 776 & 773 \\ 786 & 819 & 791 & 795 & 792 & 793 & 788 \\ 754 & 776 & 760 & 789 & 771 & 762 & 761 \\ 765 & 786 & 770 & 777 & 800 & 761 & 775 \\ 797 & 793 & 717 & 732 & 779 & 763 & 751 \\ 777 & 790 & 781 & 775 & 760 & 767 & 762 \\ 772 & 795 & 779 & 785 & 790 & 775 & 781 \end{bmatrix}$$

The above test matrix will be used in sections 6.5.2 through 6.5.8

6.5.2 Mean and Standard Deviation

The actual mean and standard deviation are calculated for the matrix "Cells" by the Mathcad functions "mean" and "Stdev".

Therefore for the matrix generated in section 6.5.1

$\mu_{actual} := mean(Cells) \qquad \sigma_{actual} := Stdev(Cells)$

$\mu_{actual} = 774.104 \qquad \sigma_{actual} = 18.258$

Inspection shows that the actual mean and standard deviations are not the same as the target mean and target standard deviation which were input. This is expected since the "rnorm" function returns an array with a probability density which is normally distributed.

6.5.3 Standard Error

The Standard Error is calculated using the following equation (reference 3.23).
For the matrix generated in section 6.5.1

$$\text{Standard}_{\text{error}} := \frac{\sigma_{\text{actual}}}{\sqrt{\text{No}_{\text{DataCells}}}} \qquad \text{Standard}_{\text{error}} = 2.578$$

6.5.4 Skewness

Skewness is calculated using the following equation (reference 3.23).

For the matrix generated in section 6.5.1

$$\text{Skewness} := \frac{\left(\text{No}_{\text{DataCells}}\right)\cdot\sum\overrightarrow{\left(\text{Cells}-\mu_{\text{actual}}\right)^3}}{\left(\text{No}_{\text{DataCells}}-1\right)\cdot\left(\text{No}_{\text{DataCells}}-2\right)\cdot\left(\sigma_{\text{actual}}\right)^3} \qquad \text{Skewness} = 0.354$$

A skewness value close to zero is indicative of a normal distribution (reference 3.22 and 3.23)

6.5 Kurtosis

Kurtosis is calculated using the following equation (reference 3.23).
For the matrix generated in section 6.5.1

$$\text{Kurtosis} := \frac{\text{No}_{\text{DataCells}}\cdot\left(\text{No}_{\text{DataCells}}+1\right)\cdot\sum\overrightarrow{\left(\text{Cells}-\mu_{\text{actual}}\right)^4}}{\left(\text{No}_{\text{DataCells}}-1\right)\cdot\left(\text{No}_{\text{DataCells}}-2\right)\cdot\left(\text{No}_{\text{DataCells}}-3\right)\cdot\left(\sigma_{\text{actual}}\right)^4} \dots + -\frac{3\cdot\left(\text{No}_{\text{DataCells}}-1\right)^2}{\left(\text{No}_{\text{DataCells}}-2\right)\cdot\left(\text{No}_{\text{DataCells}}-3\right)}$$

$$\text{Kurtosis} = 0.262$$

A Kurtosis value close to zero is indicative of a normal distribution (reference 3.23)

6.5.6 Normal Probability Plot

An alternative method to determine whether a sample distribution approaches a normal distribution is by a normal probability plot (reference 3.22 and 3.23). In a normal plot, each data value is plotted against what its value would be if it actually came from a normal distribution. The expected normal values, called normal scores, and can be estimated by first calculating the rank scores of the sorted data. The Mathcad function "sorts" sorts the "Cells" array .

$j := 0 .. \mathrm{last}(\mathrm{Cells})$ $\qquad$ $srt := \mathrm{sort}(\mathrm{Cells})$

Then each data point is ranked. The array "rank" captures these rankings

$r_j := j + 1$ $\qquad$ $rank_j := \dfrac{\Sigma \overrightarrow{\left(\overrightarrow{srt = srt_j}\right) \cdot r}}{\Sigma \overrightarrow{srt = srt_j}}$

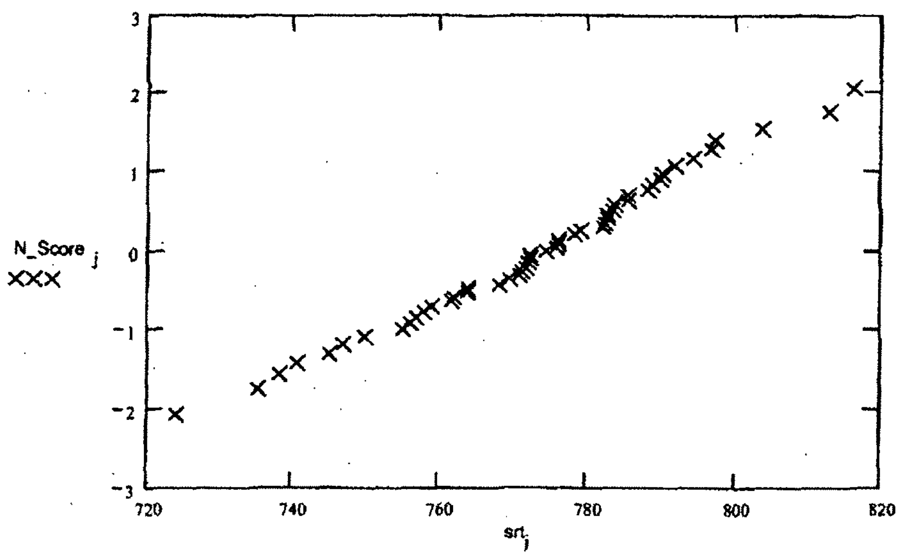
Each rank is proportioned into the "p" array. Then based on the portion an estimate for data point. The Van der Waerden's formula is used

$$p_j := \frac{rank_j}{\mathrm{rows}(\mathrm{Cells}) + 1}$$

The normal scores are the corresponding *p*th percentile points from the standard normal distribution:

$x := 1$ $\qquad$ $N\_Score_j := \mathrm{root}\left[\mathrm{cnorm}(x) - (p_j), x\right]$

If a sample is normally distributed, the points of the "Normal Plot" will seem to form a nearly straight line. The plot below shows the "Normal Plot" for the matrix generated in section 6.5.1



PT 5/18/05

6.5.7 Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence α" (reference 3.23).

$\alpha := .05$ $\qquad T\alpha := qt\left[\left(1-\frac{\alpha}{2}\right), 48\right]$ $\qquad T\alpha = 2.011$

Therefore for the matrix generated in section 6.1

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 767.726$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 778.094$$

These values represent a range on the calculated mean in which there is 95% confidence. In other words, if the 49 data points were collected 100 times the calculated mean in 95 of those 100 times would be within this range.

6.5.8 Graphical Representation

Below is the distribution of the "Cells" matrix generated in section 6.5.1 sorted in one half standard deviation increments (bins) within a range from minus 3 standard deviations to plus 3 standard deviations.

$Bins := Make_{bins}(\mu_{actual}, \sigma_{actual})$

$Distribution := hist(Bins, Cells)$

Distribution =

0
0
3
4
6
13
7
8
4
3
0
1

The mid points of the Bins are calculated

$k := 0..11$ $\qquad Midpoints_k := \frac{(Bins_k + Bins_{k+1})}{2}$

The Mathcad function pnorm calculates the normal distribution curve based on a given mean and standard deviation. The actual mean and standard deviation generated in section 6.5.2 are input. The resulting plot will provide a representation of the normally distribution corresponding the the actual mean and standard deviation.

$normal_{curve_0} := pnorm(Bins_1, \mu_{actual}, \sigma_{actual})$

$normal_{curve_k} := pnorm(Bins_{k+1}, \mu_{actual}, \sigma_{actual}) - pnorm(Bins_k, \mu_{actual}, \sigma_{actual})$

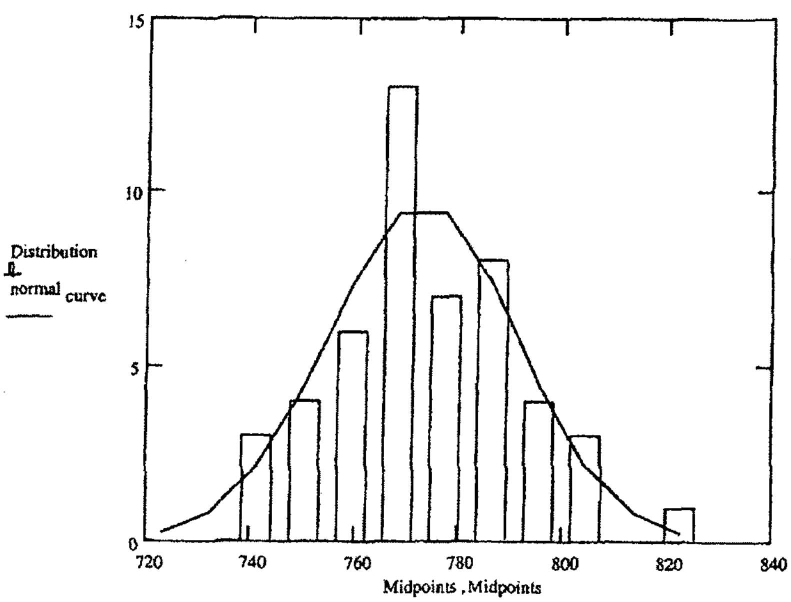
The normal curve is simply a proportion, which is multiplied by the number of "Cells" (49)

$normal_{curve} := No_{DataCells} \cdot normal_{curve}$

The following schematic shows: the actual distribution of the samples (the bars), the normal curve (solid line) based on the actual mean (μ_{actual}) and standard deviation σ_{actual}), the kurtosis (Kurtosis), the skewness (Skewness), the number of data points ($No_{DataCells}$), and the the lower and upper 95% confidence values $Lower_{95\%Con}, Upper_{95\%Con}$).

$\mu_{actual} = 772.91$ $\sigma_{actual} = 18.047$ $Standard_{error} = 2.578$

$Skewness = 0.354$ $Kurtosis = 0.262$ $No_{DataCells} = 49$



$Lower_{95\%Con} = 767.726$ $Upper_{95\%Con} = 778.094$

6.5.9 The "F" Test for Linear Regression

In order to determine whether the historical data for each location is indicative of corrosion, the means collected at each location over time are tested using the "F" Test for Linear Regression as follows (reference 3.22 and 3.23).

6.5.9.1 "F" Test Results Indicative of No Corrosion

For purposes of demonstration, five 49 point matrixes with the same input mean are generated. This will illustrate the case in which the means are indicative of a location which is not corroding.

$d := 0..4$ $\qquad \mu_{input_d} := 775$ $\qquad \sigma_{input_d} := 20$ $\qquad Cells_d := rnorm\left(No_{DataCells}, \mu_{input_d}, \sigma_{input_d}\right)$

$\mu_{actual_d} := mean\left(Cells_d\right)$ $\qquad \sigma_{actual_d} := Stdev\left(Cells_d\right)$

The five means, standard deviations, and simulated dates are shown below

$$\mu_{actual} = \begin{bmatrix} 769.638 \\ 775.647 \\ 771.334 \\ 779.326 \\ 773.555 \end{bmatrix} \qquad \sigma_{actual} = \begin{bmatrix} 18.813 \\ 19.4 \\ 23.726 \\ 19.422 \\ 18.793 \end{bmatrix} \qquad Dates_i := \begin{bmatrix} 1993 + \frac{6}{365} \\ 1994 + \frac{243 + 14}{365} \\ 1996 + \frac{243 + 16}{365} \\ 1997 + \frac{356}{365} \\ 1999 + \frac{105}{365} \end{bmatrix}$$

The following function simply returns the number of means (No_of_{means}) which will be used later

$No\_of_{means} := rows\left(\mu_{actual}\right)$ $\qquad No\_of_{means} = 5$

The curve fit equation in which the date (Dates) is the independent variable and the measured mean thickness of the location (μ_{actual}) is the dependent variable is then defined as the function "yhat". This function make use of Mathcad function " intercept " which returns the intercept value of the "Best Fit" curve fit and the Mathcad function " slope " which returns the slope value of the "Best Fit" curve fit.

$$yhat(x,y) := intercept(x,y) + slope(x,y) \cdot x$$

The Sum of Squared Error (SSE) is calculated as follows (reference 3.23)

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{actual_i} - yhat(Dates, \mu_{actual})_i\right)^2 \qquad SSE = 44.202$$

The Sum of Squared Residuals (SSR) is then calculated as follows (reference 3.23)

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{actual})_i - mean(\mu_{actual})\right)^2 \qquad SSR = 13.158$$

Degrees of freedom associated with the sum of squares for residual error is calculated (reference 3.23).

$$DegreeFree_{ss} := No\_of_{means} - 2$$

The degrees of freedom for the sum of squares due to regression is calculated (reference 3.22 and 3.23).

$$DegreeFree_{reg} := No\_of_{means}$$

Dividing a sum of squares by its degrees of freedom provides the variance estimate (reference 3.22 and 3.23).

$$MSE := \frac{SSE}{DegreeFree_{ss}} \qquad MSE = 14.734$$

AmerGen	**CALCULATION SHEET**	Preparer: Pete Tamburro 1/18/05		
Subject: Statistical Analysis of Drywell Vessel Thickness Data	**Calculation No.** C-1302-187-E310-037	**Rev. No.** ~~1~~ 2	**System Nos.** 187	**Sheet** 22 of 35

DT 5/15/05

An estimate of the error standard deviation which is also called the standard error of estimate is calculated (reference 3.23).

$\text{Standard}_{error} := \sqrt{MSE}$ $\quad\quad$ $\text{Standard}_{error} = 3.838$

MSR, the population error variance is calculated (reference 3.23)

$MSR := \dfrac{SSR}{\text{DegreeFree}_{reg}}$ $\quad\quad$ $MSR = 2.632$

The MSE is the variance estimate for the mean model. Similarly, the MSR is an estimate for the variance that is explained by the regression model. The ratio of regression variance (MSR) to mean variance MSE, gives measure of the regression relationship.

$F_{actaul} := \dfrac{MSR}{MSE}$

For 95% confidence level the "F" critical is calculated as follows (reference 3.22 and 3.23)

$\alpha := 0.05$ $\quad\quad$ $F_{critical} := qF\left(1-\alpha, \text{DegreeFree}_{reg}, \text{DegreeFree}_{ss}\right)$ $\quad\quad$ $F_{critical} = 9.013$

The "F" ratio for 95% confidence is calculated:

$F_{ratio} := \dfrac{F_{actaul}}{F_{critical}}$ $\quad\quad$ $F_{ratio} = 0.02$

An F-Ratio less than 1.0 occurs when the amount of corrosion which has occurred since the initial measurement is less than the random variations in the measurements or fewer than four measurements have been taken. If the F ratio is less than 1.0, the computer corrosion rate does not reflect the actual corrosion rate but rather is provided as a conservative projection(reference 3.22).

An "F" ratio of 1 or less indicates that the data trend is best explained by the grand mean of the data and the the trend has no slope. The variability in the data is within the distribution profile for the data which is normally distributed. Therefore a grand mean $\mu grand_{actual}$) is best estimate of the thickness of the location.

An F-Ratio of 1.0 is greater occurs when the amount of corrosion which has occurred since the initial measurement is significant compared to the random variations, and four or more measurements have been taken. In these cases the computed corrosion rate more accurately reflects the actual corrosion rate, and there is a very low probability that the actual corrosion rate is zero. The greater the F-Ratio the lower the uncertainty in the corrosion rate (reference 3.22).

Where the F-Ratio of 1.0 or greater provides confidence in the historical corrosion rate, the F-Ratio should be 4 to 5 if the corrosion rate is to be used to predict the thickness in the future. To have a high degree of confidence in the predicted thickness, the ratio should be at least 8 or 9 (reference 3.22 calculation).

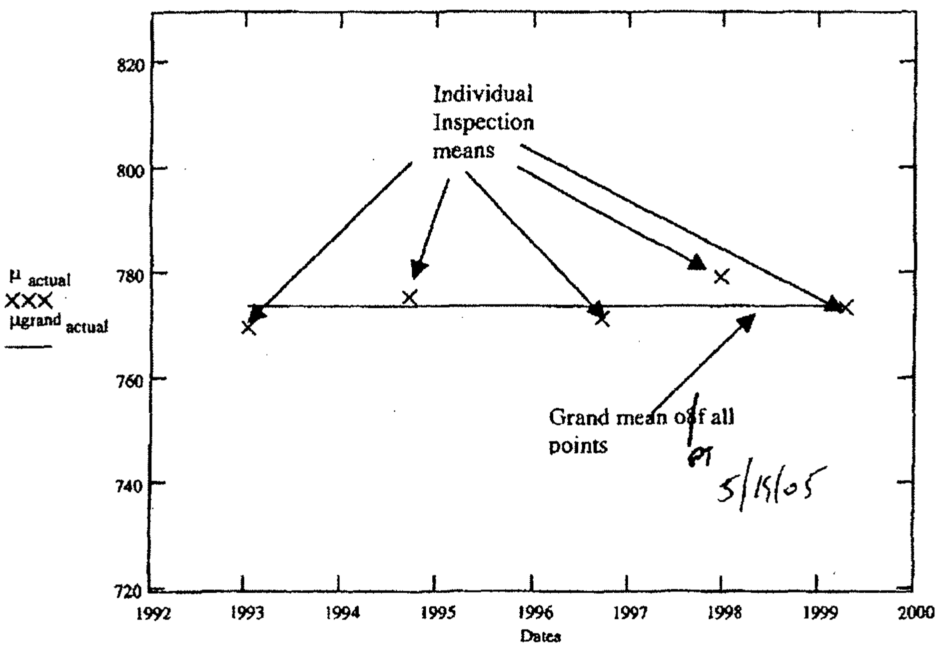
12/08/05 12:05:34

AmerGen	**CALCULATION SHEET**		Preparer: Pete Tamburro 1/18/05	
Subject: Statistical Analysis of Drywell Vessel Thickness Data	**Calculation No.** C-1302-187-E310-037	**Rev. No.** ~~1~~ 2	**System Nos.** 187	**Sheet** 23 of 35

PT 5/15/05

The following shows the results in a graph

$$\mu grand_{actual_i} := mean(\mu_{actual})$$



6.5.9.2 "F" Test Results Indicative of Corrosion

To illustrate the case in which the location is corroding the five, 49 point matrixes will now be generated with input means which are descending over time.

$d := 0..4 \qquad \mu_{input_d} := 775 - (d \cdot 4)$

$\sigma_{input_d} := 20 \qquad Cells_d := rnorm\left(No_{DataCells}, \mu_{input_d}, \sigma_{input_d}\right)$

$\mu_{actual_d} := mean\left(Cells_d\right) \qquad \sigma_{actual_d} := Stdev\left(Cells_d\right)$

$$\mu_{actual} = \begin{bmatrix} 779.579 \\ 775.201 \\ 769.326 \\ 766.983 \\ 762.322 \end{bmatrix} \qquad \sigma_{actual} = \begin{bmatrix} 19.489 \\ 17.654 \\ 19.735 \\ 19.979 \\ 20.121 \end{bmatrix}$$

$Dates_i :=$

$1993 + \frac{6}{365}$
$1994 + \frac{243+14}{365}$
$1996 + \frac{243+16}{365}$
$1997 + \frac{356}{365}$
$1999 + \frac{105}{365}$

$Total_{means} := rows\left(\mu_{actual}\right) \qquad Total_{means} = 5$

The curve fit equation is then defined for the function "yhat"

$yhat(x, y) := intercept(x, y) + slope(x, y) \cdot x$

The Sum of Squared Error is calculated

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{actual_i} - yhat\left(Dates, \mu_{actual}\right)_i\right)^2 \qquad SSE = 0.818$$

PT 5/19/05

The Sum of Squared Residuals is then calculated

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat\left(Dates, \mu_{actual}\right)_i - mean\left(\mu_{actual}\right)\right)^2 \qquad SSR = 184.164$$

Degrees of freedom associated with the sum of squares for residual error.

$$DegreeFree_{ss} := Total_{means} - 2$$

The degrees of freedom for the sum of squares due to regression,

$$DegreeFree_{reg} := Total_{means}$$

$$MSE := \frac{SSE}{DegreeFree_{ss}} \qquad MSE = 0.273$$

$$Standard_{error} := \sqrt{MSE} \qquad Standard_{error} = 0.522$$

$$MSR := \frac{SSR}{DegreeFree_{reg}} \qquad MSR = 36.833$$

$$F_{actaul} := \frac{MSR}{MSE}$$

$$\alpha := 0.05 \qquad F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right) \qquad F_{critical} = 9.013$$

The "F" ratio for 95% confidence is calculated:

$$F_{ratio} := \frac{F_{actaul}}{F_{critical}} \qquad F_{ratio} = 14.983$$

The "F" ratio is greater than 1.0, therefore the regression model holds for the data. The curve fit for the five means is best explained by a curve fit with a slope.

6.9.3 Linear Regression with 95% Confidence Bounds

Using data generated in section 6.9.2 the curve fit for linear regression is calculated by the Mathcad functions "slope" and "intercept".

$$m_s := \text{slope}(\text{Dates}, \mu_{actual}) \qquad y_b := \text{intercept}(\text{Dates}, \mu_{actual})$$

$$m_s = -2.702 \qquad y_b = 6.165 \times 10^3$$

The predicted curve is calculated over time where "$\text{year}_{predict}$" is time (independent variable), and "$\text{Thick}_{predict}$" is thickness (dependent variable).

$$\text{Remaining}_{Pl\_life} := 13 \qquad f := 0 .. \text{Remaining}_{Pl\_life} - 1 \qquad \text{year}_{predict_f} := 1985 + f \cdot 2$$

$$\text{Thick}_{predict} := m_s \cdot \text{year}_{predict} + y_b$$

The 95% Confidence ("1 α_t") curves are calculated as follows (reference 3.3)

$$\alpha_t := 0.05$$

$$\text{Thick}_{actualmean} := \text{mean}(\text{Dates})$$

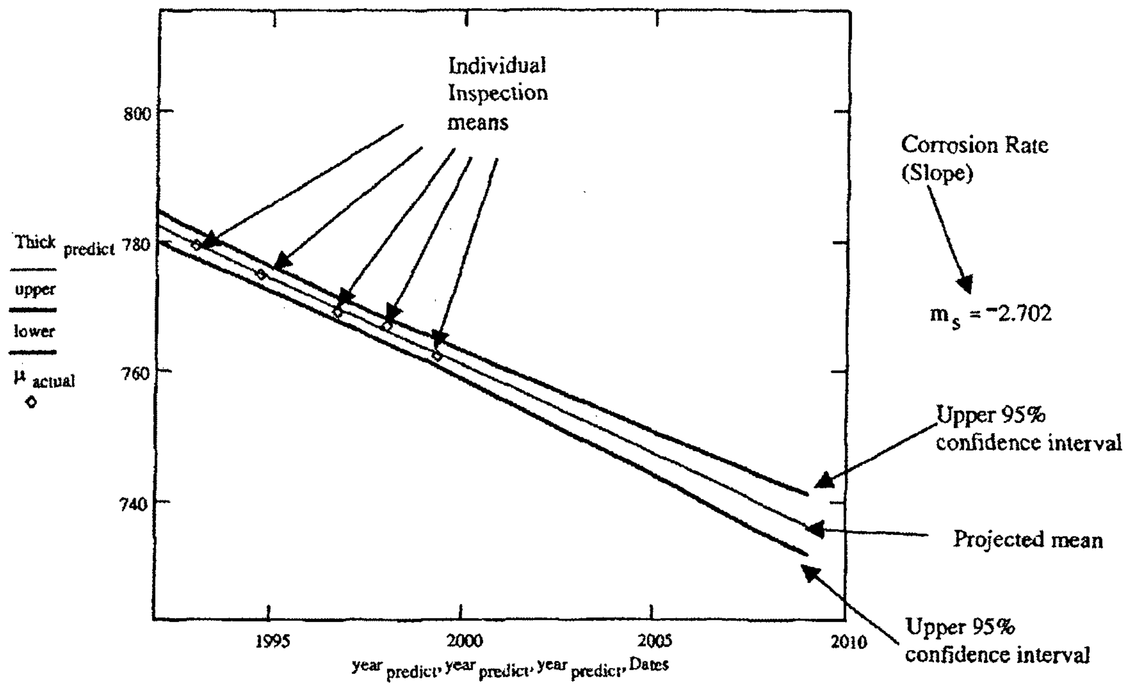
$$\text{sum} := \sum_d (\text{Dates}_d - \text{mean}(\text{Dates}))^2$$

$$\text{upper}_f := \text{Thick}_{predict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, \text{Total}_{means} - 2\right) \cdot \text{Standard}_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{(\text{year}_{predict_f} - \text{Thick}_{actualmean})^2}{\text{sum}}}$$

$$\text{lower}_f := \text{Thick}_{predict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, \text{Total}_{means} - 2\right) \cdot \text{Standard}_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{(\text{year}_{predict_f} - \text{Thick}_{actualmean})^2}{\text{sum}}}\right]$$

PT 5/15/05

Therefore the following is a plot of the curve fit of the data generated in section 6.9.2 and the Upper and Lower 95% confidence Intervals. The Upper and Lower 95% Confidence Intervals are the two curves shown below which bound the data points and the curve fit.



7.0 Calculation

7.1. Elevation 50' 2"

7.1.1 Bay 5 Area D12, Feb. 1990 through November 2004

Refer to Appendix #1 for the complete calculation.

Twelve inspections have been performed at this location. A plug lies within this location and therefore the nine points over the plug are eliminated from the calculation (see section 5.2). The data collected in Nov. 2004 inspection is normally distributed after the nine points are eliminated.

In addition to the nine points the following adjustments have been made over time:

1) Point 9 is a significant pit and is trended separately
2) Points 1, 4 and 37 in the 4/25/90 data set are much greater than the preceding or succeeding measurements. Therefore these three points were dropped from the 4/25/90 data (ref. 2.22).
3) Points 3 and 36 in the 11/02/91 data set are much greater than the preceding or succeeding measurements. Therefore these two points were dropped from the 11/02/91 data (ref. 2.22).

The data indicates no ongoing corrosion since Feb 1990

Point 9

Analysis of this point prior to Nov 2004 (ref. 3.22) indicated that there was a potential corrosion rate. The addition of the Sept. 2000 and Nov 2004 data now drives the F-ratio for this point to 3.345, which now suggest that a rate exists. The calculated rate is 1.2 mils per year. This corrosion rate is very small. Projection based on this corrosion rate using the 95% lower confidence interval shows that this point will not corrode to less than the minimum required thickness by the year 2029.

7.1.2 Bay 5 Area 5, March 1990 through November 2004

Refer to Attachment #2 for the complete calculation.

Eleven Inspections have been performed at this location. Previous data sets were not normally distributed since there is a thinner area in the center of the grid and several smaller patches on the periphery. Past calculations separated these regions into subsets. The two subsets are separated as points less than and greater than 734.5 mils. Analysis of past subsets shows that both data sets are normally distributed. The Nov. 2004 data is consistent with past data.

In addition, point 17 has been identified as a pit and is trended separately

Results of the two subsets are described below:

Thinner Points
This subset is normally distributed. The F-ratio for this subset indicates that there is no ongoing corrosion.

Thicker Points
This subset is normally distributed. The F-ratio for this subset (1.03) indicates that there is ongoing corrosion at a rate of 0.3 mils per year. This corrosion rate is very small. Projection based on this corrosion rate using the 95% lower confidence interval shows that it will not corrode to less than the minimum required thickness by the year 2029.

Point 17
The F-ratio for this point indicates no on going corrosion.

7.1.3 Bay 13 Area 31, March 1990 through November 2004

Refer to Appendix #3 for the complete calculation.

Eleven inspections have been performed at this location. Previous data sets have not been normally distributed since there is a thinner area on the left edge of the grid. Past calculations have separated these regions in two subsets. . Analysis of past subsets shows that both data sets are normally distributed. The Nov. 2004 data is consistent with this past data.

Results of the two subsets are described below:

Thinner Points
This subset is normally distributed. The F-ratio for this subset indicates that there is no ongoing corrosion.

Thicker Points
This subset is normally distributed. The F-ratio for this subset indicates that there is no ongoing corrosion.

7.1.4 Bay 13 Area 23 March 1990 through November 2004

Refer to Appendix #4 for the complete calculation.

Eleven inspections have been performed at this location. Previous data sets were not normally distributed since there is a thinner area in the center of the grid. Past calculations separated these regions into subsets. Analysis of past subsets shows that both data sets are normally distributed. The Nov. 2004 is consistent with this past data.

Also point 26 is significantly thinner than these two areas. Therefore point 26 is trended separately

Point 27 in the November 1991 data set is much less than the preceding or succeeding measurements. Therefore this point was dropped from the 11/91 data (ref. 2.22).

Results of the two subsets are described below:

Thinner Points
This subset is normally distributed. The F-ratio for this subset indicates that there is no ongoing corrosion.

Thicker Points

This subset is normally distributed. The F-ratio for this subset (1.05) indicates that there is ongoing corrosion at a rate of 0.4 mils per year. Nov. 2004 is the first time a potential corrosion rate has been observed at this location. This corrosion rate is very small. Projection based on this corrosion rate using the 95% lower confidence interval shows that it will not corrode to less than the minimum required thickness by the year 2029.

Point 26
The addition of the Sept. 2000 and Nov. 2004 data now drives the F-ratio to 3.74, which now suggests that a rate exists. The calculated rate is 1.33 per year. This corrosion rate is very small. Projection based on these corrosion rates using the 95% lower confidence interval shows that this point will not corrode to less than the minimum required thickness by the year 2029.

7.2 Elevation 51' 10" through November 2004.

7.2.1 Bay 13 Area 32 April 1990 through November 2004

Refer to Appendix #5 for the complete calculation.

Ten inspections have been performed at this location. Previous data sets were not normally distributed since there is a "T" shaped thinner area along the right side of the grid. Past calculations separated these regions into subsets. Analysis of past subsets shows that both data sets are normally distributed. The November 2004 data is consistent with this past data.

In addition, points 20, 23, 25, and 28 are significantly thinner than these two areas. Therefore these points are trended separately

Point 11 in the 5/23/91 data set was much less than the preceding or succeeding measurements. Therefore this point was dropped from the 5/22/91 data (ref. 2.22).

Results of the two subsets are described below:

Thinner Points
This subset is normally distributed. The F-ratio for this subset indicates that there is no ongoing corrosion.

Thicker Points
This subset is normally distributed. The F-ratio for this subset indicates that there is no ongoing corrosion.

Points 20, 23, 25, and 28
The F-ratio for these points indicates no on going corrosion.

7.3 Elevation 60' 10"

PT 5/15/05

7.3.1 Bay 1 Area 5-22 April 1990 through November 2004

Refer to Appendix #6 for the complete calculation.

Five inspections have been performed at this location. Data collected in all four inspections are normally distributed after point 48 is eliminated. Point 48 is a significant pit and is trended separately

The data indicates no ongoing corrosion since Feb 1990

Point 48

Point 48 may be experiencing a corrosion rate of 3.2 mils per year. This relatively greater calculated rate may be due to the limited amount of inspections. The methodology and analysis results in greater rate and confidence levels for less data. Since the amount of data on this pit is limited to 5 inspections, the upper and lower 95% confidence intervals are very broad and conservative. Never-the-less projection based on this corrosion rates using the 95% lower confidence interval, which is significantly more conservative than other locations, show that this point will not corrode to less than the minimum required thickness by the year 2029.

7.4 Elevation 87' 5"

7.4.1 Bay 9 Area 20 November 1987 through November 2004

Refer to Appendix #7 for the complete calculation.

Thirteen inspections have been performed at this location. UT data collected in November 2004 is normally distributed.

Point 13 in the May 1992 data set was much less than the preceding or succeeding measurements. Therefore this point was dropped from the May 1992 data (ref. 2.22).

Based on a calculated F-ratio of 1.38, this location is experiencing a minor corrosion rate of approximately 0.75 mils per year. This corrosion rate is very small. Projections based on this corrosion rate using the 95% lower confidence interval shows that this area they will not corrode to less than the minimum required thickness by the year 2029.

7.4.2 Bay 13 Area 28 November 1987 through November 2004

Refer to Appendix #8 for the complete calculation.

Thirteen inspections have been performed at this location. Previous data sets were not normally distributed. Past calculations separated out points 1, 2, 22, 25, 26, 36, and 48. Analysis of past data sets without these points show that the data is normally distributed. The Nov 2004 data is consistent with this past data.

Analysis of the data indicates no ongoing corrosion since Feb 1990

Points 1, 2, 22, 25, 26, 36, and 48
Analysis of these individual points shows no ongoing corrosion

7.4.1 Bay 15 Area 31 November 1987 through Nov. 2004

Refer to Appendix #9 for the complete calculation.

Thirteen inspections have been performed at this location. Previous data sets have not been normally distributed. Past calculations have separated out points 34 and 35. Analysis of past data sets without these points showed that the data set was normally distributed. The Nov. 2004 data is consistent with this past data.

Based on a calculated F-ratio of 0.90 for this location it may be experiencing minor a corrosion rate of approximately 0.49 mils per year. This corrosion rate is very small. Projections based on this corrosion rate using the 95% lower confidence interval shows that they will not corrode to less than the minimum required thickness by the year 2029.

Points 34 and 35
The F-ratio for these points indicate no on going corrosion

PT 5/15/05

8.0 Appendices

Appendix 1 - Bay 5 Area D12, Feb. 1990 through Sept. 2004 Calculation (25 Pages)

Appendix 2 - Bay 5 Area 5, March 1990 through Sept. 2004 Calculation (24 Pages)

Appendix 3 - Bay 13 Area 31, March 1990 through Sept. 2004 Calculation (29 Pages)

Appendix 4 -Bay 13 Area 23 March 1990 through Sept. 2004 Calculation (32 Pages)

Appendix 5 -Bay 13 Area 32 April 1990 through Sept. 2004 Calculation (31 Pages)

Appendix 6 -Bay 1 Area 5-22 April 1990 through Sept. 2004 Calculation (16 Pages)

Appendix 7 -Bay 9 Area 20 November 1987 through Sept. 2004 Calculation (23 Pages)

Appendix 8 -Bay 13 Area 28 November 1987 through Sept. 2004 Calculation (26 Pages)

Appendix 9 -Bay 15 Area 31 November 1987 through Sept. 2004 Calculation (26 Pages)

Appendix 10 – September 2000 Data – NDE Report 2000-34-001 through 009 (9 Pages)

Appendix 11 – November 2004 Data – NDE Report CDS 065 (4 Pages)

Bay 5 Area D/12

Subject: Drywell Corrosion	Calc. No.	Rev. No.	System No.	Sheet No.
	C-1302-187-E310-037	1 2	187	A1-1 of 25

PT 5/15/05

Appendix 1 - Elevation 50' 2" Bay 5, Area D/12

Nov. 9, 2004 Data

The data shown below was collected on 11/9/2004 .

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5112_00.txt")

$Points_{49}$:= showcells(page , 7 , 0)

$Points_{49}$ =

0.75	0.72	0.752	0.741	0.745	0.756	0.758
0.751	0.676	0.746	0.728	0.752	0.708	0.737
0.752	0.751	0.751	0.706	0.746	0.737	0.74
0.747	0.74	0.736	0.689	0.745	0	0.74
0.753	0.755	0.756	0.741	0.731	1.154	0.727
0.765	0.748	0.742	0.725	0.733	0.735	0.721
0.746	0.74	0.743	0.745	0.737	0.738	0.742

Cells := convert($Points_{49}$, 7) $No_{DataCells}$:= length(Cells)

For this location the following points are on a plug (Reference 3.22)

Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 13)   Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 27)

Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 20)   Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 28)

Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 25)   Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 33)

Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 26)   Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 34)

Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 35)

The following Locations is classified as a pit and has been omitted from the overall mean calculation for this location and is trended separately as a pit.

Cells := $Zero_{one}$(Cells , $No_{DataCells}$, 9)

Cells := $deletezero_{cells}$(Cells , $No_{DataCells}$)

$No_{DataCells}$:= length(Cells)

The thinnest point at this location is shown below

minpoint := min(Cells)

minpoint = 706

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(\text{Cells})$ $\mu_{actual} = 742.821$ $\sigma_{actual} := \text{Stdev}(\text{Cells})$ $\sigma_{actual} = 11.616$

Standard Error

$$\text{Standard}_{error} := \frac{\sigma_{actual}}{\sqrt{\text{No}_{DataCells}}}$$

$\text{Standard}_{error} = 1.86$

Skewness

$$\text{Skewness} := \frac{\left(\text{No}_{DataCells}\right)\cdot\overrightarrow{\Sigma\left(\text{Cells} - \mu_{actual}\right)^3}}{\left(\text{No}_{DataCells} - 1\right)\cdot\left(\text{No}_{DataCells} - 2\right)\cdot\left(\sigma_{actual}\right)^3}$$

$\text{Skewness} = -1.007$

Kurtosis

$$\text{Kurtosis} := \frac{\text{No}_{DataCells}\cdot\left(\text{No}_{DataCells} + 1\right)\cdot\overrightarrow{\Sigma\left(\text{Cells} - \mu_{actual}\right)^4}}{\left(\text{No}_{DataCells} - 1\right)\cdot\left(\text{No}_{DataCells} - 2\right)\cdot\left(\text{No}_{DataCells} - 3\right)\cdot\left(\sigma_{actual}\right)^4} + -\frac{3\cdot\left(\text{No}_{DataCells} - 1\right)^2}{\left(\text{No}_{DataCells} - 2\right)\cdot\left(\text{No}_{DataCells} - 3\right)}$$

$\text{Kurtosis} = 1.707$

Normal Probability Plot

$j := 0 .. \text{last}(\text{Cells})$ $srt := \text{sort}(\text{Cells})$

$r_j := j + 1$ $rank_j := \dfrac{\sum \overrightarrow{\left(\overrightarrow{srt = srt_j}\right) \cdot r}}{\sum \overrightarrow{srt = srt_j}}$

$p_j := \dfrac{rank_j}{\text{rows}(\text{Cells}) + 1}$

$x := 1$ $N\_Score_j := \text{root}\left[\text{cnorm}(x) - \left(p_j\right), x\right]$

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$$\alpha := .05 \qquad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 739.081$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 746.561$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$$Bins := Make_{bins}\left(\mu_{actual}, \sigma_{actual}\right)$$

$$Distribution := hist(Bins, Cells)$$

Distribution =

0
0
3
1
5
8
8
8
4
1
0
0

The mid points of the Bins are calculated

$$k := 0..11 \qquad Midpoints_k := \frac{\left(Bins_k + Bins_{k+1}\right)}{2}$$

The Mathcad function pnorm calculates a portion of normal distribution curve based on a given mean and standard deviation

$$normal_{curve_0} := pnorm\left(Bins_1, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve_k} := pnorm\left(Bins_{k+1}, \mu_{actual}, \sigma_{actual}\right) - pnorm\left(Bins_k, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve} := No_{DataCells} \cdot normal_{curve}$$

Bay 5 Area D/12

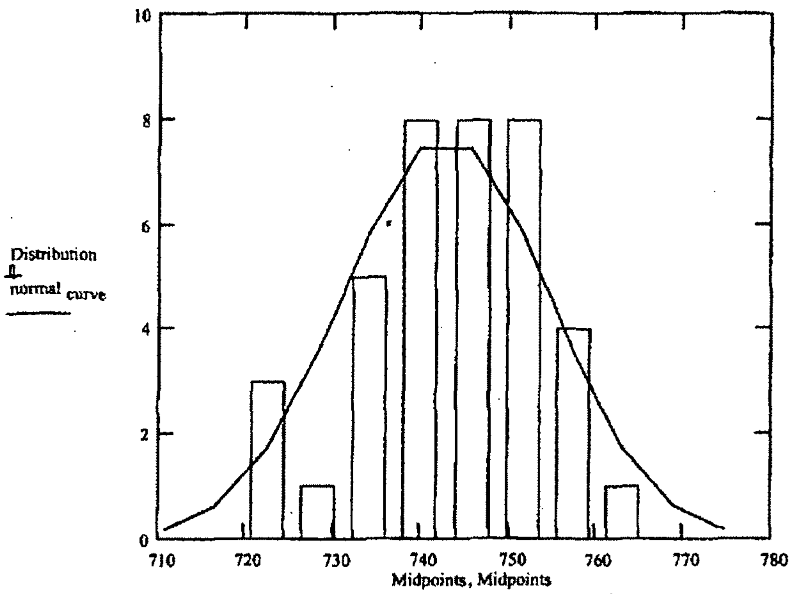
Subject: Drywell Corrosion	Calc. No.	Rev. No.	System No.	Sheet No.
	C-1302-187-E310-037	2	187	A1-5 of 25

PT 5/15/05

Results For Elevation 50' 2" Bay 5, Area D/12
Sept. 17, 2000

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values. Below is the Normal Probability Plot for the data.

Data Distribution



$\mu_{actual} = 742.821$

$\sigma_{actual} = 11.616$

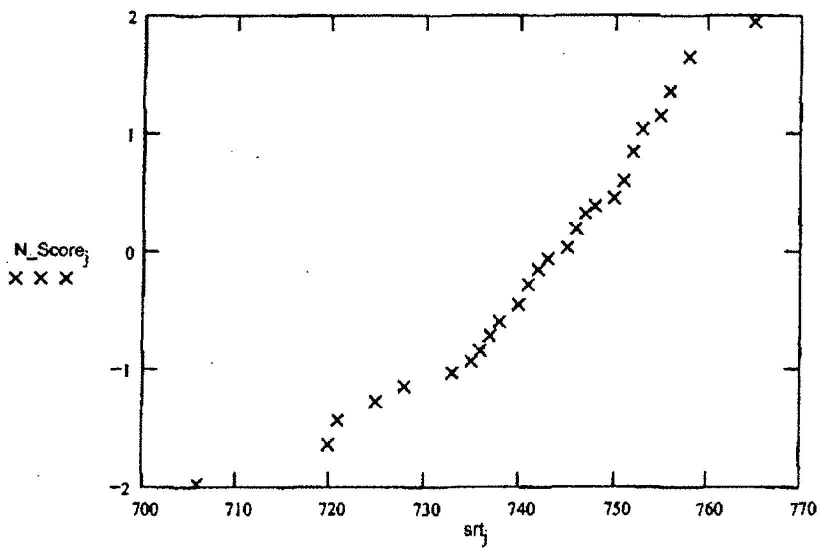
$Standard_{error} = 1.86$

Skewness = −1.007

Kurtosis = 1.707

$Lower_{95\%Con} = 739.081$ $Upper_{95\%Con} = 746.561$

Normal Probability Plot



Based on the Normal Probability Plot, Skewness, and the Kurtosis this data is normally distributed.

Elevation 50' 2" Bay 5, Area D12 Trend

Data from Feb 1990 to Sept 2000 is retrieved.

$d := 0$

For Feb 8 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1990 Data\DATA ONLY\D5112_Feb90.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(2, 8, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.752 & 0.722 & 0.747 & 0.719 & 0.747 & 0.76 & 0.738 \\ 0.745 & 0.688 & 0.75 & 0.736 & 0.759 & 0.696 & 0.739 \\ 0.748 & 0.752 & 0.755 & 0.717 & 0.744 & 0.315 & 0.738 \\ 0.753 & 0.742 & 0.742 & 0.7 & 0.745 & 0.671 & 0.332 \\ 0.755 & 0.755 & 0.748 & 0.743 & 0.741 & 0.301 & 0.735 \\ 0.766 & 0.743 & 0.738 & 0.727 & 0.732 & 0.74 & 0.727 \\ 0.742 & 0.738 & 0.742 & 0.749 & 0.741 & 0.742 & 0.745 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit_{9_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For March 28 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D5112_March90.txt"

$Points_{49}$:= showcells(page , 7 , 0)

$Dates_d$:= Day_{year}(3 , 28 , 1990)

Data

$Points_{49}$ =

0.752	0.725	0.746	0.716	0.743	0.76	0.731
0.749	0.699	0.75	0.736	0.758	0.696	0.74
0.755	0.753	0.755	0.719	0.741	0.309	0.739
0.757	0.743	0.747	0.748	0.757	0.856	0.348
0.755	0.757	0.752	0.743	0.744	0.296	0.737
0.767	0.753	0.742	0.73	0.737	0.747	0.737
0.745	0.734	0.737	0.755	0.749	0.746	0.753

nnn := convert$\left(Points_{49}, 7\right)$ $\quad$ $No_{DataCells}$:= length(nnn)

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

Pit_{9_d} := $Get\_Pit_{data}\left(nnn, No_{DataCells}, 9\right)$ $\quad$ nnn := $Zero_{one}\left(nnn, No_{DataCells}, 9\right)$

The following locations are over a core sample location and therefore are omitted from the data

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 13\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 20\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 25\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 26\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 27\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 28\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 33\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 34\right)$

nnn := $Zero_{one}\left(nnn, No_{DataCells}, 35\right)$

Cells := $deletezero_{cells}\left(nnn, No_{DataCells}\right)$

$\mu_{measured_d}$:= mean(Cells) $\quad$ $\sigma_{measured_d}$:= Stdev(Cells) $\quad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For April 25 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\April 1990 Data\DATA ONLY\D5112_April90.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(5, 25, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.79 & 0.725 & 0.752 & 0.771 & 0.745 & 0.761 & 0.739 \\ 0.747 & 0.689 & 0.753 & 0.738 & 0.759 & 0.721 & 0.747 \\ 0.753 & 0.753 & 0.755 & 0.716 & 0.741 & 0.313 & 0.738 \\ 0.754 & 0.739 & 0.743 & 0.703 & 1.153 & 0.104 & 0.705 \\ 0.755 & 0.757 & 0.76 & 0.743 & 0.742 & 0.301 & 0.737 \\ 0.764 & 0.806 & 0.741 & 0.728 & 0.737 & 0.743 & 0.728 \\ 0.744 & 0.736 & 0.729 & 0.75 & 0.743 & 0.743 & 0.748 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit\,9_d := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

The following points were eliminated from the April 25 1990 data set (ref. 30 calc.)

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 4)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 37)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

ATS 5/19/05

$d := d + 1$

For Feb. 23 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D5112_F91.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.753 & 0.717 & 0.745 & 0.715 & 0.742 & 0.757 & 0.734 \\ 0.745 & 0.695 & 0.747 & 0.732 & 0.76 & 0.695 & 0.738 \\ 0.751 & 0.749 & 0.751 & 0.722 & 0.739 & 0.754 & 0.735 \\ 0.755 & 0.738 & 0.745 & 0.701 & 0.744 & 0.305 & 0.731 \\ 0.748 & 0.752 & 0.75 & 0.74 & 0.741 & 0.299 & 0.733 \\ 0.758 & 0.752 & 0.754 & 0.722 & 0.734 & 0.737 & 0.726 \\ 0.731 & 0.737 & 0.729 & 0.747 & 0.742 & 0.747 & 0.745 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit_{9_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For May 23 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D5112_M91.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.754 & 0.723 & 0.753 & 0.72 & 0.748 & 0.762 & 0.742 \\ 0.748 & 0.688 & 0.752 & 0.74 & 0.76 & 0.704 & 0.741 \\ 0.752 & 0.754 & 0.757 & 0.716 & 0.753 & 0.315 & 0.744 \\ 0.754 & 0.74 & 0.744 & 0.7 & 0.28 & 0 & 0.294 \\ 0.758 & 0.758 & 0.752 & 0.745 & 0.742 & 0.305 & 0.736 \\ 0.767 & 0.747 & 0.741 & 0.73 & 0.737 & 0.743 & 0.729 \\ 0.746 & 0.739 & 0.728 & 0.75 & 0.743 & 0.747 & 0.749 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit_{9_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

IT 5/19/05

$d := d + 1$

For Nov. 2 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov. 1991 Data\DATA ONLY\D5112_N91.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\qquad$ $\text{Dates}_d := \text{Day}_{\text{year}}(11, 2, 1991)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.745 & 0.718 & 0.797 & 0.75 & 0.752 & 0.757 & 0.747 \\ 0.745 & 0.689 & 0.755 & 0.72 & 0.756 & 0.761 & 0.746 \\ 0.765 & 0.755 & 0.755 & 0.72 & 0.753 & 0.758 & 0.746 \\ 0.755 & 0.743 & 0.746 & 0.704 & 0.806 & 0 & 0.755 \\ 0.754 & 0.758 & 0.764 & 0.774 & 0.737 & 1.128 & 0.742 \\ 0.829 & 0.741 & 0.754 & 0.733 & 0.745 & 0.744 & 0.739 \\ 0.755 & 0.75 & 0.733 & 0.749 & 0.748 & 0.762 & 0.746 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\qquad$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$\text{Pit}_{9_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 9)$ $\qquad$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 13)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 20)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 26)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 27)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 28)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 33)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 34)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 35)$

The following points were eiminated from the Nov 1991 data (ref. 30 Calc.)

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 3)$ $\qquad$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 36)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\qquad$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\qquad$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

17 5/5/05

$d := d + 1$

For May 30 1992

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D5112_M92.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(5, 30, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.753 & 0.721 & 0.749 & 0.726 & 0.742 & 0.759 & 0.738 \\ 0.748 & 0.689 & 0.75 & 0.741 & 0.764 & 0.716 & 0.747 \\ 0.756 & 0.757 & 0.763 & 0.72 & 0.75 & 0.308 & 0.74 \\ 0.753 & 0.745 & 0.747 & 0.71 & 0.753 & 0.514 & 0.287 \\ 0.759 & 0.758 & 0.752 & 0.748 & 0.745 & 0.297 & 0.735 \\ 0.773 & 0.746 & 0.744 & 0.733 & 0.742 & 0.745 & 0.732 \\ 0.744 & 0.735 & 0.741 & 0.755 & 0.743 & 0.747 & 0.752 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit\ 9_d := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

PS 5/5/05

$d := d + 1$

For Dec. 5 1992

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D5112_D92.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.752 & 0.721 & 0.754 & 0.752 & 0.751 & 0.762 & 0.744 \\ 0.753 & 0.687 & 0.759 & 0.749 & 0.763 & 0.717 & 0.743 \\ 0.753 & 0.754 & 0.762 & 0.717 & 0.748 & 0.749 & 0.743 \\ 0.751 & 0.743 & 0.745 & 0.704 & 0.303 & 0.534 & 0.358 \\ 0.758 & 0.756 & 0.753 & 0.746 & 0.74 & 1.158 & 0.733 \\ 0.768 & 0.739 & 0.744 & 0.729 & 0.738 & 0.748 & 0.733 \\ 0.749 & 0.739 & 0.742 & 0.748 & 0.741 & 0.742 & 0.747 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit_{9_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/5/05

$d := d + 1$

For Sept. 14 1994

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D5112_94.txt")

$Points_{49} :=$ showcells(page , 7 , 0) $Dates_d :=$ Day_{year}(9 , 14 , 1994)

Data

$Points_{49} =$

0.75	0.718	0.752	0.736	0.743	0.756	0.739
0.741	0.683	0.746	0.734	0.753	0.691	0.736
0.744	0.748	0.75	0.712	0.737	0.293	0.738
0.746	0.738	0.737	0.697	0.28	0.253	0.298
0.752	0.752	0.745	0.74	0.738	0.297	0.749
0.763	0.737	0.737	0.725	0.733	0.739	0.725
0.751	0.736	0.739	0.745	0.736	0.739	0.743

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit_{9_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

AT 5/15/05

$d := d + 1$

For Sept. 9 1996

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D5112_96.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.751 & 0.727 & 0.743 & 0.716 & 0.746 & 0.758 & 0.732 \\ 0.748 & 0.692 & 0.75 & 0.732 & 0.759 & 0.701 & 0.741 \\ 0.754 & 0.753 & 0.757 & 0.763 & 0.765 & 0.35 & 0.742 \\ 0.758 & 0.746 & 0.747 & 0.751 & 0.76 & 0.344 & 0.255 \\ 0.758 & 0.759 & 0.752 & 0.747 & 0.745 & 0.297 & 0.739 \\ 0.777 & 0.768 & 0.744 & 0.733 & 0.733 & 0.743 & 0.731 \\ 0.745 & 0.741 & 0.746 & 0.754 & 0.746 & 0.746 & 0.747 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit\,9_d := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

PT 5/15/05

$d := d + 1$

For Sept. 16 2000

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D5112_00.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(9, 16, 2000)$

Data

$$Points_{49} = \begin{bmatrix} 0.748 & 0.718 & 0.743 & 0.735 & 0.744 & 0.759 & 0.738 \\ 0.743 & 0.675 & 0.747 & 0.731 & 0.752 & 0.703 & 0.734 \\ 0.751 & 0.75 & 0.752 & 0.713 & 0.745 & 0.32 & 0.741 \\ 0.75 & 0.741 & 0.735 & 0.687 & 0.278 & 0 & 0.266 \\ 0.752 & 0.755 & 0.754 & 0.744 & 0.733 & 0.308 & 0.729 \\ 0.766 & 0.726 & 0.742 & 0.727 & 0.731 & 0.735 & 0.722 \\ 0.747 & 0.74 & 0.724 & 0.747 & 0.74 & 0.742 & 0.744 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit\,9_d := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For Nov. 9, 2004

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5112_00.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(11, 9, 2004)$

Data

$$Points_{49} = \begin{bmatrix} 0.75 & 0.72 & 0.752 & 0.741 & 0.745 & 0.756 & 0.758 \\ 0.751 & 0.676 & 0.746 & 0.728 & 0.752 & 0.708 & 0.737 \\ 0.752 & 0.751 & 0.751 & 0.706 & 0.746 & 0.737 & 0.74 \\ 0.747 & 0.74 & 0.736 & 0.689 & 0.745 & 0 & 0.74 \\ 0.753 & 0.755 & 0.756 & 0.741 & 0.731 & 1.154 & 0.727 \\ 0.765 & 0.748 & 0.742 & 0.725 & 0.733 & 0.735 & 0.721 \\ 0.746 & 0.74 & 0.743 & 0.745 & 0.737 & 0.738 & 0.742 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location point 9 is a pit. It will be trended separately and is omitted from calculation of the mean.

$Pit_{9_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 9)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 9)$

The following locations are over a core sample location and therefore are omitted from the data

$nnn := Zero_{one}(nnn, No_{DataCells}, 13)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 27)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Below are matrices which contain the date when the data was collected, Mean, Standard Deviation, Standard Error for each date.

Dates =

$1.99 \cdot 10^3$
$1.99 \cdot 10^3$
$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$
$2.001 \cdot 10^3$
$2.005 \cdot 10^3$

$\mu_{measured}$ =	Standard$_{error}$ =	$\sigma_{measured}$ =
743.026	1.546	10.825
744.974	1.598	11.184
746.444	1.829	12.805
741.564	1.626	11.385
745.282	1.636	11.452
748.054	1.711	11.974
746.615	1.592	11.146
747.154	1.511	10.579
740.795	1.432	10.024
747.641	1.71	11.973
741.231	1.622	11.354
742.821	1.659	11.616

5/15/05

$Total_{means} := rows(\mu_{measured})$ $Total_{means} = 12$

The F-Ratio is calculated

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2 \qquad SSE = 67.93$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2 \qquad SSR = 8.519$$

$DegreeFree_{ss} := Total_{means} - 2$ $DegreeFree_{reg} := 1$

$MSE := \frac{SSE}{DegreeFree_{ss}}$ $MSE = 6.793$ $MSR := \frac{SSR}{DegreeFree_{reg}}$ $MSR = 8.519$

$StGrand_{err} := \sqrt{MSE}$ $StGrand_{err} = 2.606$

$F_{actaul} := \frac{MSR}{MSE}$

$\alpha := 0.05$ $F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right)$

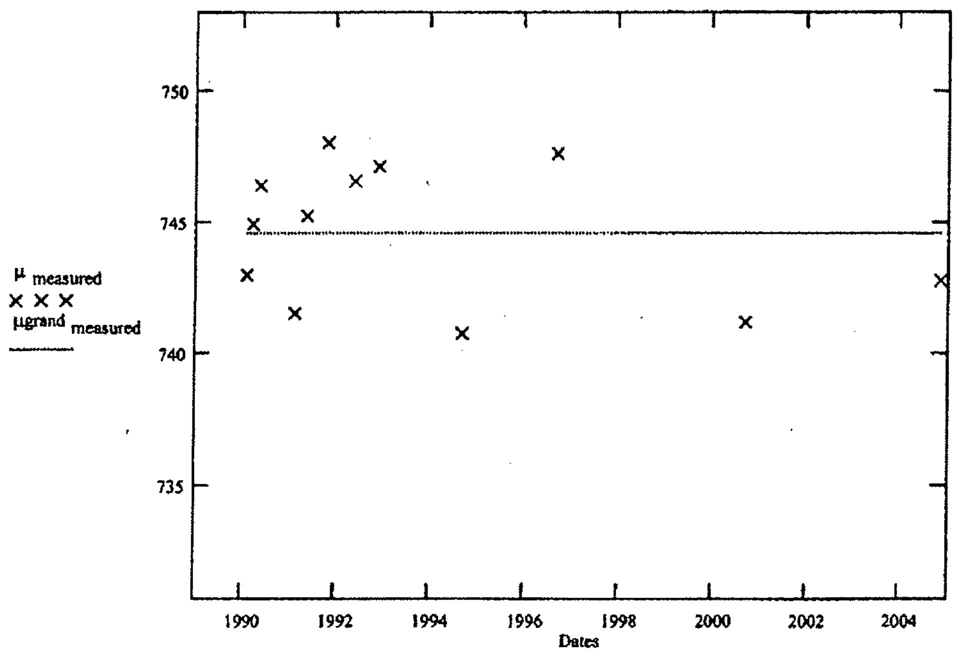
$F_{ratio} := \frac{F_{actaul}}{F_{critical}}$ $F_{ratio} = 0.253$

Therefore the curve fit of the means does not have a slope and the grandmean is an accurate measure of the thickness at this location

$i := 0 .. Total_{means} - 1$ $\mu grand_{measured_i} := mean\left(\mu_{measured}\right)$

$\sigma grand_{measured} := Stdev\left(\mu_{measured}\right)$ $GrandStandard_{error_0} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$

Plot of the grand mean and the actual means over time



$\mu grand_{measured_0} = 744.633$ $GrandStandard_{error} = 0.761$

To conservatively address the location, the apparent corrosion rate is calculated and compared to the minimum required wall thickness at this elevation

$m_s := \text{slope}\left(\text{Dates}, \mu_{\text{measured}}\right) \quad m_s = -0.19 \qquad y_b := \text{intercept}\left(\text{Dates}, \mu_{\text{measured}}\right) \quad y_b = 1.123 \cdot 10^3$

The 95% Confidence curves are calculated

$\alpha_t := 0.05 \quad k := 23 \qquad f := 0..k-1$

$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2 \quad \text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$

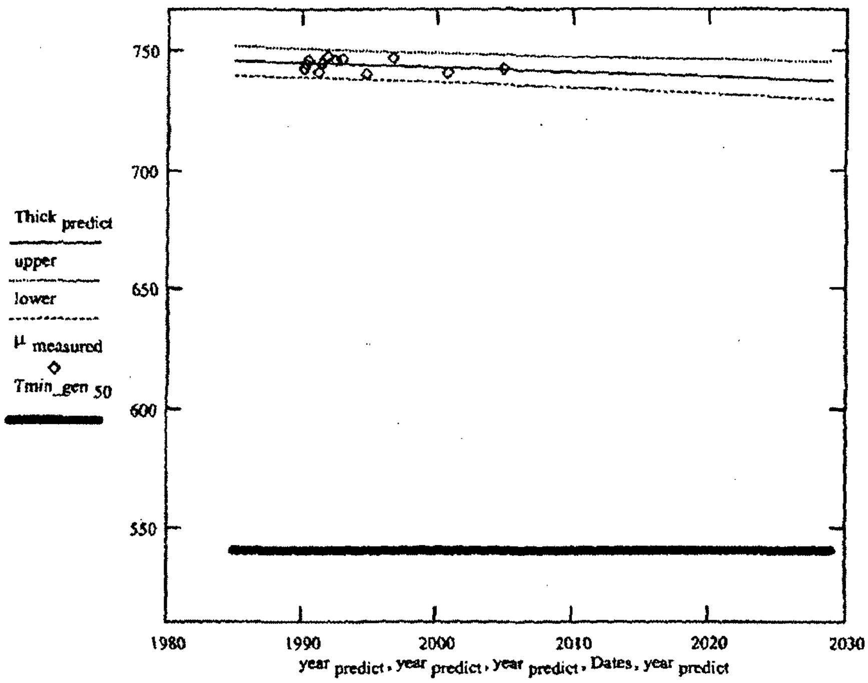
$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates}) \qquad \text{sum} := \sum_i \left(\text{Dates}_d - \text{mean}(\text{Dates})\right)^2$

$$\text{upper}_f := \text{Thick}_{\text{predict}_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}$$

$$\text{lower}_f := \text{Thick}_{\text{predict}_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}\right]$$

The minimum required thickness at this elevation is $Tmin\_gen_{50_f} := 541$ (Ref. Calc. SE-000243-002)

Location Curve Fit Projected to Plant End Of Life



$m_s = -0.19$

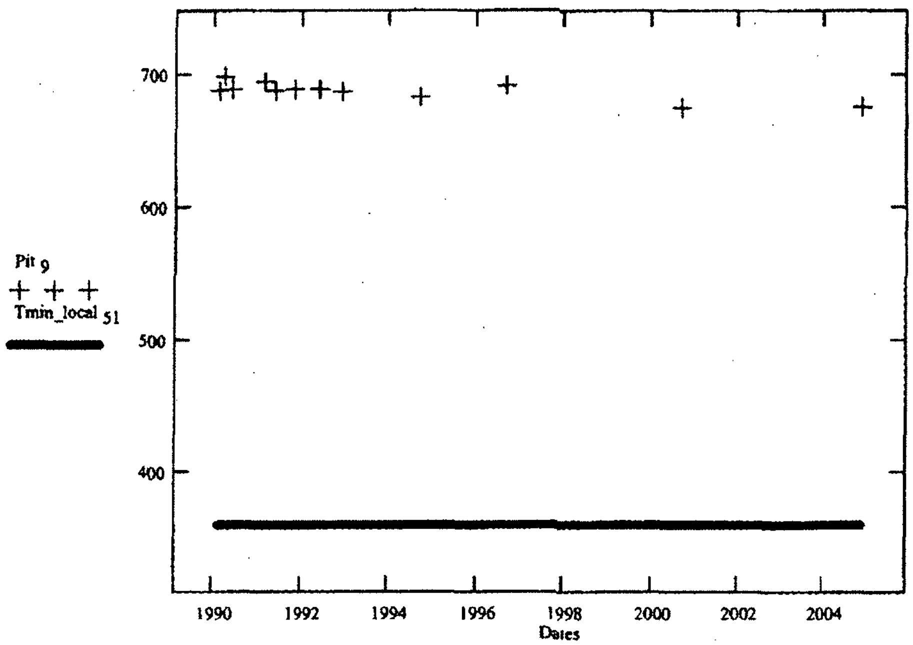
Therefore even though F-ratio does not support the regression model the above curve shows that even at the lower 95% confidence band this location will not corrode to below Drywell Vessel Minimum required thickness by the plant end of life.

The following trend is shown for pit 9

Local Tmin for this elevation in the Drywell $Tmin\_local_{51_f} := 360$ (Ref. Calc. SE-000243-002)

$A_j := \max(Pit_9)$ $B_j := \min(Pit_9)$

Pit 9 Trend



The following addresses the pit identified at this location

The F-Ratio is calculated for the pit as follows

$$SSE_{pit} := \sum_{i=0}^{last(Dates)} \left(Pit_{9_i} - yhat(Dates, Pit_9)_i\right)^2 \qquad SSE_{pit} = 197.332$$

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, Pit_9)_i - mean(Pit_9)\right)^2 \qquad SSR_{pit} = 327.668$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 3.345$$

Therefore this pit may be experiencing corrosion.

$$m_{pit} := slope(Dates, Pit_9) \qquad m_{pit} = -1.178 \qquad y_{pit} := intercept(Dates, Pit_9) \qquad y_{pit} = 3.036 \cdot 10^3$$

The 95% Confidence curves are calculated

$$Pit_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$$

$$Pit_{actualmean} := mean(Dates) \qquad sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$$

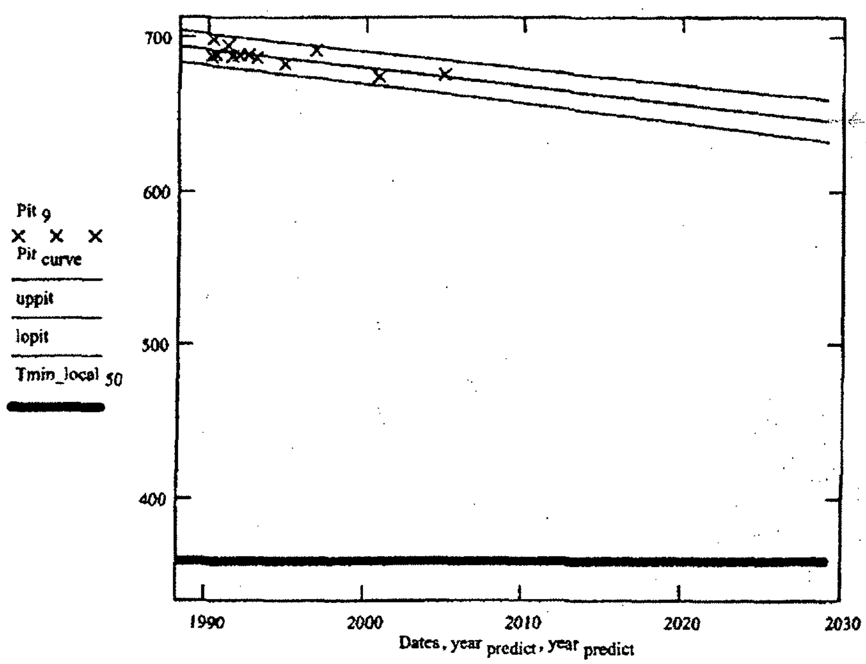
$$uppit_f := Pit_{curve_f} \cdots$$
$$+ qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

PT 5/15/05

$$lopit_f := Pit_{curve_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}\right]$$

Local Tmin for this elevation in the Drywell $Tmin\_local_{50_f} := 360$ *(Ref. Calc. SE-000243-002)*

Curve Fit For Pit 9 Projected to Plant End Of Life



$m_{pit} = -1.178$

Therefore based on the regression model the above curve shows that this pit will not corrode to below minimum required thickness by the plant end of life or past plant life extension.

Appendix 2 - Elevation 50' 2" Bay 5, Area 5
Nov. 9, 2004 Data

The data shown below was collected on 11/9/2004 (reference NDE data sheet EDS 065.

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D515_00.txt")

$Points_{49}$:= showcells(page , 7 , 0)

$$Points_{49} = \begin{bmatrix} 0.743 & 0.648 & 0.732 & 0.762 & 0.765 & 0.764 & 0.713 \\ 0.757 & 0.739 & 0.749 & 0.744 & 0.769 & 0.767 & 0.714 \\ 0.76 & 0.752 & 0.658 & 0.674 & 0.741 & 0.756 & 0.757 \\ 0.734 & 0.757 & 0.689 & 0.659 & 0.741 & 0.758 & 0.764 \\ 0.756 & 0.754 & 0.756 & 0.763 & 0.749 & 0.769 & 0.743 \\ 0.753 & 0.747 & 0.713 & 0.74 & 0.751 & 0.762 & 0.759 \\ 0.754 & 0.762 & 0.761 & 0.729 & 0.768 & 0.759 & 0.763 \end{bmatrix}$$

Cells := convert$(Points_{49}, 7)$

$No_{DataCells}$:= length(Cells)

For this location the following point is a pit and will be trended separately (Reference 3.22)

Cells := $Zero_{one}(Cells, No_{DataCells}, 17)$

The thinnest point at this location is shown below

Cells := $deletezero_{cells}(Cells, No_{DataCells})$

minpoint := $min(Points_{49})$

$No_{DataCells}$:= length(Cells)

minpoint = 0.648

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(\text{Cells}) \quad \mu_{actual} = 744.146 \qquad \sigma_{actual} := \text{Stdev}(\text{Cells}) \quad \sigma_{actual} = 27.518$

Standard Error

$$\text{Standard}_{error} := \frac{\sigma_{actual}}{\sqrt{\text{No}_{DataCells}}} \qquad \text{Standard}_{error} = 3.972$$

Skewness

$$\text{Skewness} := \frac{\left(\text{No}_{DataCells}\right)\cdot\overrightarrow{\Sigma\left(\text{Cells}-\mu_{actual}\right)^3}}{\left(\text{No}_{DataCells}-1\right)\cdot\left(\text{No}_{DataCells}-2\right)\cdot\left(\sigma_{actual}\right)^3} \qquad \text{Skewness} = -2.098$$

Kurtosis

$$\text{Kurtosis} := \frac{\text{No}_{DataCells}\cdot\left(\text{No}_{DataCells}+1\right)\cdot\overrightarrow{\Sigma\left(\text{Cells}-\mu_{actual}\right)^4}}{\left(\text{No}_{DataCells}-1\right)\cdot\left(\text{No}_{DataCells}-2\right)\cdot\left(\text{No}_{DataCells}-3\right)\cdot\left(\sigma_{actual}\right)^4} + -\frac{3\cdot\left(\text{No}_{DataCells}-1\right)^2}{\left(\text{No}_{DataCells}-2\right)\cdot\left(\text{No}_{DataCells}-3\right)} \qquad \text{Kurtosis} = 4.267$$

Normal Probability Plot

$j := 0 .. \text{last}(\text{Cells}) \qquad srt := \text{sort}(\text{Cells})$

$$r_j := j + 1 \qquad rank_j := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt = srt_j}\right)\cdot r}}{\overrightarrow{\Sigma srt = srt_j}}$$

$$p_j := \frac{rank_j}{\text{rows}(\text{Cells}) + 1}$$

$x := 1 \qquad N\_Score_j := \text{root}\left[\text{cnorm}(x) - \left(p_j\right), x\right]$

5/16/05

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$\alpha := .05 \qquad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 736.16$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 752.132$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$Bins := Make_{bins}(\mu_{actual}, \sigma_{actual})$

$Distribution := hist(Bins, Cells)$

Distribution =

1
1
0
3
1
9
14
17
0
0
0
0

The mid points of the Bins are calculated

$k := 0..11 \qquad Midpoints_k := \frac{(Bins_k + Bins_{k+1})}{2}$

$normal_{curve_0} := pnorm(Bins_1, \mu_{actual}, \sigma_{actual})$

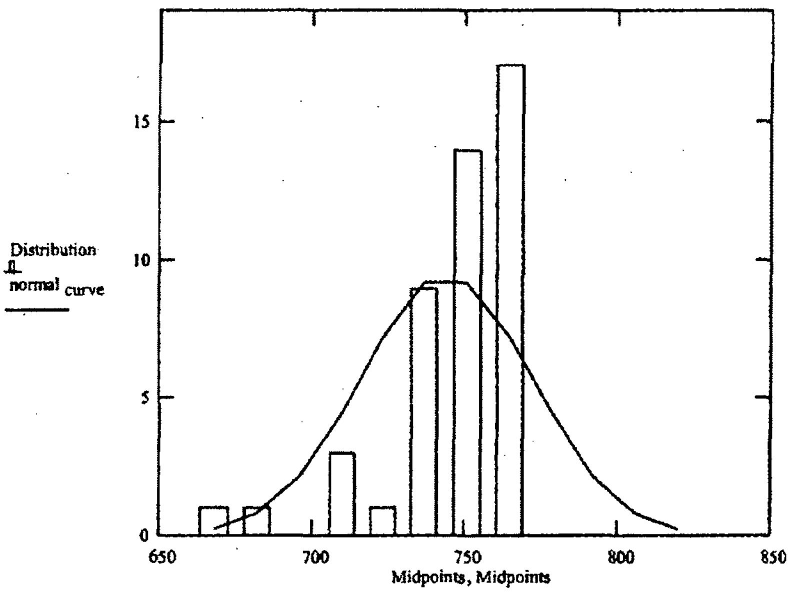
$normal_{curve_k} := pnorm(Bins_{k+1}, \mu_{actual}, \sigma_{actual}) - pnorm(Bins_k, \mu_{actual}, \sigma_{actual})$

$normal_{curve} := No_{DataCells} \cdot normal_{curve}$

Results For Elevation 51' 10" Bay 5, Area 5

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values.

Data Distribution



$\mu_{actual} = 744.146$

$\sigma_{actual} = 27.518$

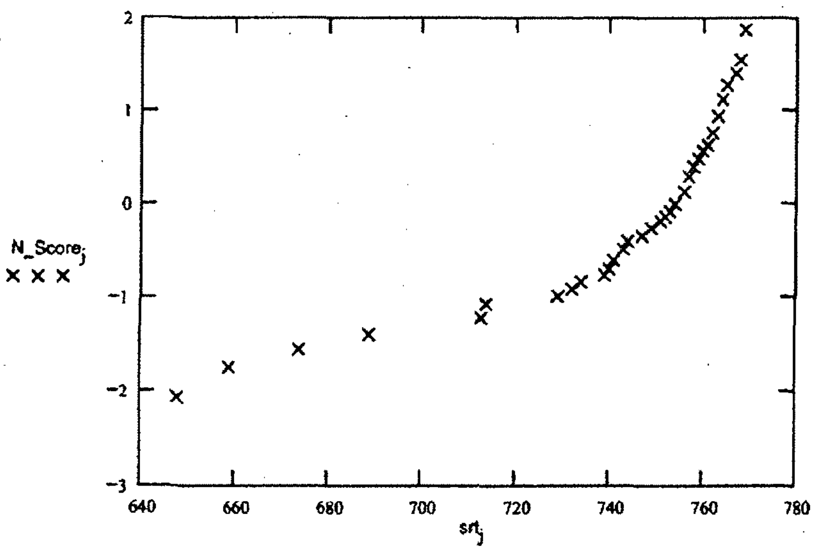
$\text{Standard}_{error} = 3.972$

Skewness = −2.098

Kurtosis = 4.267

$\text{Lower}_{95\%Con} = 736.16$ $\text{Upper}_{95\%Con} = 752.132$

Normal Probability Plot



There is a slightly thinner area near the center of this location. Past calculations (ref. 3.22) have split this area out as a separate groups and performed analysis on both groups. For consistency with past calculations the data will be analyzed in the two groups as well as the entire 48 point data set.

$Split := 734.5$ This value will split the subset consisitent with past calculations (ref. 3.22)

The two groups are named as follows:

$low_{points} := lessmean(Cells, No_{DataCells}, Split)$ $high_{points} := Moremean(Cells, No_{DataCells}, Split)$

Mean and Standard Deviation

$\mu low_{actual} := mean(low_{points})$ $\sigma low_{actual} := Stdev(low_{points})$

$\mu high_{actual} := mean(high_{points})$ $\sigma high_{actual} := Stdev(high_{points})$

Standard Error

$$Standardlow_{error} := \frac{\sigma low_{actual}}{\sqrt{length(low_{points})}} \qquad Standardhigh_{error} := \frac{\sigma high_{actual}}{\sqrt{length(high_{points})}}$$

Skewness

$Nolow_{DataCells} := length(low_{points})$

$$Skewness_{low} := \frac{(Nolow_{DataCells}) \cdot \Sigma \overrightarrow{(low_{points} - \mu low_{actual})^3}}{(Nolow_{DataCells} - 1) \cdot (Nolow_{DataCells} - 2) \cdot (\sigma low_{actual})^3}$$

$Nohigh_{DataCells} := length(high_{points})$

$$Skewness_{high} := \frac{(Nohigh_{DataCells}) \cdot \Sigma \overrightarrow{(high_{points} - \mu high_{actual})^3}}{(Nohigh_{DataCells} - 1) \cdot (Nohigh_{DataCells} - 2) \cdot (\sigma high_{actual})^3}$$

Kurtosis

$$Kurtosis_{low} := \frac{Nolow_{DataCells} \cdot (Nolow_{DataCells}+1) \cdot \overrightarrow{\Sigma(low_{points} - \mu low_{actual})^4}}{(Nolow_{DataCells}-1)\cdot(Nolow_{DataCells}-2)\cdot(Nolow_{DataCells}-3)\cdot(\sigma low_{actual})^4} \ldots + -\frac{3\cdot(Nolow_{DataCells}-1)^2}{(Nolow_{DataCells}-2)\cdot(Nolow_{DataCells}-3)}$$

$$Kurtosis_{high} := \frac{Nohigh_{DataCells} \cdot (Nohigh_{DataCells}+1) \cdot \overrightarrow{\Sigma(high_{points} - \mu high_{actual})^4}}{(Nohigh_{DataCells}-1)\cdot(Nohigh_{DataCells}-2)\cdot(Nohigh_{DataCells}-3)\cdot(\sigma high_{actual})^4} \ldots + -\frac{3\cdot(Nohigh_{DataCells}-1)^2}{(Nohigh_{DataCells}-2)\cdot(Nohigh_{DataCells}-3)}$$

Normal Probability Plot - Low points

$l := 0 .. last(low_{points}) \quad srt_{low} := sort(low_{points})$

$L_l := l + 1$

$$rank_{low_l} := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt_{low} = srt_{low_l}}\right)\cdot L}}{\Sigma \overrightarrow{srt_{low} = srt_{low_l}}} \qquad p_{low_l} := \frac{rank_{low_l}}{rows(low_{points}) + 1}$$

$x := 1 \qquad N\_Score_{low_l} := root\left[cnorm(x) - \left(p_{low_l}\right), x\right]$

Normal Probability Plot - High points

$h := 0 .. last(high_{points}) \qquad srt_{high} := sort(high_{points})$

$H_h := h + 1$

$$rank_{high_h} := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt_{high} = srt_{high_h}}\right)\cdot H}}{\Sigma \overrightarrow{srt_{high} = srt_{high_h}}} \qquad p_{high_h} := \frac{rank_{high_h}}{rows(high_{points}) + 1}$$

$x := 1 \qquad N\_Score_{high_h} := root\left[cnorm(x) - \left(p_{high_h}\right), x\right]$

Upper and Lower Confidence Values

$\alpha := .05 \qquad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$

$$Lowerhigh_{95\%Con} := \mu high_{actual} - T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Upperhigh_{95\%Con} := \mu high_{actual} + T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Lowerlow_{95\%Con} := \mu low_{actual} - T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

$$Upperlow_{95\%Con} := \mu low_{actual} + T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

Graphical Representation of Low Points

$Bins_{low} := Make_{bins}\left(\mu low_{actual}, \sigma low_{actual}\right)$

$Distribution_{low} := hist\left(Bins_{low}, low_{points}\right)$

$$Distribution_{low} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ 3 \\ 1 \\ 2 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

The mid points of the Bins are calculated

$k := 0 .. 11 \qquad Midpoints_{low_k} := \frac{\left(Bins_{low_k} + Bins_{low_{k+1}}\right)}{2}$

$normallow_{curve_0} := pnorm\left(Bins_{low_1}, \mu low_{actual}, \sigma low_{actual}\right)$

$normallow_{curve_k} := pnorm\left(Bins_{low_{k+1}}, \mu low_{actual}, \sigma low_{actual}\right) - pnorm\left(Bins_{low_k}, \mu low_{actual}, \sigma low_{actual}\right)$

$normallow_{curve} := Nolow_{DataCells} \cdot normallow_{curve}$

Graphical Representation of High Points

$$Bins_{high} := Make_{bins}\left(\mu high_{actual}, \sigma high_{actual}\right)$$

$$Distribution_{high} := hist\left(Bins_{high}, high_{points}\right)$$

$$Distribution_{high} = \begin{pmatrix} 0 \\ 0 \\ 4 \\ 3 \\ 4 \\ 4 \\ 9 \\ 9 \\ 3 \\ 2 \\ 0 \\ 0 \end{pmatrix}$$

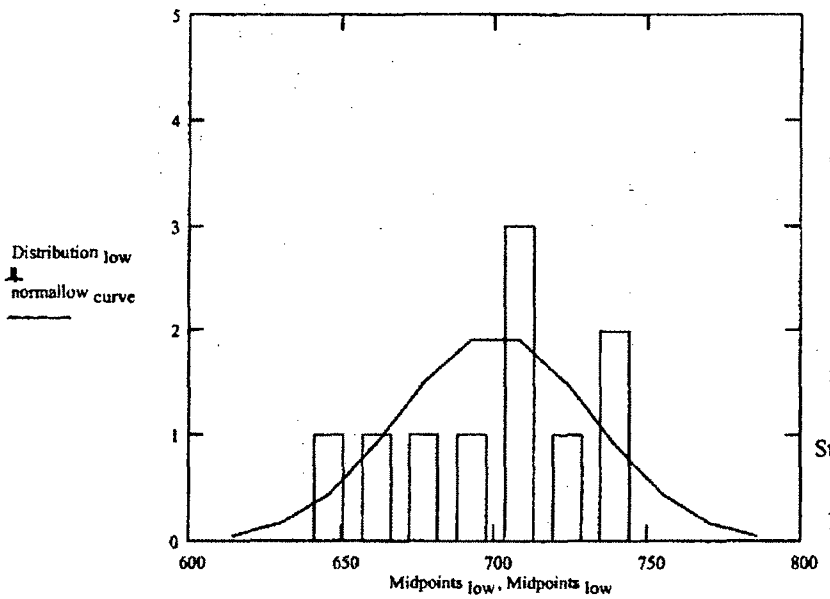
$$k := 0..11 \qquad Midpoints_{high_k} := \frac{\left(Bins_{high_k} + Bins_{high_{k+1}}\right)}{2}$$

$$normalhigh_{curve_0} := pnorm\left(Bins_{high_1}, \mu high_{actual}, \sigma high_{actual}\right)$$

$$normalhigh_{curve_k} := pnorm\left(Bins_{high_{k+1}}, \mu high_{actual}, \sigma high_{actual}\right) - pnorm\left(Bins_{high_k}, \mu high_{actual}, \sigma high_{actual}\right)$$

$$normalhigh_{curve} := Nohigh_{DataCells} \cdot normalhigh_{curve}$$

Results For Elevation 51' 10" Bay 5, Area 23 Thinner Points



μlow actual = 700.5

σlow actual = 31.153

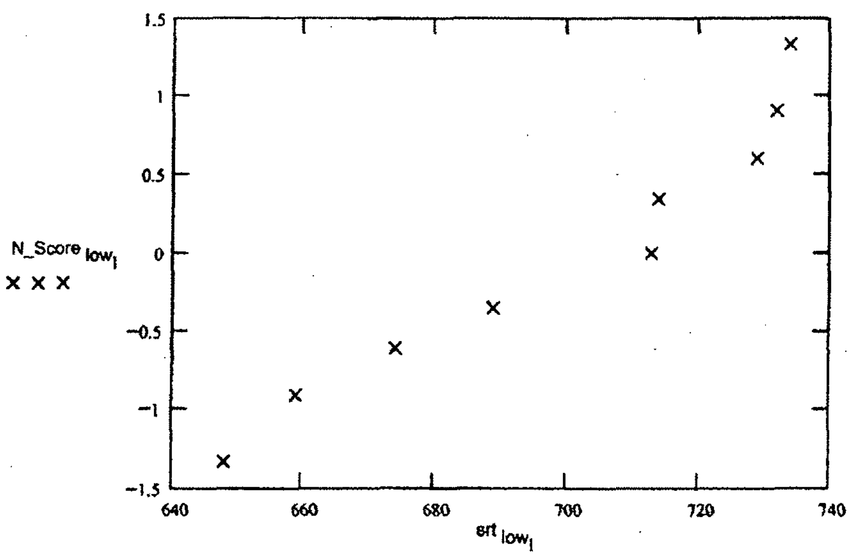
Kurtosis low = −1.081

Skewness low = −0.634

Standardlow error = 9.851

Nolow DataCells = 10

Lowerlow 95%Con = 680.692 Upperlow 95%Con = 720.308

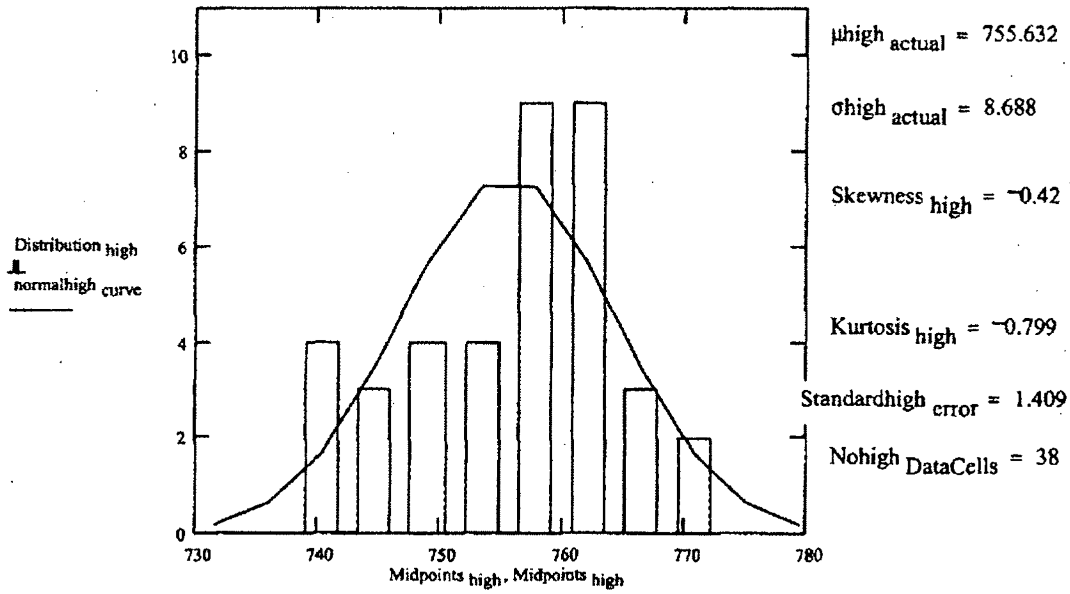


The above plots indicates that the thinner area is normally distributed.

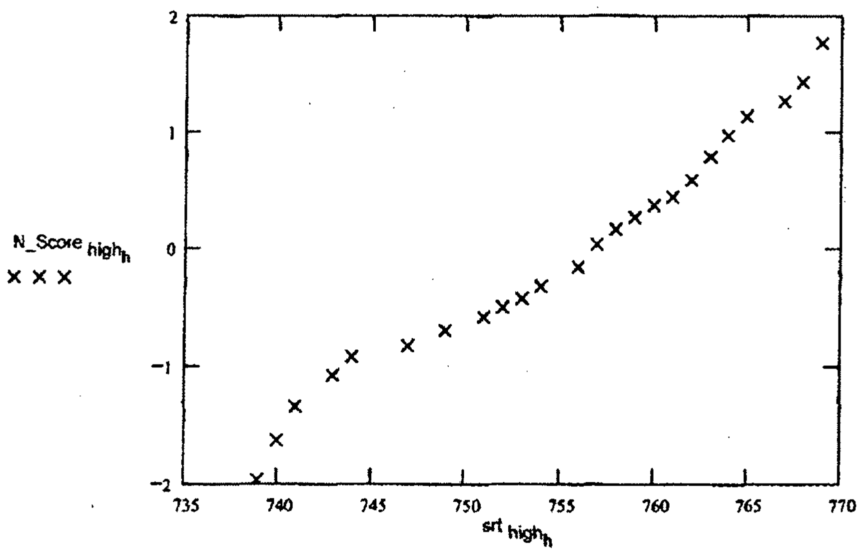
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1302-187-E310-037	~~1~~ 2	187	A2- 10 of 32

PT 5/16/05

Results For Elevation 51' 10" Bay 13, Area 32 Thicker Points



Lower $_{95\%Con}$ = 736.16 Upper $_{95\%Con}$ = 752.132



The above plots indicates that the thicker areas are normally distributed.

Elevation 51' 10" Bay 5, Area 5 Trend

Data from March. 1990 to Sept. 2000 is retrieved.

$d := 0$

For March 31 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D515_March90.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\text{Dates}_d := \text{Day}_{\text{year}}(3, 31, 1990)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.748 & 0.682 & 0.744 & 0.766 & 0.762 & 0.767 & 0.717 \\ 0.766 & 0.748 & 0.759 & 0.745 & 0.774 & 0.773 & 0.71 \\ 0.767 & 0.759 & 0.656 & 0.68 & 0.746 & 0.751 & 0.76 \\ 0.733 & 0.757 & 0.695 & 0.662 & 0.702 & 0.758 & 0.764 \\ 0.689 & 0.761 & 0.704 & 0.765 & 0.765 & 0.77 & 0.746 \\ 0.76 & 0.753 & 0.72 & 0.711 & 0.729 & 0.76 & 0.729 \\ 0.76 & 0.764 & 0.763 & 0.734 & 0.771 & 0.763 & 0.784 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

The following point is a pit and ise omitted from the calculation of the mean. This pit will be trended separately.

The following function deletes cells from the data sample

$\text{Pit}_{17_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 17)$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 17)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$ $\text{No}_{\text{Cells}} := \text{length}(\text{Cells})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

$\text{high}_{\text{points}} := \text{Moremean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$ $\text{low}_{\text{points}} := \text{lessmean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$

$\mu\text{high}_{\text{measured}_d} := \text{mean}(\text{high}_{\text{points}})$ $\mu\text{low}_{\text{measured}_d} := \text{mean}(\text{low}_{\text{points}})$

$\sigma\text{high}_{\text{measured}_d} := \text{Stdev}(\text{high}_{\text{points}})$ $\sigma\text{low}_{\text{measured}_d} := \text{Stdev}(\text{low}_{\text{points}})$

$\text{Standardhigh}_{\text{error}_d} := \dfrac{\sigma\text{high}_{\text{measured}_d}}{\sqrt{\text{length}(\text{high}_{\text{points}})}}$ $\text{Standardlow}_{\text{error}_d} := \dfrac{\sigma\text{low}_{\text{measured}_d}}{\sqrt{\text{length}(\text{low}_{\text{points}})}}$

$d := d + 1$

For April 25 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\April 1990 Data\DATA ONLY\D515_April90.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(4, 25, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.742 & 0.679 & 0.74 & 0.764 & 0.762 & 0.765 & 0.716 \\ 0.758 & 0.747 & 0.758 & 0.742 & 0.773 & 0.77 & 0.71 \\ 0.765 & 0.753 & 0.72 & 0.678 & 0.751 & 0.76 & 0.761 \\ 0.79 & 0.755 & 0.699 & 0.673 & 0.71 & 0.785 & 0.765 \\ 0.779 & 0.755 & 0.71 & 0.769 & 0.762 & 0.775 & 0.75 \\ 0.75 & 0.752 & 0.723 & 0.75 & 0.742 & 0.765 & 0.731 \\ 0.765 & 0.768 & 0.763 & 0.763 & 0.77 & 0.765 & 0.764 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad$ $Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Feb. 23, 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D515_F91.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.759 & 0.677 & 0.739 & 0.77 & 0.762 & 0.763 & 0.727 \\ 0.756 & 0.745 & 0.752 & 0.739 & 0.77 & 0.772 & 0.707 \\ 0.762 & 0.751 & 0.632 & 0.675 & 0.738 & 0.736 & 0.757 \\ 0.733 & 0.754 & 0.692 & 0.66 & 0.748 & 0.75 & 0.763 \\ 0.68 & 0.751 & 0.7 & 0.759 & 0.757 & 0.767 & 0.738 \\ 0.755 & 0.749 & 0.712 & 0.711 & 0.732 & 0.754 & 0.734 \\ 0.757 & 0.757 & 0.756 & 0.737 & 0.765 & 0.771 & 0.764 \end{bmatrix}$$

$nnn := convert\left(Points_{49}, 7\right)$ $\qquad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}\left(nnn, No_{DataCells}, 17\right)$ $\qquad nnn := Zero_{one}\left(nnn, No_{DataCells}, 17\right)$

$Cells := deletezero_{cells}\left(nnn, No_{DataCells}\right)$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean\left(Cells, No_{Cells}, Split\right)$ $\qquad low_{points} := lessmean\left(Cells, No_{Cells}, Split\right)$

$\mu high_{measured_d} := mean\left(high_{points}\right)$ $\qquad \mu low_{measured_d} := mean\left(low_{points}\right)$

$\sigma high_{measured_d} := Stdev\left(high_{points}\right)$ $\qquad \sigma low_{measured_d} := Stdev\left(low_{points}\right)$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length\left(high_{points}\right)}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length\left(low_{points}\right)}}$

For May 23 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D515_M91.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.742 & 0.679 & 0.741 & 0.761 & 0.762 & 0.766 & 0.717 \\ 0.756 & 0.748 & 0.757 & 0.743 & 0.773 & 0.773 & 0.711 \\ 0.764 & 0.754 & 0.639 & 0.679 & 0.748 & 0.758 & 0.745 \\ 0.732 & 0.755 & 0.694 & 0.662 & 0.699 & 0.759 & 0.764 \\ 0.686 & 0.754 & 0.704 & 0.762 & 0.749 & 0.768 & 0.746 \\ 0.76 & 0.767 & 0.72 & 0.712 & 0.726 & 0.76 & 0.727 \\ 0.757 & 0.759 & 0.763 & 0.733 & 0.77 & 0.763 & 0.765 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\quad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Nov. 2 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov. 1991 Data\DATA ONLY\D515_N91.txt")

$Points_{49}$:= showcells(page , 7 , 0)

$Dates_d := Day_{year}(11, 2, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.762 & 0.679 & 0.747 & 0.761 & 0.771 & 0.769 & 0.72 \\ 0.759 & 0.747 & 0.759 & 0.733 & 0.772 & 0.774 & 0.747 \\ 0.765 & 0.752 & 0.694 & 0.685 & 0.763 & 0.761 & 0.732 \\ 0.76 & 0.762 & 0.699 & 0.671 & 0.694 & 0.76 & 0.77 \\ 0.684 & 0.759 & 0.689 & 0.77 & 0.751 & 0.773 & 0.752 \\ 0.764 & 0.753 & 0.727 & 0.717 & 0.717 & 0.754 & 0.735 \\ 0.76 & 0.762 & 0.764 & 0.733 & 0.774 & 0.761 & 0.761 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1302-187-E310-037	~~1~~ 2	187	A2- 16 of 32

PT 5/19/05

For May. 30 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D515_M92.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(5, 30, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.768 & 0.682 & 0.742 & 0.769 & 0.767 & 0.766 & 0.725 \\ 0.757 & 0.749 & 0.758 & 0.744 & 0.773 & 0.772 & 0.711 \\ 0.769 & 0.748 & 0.644 & 0.68 & 0.743 & 0.761 & 0.768 \\ 0.736 & 0.76 & 0.697 & 0.664 & 0.742 & 0.753 & 0.766 \\ 0.691 & 0.759 & 0.709 & 0.768 & 0.758 & 0.773 & 0.744 \\ 0.76 & 0.763 & 0.717 & 0.743 & 0.732 & 0.763 & 0.73 \\ 0.759 & 0.763 & 0.767 & 0.738 & 0.775 & 0.763 & 0.768 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7) \qquad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 17) \qquad nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells}) \qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells) \qquad \sigma_{measured_d} := Stdev(Cells) \qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split) \qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points}) \qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points}) \qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Dec. 5 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D515_D92.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.815 & 0.674 & 0.744 & 0.762 & 0.771 & 0.769 & 0.719 \\ 0.755 & 0.744 & 0.755 & 0.743 & 0.773 & 0.775 & 0.718 \\ 0.763 & 0.755 & 0.639 & 0.683 & 0.742 & 0.758 & 0.759 \\ 0.734 & 0.755 & 0.694 & 0.664 & 0.747 & 0.753 & 0.765 \\ 0.767 & 0.755 & 0.727 & 0.768 & 0.754 & 0.771 & 0.746 \\ 0.758 & 0.756 & 0.717 & 0.717 & 0.756 & 0.762 & 0.733 \\ 0.76 & 0.764 & 0.764 & 0.737 & 0.771 & 0.77 & 0.768 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

Pit 17 is will be trended and Pit 1 was eliminated from the Dec. 5 1992 data (ref 30 calc)

$Pit\,17_d := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad$ $Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Sept. 14 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D515_94.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(9, 14, 1994)$

Data

$$Points_{49} = \begin{bmatrix} 0.738 & 0.675 & 0.736 & 0.755 & 0.762 & 0.762 & 0.714 \\ 0.75 & 0.741 & 0.751 & 0.739 & 0.769 & 0.768 & 0.705 \\ 0.76 & 0.749 & 0.63 & 0.678 & 0.735 & 0.729 & 0.764 \\ 0.727 & 0.75 & 0.687 & 0.661 & 0.708 & 0.747 & 0.763 \\ 0.678 & 0.75 & 0.697 & 0.752 & 0.749 & 0.767 & 0.74 \\ 0.754 & 0.755 & 0.712 & 0.703 & 0.725 & 0.756 & 0.752 \\ 0.752 & 0.755 & 0.76 & 0.731 & 0.766 & 0.76 & 0.762 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Subject:
Drywell Corrosion

Calc. No. C-1302-187-E310-037 | Rev. No. ~~1~~ 2 | System No. 187 | Sheet No. A2- 19 of 32

M 5/15/05

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D515_96.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.759 & 0.673 & 0.737 & 0.759 & 0.757 & 0.764 & 0.716 \\ 0.754 & 0.742 & 0.754 & 0.742 & 0.771 & 0.771 & 0.709 \\ 0.758 & 0.752 & 0.636 & 0.675 & 0.742 & 0.757 & 0.757 \\ 0.73 & 0.753 & 0.691 & 0.661 & 0.702 & 0.755 & 0.765 \\ 0.711 & 0.755 & 0.701 & 0.765 & 0.756 & 0.769 & 0.742 \\ 0.756 & 0.769 & 0.713 & 0.744 & 0.729 & 0.757 & 0.73 \\ 0.751 & 0.758 & 0.762 & 0.733 & 0.769 & 0.759 & 0.765 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit\,17_d := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

PT 5/15/05

For Sept. 16 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D515_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 16, 2000)$

Data

$$Points_{49} = \begin{bmatrix} 0.74 & 0.65 & 0.733 & 0.764 & 0.761 & 0.765 & 0.716 \\ 0.755 & 0.745 & 0.749 & 0.743 & 0.727 & 0.734 & 0.737 \\ 0.762 & 0.755 & 0.632 & 0.676 & 0.739 & 0.735 & 0.738 \\ 0.734 & 0.753 & 0.69 & 0.662 & 0.705 & 0.757 & 0.765 \\ 0.693 & 0.754 & 0.703 & 0.76 & 0.747 & 0.769 & 0.742 \\ 0.769 & 0.748 & 0.71 & 0.703 & 0.741 & 0.76 & 0.727 \\ 0.757 & 0.765 & 0.762 & 0.734 & 0.769 & 0.758 & 0.767 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit_{17_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\quad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

PT 5/15/05

For Nov 9, 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D515_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(11, 9, 2004)$

Data

$$Points_{49} = \begin{bmatrix} 0.743 & 0.648 & 0.732 & 0.762 & 0.765 & 0.764 & 0.713 \\ 0.757 & 0.739 & 0.749 & 0.744 & 0.769 & 0.767 & 0.714 \\ 0.76 & 0.752 & 0.658 & 0.674 & 0.741 & 0.756 & 0.757 \\ 0.734 & 0.757 & 0.689 & 0.659 & 0.741 & 0.758 & 0.764 \\ 0.756 & 0.754 & 0.756 & 0.763 & 0.749 & 0.769 & 0.743 \\ 0.753 & 0.747 & 0.713 & 0.74 & 0.751 & 0.762 & 0.759 \\ 0.754 & 0.762 & 0.761 & 0.729 & 0.768 & 0.759 & 0.763 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

The following function deletes cells from the data sample

$Pit\,17_d := Get\_Pit_{data}(nnn, No_{DataCells}, 17)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 17)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Below are the results

Dates =

$1.99 \cdot 10^3$
$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$
$2.001 \cdot 10^3$
$2.005 \cdot 10^3$

$\mu_{measured}$	$\sigma_{measured}$	$Standard_{error}$
743.667	28.979	4.14
748.792	27.335	3.905
740.896	27.879	3.983
741.521	28.265	4.038
744.458	28.678	4.097
746.104	27.438	3.92
746.702	26.244	3.749
737.479	28.136	4.019
741.667	27.584	3.941
738.083	28.676	4.097
744.146	27.518	3.931

$\mu high_{measured}$	$\sigma high_{measured}$	$Standardhigh_{error}$
760.576	9.24	1.608
760.868	11.506	1.867
754.943	10.324	1.745
757.939	8.789	1.53
760.412	8.897	1.526
758.784	11.066	1.819
758.75	9.86	1.643
753.606	9.546	1.662
756.647	9.001	1.544
754.094	10.693	1.89
755.632	8.688	1.409

$$\mu low_{measured} = \begin{pmatrix} 706.467 \\ 702.9 \\ 703.077 \\ 705.4 \\ 705.714 \\ 703.455 \\ 707.273 \\ 702 \\ 705.286 \\ 706.063 \\ 700.5 \end{pmatrix} \qquad \sigma low_{measured} = \begin{pmatrix} 21.62 \\ 20.047 \\ 24.844 \\ 21.728 \\ 22.141 \\ 22.403 \\ 24.397 \\ 22.081 \\ 23.083 \\ 26.451 \\ 31.153 \end{pmatrix} \qquad Standardlow_{error} = \begin{pmatrix} 5.582 \\ 6.339 \\ 6.891 \\ 5.61 \\ 5.917 \\ 6.755 \\ 7.356 \\ 5.701 \\ 6.169 \\ 6.613 \\ 9.851 \end{pmatrix}$$

$$Total_{means} := rows(\mu_{measured}) \qquad Total_{means} = 11$$

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2$$

$$SSE_{low} := \sum_{i=0}^{last(Dates)} \left(\mu low_{measured_i} - yhat(Dates, \mu low_{measured})_i\right)^2$$

$$SSE_{high} := \sum_{i=0}^{last(Dates)} \left(\mu high_{measured_i} - yhat(Dates, \mu high_{measured})_i\right)^2$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2$$

$$SSR_{low} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu low_{measured})_i - mean(\mu low_{measured})\right)^2$$

$$SSR_{high} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu high_{measured})_i - mean(\mu high_{measured})\right)^2$$

$DegreeFree_{ss} := Total_{means} - 2$ $\quad$ $DegreeFree_{reg} := 1$

$$MSE := \frac{SSE}{DegreeFree_{ss}} \qquad MSE_{low} := \frac{SSE_{low}}{DegreeFree_{ss}} \qquad MSE_{high} := \frac{SSE_{high}}{DegreeFree_{ss}}$$

$$Standard_{error} := \sqrt{MSE} \qquad Standard_{lowerror} := \sqrt{MSE_{low}} \qquad Standard_{higherror} := \sqrt{MSE_{high}}$$

$$MSR := \frac{SSR}{DegreeFree_{reg}} \qquad MSR_{low} := \frac{SSR_{low}}{DegreeFree_{reg}} \qquad MSR_{high} := \frac{SSR_{high}}{DegreeFree_{reg}}$$

$$F_{actaul} := \frac{MSR}{MSE} \qquad F\_low_{actaul} := \frac{MSR_{low}}{MSE_{low}} \qquad F\_high_{actaul} := \frac{MSR_{high}}{MSE_{high}}$$

For 95% confidence level the F Critical is calculated as follows

$$\alpha := 0.05 \qquad F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right) \qquad F_{critical} = 5.117$$

The "F" ratio for 95% confidence is calculated:

$$F_{ratio} := \frac{F_{actaul}}{F_{critical}} \qquad F\_low_{ratio} := \frac{F\_low_{actaul}}{F_{critical}} \qquad F\_high_{ratio} := \frac{F\_high_{actaul}}{F_{critical}}$$

$$F_{ratio} = 0.212 \qquad F\_low_{ratio} = 0.265 \qquad F\_high_{ratio} = 1.028$$

The F ratio for the overall mean and the thinner points are close to 0. Therefero the curve fit for the overall mean and the thinner points may note have a slopes. The F ratio for the thicker points is close to 1 and therefore the curve fit of thicker points does have a slope and the regression model is more appropriate.

The following will plot the results for the overall mean, the mean of thinner points, and the mean of thicker points.

$i := 0 .. Total_{means} - 1$

$\mu grand_{measured_i} := mean(\mu_{measured})$ $\sigma grand_{measured} := Stdev(\mu_{measured})$

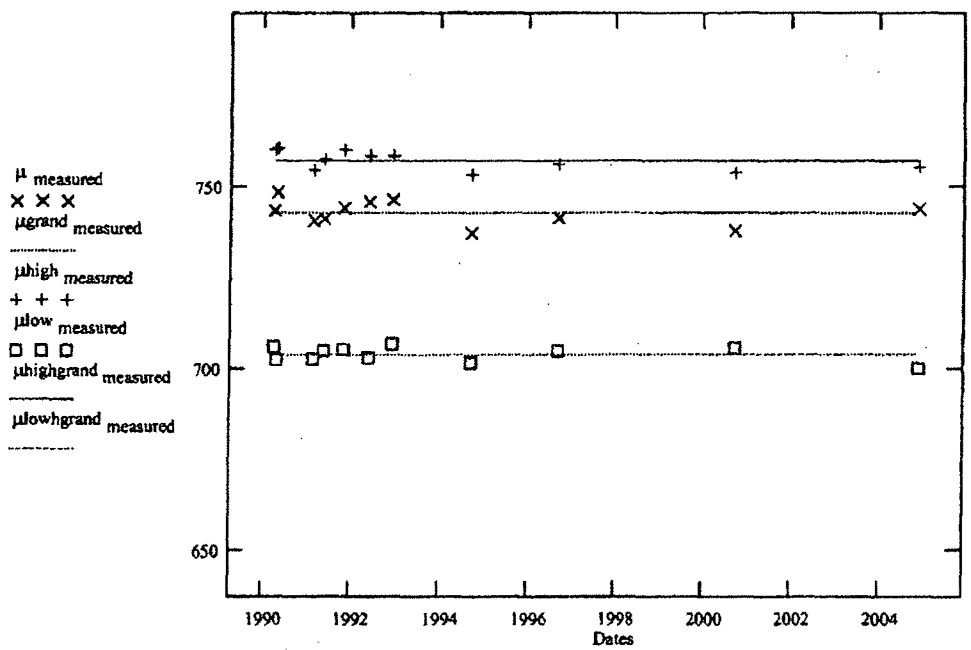
$$GrandStandard_{error} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$$

$\sigma grand_{lowmeasured} := Stdev(\mu low_{measured})$ $\mu lowhgrand_{measured_i} := mean(\mu low_{measured})$

$$GrandStandard_{lowerror} := \frac{\sigma grand_{lowmeasured}}{\sqrt{Total_{means}}}$$

$\sigma grand_{highmeasured} := Stdev(\mu high_{measured})$ $\mu highgrand_{measured_i} := mean(\mu high_{measured})$

$$GrandStandard_{higherror} := \frac{\sigma grand_{highmeasured}}{\sqrt{Total_{means}}}$$



$\mu grand_{measured_0} = 743.047$ $GrandStandard_{error} = 1.061$

$mean(\mu low_{measured}) = 704.376$ $GrandStandard_{lowerror} = 0.637$

$mean(\mu high_{measured}) = 757.477$ $GrandStandard_{higherror} = 0.799$

The slopes and 95% Confidence curves are generated for all three cases.

$m_s := \text{slope}(\text{Dates}, \mu_{measured})$ $\quad y_b := \text{intercept}(\text{Dates}, \mu_{measured})$

$m_{lows} := \text{slope}(\text{Dates}, \mu low_{measured})$ $\quad y_{lowb} := \text{intercept}(\text{Dates}, \mu low_{measured})$

$m_{highs} := \text{slope}(\text{Dates}, \mu high_{measured})$ $\quad y_{highb} := \text{intercept}(\text{Dates}, \mu high_{measured})$

$m_{highs} = -0.343$

$\alpha_t := 0.05 \quad k := 23 \quad f := 0..k-1$

$year_{predict_f} := 1985 + f \cdot 2$

$Thick_{predict} := m_s \cdot year_{predict} + y_b$

$Thick_{lowpredict} := m_{lows} \cdot year_{predict} + y_{lowb}$

$Thick_{highpredict} := m_{highs} \cdot year_{predict} + y_{highb}$

$Thick_{actualmean} := \text{mean}(\text{Dates})$

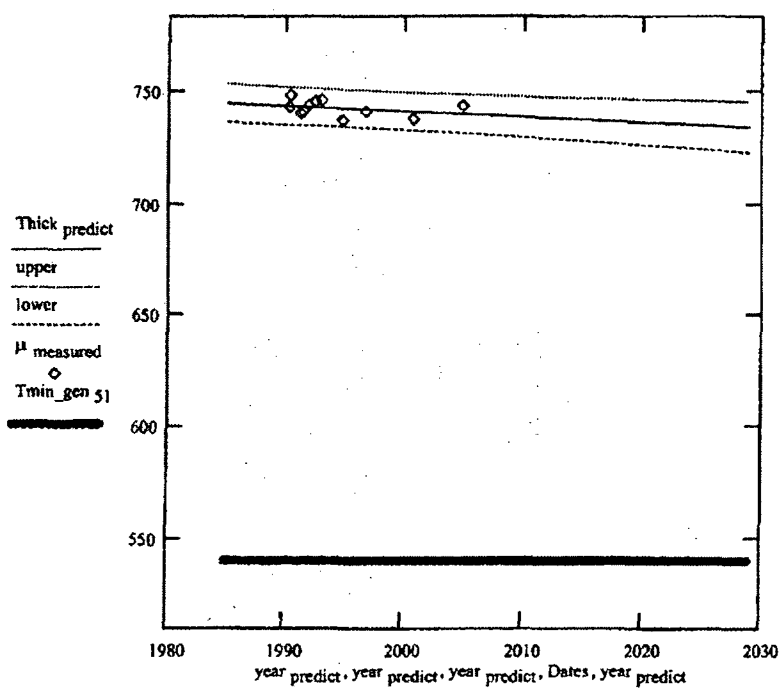
$$sum := \sum_i \left(\text{Dates}_d - \text{mean}(\text{Dates})\right)^2$$

$$upper_f := Thick_{predict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{predict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$

General area Tmin for this elevation in the Drywell

$Tmin\_gen_{51_f} := 541$ (Ref. Calc. SE-000243-002)



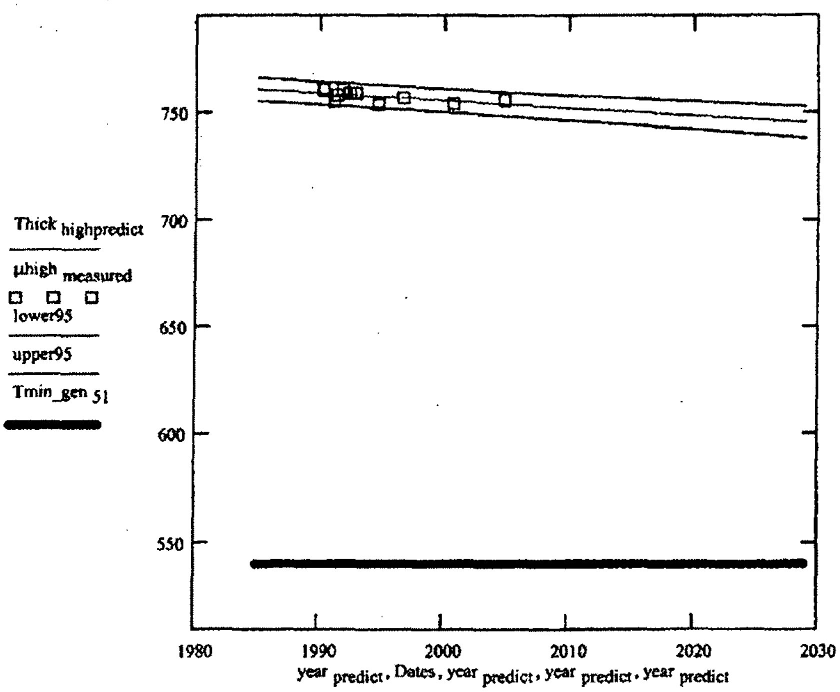
$m_s = -0.246$

For the thicker points

$$upper95_f := Thick_{highpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower95_f := Thick_{highpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$

$\max(upper) + 30 = 783.871$ $\qquad$ $\min(Tmin\_gen_{51}) - 30 = 511$



$m_{highs} = -0.343$

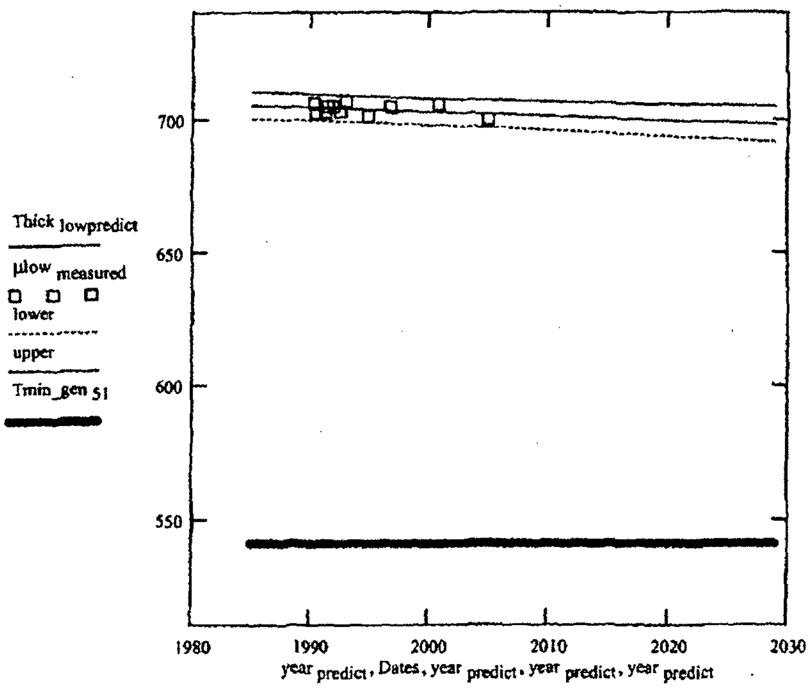
The projected lower 95% confidence thickness in 2029 is shown below

$lower95_{22} = 738.362$ $\qquad$ $year_{predict_{22}} = 2.029 \cdot 10^3$

For the thinner points

$$upper_f := Thick_{lowpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{lowpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$



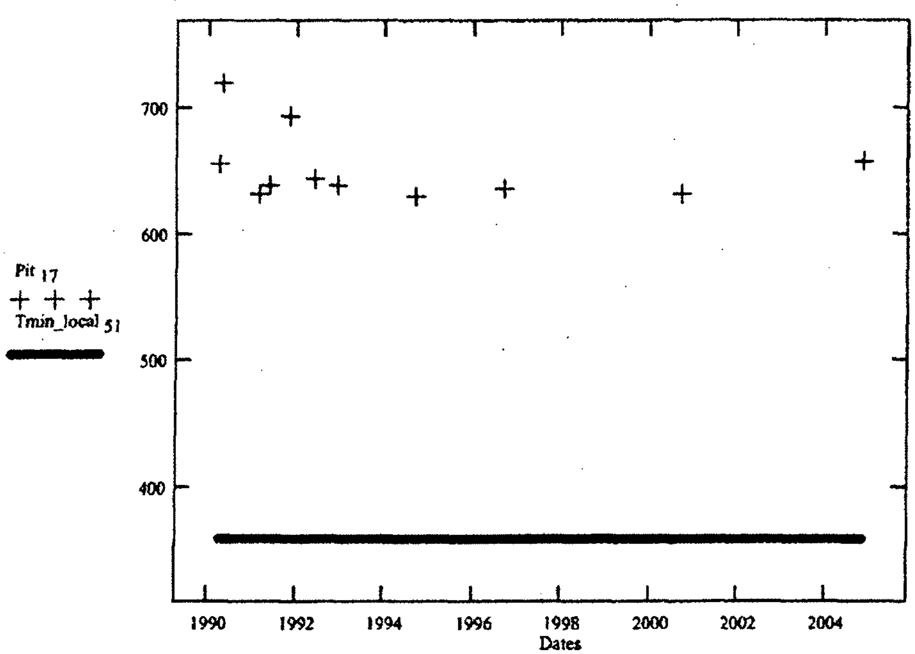
$m_{lows} = -0.163$

The following trend shows pit 17

Local Tmin for this elevation in the Drywell $\text{Tmin\_local}_{51_f} := 360$ (Ref. Calc. SE-000243-002)

$A_j := \max(\text{Pit}_{17})$ $B_j := \min(\text{Pit}_{17})$

Pit 17 Trend



The F-Ratio is calculated for this pit

$$SSE_{pit} := \sum_{i=0}^{\text{last(Dates)}} \left(\text{Pit}_{17_i} - \text{yhat}(\text{Dates}, \text{Pit}_{17})_i\right)^2 \qquad SSE_{pit} = 7.76 \cdot 10^3$$

RS 5/15/05

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat\left(Dates, Pit_{17}\right)_i - mean\left(Pit_{17}\right)\right)^2 \qquad SSR_{pit} = 616.244$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 0.14$$

Therefore pit 17 is not corroding. However for conservatism the regression model is calculated

$$m_{pit} := slope\left(Dates, Pit_{17}\right) \qquad m_{pit} = -1.671 \qquad y_{pit} := intercept\left(Dates, Pit_{17}\right) \qquad y_{pit} = 3.986 \cdot 10^3$$

The 95% Confidence curves are calculated

$$Pit_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$$

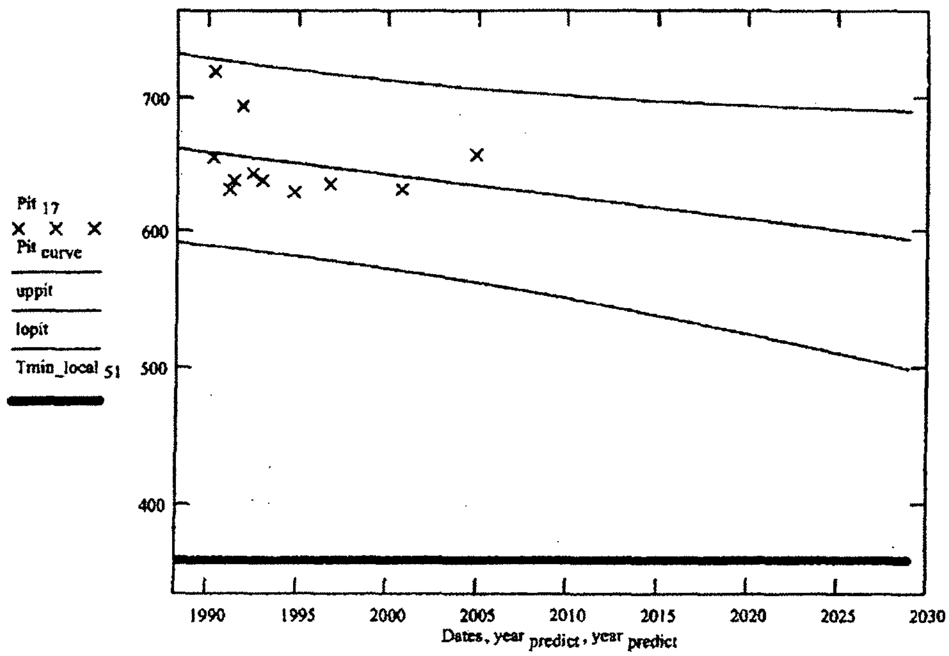
$$Pit_{actualmean} := mean(Dates) \qquad sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$$

$$uppit_f := Pit_{curve_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

$$lopit_f := Pit_{curve_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}\right]$$

Local Tmin for this elevation in the Drywell $Tmin\_local_{50_f} := 360$ (Ref. Calc. SE-000243-002)

Curve Fit For Pit 17 Projected to Plant End Of Life



$lopit_{22} = 499.105$ $year_{predict_{22}} = 2.029 \cdot 10^3$

Therefore based on regression model the above curve shows that this pit will not corrode to below minimum required thickness by the plant end of life or to life extension Please note, as more data is collect the upper and lower 95% confidence intervals should become approach the curve fit and the projects should acquire more margin.

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 PT 5/19/05	187	A3- 1 of 29

Appendix 3 - Elevation 50' 2" Bay 13, Area 31
Nov. 9 2004 Data

The data shown below was collected on 11/9/2004

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5131_00.txt")

$Points_{49}$:= showcells(page , 7 , 0)

$$Points_{49} = \begin{bmatrix} 0.694 & 0.649 & 0.764 & 0.753 & 0.761 & 0.773 & 0.764 \\ 0.708 & 0.657 & 0.766 & 0.748 & 0.744 & 0.761 & 0.769 \\ 0.743 & 0.659 & 0.757 & 0.711 & 0.716 & 0.759 & 0.754 \\ 0.706 & 0.703 & 0.75 & 0.683 & 0.766 & 0.768 & 0.76 \\ 0.721 & 0.753 & 0.695 & 0.76 & 0.762 & 0.763 & 0.743 \\ 0.726 & 0.719 & 0.677 & 0.762 & 0.765 & 0.747 & 0.76 \\ 0.761 & 0.768 & 0.737 & 0.77 & 0.759 & 0.704 & 0.763 \end{bmatrix}$$

Cells := convert$(Points_{49}, 7)$

$No_{DataCells}$:= length(Cells)

Cells := $deletezero_{cells}(Cells, No_{DataCells})$

$No_{DataCells}$:= length(Cells)

The thinnest point at this location is shown below

minpoint := min$(Points_{49})$

minpoint = 0.649

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(\text{Cells})$ $\mu_{actual} = 737.98$ $\sigma_{actual} := \text{Stdev}(\text{Cells})$ $\sigma_{actual} = 33.549$

Standard Error

$$\text{Standard}_{error} := \frac{\sigma_{actual}}{\sqrt{\text{No}_{DataCells}}}$$ $\text{Standard}_{error} = 4.793$

Skewness

$$\text{Skewness} := \frac{(\text{No}_{DataCells}) \cdot \overrightarrow{\Sigma(\text{Cells} - \mu_{actual})^3}}{(\text{No}_{DataCells} - 1) \cdot (\text{No}_{DataCells} - 2) \cdot (\sigma_{actual})^3}$$ $\text{Skewness} = -1.176$

Kurtosis

$$\text{Kurtosis} := \frac{\text{No}_{DataCells} \cdot (\text{No}_{DataCells} + 1) \overrightarrow{\Sigma(\text{Cells} - \mu_{actual})^4}}{(\text{No}_{DataCells} - 1) \cdot (\text{No}_{DataCells} - 2) \cdot (\text{No}_{DataCells} - 3) \cdot (\sigma_{actual})^4} + -\frac{3 \cdot (\text{No}_{DataCells} - 1)^2}{(\text{No}_{DataCells} - 2) \cdot (\text{No}_{DataCells} - 3)}$$ $\text{Kurtosis} = 0.379$

Normal Probability Plot

$j := 0 .. \text{last}(\text{Cells})$ $\text{srt} := \text{sort}(\text{Cells})$

$r_j := j + 1$ $$\text{rank}_j := \frac{\overrightarrow{\Sigma(\overrightarrow{\text{srt} = \text{srt}_j}) \cdot r}}{\Sigma \overrightarrow{\text{srt} = \text{srt}_j}}$$

$$p_j := \frac{\text{rank}_j}{\text{rows}(\text{Cells}) + 1}$$

$x := 1$ $\text{N\_Score}_j := \text{root}\left[\text{cnorm}(x) - (p_j), x\right]$

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$\alpha := .05$ $\quad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right]$ $\quad T\alpha = 2.011$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 728.343$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 747.616$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$Bins := Make_{bins}(\mu_{actual}, \sigma_{actual})$

$Distribution := hist(Bins, Cells)$

Distribution =
1
2
2
4
6
2
9
22
1
0
0
0

The mid points of the Bins are calculated

$k := 0 .. 11$ $\quad Midpoints_k := \frac{(Bins_k + Bins_{k+1})}{2}$

$$normal_{curve_0} := pnorm(Bins_1, \mu_{actual}, \sigma_{actual})$$

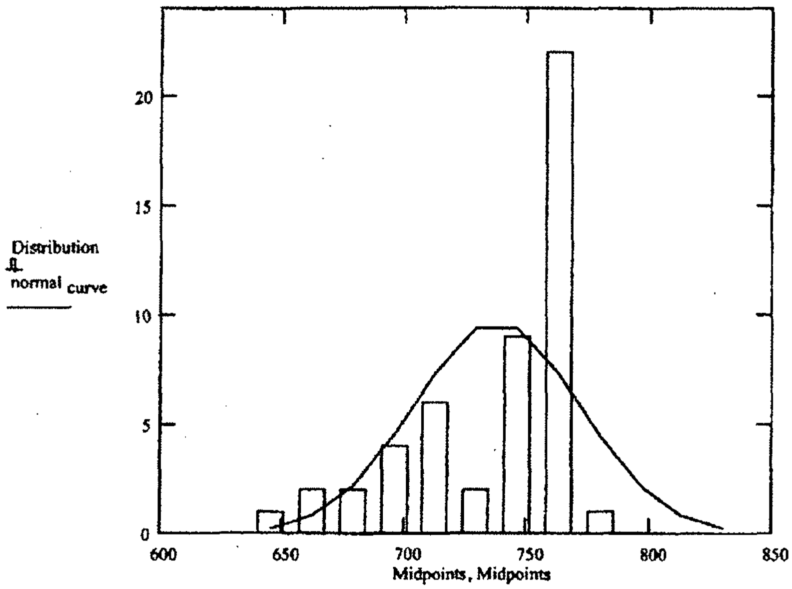
$$normal_{curve_k} := pnorm(Bins_{k+1}, \mu_{actual}, \sigma_{actual}) - pnorm(Bins_k, \mu_{actual}, \sigma_{actual})$$

$$normal_{curve} := No_{DataCells} \cdot normal_{curve}$$

Results For Elevation 51' 10" Bay 13, Area 31

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values.

Data Distribution



μ_{actual} = 737.98

σ_{actual} = 33.549

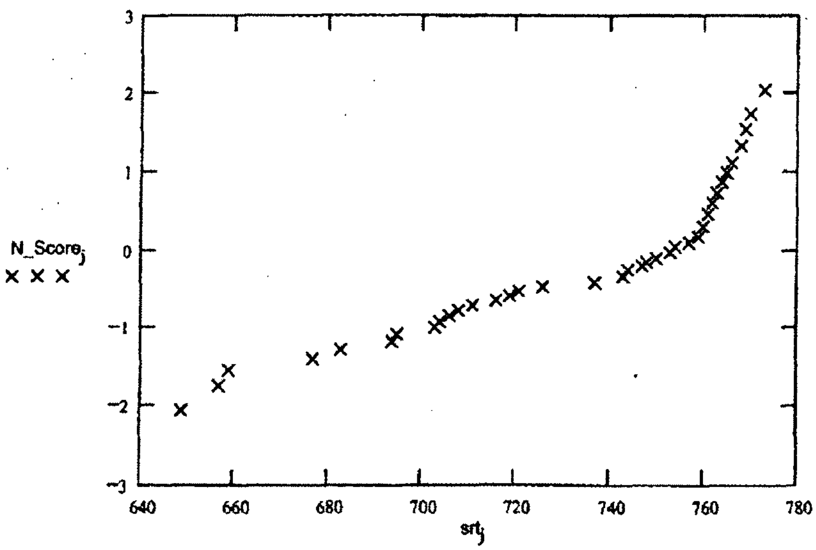
$Standard_{error}$ = 4.793

Skewness = −1.176

Kurtosis = 0.379

$Lower_{95\%Con}$ = 728.343 $Upper_{95\%Con}$ = 747.616

Normal Probability Plot



There is a slightly thinner area of approximately 15 to 16 points near the center of this location. Past calculations (ref. 3.22) have split this area out as a separate groups and performed analysis on both groups. In order to be consistent with past calculations this data will be split in two groups and analyzed. The entire data set will also be evaluated.

$Split := 724$ This value will results in a thinner sub set of 15 to 16 points to which is consistent with previous calculations (ref. 3.22)

The two groups are named as follows:

$$low_{points} := lessmean(Cells, No_{DataCells}, Split) \qquad high_{points} := Moremean(Cells, No_{DataCells}, Split)$$

Mean and Standard Deviation

$$\mu low_{actual} := mean(low_{points}) \qquad \sigma low_{actual} := Stdev(low_{points})$$

$$\mu high_{actual} := mean(high_{points}) \qquad \sigma high_{actual} := Stdev(high_{points})$$

Standard Error

$$Standardlow_{error} := \frac{\sigma low_{actual}}{\sqrt{length(low_{points})}} \qquad Standardhigh_{error} := \frac{\sigma high_{actual}}{\sqrt{length(high_{points})}}$$

Skewness

$$Nolow_{DataCells} := length(low_{points})$$

$$Skewness_{low} := \frac{(Nolow_{DataCells}) \cdot \overrightarrow{\Sigma(low_{points} - \mu low_{actual})^3}}{(Nolow_{DataCells} - 1) \cdot (Nolow_{DataCells} - 2) \cdot (\sigma low_{actual})^3}$$

$$Nohigh_{DataCells} := length(high_{points})$$

$$Skewness_{high} := \frac{(Nohigh_{DataCells}) \cdot \overrightarrow{\Sigma(high_{points} - \mu high_{actual})^3}}{(Nohigh_{DataCells} - 1) \cdot (Nohigh_{DataCells} - 2) \cdot (\sigma high_{actual})^3}$$

Kurtosis

$$Kurtosis_{low} := \frac{Nolow_{DataCells}\cdot(Nolow_{DataCells}+1)\cdot\overrightarrow{\Sigma(low_{points}-\mu low_{actual})^4}}{(Nolow_{DataCells}-1)\cdot(Nolow_{DataCells}-2)\cdot(Nolow_{DataCells}-3)\cdot(\sigma low_{actual})^4} \ldots + -\frac{3\cdot(Nolow_{DataCells}-1)^2}{(Nolow_{DataCells}-2)\cdot(Nolow_{DataCells}-3)}$$

$$Kurtosis_{high} := \frac{Nohigh_{DataCells}\cdot(Nohigh_{DataCells}+1)\cdot\overrightarrow{\Sigma(high_{points}-\mu high_{actual})^4}}{(Nohigh_{DataCells}-1)\cdot(Nohigh_{DataCells}-2)\cdot(Nohigh_{DataCells}-3)\cdot(\sigma high_{actual})^4} \ldots + -\frac{3\cdot(Nohigh_{DataCells}-1)^2}{(Nohigh_{DataCells}-2)\cdot(Nohigh_{DataCells}-3)}$$

Normal Probability Plot - Low points

$l := 0..last(low_{points})$ $srt_{low} := sort(low_{points})$

$L_l := l + 1$

$$rank_{low_l} := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt_{low} = srt_{low_l}}\right)\cdot L}}{\Sigma\overrightarrow{srt_{low} = srt_{low_l}}} \qquad p_{low_l} := \frac{rank_{low_l}}{rows(low_{points})+1}$$

$x := 1$ $N\_Score_{low_l} := root\left[cnorm(x) - (p_{low_l}), x\right]$

Normal Probability Plot - High points

$h := 0..last(high_{points})$ $srt_{high} := sort(high_{points})$

$H_h := h + 1$

$$rank_{high_h} := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt_{high} = srt_{high_h}}\right)\cdot H}}{\Sigma\overrightarrow{srt_{high} = srt_{high_h}}} \qquad p_{high_h} := \frac{rank_{high_h}}{rows(high_{points})+1}$$

$x := 1$ $N\_Score_{high_h} := root\left[cnorm(x) - (p_{high_h}), x\right]$

Upper and Lower Confidence Values

$\alpha := .05$ $\quad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right]$ $\quad T\alpha = 2.011$

$$Lowerhigh_{95\%Con} := \mu high_{actual} - T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Upperhigh_{95\%Con} := \mu high_{actual} + T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Lowerlow_{95\%Con} := \mu low_{actual} - T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

$$Upperlow_{95\%Con} := \mu low_{actual} + T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

Graphical Representation of Low Points

$Bins_{low} := Make_{bins}\left(\mu low_{actual}, \sigma low_{actual}\right)$

$Distribution_{low} := hist\left(Bins_{low}, low_{points}\right)$

The mid points of the Bins are calculated

$k := 0..11$ $\quad Midpoints_{low_k} := \frac{\left(Bins_{low_k} + Bins_{low_{k+1}}\right)}{2}$

$Distribution_{low} =$

0
0
2
1
1
1
4
4
2
0
0
0

$$normallow_{curve_0} := pnorm\left(Bins_{low_1}, \mu low_{actual}, \sigma low_{actual}\right)$$

$$normallow_{curve_k} := pnorm\left(Bins_{low_{k+1}}, \mu low_{actual}, \sigma low_{actual}\right) - pnorm\left(Bins_{low_k}, \mu low_{actual}, \sigma low_{actual}\right)$$

$$normallow_{curve} := Nolow_{DataCells} \cdot normallow_{curve}$$

Graphical Representation of High Points

$Bins_{high} := Make_{bins}(\mu high_{actual}, \sigma high_{actual})$

$Distribution_{high} := hist(Bins_{high}, high_{points})$

$Distribution_{high} =$

0
0
1
4
2
4
10
7
5
0
0
0

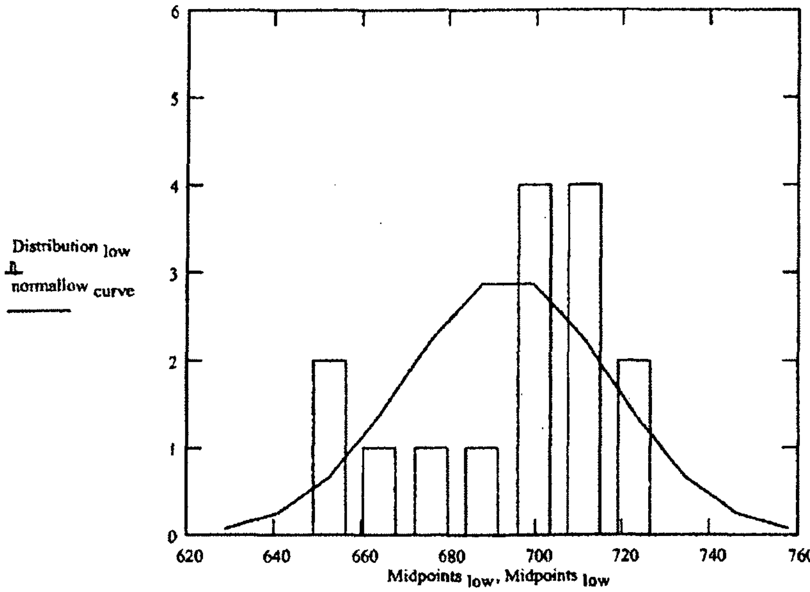
$k := 0..11$ $\quad Midpoints_{high_k} := \dfrac{\left(Bins_{high_k} + Bins_{high_{k+1}}\right)}{2}$

$normalhigh_{curve_0} := pnorm(Bins_{high_1}, \mu high_{actual}, \sigma high_{actual})$

$normalhigh_{curve_k} := pnorm(Bins_{high_{k+1}}, \mu high_{actual}, \sigma high_{actual}) - pnorm(Bins_{high_k}, \mu high_{actual}, \sigma high_{actual})$

$normalhigh_{curve} := Nohigh_{DataCells} \cdot normalhigh_{curve}$

Results For Elevation 51' 10" Bay 13, Area 31 Thinner Points



μlow actual = 693.467

σlow actual = 23.412

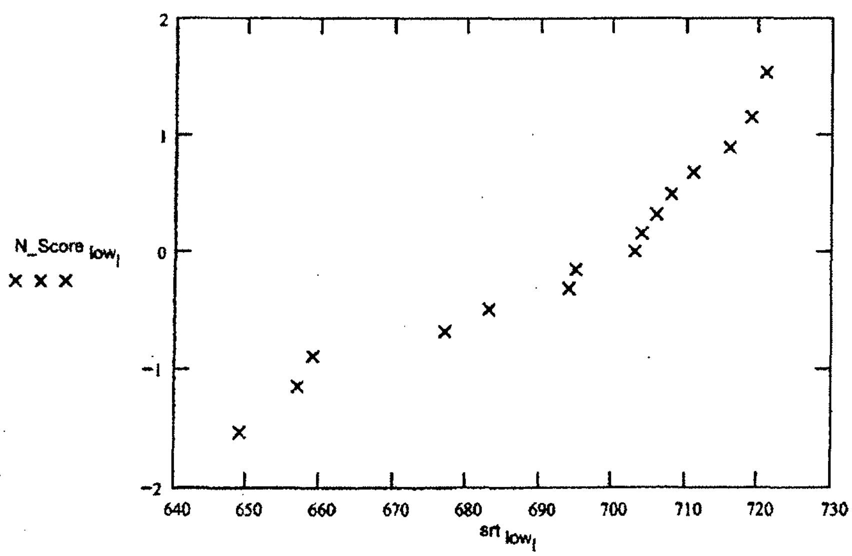
Kurtosis low = −0.618

Skewness low = −0.781

Standardlow error = 6.045

Nolow DataCells = 15

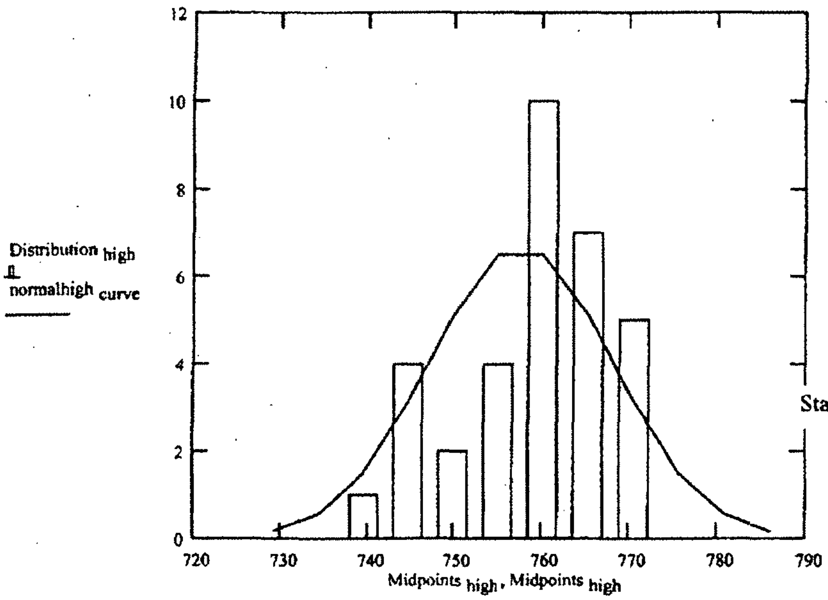
Lowerlow 95%Con = 681.312 Upperlow 95%Con = 705.621



The above plots indicates that the thinner area is more normally distributed than the entire population.

Subject: Drywell Corrosion | **Calc. No.** C-1301-187-E310-037 | **Rev. No.** ~~1~~ 2 ~~05~~ 5/15/05 | **System No.** 187 | **Sheet No.** A3- 10 of 29

Results For Elevation 51' 10" Bay 13, Area 31 Thicker Points



$\mu high_{actual}$ = 757.618

$\sigma high_{actual}$ = 10.328

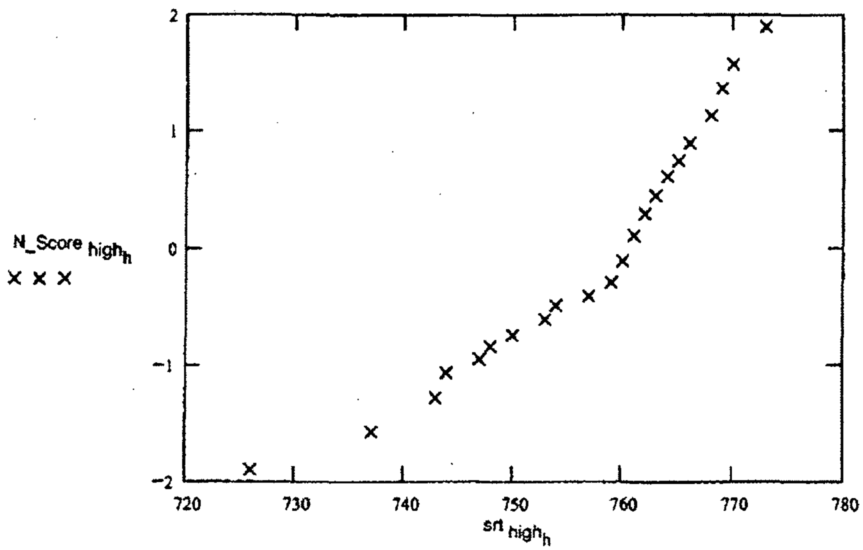
$Skewness_{high}$ = −1.167

$Kurtosis_{high}$ = 1.403

$Standardhigh_{error}$ = 1.771

$Nohigh_{DataCells}$ = 34

$Lower_{95\%Con}$ = 728.343 $Upper_{95\%Con}$ = 747.616



The above plots indicates that the thicker areas are normally distributed.

Elevation 51' 10" Bay 13, Area 31 Trend

Data from March. 1990 to Sept. 2000 is retrieved. $d := 0$

For March 31 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D5131_March90.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(3, 31, 1990)$

Data

$Points_{49} =$

0.706	0.646	0.771	0.754	0.765	0.774	0.763
0.699	0.648	0.77	0.753	0.734	0.759	0.773
0.649	0.674	0.764	0.73	0.719	0.766	0.758
0.717	0.7	0.75	0.69	0.769	0.771	0.763
0.64	0.766	0.702	0.761	0.768	0.772	0.75
0.733	0.708	0.686	0.767	0.785	0.793	0.768
0.734	0.766	0.763	0.779	0.762	0.717	0.77

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

$d := d + 1$

For April 26 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\April 1990 Data\DATA ONLY\D5131_April90.txt")

$Points_{49} :=$ showcells(page , 7 , 0) $\qquad Dates_d := Day_{year}(4, 26, 1990)$

Data

$Points_{49} =$

0.703	0.652	0.772	0.767	0.783	0.803	0.842
0.708	0.655	0.856	0.779	0.791	0.784	0.775
0.682	0.674	0.772	0.798	0.777	0.8	0.793
0.766	0.784	0.783	0.653	0.79	0.79	0.778
0.653	0.775	0.794	0.782	0.768	0.771	0.771
0.77	0.713	0.718	0.782	0.765	0.773	0.765
0.765	0.78	0.766	0.783	0.778	0.716	0.759

$nnn := convert(Points_{49}, 7) \qquad No_{DataCells} := length(nnn)$

Point 7 and 10 were omitted from the 4/26/90 data (reference 3.22)

$nnn := Zero_{one}(nnn, No_{DataCells}, 7) \qquad nnn := Zero_{one}(nnn, No_{DataCells}, 10)$

$Cells := deletezero_{cells}(nnn, No_{DataCells}) \qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells) \qquad \sigma_{measured_d} := Stdev(Cells) \qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split) \qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points}) \qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points}) \qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

OS 8/15/05

For Feb. 23, 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D5131_F91.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.706 & 0.638 & 0.782 & 0.75 & 0.763 & 0.779 & 0.76 \\ 0.695 & 0.7 & 0.769 & 0.758 & 0.763 & 0.766 & 0.771 \\ 0.692 & 0.694 & 0.764 & 0.727 & 0.746 & 0.763 & 0.76 \\ 0.71 & 0.748 & 0.75 & 0.686 & 0.768 & 0.747 & 0.765 \\ 0.638 & 0.706 & 0.768 & 0.758 & 0.762 & 0.76 & 0.761 \\ 0.755 & 0.706 & 0.703 & 0.77 & 0.757 & 0.742 & 0.768 \\ 0.665 & 0.761 & 0.769 & 0.748 & 0.759 & 0.704 & 0.759 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

Point 30 and 43 were omitted from the 4/26/90 data

$nnn := Zero_{one}(nnn, No_{DataCells}, 30)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 43)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 5/15/05	187	A3- 14 of 29

For May 23 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D5131_M91.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.7 & 0.645 & 0.769 & 0.753 & 0.764 & 0.773 & 0.764 \\ 0.693 & 0.653 & 0.77 & 0.75 & 0.735 & 0.758 & 0.771 \\ 0.649 & 0.67 & 0.762 & 0.725 & 0.669 & 0.764 & 0.755 \\ 0.726 & 0.694 & 0.749 & 0.686 & 0.767 & 0.77 & 0.762 \\ 0.638 & 0.749 & 0.693 & 0.76 & 0.766 & 0.77 & 0.748 \\ 0.73 & 0.704 & 0.685 & 0.766 & 0.767 & 0.762 & 0.765 \\ 0.736 & 0.762 & 0.758 & 0.792 & 0.765 & 0.711 & 0.761 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$

$\sigma_{measured_d} := Stdev(Cells)$

$Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$

$low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$

$\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$

$\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$

$Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Nov. 2 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov. 1991 Data\DATA ONLY\D5131_N91.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(11, 2, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.697 & 0.651 & 0.77 & 0.758 & 0.767 & 0.779 & 0.768 \\ 0.7 & 0.665 & 0.773 & 0.751 & 0.772 & 0.768 & 0.78 \\ 0.664 & 0.674 & 0.766 & 0.724 & 0.725 & 0.768 & 0.77 \\ 0.758 & 0.716 & 0.752 & 0.69 & 0.772 & 0.773 & 0.768 \\ 0.651 & 0.757 & 0.69 & 0.768 & 0.768 & 0.779 & 0.753 \\ 0.735 & 0.715 & 0.684 & 0.767 & 0.77 & 0.765 & 0.775 \\ 0.769 & 0.771 & 0.753 & 0.775 & 0.766 & 0.711 & 0.762 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$

$\sigma_{measured_d} := Stdev(Cells)$

$$Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$

$low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$

$\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$

$\sigma low_{measured_d} := Stdev(low_{points})$

$$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$$

$$Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$$

For May. 30 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D5131_M92.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d :=$ Day_{year}(5 , 30 , 1992)

Data

$$Points_{49} = \begin{bmatrix} 0.705 & 0.646 & 0.772 & 0.755 & 0.767 & 0.778 & 0.77 \\ 0.699 & 0.642 & 0.772 & 0.753 & 0.744 & 0.762 & 0.778 \\ 0.652 & 0.683 & 0.766 & 0.738 & 0.751 & 0.769 & 0.762 \\ 0.755 & 0.697 & 0.755 & 0.688 & 0.772 & 0.773 & 0.765 \\ 0.642 & 0.754 & 0.709 & 0.764 & 0.772 & 0.771 & 0.755 \\ 0.762 & 0.711 & 0.705 & 0.77 & 0.774 & 0.772 & 0.773 \\ 0.773 & 0.774 & 0.767 & 0.767 & 0.77 & 0.721 & 0.768 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad$ $\sigma_{measured_d} := Stdev(Cells)$ $\quad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\quad$ $Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Dec. 5 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D5131_D92.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\quad$ $\text{Dates}_d := \text{Day}_{year}(12, 5, 1992)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.699 & 0.651 & 0.77 & 0.757 & 0.766 & 0.774 & 0.766 \\ 0.696 & 0.696 & 0.774 & 0.752 & 0.769 & 0.766 & 0.773 \\ 0.657 & 0.687 & 0.761 & 0.73 & 0.756 & 0.766 & 0.763 \\ 0.761 & 0.706 & 0.75 & 0.685 & 0.769 & 0.771 & 0.761 \\ 0.643 & 0.756 & 0.71 & 0.763 & 0.766 & 0.766 & 0.748 \\ 0.757 & 0.707 & 0.688 & 0.763 & 0.765 & 0.767 & 0.768 \\ 0.768 & 0.771 & 0.766 & 0.771 & 0.768 & 0.716 & 0.764 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\quad$ $\text{No}_{DataCells} := \text{length}(\text{nnn})$

$\text{Cells} := \text{deletezero}_{cells}(\text{nnn}, \text{No}_{DataCells})$ $\quad$ $\text{No}_{Cells} := \text{length}(\text{Cells})$

$\mu_{measured_d} := \text{mean}(\text{Cells})$ $\quad$ $\sigma_{measured_d} := \text{Stdev}(\text{Cells})$ $\quad$ $\text{Standard}_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{\text{No}_{DataCells}}}$

$\text{high}_{points} := \text{Moremean}(\text{Cells}, \text{No}_{Cells}, \text{Split})$ $\quad$ $\text{low}_{points} := \text{lessmean}(\text{Cells}, \text{No}_{Cells}, \text{Split})$

$\mu\text{high}_{measured_d} := \text{mean}(\text{high}_{points})$ $\quad$ $\mu\text{low}_{measured_d} := \text{mean}(\text{low}_{points})$

$\sigma\text{high}_{measured_d} := \text{Stdev}(\text{high}_{points})$ $\quad$ $\sigma\text{low}_{measured_d} := \text{Stdev}(\text{low}_{points})$

$\text{Standardhigh}_{error_d} := \dfrac{\sigma\text{high}_{measured_d}}{\sqrt{\text{length}(\text{high}_{points})}}$ $\quad$ $\text{Standardlow}_{error_d} := \dfrac{\sigma\text{low}_{measured_d}}{\sqrt{\text{length}(\text{low}_{points})}}$

For Sept. 14 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D5131_94.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(9 , 14 , 1994)$

Data

$$Points_{49} = \begin{bmatrix} 0.695 & 0.644 & 0.767 & 0.751 & 0.761 & 0.77 & 0.759 \\ 0.69 & 0.653 & 0.767 & 0.745 & 0.724 & 0.758 & 0.768 \\ 0.656 & 0.666 & 0.758 & 0.711 & 0.713 & 0.761 & 0.754 \\ 0.698 & 0.695 & 0.748 & 0.686 & 0.764 & 0.767 & 0.759 \\ 0.638 & 0.749 & 0.692 & 0.758 & 0.761 & 0.768 & 0.75 \\ 0.724 & 0.712 & 0.68 & 0.762 & 0.764 & 0.756 & 0.76 \\ 0.762 & 0.766 & 0.736 & 0.769 & 0.759 & 0.701 & 0.756 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

Point 12 and 36 were omitted from the 9/94 data

$nnn := Zero_{one}(nnn, No_{DataCells}, 12)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$$

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D5131_96.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.698 & 0.642 & 0.768 & 0.748 & 0.759 & 0.77 & 0.795 \\ 0.689 & 0.635 & 0.766 & 0.749 & 0.764 & 0.806 & 0.793 \\ 0.687 & 0.713 & 0.761 & 0.728 & 0.744 & 0.761 & 0.755 \\ 0.71 & 0.691 & 0.8 & 0.72 & 0.764 & 0.766 & 0.759 \\ 0.634 & 0.748 & 0.698 & 0.79 & 0.766 & 0.768 & 0.748 \\ 0.756 & 0.707 & 0.722 & 0.765 & 0.764 & 0.767 & 0.765 \\ 0.764 & 0.764 & 0.759 & 0.762 & 0.796 & 0.714 & 0.764 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad \sigma low_{measured_d} := Stdev(low_{points})$

$$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$$

pv 5/15/07

For Sept. 16 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D5131_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 16, 2000)$

Data

$$Points_{49} = \begin{bmatrix} 0.689 & 0.644 & 0.768 & 0.753 & 0.763 & 0.773 & 0.761 \\ 0.694 & 0.64 & 0.769 & 0.749 & 0.733 & 0.758 & 0.772 \\ 0.651 & 0.663 & 0.762 & 0.723 & 0.716 & 0.764 & 0.753 \\ 0.691 & 0.69 & 0.751 & 0.689 & 0.769 & 0.781 & 0.762 \\ 0.635 & 0.756 & 0.688 & 0.759 & 0.768 & 0.769 & 0.757 \\ 0.732 & 0.707 & 0.683 & 0.768 & 0.777 & 0.784 & 0.77 \\ 0.763 & 0.773 & 0.753 & 0.768 & 0.76 & 0.709 & 0.762 \end{bmatrix}$$

$nnn := convert\left(Points_{49}, 7\right)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}\left(nnn, No_{DataCells}\right)$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean\left(Cells, No_{Cells}, Split\right)$ $low_{points} := lessmean\left(Cells, No_{Cells}, Split\right)$

$\mu high_{measured_d} := mean\left(high_{points}\right)$ $\mu low_{measured_d} := mean\left(low_{points}\right)$

$\sigma high_{measured_d} := Stdev\left(high_{points}\right)$ $\sigma low_{measured_d} := Stdev\left(low_{points}\right)$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length\left(high_{points}\right)}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length\left(low_{points}\right)}}$

For Nov. 9 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5131_00.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(11 , 9 , 2004)$

Data

$$Points_{49} = \begin{bmatrix} 0.694 & 0.649 & 0.764 & 0.753 & 0.761 & 0.773 & 0.764 \\ 0.708 & 0.657 & 0.766 & 0.748 & 0.744 & 0.761 & 0.769 \\ 0.743 & 0.659 & 0.757 & 0.711 & 0.716 & 0.759 & 0.754 \\ 0.706 & 0.703 & 0.75 & 0.683 & 0.766 & 0.768 & 0.76 \\ 0.721 & 0.753 & 0.695 & 0.76 & 0.762 & 0.763 & 0.743 \\ 0.726 & 0.719 & 0.677 & 0.762 & 0.765 & 0.747 & 0.76 \\ 0.761 & 0.768 & 0.737 & 0.77 & 0.759 & 0.704 & 0.763 \end{bmatrix}$$

$nnn := convert\left(Points_{49}, 7\right)$ $\qquad No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}\left(nnn, No_{DataCells}\right)$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean\left(Cells, No_{Cells}, Split\right)$ $\qquad low_{points} := lessmean\left(Cells, No_{Cells}, Split\right)$

$\mu high_{measured_d} := mean\left(high_{points}\right)$ $\qquad \mu low_{measured_d} := mean\left(low_{points}\right)$

$\sigma high_{measured_d} := Stdev\left(high_{points}\right)$ $\qquad \sigma low_{measured_d} := Stdev\left(low_{points}\right)$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length\left(high_{points}\right)}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length\left(low_{points}\right)}}$

Below are the results

Dates =

$1.99\cdot10^3$
$1.99\cdot10^3$
$1.991\cdot10^3$
$1.991\cdot10^3$
$1.992\cdot10^3$
$1.992\cdot10^3$
$1.993\cdot10^3$
$1.995\cdot10^3$
$1.997\cdot10^3$
$2.001\cdot10^3$
$2.005\cdot10^3$

$\mu_{measured}$ =

739.286
756.574
741.872
735.388
742.918
743.735
743.327
733.255
744.122
736.163
737.98

$\sigma_{measured}$ =

40.163
43.537
34.629
40.615
38.54
39.527
36.451
39.501
40.623
42.126
33.549

$Standard_{error}$ =

5.738
6.22
4.947
5.802
5.506
5.647
5.207
5.643
5.803
6.018
4.793

$\mu high_{measured}$ =

762.471
778.667
759.886
758.4
764.886
765.083
763.389
759.129
765.771
762.424
757.618

$\sigma high_{measured}$ =

14.065
11.045
10.627
14.287
11.578
9.479
8.61
7.835
16.693
11.363
10.328

$Standardhigh_{error}$ =

2.412
1.841
1.796
2.415
1.957
1.58
1.435
1.407
2.822
1.978
1.771

5/15/05

$\mu low_{measured}$ =

686.733
684.273
689.333
677.857
688
684.615
687.769
683.125
690
682
693.467

$\sigma low_{measured}$ =

28.28
28.015
24.937
23.806
24.22
28.878
23.392
24.459
30.787
27.512
23.412

$Standardlow_{error}$ =

7.302
8.447
7.199
6.363
6.473
8.009
6.488
6.115
8.228
6.878
6.045

$Total_{means} := rows(\mu_{measured})$ $\quad$ $Total_{means} = 11$

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2$$

$$SSE_{low} := \sum_{i=0}^{last(Dates)} \left(\mu low_{measured_i} - yhat(Dates, \mu low_{measured})_i\right)^2$$

$$SSE_{high} := \sum_{i=0}^{last(Dates)} \left(\mu high_{measured_i} - yhat(Dates, \mu high_{measured})_i\right)^2$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2$$

$$SSR_{low} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu low_{measured})_i - mean(\mu low_{measured})\right)^2$$

$$SSR_{high} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu high_{measured})_i - mean(\mu high_{measured})\right)^2$$

$DegreeFree_{ss} := Total_{means} - 2$ $\quad$ $DegreeFree_{reg} := 1$

$MSE := \frac{SSE}{DegreeFree_{ss}}$ $\quad$ $MSE_{low} := \frac{SSE_{low}}{DegreeFree_{ss}}$ $\quad$ $MSE_{high} := \frac{SSE_{high}}{DegreeFree_{ss}}$

$Standard_{error} := \sqrt{MSE}$ $\quad$ $Standard_{lowerror} := \sqrt{MSE_{low}}$ $\quad$ $Standard_{higherror} := \sqrt{MSE_{high}}$

$MSR := \frac{SSR}{DegreeFree_{reg}}$ $\quad$ $MSR_{low} := \frac{SSR_{low}}{DegreeFree_{reg}}$ $\quad$ $MSR_{high} := \frac{SSR_{high}}{DegreeFree_{reg}}$

$F_{actaul} := \frac{MSR}{MSE}$ $\quad$ $F\_low_{actaul} := \frac{MSR_{low}}{MSE_{low}}$ $\quad$ $F\_high_{actaul} := \frac{MSR_{high}}{MSE_{high}}$

For 95% confidence level the F Critical is calculated as follows

$\alpha := 0.05$ $\quad$ $F_{critical} := qF(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss})$ $\quad$ $F_{critical} = 5.117$

The "F" ratio for 95% confidence is calculated:

$F_{ratio} := \frac{F_{actaul}}{F_{critical}}$ $\quad$ $F\_low_{ratio} := \frac{F\_low_{actaul}}{F_{critical}}$ $\quad$ $F\_high_{ratio} := \frac{F\_high_{actaul}}{F_{critical}}$

$F_{ratio} = 0.302$ $\quad$ $F\_low_{ratio} = 0.271$ $\quad$ $F\_high_{ratio} = 0.286$

Therefore in all three cases means do not have a slope.

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 OT 3/15/05	187	A3- 25 of 29

The following will plot the results for the overall mean, the mean of thinner points, and the mean of thicker points

$$i := 0 .. Total_{means} - 1$$

$$\mu grand_{measured_i} := mean(\mu_{measured}) \qquad \sigma grand_{measured} := Stdev(\mu_{measured})$$

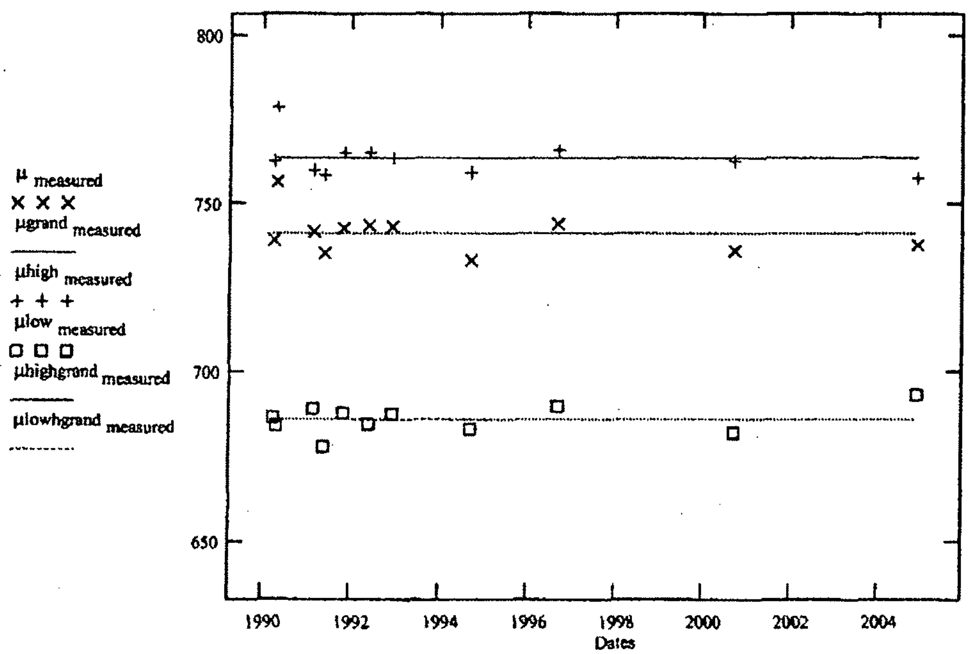
$$GrandStandard_{error} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$$

$$\sigma grand_{lowmeasured} := Stdev(\mu low_{measured}) \qquad \mu lowhgrand_{measured_i} := mean(\mu low_{measured})$$

$$GrandStandard_{lowerror} := \frac{\sigma grand_{lowmeasured}}{\sqrt{Total_{means}}}$$

$$\sigma grand_{highmeasured} := Stdev(\mu high_{measured}) \qquad \mu highgrand_{measured_i} := mean(\mu high_{measured})$$

$$GrandStandard_{higherror} := \frac{\sigma grand_{highmeasured}}{\sqrt{Total_{means}}}$$



$$\mu grand_{measured_0} = 741.329 \qquad GrandStandard_{error} = 1.896$$

$$mean(\mu low_{measured}) = 686.107 \qquad GrandStandard_{lowerror} = 1.3$$

$$mean(\mu high_{measured}) = 763.429 \qquad GrandStandard_{higherror} = 1.744$$

The F Test indicates that the regression model does not hold for any of the data sets. However, the slopes and 95% Confidence curves are generated for all three cases.

$m_s := \text{slope}\left(\text{Dates}, \mu_{\text{measured}}\right)$ $\qquad y_b := \text{intercept}\left(\text{Dates}, \mu_{\text{measured}}\right)$

$m_{\text{lows}} := \text{slope}\left(\text{Dates}, \mu\text{low}_{\text{measured}}\right)$ $\qquad y_{\text{lowb}} := \text{intercept}\left(\text{Dates}, \mu\text{low}_{\text{measured}}\right)$

$m_{\text{highs}} := \text{slope}\left(\text{Dates}, \mu\text{high}_{\text{measured}}\right)$ $\qquad y_{\text{highb}} := \text{intercept}\left(\text{Dates}, \mu\text{high}_{\text{measured}}\right)$

$\alpha_t := 0.05 \qquad k := 23 \qquad f := 0..k-1$

$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2$

$\text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$

$\text{Thick}_{\text{lowpredict}} := m_{\text{lows}} \cdot \text{year}_{\text{predict}} + y_{\text{lowb}}$

$\text{Thick}_{\text{highpredict}} := m_{\text{highs}} \cdot \text{year}_{\text{predict}} + y_{\text{highb}}$

$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates})$

$\text{sum} := \sum_i \left(\text{Dates}_d - \text{mean}(\text{Dates})\right)^2$

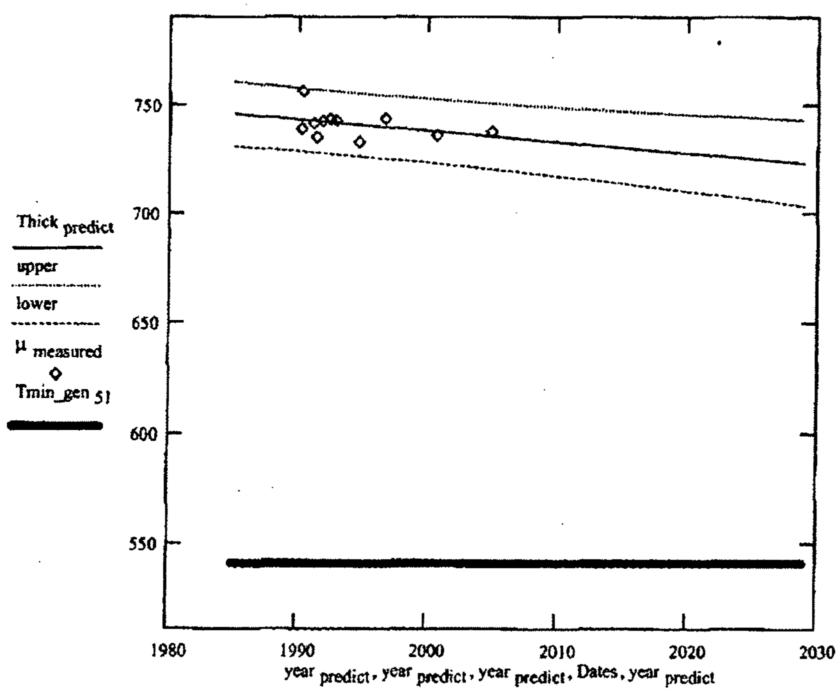
For the entire grid

$$upper_f := Thick_{predict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{predict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$

General area Tmin for this elevation in the Drywell

$Tmin\_gen_{51_f} := 541$ (Ref. Calc. SE-000243-002)



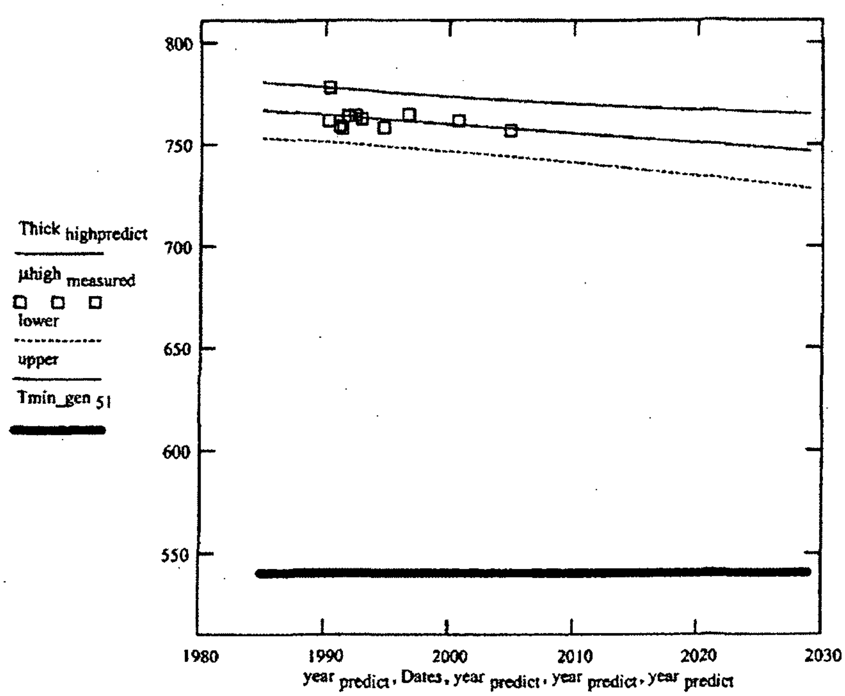
$m_s = -0.513$

8/15/05

For the points which are thicker

$$upper_f := Thick_{highpredict_f} \ldots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{highpredict_f} \ldots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$

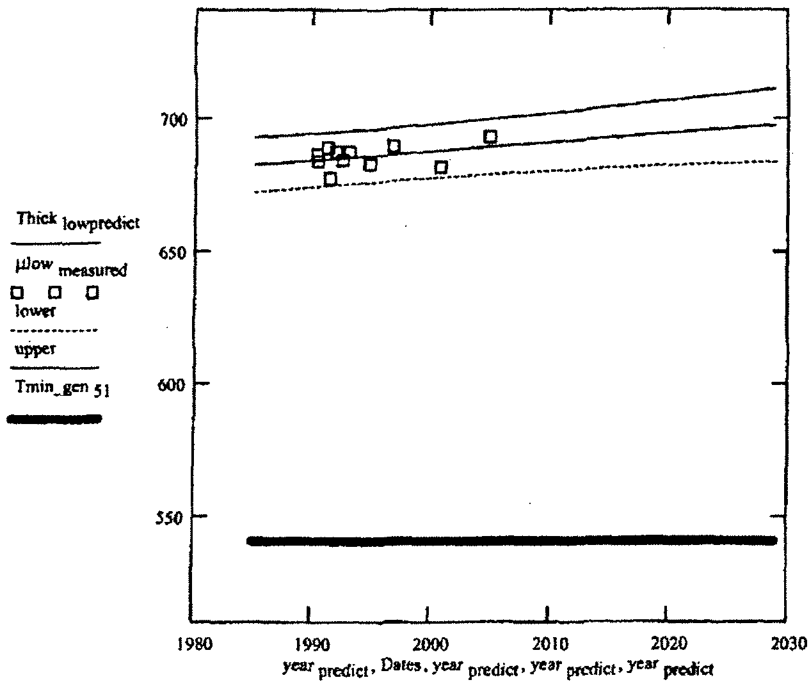


$m_{highs} = -0.46$

For the points which are thinner

$$upper_f := Thick_{lowpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{lowpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$



$m_{lows} = 0.335$

There are no pits identified at this location

~~15~~ 5/15/05

Appendix 4 - Elevation 50' 2" Bay 15, Area 23

Nov 9 2004 Data

The data shown below was collected on 11/9/2004 .

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5123_00.txt")

$$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$$

$$\text{Points}_{49} = \begin{bmatrix} 0.731 & 0.737 & 0.747 & 0.754 & 0.759 & 0.757 & 0.759 \\ 0.765 & 0.745 & 0.755 & 0.758 & 0.734 & 0.714 & 0.741 \\ 0.743 & 0.756 & 0.722 & 0.743 & 0.738 & 0.725 & 0.758 \\ 0.768 & 0.755 & 0.753 & 0.749 & 0.632 & 0.751 & 0.754 \\ 0.753 & 0.731 & 0.768 & 0.751 & 0.705 & 0.743 & 0.743 \\ 0.759 & 0.764 & 0.724 & 0.772 & 0.715 & 0.701 & 0.763 \\ 0.752 & 0.766 & 0.733 & 0.753 & 0.694 & 0.732 & 0.76 \end{bmatrix}$$

$$\text{Cells} := \text{convert}(\text{Points}_{49}, 7) \qquad \text{No}_{\text{DataCells}} := \text{length}(\text{Cells})$$

For this location the following point is a pit and will be trended separately (Reference 3.22)

$$\text{Cells} := \text{Zero}_{\text{one}}(\text{Cells}, \text{No}_{\text{DataCells}}, 26)$$

The thinnest point at this location is shown below

$$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{Cells}, \text{No}_{\text{DataCells}})$$

$$\text{minpoint} := \min(\text{Points}_{49})$$

$$\text{No}_{\text{DataCells}} := \text{length}(\text{Cells})$$

$$\text{minpoint} = 0.632$$

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(Cells)$ $\mu_{actual} = 744.854$ $\sigma_{actual} := \text{Stdev}(Cells)$ $\sigma_{actual} = 18.313$

Standard Error

$$Standard_{error} := \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}}$$ $Standard_{error} = 2.643$

Skewness

$$Skewness := \frac{(No_{DataCells}) \cdot \Sigma\overrightarrow{(Cells - \mu_{actual})^3}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (\sigma_{actual})^3}$$ $Skewness = -0.99$

Kurtosis

$$Kurtosis := \frac{No_{DataCells} \cdot (No_{DataCells} + 1) \cdot \Sigma\overrightarrow{(Cells - \mu_{actual})^4}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (No_{DataCells} - 3) \cdot (\sigma_{actual})^4} + - \frac{3 \cdot (No_{DataCells} - 1)^2}{(No_{DataCells} - 2) \cdot (No_{DataCells} - 3)}$$ $Kurtosis = 0.542$

Normal Probability Plot

$j := 0 .. \text{last}(Cells)$ $srt := \text{sort}(Cells)$

$$r_j := j + 1 \qquad rank_j := \frac{\Sigma\overrightarrow{\left(\overrightarrow{srt = srt_j}\right) \cdot r}}{\Sigma \overrightarrow{srt = srt_j}}$$

$$p_j := \frac{rank_j}{\text{rows}(Cells) + 1}$$

$x := 1$ $N\_Score_j := \text{root}\left[\text{cnorm}(x) - (p_j), x\right]$

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$$\alpha := .05 \qquad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 739.54$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 750.169$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$$Bins := Make_{bins}(\mu_{actual}, \sigma_{actual})$$

$$Distribution := hist(Bins, Cells)$$

Distribution =

1
2
2
3
5
7
11
11
6
0
0
0

The mid points of the Bins are calculated

$$k := 0 .. 11 \qquad Midpoints_k := \frac{(Bins_k + Bins_{k+1})}{2}$$

$$normal_{curve_0} := pnorm(Bins_1, \mu_{actual}, \sigma_{actual})$$

$$normal_{curve_k} := pnorm(Bins_{k+1}, \mu_{actual}, \sigma_{actual}) - pnorm(Bins_k, \mu_{actual}, \sigma_{actual})$$

$$normal_{curve} := No_{DataCells} \cdot normal_{curve}$$

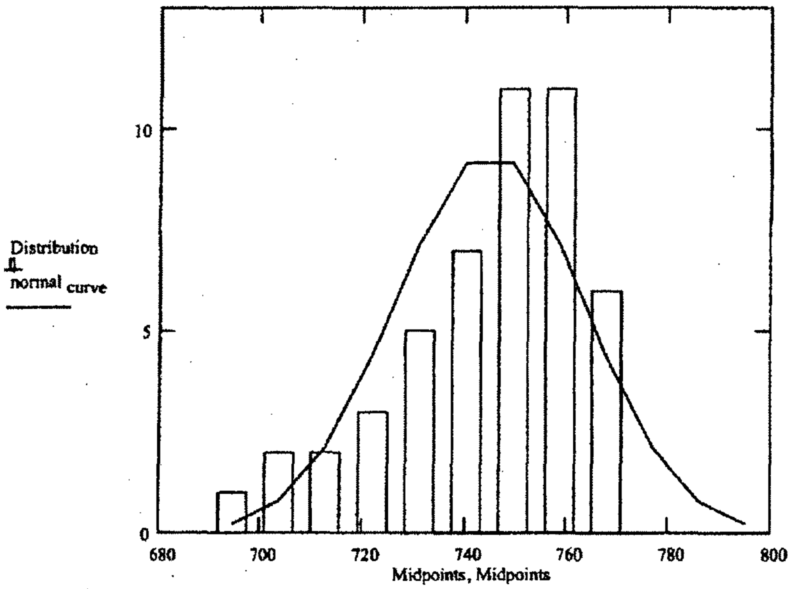
Bay 15 Area 23

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 PS 5/11/05	187	A4-4 of 32

Results For Elevation 51' 10" Bay 15, Area 23

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values.

Data Distribution



$\mu_{actual} = 744.854$

$\sigma_{actual} = 18.313$

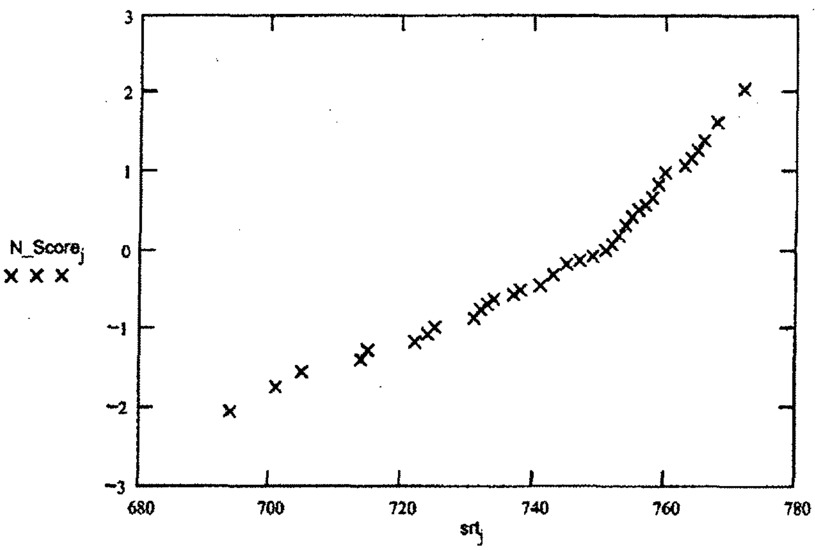
$\text{Standard}_{error} = 2.643$

Skewness = −0.99

Kurtosis = 0.542

$\text{Lower}_{95\%Con} = 739.54$ $\text{Upper}_{95\%Con} = 750.169$

Normal Probability Plot



Past calculations (ref 3.22) have split this grid into two separate groups and performed analysis on both groups. In order to be consistent with past calculations this data will be split in two groups and analyzed. The entire data set will also be evaluated.

Bay 15 Area 23

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1	187	A4- 5 of 32

17 5/14/05

$Split := 744.$ This value will results in a thinner sub set of points to which is consistent with previous calculations (ref. 3.22)

The two groups are named as follows:

$low_{points} := lessmean(Cells, No_{DataCells}, Split)$ $high_{points} := Moremean(Cells, No_{DataCells}, Split)$

Mean and Standard Deviation

$\mu low_{actual} := mean(low_{points})$ $\sigma low_{actual} := Stdev(low_{points})$

$\mu high_{actual} := mean(high_{points})$ $\sigma high_{actual} := Stdev(high_{points})$

Standard Error

$$Standardlow_{error} := \frac{\sigma low_{actual}}{\sqrt{length(low_{points})}} \qquad Standardhigh_{error} := \frac{\sigma high_{actual}}{\sqrt{length(high_{points})}}$$

Skewness

$Nolow_{DataCells} := length(low_{points})$

$$Skewness_{low} := \frac{(Nolow_{DataCells}) \cdot \sum \overrightarrow{(low_{points} - \mu low_{actual})^3}}{(Nolow_{DataCells} - 1) \cdot (Nolow_{DataCells} - 2) \cdot (\sigma low_{actual})^3}$$

$Nohigh_{DataCells} := length(high_{points})$

$$Skewness_{high} := \frac{(Nohigh_{DataCells}) \cdot \sum \overrightarrow{(high_{points} - \mu high_{actual})^3}}{(Nohigh_{DataCells} - 1) \cdot (Nohigh_{DataCells} - 2) \cdot (\sigma high_{actual})^3}$$

5/16/05

Kurtosis

$$Kurtosis_{low} := \frac{Nolow_{DataCells} \cdot (Nolow_{DataCells} + 1) \cdot \overrightarrow{\Sigma (low_{points} - \mu low_{actual})^4}}{(Nolow_{DataCells} - 1) \cdot (Nolow_{DataCells} - 2) \cdot (Nolow_{DataCells} - 3) \cdot (\sigma low_{actual})^4} \ldots + -\frac{3 \cdot (Nolow_{DataCells} - 1)^2}{(Nolow_{DataCells} - 2) \cdot (Nolow_{DataCells} - 3)}$$

$$Kurtosis_{high} := \frac{Nohigh_{DataCells} \cdot (Nohigh_{DataCells} + 1) \cdot \overrightarrow{\Sigma (high_{points} - \mu high_{actual})^4}}{(Nohigh_{DataCells} - 1) \cdot (Nohigh_{DataCells} - 2) \cdot (Nohigh_{DataCells} - 3) \cdot (\sigma high_{actual})^4} \ldots + -\frac{3 \cdot (Nohigh_{DataCells} - 1)^2}{(Nohigh_{DataCells} - 2) \cdot (Nohigh_{DataCells} - 3)}$$

Normal Probability Plot - Low points

$l := 0 .. last(low_{points}) \quad srt_{low} := sort(low_{points})$

$L_l := l + 1$

$$rank_{low_l} := \frac{\overrightarrow{\Sigma \left(\overrightarrow{srt_{low} = srt_{low_l}}\right) \cdot L}}{\Sigma \overrightarrow{srt_{low} = srt_{low_l}}} \qquad p_{low_l} := \frac{rank_{low_l}}{rows(low_{points}) + 1}$$

$x := 1 \qquad N\_Score_{low_l} := root\left[cnorm(x) - (p_{low_l}), x\right]$

Normal Probability Plot - High points

$h := 0 .. last(high_{points}) \qquad srt_{high} := sort(high_{points})$

$H_h := h + 1$

$$rank_{high_h} := \frac{\overrightarrow{\Sigma \left(\overrightarrow{srt_{high} = srt_{high_h}}\right) \cdot H}}{\Sigma \overrightarrow{srt_{high} = srt_{high_h}}} \qquad p_{high_h} := \frac{rank_{high_h}}{rows(high_{points}) + 1}$$

$x := 1 \qquad N\_Score_{high_h} := root\left[cnorm(x) - (p_{high_h}), x\right]$

Upper and Lower Confidence Values

$\alpha := .05 \qquad T\alpha := qt\left[\left(1-\frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$

$$Lowerhigh_{95\%Con} := \mu high_{actual} - T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Upperhigh_{95\%Con} := \mu high_{actual} + T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Lowerlow_{95\%Con} := \mu low_{actual} - T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

$$Upperlow_{95\%Con} := \mu low_{actual} + T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

Graphical Representation of Low Points

$Bins_{low} := Make_{bins}\left(\mu low_{actual}, \sigma low_{actual}\right)$

$Distribution_{low} := hist\left(Bins_{low}, low_{points}\right)$

The mid points of the Bins are calculated

$k := 0..11 \qquad Midpoints_{low_k} := \frac{\left(Bins_{low_k} + Bins_{low_{k+1}}\right)}{2}$

$Distribution_{low} =$

0
1
2
0
2
3
5
3
4
0
0
0

$$normallow_{curve_0} := pnorm\left(Bins_{low_1}, \mu low_{actual}, \sigma low_{actual}\right)$$

$$normallow_{curve_k} := pnorm\left(Bins_{low_{k+1}}, \mu low_{actual}, \sigma low_{actual}\right) - pnorm\left(Bins_{low_k}, \mu low_{actual}, \sigma low_{actual}\right)$$

$$normallow_{curve} := Nolow_{DataCells} \cdot normallow_{curve}$$

5/15/05

Graphical Representation of High Points

$$Bins_{high} := Make_{bins}\left(\mu high_{actual}, \sigma high_{actual}\right)$$

$$Distribution_{high} := hist\left(Bins_{high}, high_{points}\right)$$

$$Distribution_{high} = \begin{pmatrix} 0 \\ 0 \\ 2 \\ 1 \\ 6 \\ 6 \\ 6 \\ 1 \\ 3 \\ 2 \\ 1 \\ 0 \end{pmatrix}$$

$$k := 0..11 \qquad Midpoints_{high_k} := \frac{\left(Bins_{high_k} + Bins_{high_{k+1}}\right)}{2}$$

$$normalhigh_{curve_0} := pnorm\left(Bins_{high_1}, \mu high_{actual}, \sigma high_{actual}\right)$$

$$normalhigh_{curve_k} := pnorm\left(Bins_{high_{k+1}}, \mu high_{actual}, \sigma high_{actual}\right) - pnorm\left(Bins_{high_k}, \mu high_{actual}, \sigma high_{act}$$

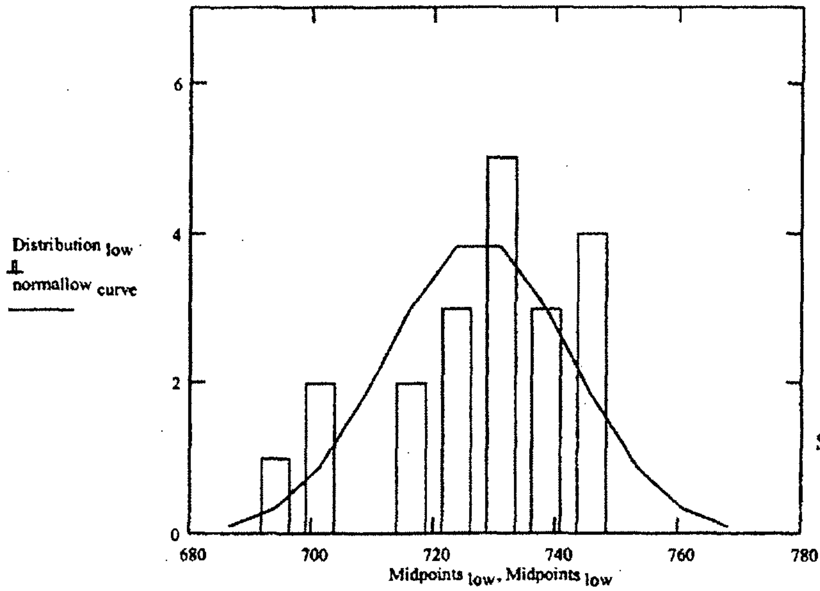
$$normalhigh_{curve} := Nohigh_{DataCells} \cdot normalhigh_{curve}$$

Bay 15 Area 23
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2	187	A4- 9 of 32

PS 5/15/05

Results For Elevation 51' 10" Bay 15, Area 23 Thinner Points



$\mu low_{actual} = 727.45$

$\sigma low_{actual} = 14.831$

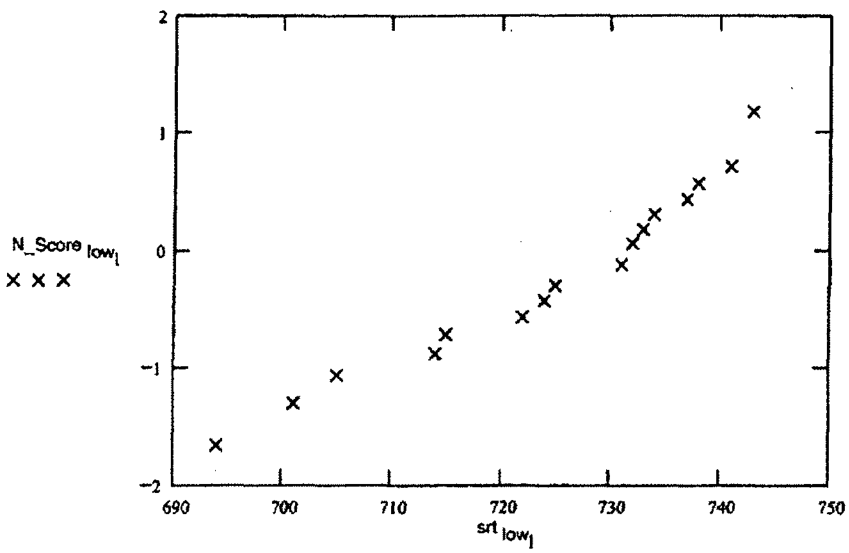
$Kurtosis_{low} = -0.037$

$Skewness_{low} = -0.925$

$Standardlow_{error} = 3.316$

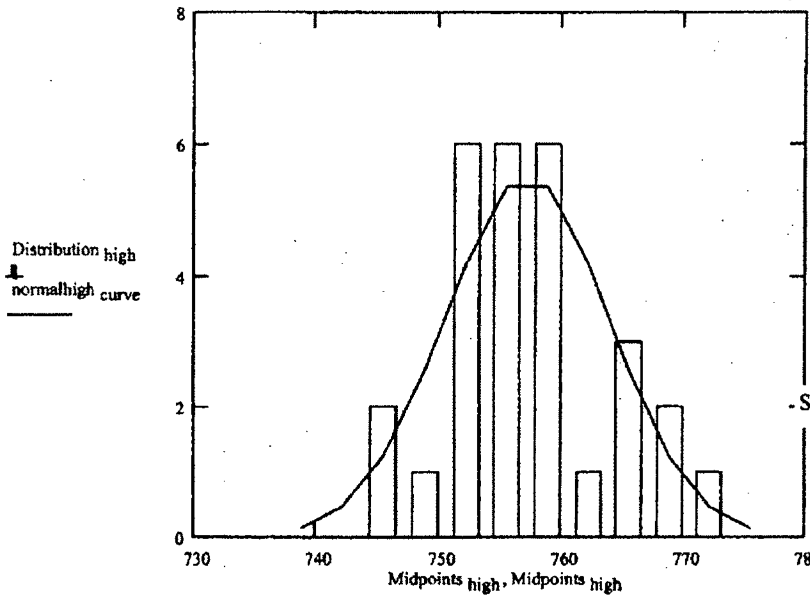
$Nolow_{DataCells} = 20$

$Lowerlow_{95\%Con} = 720.782$ $Upperlow_{95\%Con} = 734.118$



The above plots indicates that the thinner points are normally distributed.

Results For Elevation 51' 10" Bay 15, Area 23 Thicker Points



$\mu high_{actual} = 757.286$

$\sigma high_{actual} = 6.66$

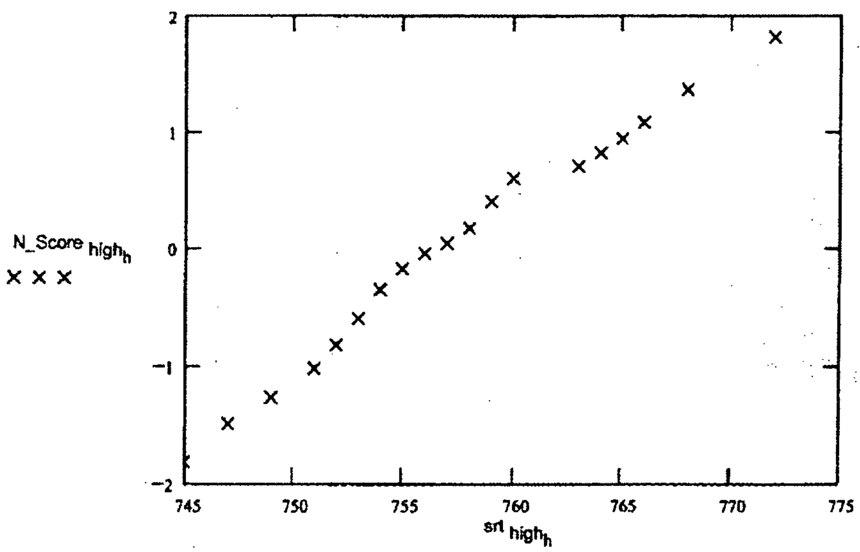
$Skewness_{high} = 0.378$

$Kurtosis_{high} = -0.317$

$Standardhigh_{error} = 1.259$

$Nohigh_{DataCells} = 28$

$Lower_{95\%Con} = 739.54$ $Upper_{95\%Con} = 750.169$



The above plots indicates that the thicker points are normally distributed.

Bay 15 Area 23

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A4- 11 of 32

05 5/11/05

Elevation 51' 10" Bay 15, Area 23 Trend

Data from March. 1990 to Sept. 2000 is retrieved. $d := 0$

For March 31 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D5123_March90.txt")

$Points_{49} := showcells(page, 7, 0)$ $\quad Dates_d := Day_{year}(3, 31, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.728 & 0.753 & 0.764 & 0.763 & 0.755 & 0.776 & 0.762 \\ 0.764 & 0.76 & 0.751 & 0.764 & 0.741 & 0.722 & 0.751 \\ 0.755 & 0.758 & 0.721 & 0.748 & 0.737 & 0.754 & 0.761 \\ 0.765 & 0.756 & 0.76 & 0.757 & 0.643 & 0.756 & 0.775 \\ 0.757 & 0.73 & 0.763 & 0.749 & 0.708 & 0.75 & 0.753 \\ 0.758 & 0.762 & 0.736 & 0.742 & 0.719 & 0.731 & 0.762 \\ 0.758 & 0.762 & 0.747 & 0.755 & 0.695 & 0.729 & 0.752 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

The following points are pits and are omitted from the calcaution of the mean. These pits will be trended separately.

Point 26 is a pit and will be trended separately

$Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\quad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

$d := d + 1$

For April 26 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\April 1990 Data\DATA ONLY\D5123_April90.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(4, 26, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.739 & 0.757 & 0.79 & 0.776 & 0.763 & 0.755 & 0.768 \\ 0.769 & 0.764 & 0.766 & 0.779 & 0.753 & 0.731 & 0.756 \\ 0.758 & 0.764 & 0.728 & 0.753 & 0.74 & 0.759 & 0.765 \\ 0.771 & 0.761 & 0.765 & 0.763 & 0.652 & 0.763 & 0.763 \\ 0.763 & 0.734 & 0.765 & 0.753 & 0.713 & 0.75 & 0.763 \\ 0.778 & 0.77 & 0.75 & 0.775 & 0.724 & 0.747 & 0.773 \\ 0.772 & 0.773 & 0.754 & 0.759 & 0.706 & 0.733 & 0.769 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

Point 26 is a pit and will be trended separately

$Pit26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Feb 23, 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D5123_F91.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d :=$ Day$_{year}$(2 , 23 , 1991)

Data

$$Points_{49} = \begin{bmatrix} 0.733 & 0.755 & 0.768 & 0.765 & 0.759 & 0.758 & 0.769 \\ 0.769 & 0.766 & 0.767 & 0.768 & 0.754 & 0.726 & 0.763 \\ 0.764 & 0.761 & 0.734 & 0.753 & 0.747 & 0.757 & 0.763 \\ 0.783 & 0.771 & 0.765 & 0.761 & 0.645 & 0.76 & 0.755 \\ 0.79 & 0.73 & 0.767 & 0.752 & 0.727 & 0.754 & 0.757 \\ 0.76 & 0.767 & 0.751 & 0.757 & 0.717 & 0.733 & 0.76 \\ 0.767 & 0.766 & 0.749 & 0.764 & 0.701 & 0.733 & 0.76 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

Point 26 is a pit and will be trended separately

$Pit26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Bay 15 Area 23

Subject:

Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	X 2	187	A4- 14 of 32

AT 8/15/05

For May 23 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D5123_M91.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.735 & 0.758 & 0.769 & 0.766 & 0.767 & 0.757 & 0.767 \\ 0.771 & 0.766 & 0.757 & 0.771 & 0.747 & 0.727 & 0.757 \\ 0.758 & 0.766 & 0.729 & 0.754 & 0.74 & 0.76 & 0.766 \\ 0.772 & 0.761 & 0.766 & 0.762 & 0.648 & 0.762 & 0.762 \\ 0.763 & 0.737 & 0.767 & 0.752 & 0.714 & 0.754 & 0.759 \\ 0.764 & 0.768 & 0.74 & 0.75 & 0.724 & 0.738 & 0.768 \\ 0.764 & 0.766 & 0.754 & 0.763 & 0.705 & 0.746 & 0.759 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

Point 26 is a pit and will be trended separately

$Pit\,26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Nov. 2 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov. 1991 Data\DATA ONLY\D5123_N91.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$

$\text{Dates}_d := \text{Day}_{\text{year}}(11, 2, 1991)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.736 & 0.757 & 0.769 & 0.768 & 0.766 & 0.763 & 0.768 \\ 0.772 & 0.769 & 0.763 & 0.771 & 0.759 & 0.73 & 0.759 \\ 0.762 & 0.768 & 0.728 & 0.756 & 0.748 & 0.757 & 0.767 \\ 0.78 & 0.767 & 0.771 & 0.769 & 0.65 & 0.638 & 0.772 \\ 0.766 & 0.747 & 0.77 & 0.757 & 0.726 & 0.773 & 0.777 \\ 0.765 & 0.771 & 0.748 & 0.771 & 0.722 & 0.745 & 0.778 \\ 0.773 & 0.771 & 0.755 & 0.764 & 0.702 & 0.731 & 0.764 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

Point 26 wase ommitted from all data and for Nov. 91 point 27 was deleted

$\text{Pit}_{26_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 26)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 26)$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 27)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$ $\text{No}_{\text{Cells}} := \text{length}(\text{Cells})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

$\text{high}_{\text{points}} := \text{Moremean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$ $\text{low}_{\text{points}} := \text{lessmean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$

$\mu\text{high}_{\text{measured}_d} := \text{mean}(\text{high}_{\text{points}})$ $\mu\text{low}_{\text{measured}_d} := \text{mean}(\text{low}_{\text{points}})$

$\sigma\text{high}_{\text{measured}_d} := \text{Stdev}(\text{high}_{\text{points}})$ $\sigma\text{low}_{\text{measured}_d} := \text{Stdev}(\text{low}_{\text{points}})$

$\text{Standardhigh}_{\text{error}_d} := \dfrac{\sigma\text{high}_{\text{measured}_d}}{\sqrt{\text{length}(\text{high}_{\text{points}})}}$ $\text{Standardlow}_{\text{error}_d} := \dfrac{\sigma\text{low}_{\text{measured}_d}}{\sqrt{\text{length}(\text{low}_{\text{points}})}}$

For May. 30 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D5123_M92.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(5, 30, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.757 & 0.765 & 0.776 & 0.774 & 0.771 & 0.764 & 0.775 \\ 0.778 & 0.773 & 0.765 & 0.778 & 0.755 & 0.736 & 0.767 \\ 0.767 & 0.775 & 0.734 & 0.763 & 0.752 & 0.767 & 0.775 \\ 0.778 & 0.768 & 0.77 & 0.767 & 0.656 & 0.77 & 0.769 \\ 0.776 & 0.738 & 0.776 & 0.756 & 0.712 & 0.755 & 0.768 \\ 0.767 & 0.772 & 0.745 & 0.756 & 0.727 & 0.746 & 0.77 \\ 0.77 & 0.774 & 0.764 & 0.763 & 0.706 & 0.752 & 0.771 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

Point 26 wase ommitted from all data

$Pit\ 26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$$

AmerGen	Calculation Sheet			Appendix 4
Bay 15 Area 23				
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A4- 17 of 32

P1 5/15/05

For Dec. 5 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D5123_D92.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.735 & 0.758 & 0.769 & 0.767 & 0.768 & 0.765 & 0.774 \\ 0.771 & 0.767 & 0.756 & 0.771 & 0.746 & 0.728 & 0.76 \\ 0.76 & 0.771 & 0.731 & 0.758 & 0.748 & 0.754 & 0.772 \\ 0.772 & 0.763 & 0.762 & 0.762 & 0.65 & 0.763 & 0.763 \\ 0.765 & 0.738 & 0.769 & 0.755 & 0.705 & 0.772 & 0.765 \\ 0.767 & 0.77 & 0.745 & 0.775 & 0.73 & 0.745 & 0.769 \\ 0.767 & 0.771 & 0.756 & 0.763 & 0.704 & 0.757 & 0.769 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7) \qquad No_{DataCells} := length(nnn)$

Point 26 wase ommitted from all data

$Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26) \quad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells}) \qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells) \qquad \sigma_{measured_d} := Stdev(Cells) \qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split) \qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points}) \qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points}) \qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

PT 5/15

For Sept. 14 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D5123_94.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(9, 14, 1994)$

Data

$$Points_{49} = \begin{bmatrix} 0.732 & 0.753 & 0.764 & 0.762 & 0.763 & 0.757 & 0.766 \\ 0.767 & 0.761 & 0.749 & 0.767 & 0.74 & 0.723 & 0.752 \\ 0.756 & 0.765 & 0.725 & 0.752 & 0.74 & 0.756 & 0.749 \\ 0.767 & 0.757 & 0.761 & 0.758 & 0.645 & 0.759 & 0.758 \\ 0.764 & 0.735 & 0.765 & 0.75 & 0.705 & 0.748 & 0.756 \\ 0.764 & 0.762 & 0.741 & 0.748 & 0.724 & 0.742 & 0.764 \\ 0.76 & 0.76 & 0.753 & 0.759 & 0.7 & 0.748 & 0.754 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

Point 26 wase ommitted from all data

$Pit26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Bay 15 Area 23
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	0	187	A4- 19 of 32

05 5/11/05

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D5123_96.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.729 & 0.753 & 0.762 & 0.761 & 0.754 & 0.754 & 0.766 \\ 0.765 & 0.762 & 0.758 & 0.77 & 0.745 & 0.725 & 0.753 \\ 0.756 & 0.763 & 0.722 & 0.752 & 0.738 & 0.752 & 0.745 \\ 0.766 & 0.759 & 0.783 & 0.761 & 0.638 & 0.758 & 0.769 \\ 0.771 & 0.735 & 0.779 & 0.753 & 0.709 & 0.754 & 0.752 \\ 0.761 & 0.765 & 0.735 & 0.744 & 0.719 & 0.754 & 0.768 \\ 0.759 & 0.766 & 0.748 & 0.76 & 0.685 & 0.725 & 0.763 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

Point 26 wase ommitted from all data

$Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $\quad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad$ $\sigma low_{measured_d} := Stdev(low_{points})$

$$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$$

5/15/05

For Sept. 16 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D5123_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 16, 2000)$

Data

$Points_{49} =$

0.735	0.746	0.758	0.757	0.761	0.753	0.761
0.768	0.756	0.757	0.763	0.738	0.72	0.744
0.74	0.76	0.726	0.747	0.744	0.739	0.74
0.77	0.757	0.76	0.753	0.634	0.757	0.761
0.754	0.736	0.769	0.753	0.695	0.75	0.749
0.763	0.764	0.734	0.749	0.719	0.717	0.769
0.756	0.759	0.753	0.758	0.704	0.739	0.759

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

Point 26 wase ommitted from all data

$Pit26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

01 5/15/05

For Nov. 9 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5123_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(11, 9, 2004)$

Data

$Points_{49} =$

0.731	0.737	0.747	0.754	0.759	0.757	0.759
0.765	0.745	0.755	0.758	0.734	0.714	0.741
0.743	0.756	0.722	0.743	0.738	0.725	0.758
0.768	0.755	0.753	0.749	0.632	0.751	0.754
0.753	0.731	0.768	0.751	0.705	0.743	0.743
0.759	0.764	0.724	0.772	0.715	0.701	0.763
0.752	0.766	0.733	0.753	0.694	0.732	0.76

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

Point 26 wase ommitted from all data

$Pit\,26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Below are the results

Dates =

$1.99 \cdot 10^3$
$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$
$2.001 \cdot 10^3$
$2.005 \cdot 10^3$

$\mu_{measured}$ =

749.479
757.146
755.333
754.75
758.957
761.521
757.729
751.271
751.792
748.333
744.854

$\sigma_{measured}$ =

16.884
17.223
16.721
15.504
16.833
16.561
16.52
15.423
18.487
16.662
18.313

$Standard_{error}$ =

2.412
2.46
2.389
2.215
2.405
2.366
2.36
2.203
2.641
2.38
2.616

$\mu high_{measured}$ =

758.171
763.974
762.103
761.553
764.9
766.667
763.415
758.216
760
757.813
757.286

$\sigma high_{measured}$ =

6.649
9.155
8.391
6.583
8.503
8.68
8.003
6.033
8.41
6.291
6.66

$Standardhigh_{error}$ =

1.124
1.466
1.344
1.068
1.344
1.339
1.25
0.992
1.383
1.112
1.259

$$\mu low_{measured} = \begin{pmatrix} 726.077 \\ 727.556 \\ 726 \\ 728.9 \\ 725 \\ 725.5 \\ 724.429 \\ 727.909 \\ 724.182 \\ 729.375 \\ 727.45 \end{pmatrix} \quad \sigma low_{measured} = \begin{pmatrix} 13.326 \\ 11.501 \\ 10.805 \\ 11.799 \\ 11.03 \\ 13.442 \\ 14.01 \\ 14.425 \\ 16.247 \\ 14.596 \\ 14.831 \end{pmatrix} \quad Standardlow_{error} = \begin{pmatrix} 3.696 \\ 3.834 \\ 3.602 \\ 3.731 \\ 4.169 \\ 5.488 \\ 5.295 \\ 4.349 \\ 4.899 \\ 3.649 \\ 3.316 \end{pmatrix}$$

$$Total_{means} := rows(\mu_{measured}) \qquad Total_{means} = 11$$

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2$$

$$SSE_{low} := \sum_{i=0}^{last(Dates)} \left(\mu low_{measured_i} - yhat(Dates, \mu low_{measured})_i\right)^2$$

$$SSE_{high} := \sum_{i=0}^{last(Dates)} \left(\mu high_{measured_i} - yhat(Dates, \mu high_{measured})_i\right)^2$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2$$

$$SSR_{low} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu low_{measured})_i - mean(\mu low_{measured})\right)^2$$

$$SSR_{high} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu high_{measured})_i - mean(\mu high_{measured})\right)^2$$

$DegreeFree_{ss} := Total_{means} - 2$ $DegreeFree_{reg} := 1$

$MSE := \frac{SSE}{DegreeFree_{ss}}$ $MSE_{low} := \frac{SSE_{low}}{DegreeFree_{ss}}$ $MSE_{high} := \frac{SSE_{high}}{DegreeFree_{ss}}$

$Standard_{error} := \sqrt{MSE}$ $Standard_{lowerror} := \sqrt{MSE_{low}}$ $Standard_{higherror} := \sqrt{MSE_{high}}$

$MSR := \frac{SSR}{DegreeFree_{reg}}$ $MSR_{low} := \frac{SSR_{low}}{DegreeFree_{reg}}$ $MSR_{high} := \frac{SSR_{high}}{DegreeFree_{reg}}$

$F_{actaul} := \frac{MSR}{MSE}$ $F\_low_{actaul} := \frac{MSR_{low}}{MSE_{low}}$ $F\_high_{actaul} := \frac{MSR_{high}}{MSE_{high}}$

For 95% confidence level the F Critical is calculated as follows

$\alpha := 0.05$ $F_{critical} := qF(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss})$ $F_{critical} = 5.117$

The "F" ratio for 95% confidence is calculated:

$F_{ratio} := \frac{F_{actaul}}{F_{critical}}$ $F\_low_{ratio} := \frac{F\_low_{actaul}}{F_{critical}}$ $F\_high_{ratio} := \frac{F\_high_{actaul}}{F_{critical}}$

$F_{ratio} = 1.92$ $F\_low_{ratio} = 0.16$ $F\_high_{ratio} = 1.046$

Since the "F" ratios for the overall mean and the mean of thinner points are greater than one. Therefore the regression model is appropriate.

5/15/05

The following will plot the results for the overall mean, the mean of thicker points, and the mean of thicker points.

$i := 0 .. Total_{means} - 1$

$\mu grand_{measured_i} := mean(\mu_{measured})$ $\sigma grand_{measured} := Stdev(\mu_{measured})$

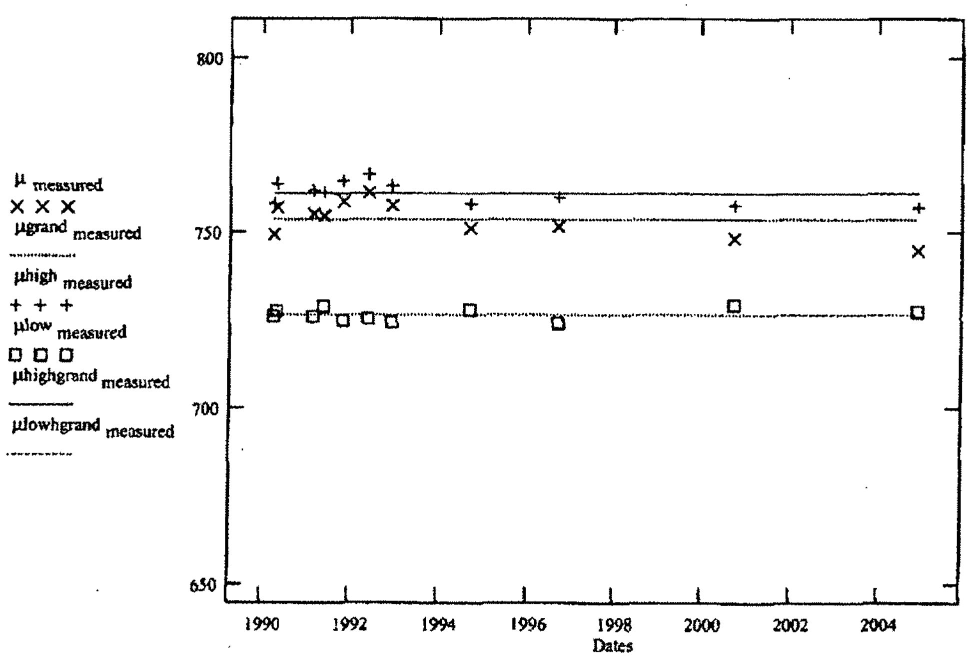
$$GrandStandard_{error} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$$

$\sigma grand_{lowmeasured} := Stdev(\mu low_{measured})$ $\mu lowhgrand_{measured_i} := mean(\mu low_{measured})$

$$GrandStandard_{lowerror} := \frac{\sigma grand_{lowmeasured}}{\sqrt{Total_{means}}}$$

$\sigma grand_{highmeasured} := Stdev(\mu high_{measured})$ $\mu highgrand_{measured_i} := mean(\mu high_{measured})$

$$GrandStandard_{higherror} := \frac{\sigma grand_{highmeasured}}{\sqrt{Total_{means}}}$$



$\mu grand_{measured_0} = 753.742$ $GrandStandard_{error} = 1.523$

$mean(\mu low_{measured}) = 726.58$ $GrandStandard_{lowerror} = 0.533$

$mean(\mu high_{measured}) = 761.282$ $GrandStandard_{higherror} = 0.969$

The F Test indicates that the Regression model does holds for overall mean and the mean of thicker points. However, the slopes and 95% Confidence curves are generated for all three cases.

$m_s := \text{slope}(\text{Dates}, \mu_{\text{measured}})$ $\quad$ $y_b := \text{intercept}(\text{Dates}, \mu_{\text{measured}})$

$m_{\text{lows}} := \text{slope}(\text{Dates}, \mu\text{low}_{\text{measured}})$ $\quad$ $y_{\text{lowb}} := \text{intercept}(\text{Dates}, \mu\text{low}_{\text{measured}})$

$m_{\text{highs}} := \text{slope}(\text{Dates}, \mu\text{high}_{\text{measured}})$ $\quad$ $y_{\text{highb}} := \text{intercept}(\text{Dates}, \mu\text{high}_{\text{measured}})$

$\alpha_t := 0.05 \qquad k := 23 \qquad f := 0..k-1$

$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2$

$\text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$

$\text{Thick}_{\text{lowpredict}} := m_{\text{lows}} \cdot \text{year}_{\text{predict}} + y_{\text{lowb}}$

$\text{Thick}_{\text{highpredict}} := m_{\text{highs}} \cdot \text{year}_{\text{predict}} + y_{\text{highb}}$

$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates})$

$\text{sum} := \sum_i (\text{Dates}_d - \text{mean}(\text{Dates}))^2$

5/15/05

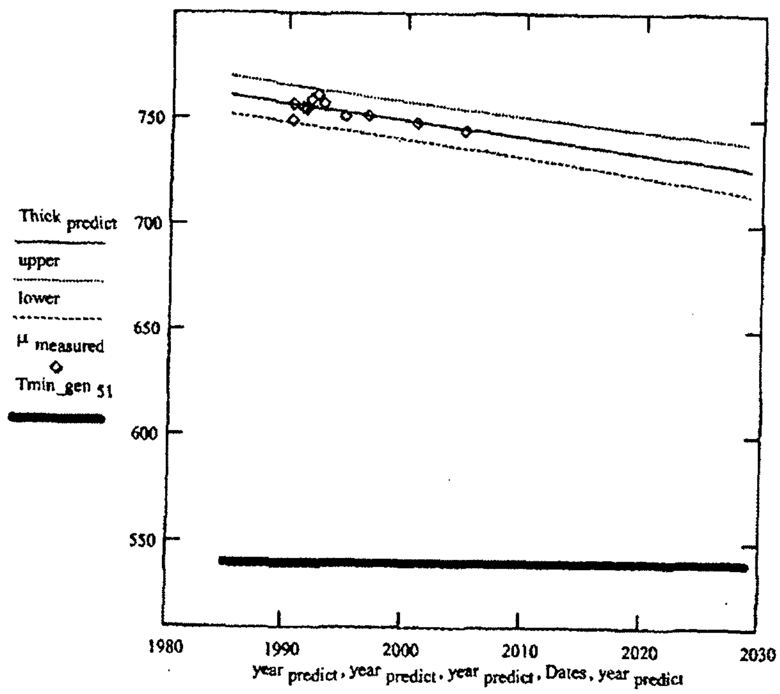
For the overall mean

$$upper_f := Thick_{predict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{predict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right]$$

General area Tmin for this elevation in the Drywell

$Tmin\_gen_{51_f} := 541$ (Ref. Calc. SE-000243-002)



$m_s = -0.777$

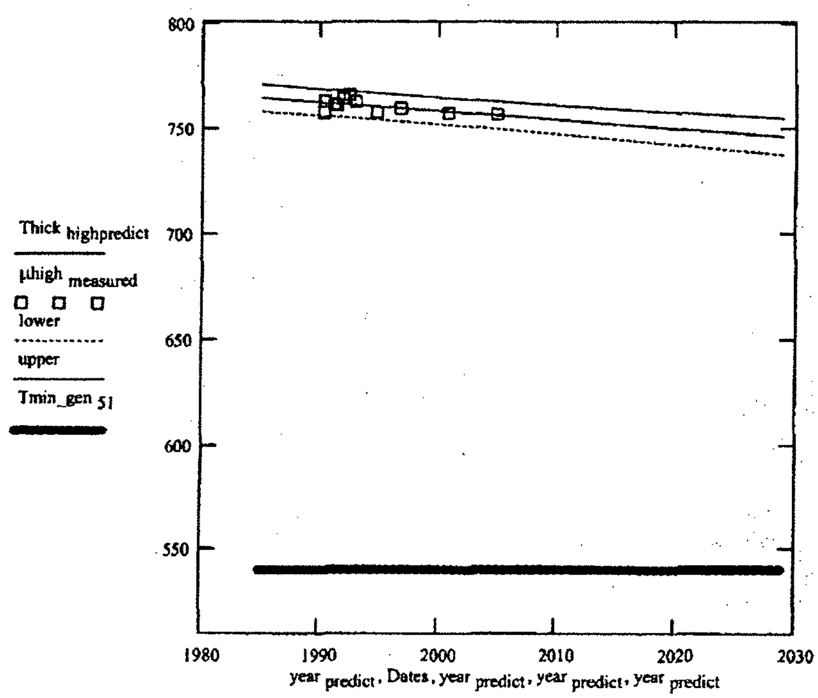
$lower_{22} = 714.795$ $year_{predict_{22}} = 2.029 \cdot 10^3$

5/15/05

For the thicker points

$$upper_f := Thick_{highpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualme}\right.}{sum}}$$

$$lower_f := Thick_{highpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualn}\right.}{sum}}\right.$$



$m_{highs} = -0.418$

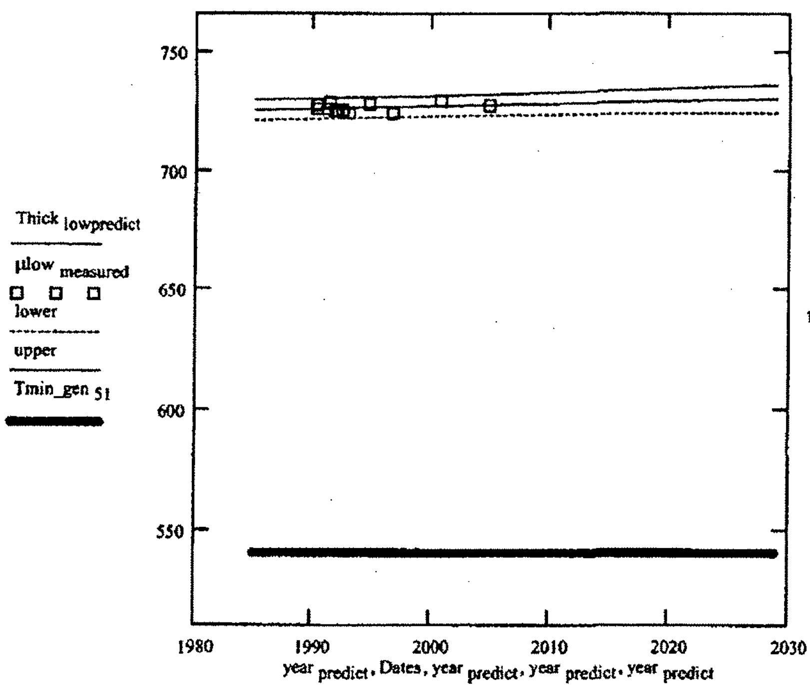
$lower_{22} = 738.036$ $\quad year_{predict_{22}} = 2.029 \cdot 10^3$

5/15/05

For the thinner points

$$upper_f := Thick_{lowpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualm}\right.}{sum}}$$

$$lower_f := Thick_{lowpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actuah}\right.}{sum}}\right.$$



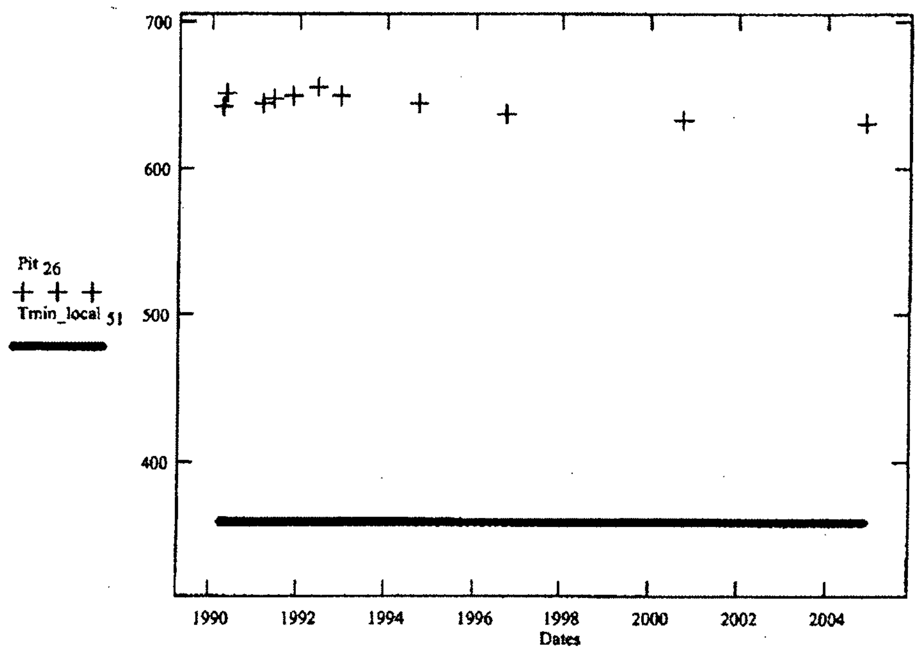
$m_{lows} = 0.109$

The following trends are shown for pit 26

Local Tmin for this elevation in the Drywell $Tmin\_local_{51_f} := 360$ (Ref. Calc. SE-000243-002)

$A_i := \max\left(Pit_{26}\right)$ $B_i := \min\left(Pit_{26}\right)$

Pit 26 Trend



rr 5/15/05

The F-Ratio is calculated for the worse pit (#26) $\text{Pit}_{worse} := \text{Pit}_{26}$

$$SSE_{pit} := \sum_{i=0}^{last(Dates)} \left(\text{Pit}_{worse_i} - yhat\left(Dates, \text{Pit}_{worse}\right)_i\right)^2 \qquad SSE_{pit} = 182.671$$

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat\left(Dates, \text{Pit}_{worse}\right)_i - mean\left(\text{Pit}_{worse}\right)\right)^2 \qquad SSR_{pit} = 388.965$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 3.745$$

Therefore pit 26 may be corroding.

$$m_{pit} := slope\left(Dates, \text{Pit}_{worse}\right) \quad m_{pit} = -1.328 \quad y_{pit} := intercept\left(Dates, \text{Pit}_{worse}\right) \quad y_{pit} = 3.293 \cdot 10^3$$

The 95% Confidence curves are calculated

$$\text{Pit}_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$$

$$\text{Pit}_{actualmean} := mean(Dates) \qquad sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$$

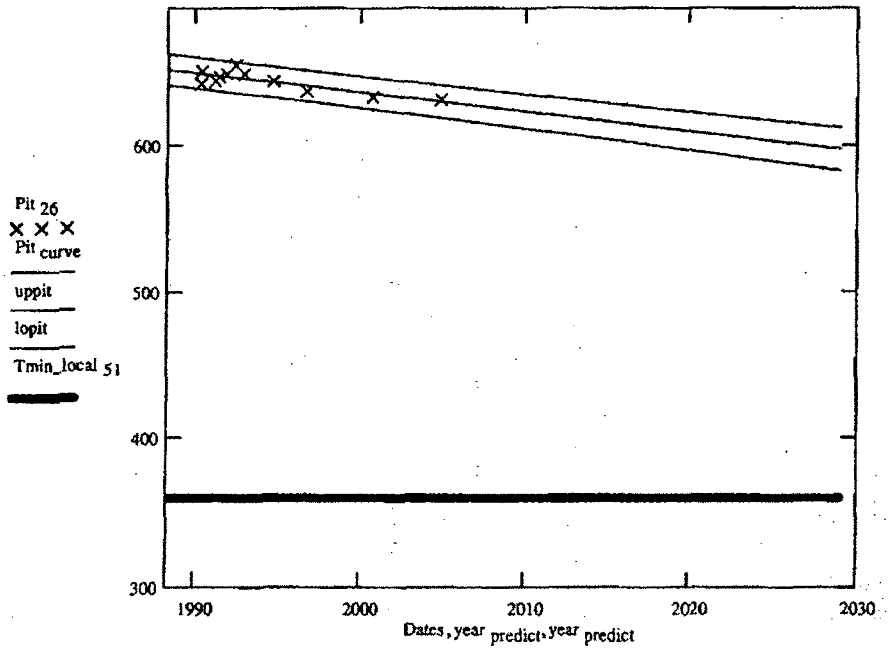
$$uppit_f := Pit_{curve_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

$$lopit_f := Pit_{curve_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}\right]$$

Local Tmin for this elevation in the Drywell $Tmin\_local_{50_f} := 360$ (Ref. SE-000243-002)

$\max(uppit) + 25 = 693.143$ $\min(Tmin\_local_{51}) - 25 = 335$

Curve Fit For Pit 26 Projected to Plant End Of Life



$m_{pit} = -1.328$

Therefore based on regression model the above curve shows that this pit will not corrode to below minimum required thickness by the plant end of life or life extension.

$minpoint = 0.632$ $year_{predict_{22}} = 2.029 \cdot 10^3$ $Tmin\_local_{51_{22}} = 360$

$$required_{rate.} := \frac{\left(1000 \cdot minpoint - Tmin\_local_{51_{22}}\right)}{\left(2005 - year_{predict}\right)_{22}}$$

$1000 \cdot minpoint - Tmin\_local_{51_{22}} = 272$

$required_{rate.} = -11.333$

Bay 13 Area 32

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1 2	187	A5 -1 of 31

5/15/5

Appendix 5 - Elevation 51' 10" Bay 13, Area 32

Nov. 9 2004 Data

The data shown below was collected on 11/9/2004 (reference NDE data sheet 2000-034-006).

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5232_00.txt")

$$Points_{49} := showcells(page, 7, 0)$$

$$Points_{49} = \begin{bmatrix} 0.709 & 0.707 & 0.714 & 0.712 & 0.697 & 0.684 & 0.706 \\ 0.71 & 0.71 & 0.715 & 0.697 & 0.715 & 0.672 & 0.703 \\ 0.714 & 0.687 & 0.711 & 0.681 & 0.708 & 0.621 & 0.67 \\ 0.717 & 0.646 & 0.713 & 0.621 & 0.713 & 0.711 & 0.562 \\ 0.716 & 0.694 & 0.717 & 0.714 & 0.715 & 0.714 & 0.674 \\ 0.708 & 0.707 & 0.718 & 0.719 & 0.716 & 0.717 & 0.706 \\ 0.716 & 0.7 & 0.717 & 0.718 & 0.717 & 0.716 & 0.71 \end{bmatrix}$$

$Cells := convert(Points_{49}, 7)$ $No_{DataCells} := length(Cells)$

For this location the following points are pits and are trended separately (Reference 3.22)

$Cells := Zero_{one}(Cells, No_{DataCells}, 20)$ $Cells := Zero_{one}(Cells, No_{DataCells}, 25)$

$Cells := Zero_{one}(Cells, No_{DataCells}, 23)$ $Cells := Zero_{one}(Cells, No_{DataCells}, 28)$

$Cells := deletezero_{cells}(Cells, No_{DataCells})$

$No_{DataCells} := length(Cells)$

The thinnest point at this location is shown below

$minpoint := min(Points_{49})$

$minpoint = 0.562$

5/19/5

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(Cells) \quad \mu_{actual} = 706.778 \qquad \sigma_{actual} := \text{Stdev}(Cells) \quad \sigma_{actual} = 13.04$

Standard Error

$$Standard_{error} := \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Standard_{error} = 1.944$$

Skewness

$$Skewness := \frac{(No_{DataCells}) \cdot \overrightarrow{\Sigma(Cells - \mu_{actual})^3}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (\sigma_{actual})^3} \qquad Skewness = -1.618$$

Kurtosis

$$Kurtosis := \frac{No_{DataCells} \cdot (No_{DataCells} + 1) \cdot \overrightarrow{\Sigma(Cells - \mu_{actual})^4}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (No_{DataCells} - 3) \cdot (\sigma_{actual})^4} + -\frac{3 \cdot (No_{DataCells} - 1)^2}{(No_{DataCells} - 2) \cdot (No_{DataCells} - 3)} \qquad Kurtosis = 1.761$$

Normal Probability Plot

$j := 0 .. \text{last}(Cells) \qquad srt := \text{sort}(Cells)$

$$r_j := j + 1 \qquad rank_j := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt = srt_j}\right) \cdot r}}{\Sigma \overrightarrow{srt = srt_j}}$$

$$p_j := \frac{rank_j}{\text{rows}(Cells) + 1}$$

$$x := 1 \qquad N\_Score_j := \text{root}\left[\text{cnorm}(x) - (p_j), x\right]$$

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$$\alpha := .05 \qquad T\alpha := qt\left[\left(1-\frac{\alpha}{2}\right),48\right] \qquad T\alpha = 2.011$$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha\cdot\frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 702.869$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha\cdot\frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 710.686$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$$Bins := Make_{bins}\left(\mu_{actual},\sigma_{actual}\right)$$

$$Distribution := hist(Bins, Cells)$$

The mid points of the Bins are calculated

$$k := 0..11 \qquad Midpoints_k := \frac{\left(Bins_k + Bins_{k+1}\right)}{2}$$

Distribution =

3
0
3
0
4
3
13
19
0
0
0
0

$$normal_{curve_0} := pnorm\left(Bins_1,\mu_{actual},\sigma_{actual}\right)$$

$$normal_{curve_k} := pnorm\left(Bins_{k+1},\mu_{actual},\sigma_{actual}\right) - pnorm\left(Bins_k,\mu_{actual},\sigma_{actual}\right)$$

$$normal_{curve} := No_{DataCells}\cdot normal_{curve}$$

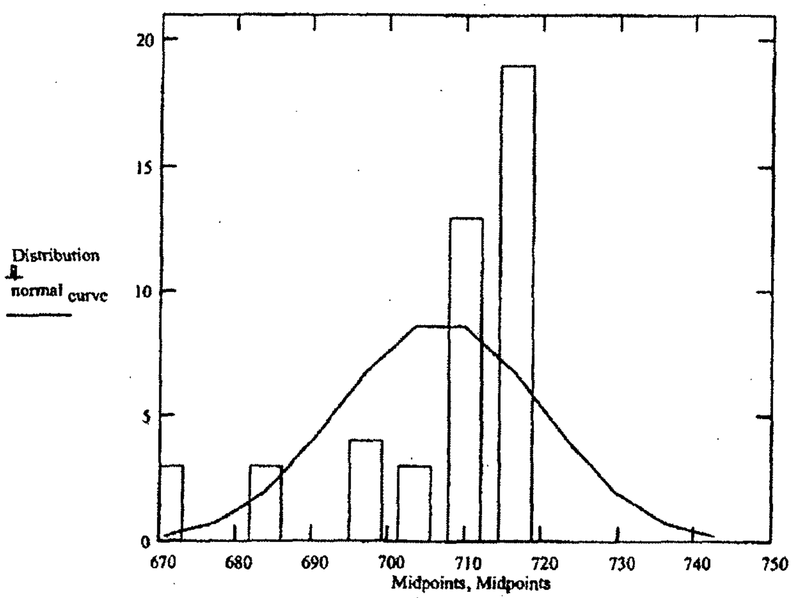
Bay 13 Area 32

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 PT 5/15/05	187	A5 -4 of 31

Results For Elevation 51' 10" Bay 13, Area 32

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values.

Data Distribution



μ_{actual} = 706.778

σ_{actual} = 13.04

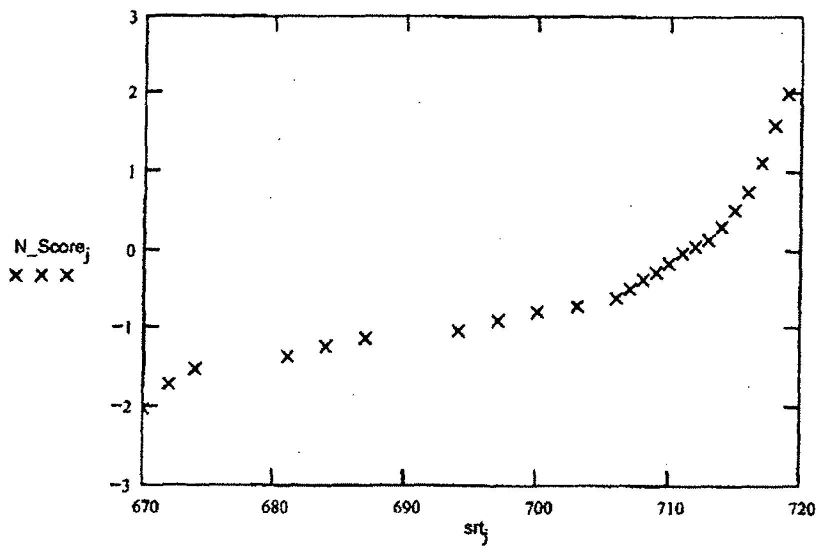
$Standard_{error}$ = 1.944

Skewness = −1.618

Kurtosis = 1.761

$Lower_{95\%Con}$ = 702.869 $Upper_{95\%Con}$ = 710.686

Normal Probability Plot



Past calculations (ref 3.22) have split this grid into two separate groups and performed analysis on both groups and performed analysis on both groups. In order to be consistent with past calculations this data will be split in two groups and analyzed. The entire data set will also be evaluated.

PT 5/18/05

$Split := 704$ This value will results in a thinner sub set of 13 points to which is consistent with previous calculations (ref. 3.22).

The two groups are named as follows:

$$low_{points} := lessmean(Cells, No_{DataCells}, Split) \qquad high_{points} := Moremean(Cells, No_{DataCells}, Split)$$

Mean and Standard Deviation

$$\mu low_{actual} := mean(low_{points}) \qquad \sigma low_{actual} := Stdev(low_{points})$$

$$\mu high_{actual} := mean(high_{points}) \qquad \sigma high_{actual} := Stdev(high_{points})$$

Standard Error

$$Standardlow_{error} := \frac{\sigma low_{actual}}{\sqrt{length(low_{points})}} \qquad Standardhigh_{error} := \frac{\sigma high_{actual}}{\sqrt{length(high_{points})}}$$

Skewness

$$Nolow_{DataCells} := length(low_{points})$$

$$Skewness_{low} := \frac{(Nolow_{DataCells}) \cdot \sum \overrightarrow{(low_{points} - \mu low_{actual})^3}}{(Nolow_{DataCells} - 1) \cdot (Nolow_{DataCells} - 2) \cdot (\sigma low_{actual})^3}$$

$$Nohigh_{DataCells} := length(high_{points})$$

$$Skewness_{high} := \frac{(Nohigh_{DataCells}) \cdot \sum \overrightarrow{(high_{points} - \mu high_{actual})^3}}{(Nohigh_{DataCells} - 1) \cdot (Nohigh_{DataCells} - 2) \cdot (\sigma high_{actual})^3}$$

5/19/5

Kurtosis

$$Kurtosis_{low} := \frac{Nolow_{DataCells}\cdot(Nolow_{DataCells}+1)\cdot\sum\overrightarrow{(low_{points}-\mu low_{actual})^4}}{(Nolow_{DataCells}-1)\cdot(Nolow_{DataCells}-2)\cdot(Nolow_{DataCells}-3)\cdot(\sigma low_{actual})^4} \ldots + -\frac{3\cdot(Nolow_{DataCells}-1)^2}{(Nolow_{DataCells}-2)\cdot(Nolow_{DataCells}-3)}$$

$$Kurtosis_{high} := \frac{Nohigh_{DataCells}\cdot(Nohigh_{DataCells}+1)\cdot\sum\overrightarrow{(high_{points}-\mu high_{actual})^4}}{(Nohigh_{DataCells}-1)\cdot(Nohigh_{DataCells}-2)\cdot(Nohigh_{DataCells}-3)\cdot(\sigma high_{actual})^4} \ldots + -\frac{3\cdot(Nohigh_{DataCells}-1)^2}{(Nohigh_{DataCells}-2)\cdot(Nohigh_{DataCells}-3)}$$

Normal Probability Plot - Low points

$l := 0 .. last(low_{points})$ $srt_{low} := sort(low_{points})$

$L_l := l + 1$

$$rank_{low_l} := \frac{\sum\overrightarrow{\left(\overrightarrow{srt_{low} = srt_{low_l}}\right)\cdot L}}{\sum\overrightarrow{srt_{low} = srt_{low_l}}} \qquad p_{low_l} := \frac{rank_{low_l}}{rows(low_{points})+1}$$

$x := 1$ $N\_Score_{low_l} := root\left[cnorm(x) - \left(p_{low_l}\right), x\right]$

Normal Probability Plot - High points

$h := 0 .. last(high_{points})$ $srt_{high} := sort(high_{points})$

$H_h := h + 1$

$$rank_{high_h} := \frac{\sum\overrightarrow{\left(\overrightarrow{srt_{high} = srt_{high_h}}\right)\cdot H}}{\sum\overrightarrow{srt_{high} = srt_{high_h}}} \qquad p_{high_h} := \frac{rank_{high_h}}{rows(high_{points})+1}$$

$x := 1$ $N\_Score_{high_h} := root\left[cnorm(x) - \left(p_{high_h}\right), x\right]$

Upper and Lower Confidence Values

$\alpha := .05 \qquad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$

$$Lowerhigh_{95\%Con} := \mu high_{actual} - T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Upperhigh_{95\%Con} := \mu high_{actual} + T\alpha \cdot \frac{\sigma high_{actual}}{\sqrt{Nohigh_{DataCells}}}$$

$$Lowerlow_{95\%Con} := \mu low_{actual} - T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

$$Upperlow_{95\%Con} := \mu low_{actual} + T\alpha \cdot \frac{\sigma low_{actual}}{\sqrt{Nolow_{DataCells}}}$$

Graphical Representation of Low Points

$$Bins_{low} := Make_{bins}\left(\mu low_{actual}, \sigma low_{actual}\right)$$

$$Distribution_{low} := hist\left(Bins_{low}, low_{points}\right)$$

$$Distribution_{low} = \begin{pmatrix} 0 \\ 0 \\ 0 \\ 3 \\ 1 \\ 2 \\ 0 \\ 3 \\ 2 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

The mid points of the Bins are calculated

$k := 0 .. 11 \qquad Midpoints_{low_k} := \frac{\left(Bins_{low_k} + Bins_{low_{k+1}}\right)}{2}$

$$normallow_{curve_0} := pnorm\left(Bins_{low_1}, \mu low_{actual}, \sigma low_{actual}\right)$$

$$normallow_{curve_k} := pnorm\left(Bins_{low_{k+1}}, \mu low_{actual}, \sigma low_{actual}\right) - pnorm\left(Bins_{low_k}, \mu low_{actual}, \sigma low_{actual}\right)$$

$$normallow_{curve} := Nolow_{DataCells} \cdot normallow_{curve}$$

Graphical Representation of High Points

$Bins_{high} := Make_{bins}\left(\mu high_{actual}, \sigma high_{actual}\right)$

$Distribution_{high} := hist\left(Bins_{high}, high_{points}\right)$

$Distribution_{high} =$

0
0
4
3
5
3
7
4
7
1
0
0

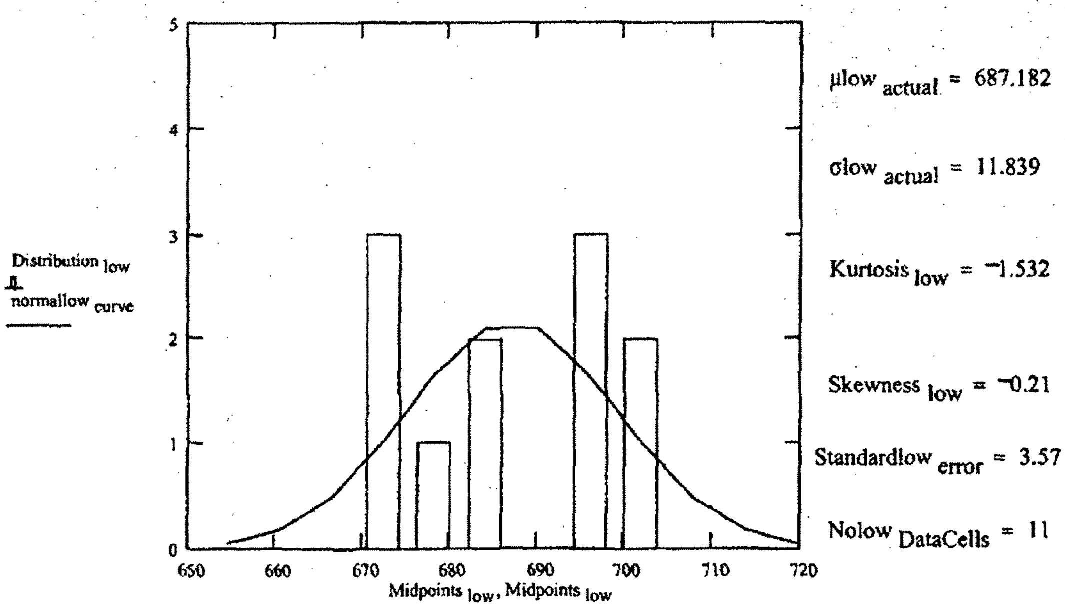
$k := 0..11 \qquad Midpoints_{high_k} := \dfrac{\left(Bins_{high_k} + Bins_{high_{k+1}}\right)}{2}$

$normalhigh_{curve_0} := pnorm\left(Bins_{high_1}, \mu high_{actual}, \sigma high_{actual}\right)$

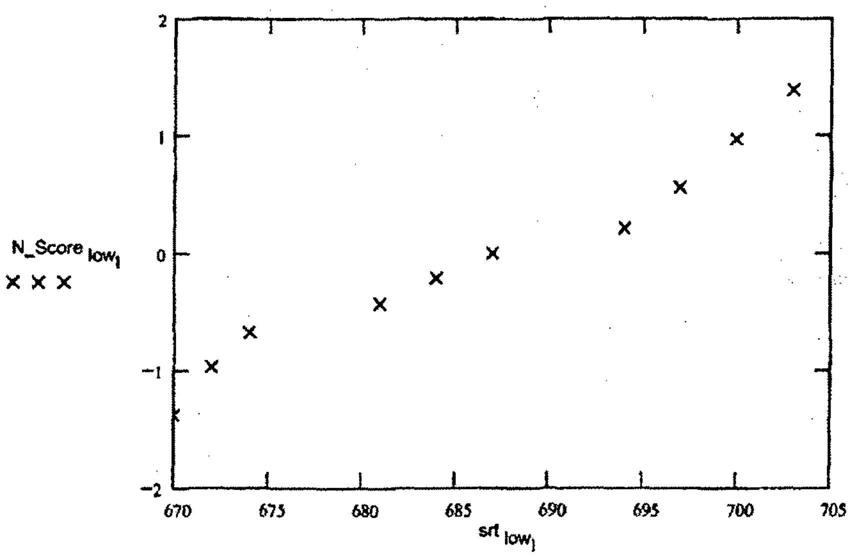
$normalhigh_{curve_k} := pnorm\left(Bins_{high_{k+1}}, \mu high_{actual}, \sigma high_{actual}\right) - pnorm\left(Bins_{high_k}, \mu high_{actual}, \sigma high_{act}\right.$

$normalhigh_{curve} := Nohigh_{DataCells} \cdot normalhigh_{curve}$

Results For Elevation 51' 10" Bay 13, Area 32 Thinner Points



Lowerlow $_{95\%Con}$ = 680.005 Upperlow $_{95\%Con}$ = 694.359



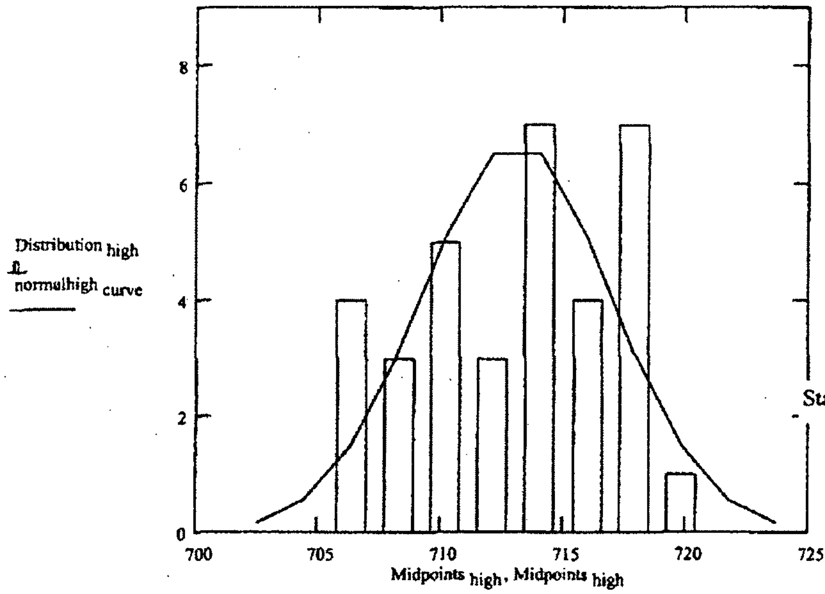
The above plots indicates that the thinner area is normally distributed.

Bay 13 Area 32

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A5 -10 of 31

5/15/5

Results For Elevation 51' 10" Bay 13, Area 32 Thicker Points



$\mu high_{actual}$ = 713.118

$\sigma high_{actual}$ = 3.852

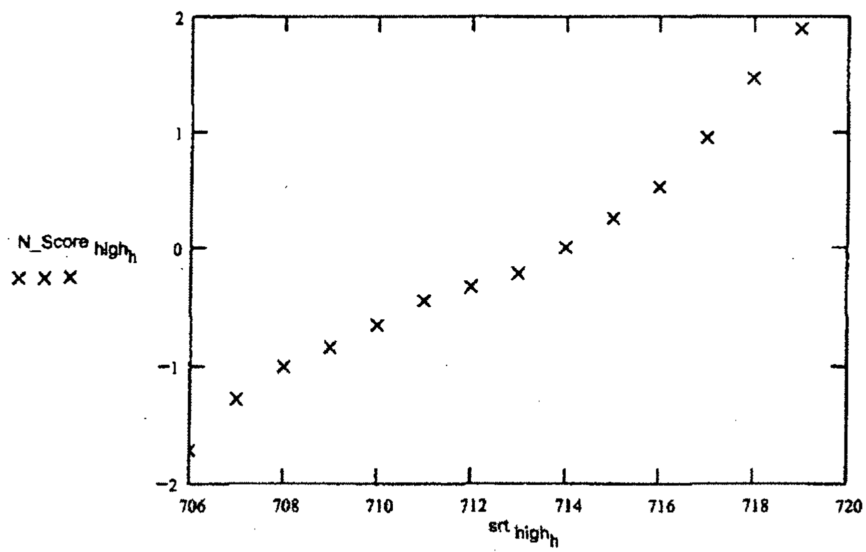
$Skewness_{high}$ = −0.44

$Kurtosis_{high}$ = −1.029

$Standardhigh_{error}$ = 0.661

$Nohigh_{DataCells}$ = 34

$Lower_{95\%Con}$ = 702.869 $Upper_{95\%Con}$ = 710.686



The above plots indicates that the thinner area is normally distributed.

5/15/05

Elevation 51' 10" Bay 13, Area 32 Trend

Data from Feb. 1990 to Sept. 2000 is retrieved. $d := 0$

For April 26 1990

page := READPRN("U:\MSOFFICE\Drywell Program data\April 1990 Data\DATA ONLY\D5232_April 1990.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(4, 26, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.715 & 0.711 & 0.715 & 0.713 & 0.697 & 0.688 & 0.7 \\ 0.712 & 0.708 & 0.693 & 0.699 & 0.713 & 0.647 & 0.704 \\ 0.719 & 0.663 & 0.714 & 0.683 & 0.712 & 0.628 & 0.676 \\ 0.718 & 0.594 & 0.713 & 0.622 & 0.711 & 0.714 & 0.558 \\ 0.719 & 0.702 & 0.72 & 0.717 & 0.717 & 0.732 & 0.696 \\ 0.713 & 0.713 & 0.722 & 0.721 & 0.719 & 0.721 & 0.667 \\ 0.72 & 0.712 & 0.72 & 0.721 & 0.72 & 0.719 & 0.687 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

The following points are pits and are omitted from the calcaution of the mean (ref 3.22). These pits will be trended separately.

$Pit20_d := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$ $Pit25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit23_d := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$ $Pit28_d := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

Point 34 was omitted from the 4/26/90 data (ref. 3.22.) $nnn := Zero_{one}(nnn, No_{DataCells}, 34)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

$d := d + 1$

For Feb. 23 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D5232_F91.txt")

$Points_{49} :=$ showcells(page , 7 , 0) $\quad Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.713 & 0.708 & 0.713 & 0.71 & 0.695 & 0.684 & 0.703 \\ 0.718 & 0.712 & 0.691 & 0.701 & 0.714 & 0.643 & 0.704 \\ 0.717 & 0.663 & 0.71 & 0.681 & 0.709 & 0.626 & 0.669 \\ 0.717 & 0.594 & 0.711 & 0.621 & 0.711 & 0.71 & 0.558 \\ 0.717 & 0.697 & 0.718 & 0.715 & 0.736 & 0.713 & 0.678 \\ 0.709 & 0.71 & 0.722 & 0.72 & 0.729 & 0.719 & 0.667 \\ 0.719 & 0.708 & 0.719 & 0.719 & 0.726 & 0.717 & 0.715 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7) \qquad No_{DataCells} := length(nnn)$

$Pit20_d := Get\_Pit_{data}(nnn, No_{DataCells}, 20) \qquad Pit25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit23_d := Get\_Pit_{data}(nnn, No_{DataCells}, 23) \qquad Pit28_d := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20) \qquad nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23) \qquad nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

Point 33 was omitted from the 2/23/91 data (ref. 3.22) $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 33)$

$Cells := deletezero_{cells}(nnn, No_{DataCells}) \qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells) \qquad \sigma_{measured_d} := Stdev(Cells) \qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split) \qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points}) \qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points}) \qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Bay 13 Area 32
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	X2 an 5/15/08	187	A5 -13 of 31

For May 23, 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D5232_M91.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.69 & 0.713 & 0.716 & 0.711 & 0.697 & 0.687 & 0.7 \\ 0.711 & 0.706 & 0.696 & 0.66 & 0.714 & 0.646 & 0.704 \\ 0.718 & 0.663 & 0.713 & 0.682 & 0.71 & 0.626 & 0.669 \\ 0.718 & 0.592 & 0.712 & 0.62 & 0.71 & 0.712 & 0.555 \\ 0.719 & 0.699 & 0.719 & 0.716 & 0.716 & 0.713 & 0.681 \\ 0.712 & 0.711 & 0.721 & 0.72 & 0.718 & 0.72 & 0.665 \\ 0.719 & 0.71 & 0.72 & 0.721 & 0.719 & 0.718 & 0.684 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

$Pit_{20_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$ $\qquad Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{23_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$ $\qquad Pit_{28_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

Point 11 was omitted from the 5/23/91 data (ref. 3.22). $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 11)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Bay 13 Area 32 Subject: Drywell Corrosion	Calc. No.	Rev. No.	System No.	Sheet No.
	C-1301-187-E310-037	K2	187	A5 -14 of 31

5/15/05

For Nov. 2 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov. 1991 Data\DATA ONLY\D5232_N91.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(11, 2, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.718 & 0.718 & 0.724 & 0.717 & 0.721 & 0.689 & 0.72 \\ 0.713 & 0.715 & 0.7 & 0.705 & 0.723 & 0.653 & 0.71 \\ 0.722 & 0.681 & 0.715 & 0.691 & 0.716 & 0.63 & 0.675 \\ 0.72 & 0.601 & 0.717 & 0.626 & 0.72 & 0.717 & 0.563 \\ 0.722 & 0.701 & 0.722 & 0.721 & 0.728 & 0.718 & 0.679 \\ 0.714 & 0.715 & 0.732 & 0.73 & 0.721 & 0.722 & 0.671 \\ 0.724 & 0.71 & 0.724 & 0.724 & 0.726 & 0.72 & 0.681 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit\,20_d := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$

$Pit\,23_d := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$

$Pit\,25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit\,28_d := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Bay 13 Area 32
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2	187	A5 -15 of 31

15 5/18/05

For May 30 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D5232_M92.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\qquad$ $\text{Dates}_d := \text{Day}_{\text{year}}(5, 30, 1992)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.715 & 0.71 & 0.711 & 0.714 & 0.699 & 0.694 & 0.718 \\ 0.713 & 0.71 & 0.691 & 0.701 & 0.716 & 0.645 & 0.705 \\ 0.721 & 0.664 & 0.714 & 0.685 & 0.71 & 0.63 & 0.676 \\ 0.72 & 0.598 & 0.715 & 0.621 & 0.713 & 0.724 & 0.557 \\ 0.721 & 0.703 & 0.724 & 0.721 & 0.721 & 0.72 & 0.684 \\ 0.714 & 0.715 & 0.723 & 0.721 & 0.721 & 0.723 & 0.667 \\ 0.72 & 0.714 & 0.722 & 0.723 & 0.722 & 0.721 & 0.705 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\qquad$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\text{Pit}\,20_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 20)$ $\qquad$ $\text{Pit}\,25_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{Pit}\,23_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 23)$ $\qquad$ $\text{Pit}\,28_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 28)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 20)$ $\qquad$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 23)$ $\qquad$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 28)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$ $\qquad$ $\text{No}_{\text{Cells}} := \text{length}(\text{Cells})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\qquad$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\qquad$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

$\text{high}_{\text{points}} := \text{Moremean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$ $\qquad$ $\text{low}_{\text{points}} := \text{lessmean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$

$\mu\text{high}_{\text{measured}_d} := \text{mean}(\text{high}_{\text{points}})$ $\qquad$ $\mu\text{low}_{\text{measured}_d} := \text{mean}(\text{low}_{\text{points}})$

$\sigma\text{high}_{\text{measured}_d} := \text{Stdev}(\text{high}_{\text{points}})$ $\qquad$ $\sigma\text{low}_{\text{measured}_d} := \text{Stdev}(\text{low}_{\text{points}})$

$\text{Standardhigh}_{\text{error}_d} := \dfrac{\sigma\text{high}_{\text{measured}_d}}{\sqrt{\text{length}(\text{high}_{\text{points}})}}$ $\qquad$ $\text{Standardlow}_{\text{error}_d} := \dfrac{\sigma\text{low}_{\text{measured}_d}}{\sqrt{\text{length}(\text{low}_{\text{points}})}}$

For Dec. 5 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D5232_D92.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.72 & 0.713 & 0.722 & 0.716 & 0.705 & 0.688 & 0.718 \\ 0.718 & 0.715 & 0.696 & 0.707 & 0.716 & 0.639 & 0.707 \\ 0.72 & 0.69 & 0.717 & 0.686 & 0.715 & 0.626 & 0.673 \\ 0.72 & 0.603 & 0.714 & 0.635 & 0.717 & 0.715 & 0.565 \\ 0.722 & 0.689 & 0.721 & 0.717 & 0.72 & 0.718 & 0.675 \\ 0.712 & 0.71 & 0.723 & 0.725 & 0.723 & 0.723 & 0.648 \\ 0.721 & 0.706 & 0.721 & 0.723 & 0.722 & 0.722 & 0.68 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

$Pit20_d := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$

$Pit23_d := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$

$Pit25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit28_d := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\qquad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\qquad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\qquad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\qquad \sigma low_{measured_d} := Stdev(low_{points})$

$$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}} \qquad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$$

For Sept. 14 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D5232_94.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 14, 1994)$

Data

$$Points_{49} = \begin{bmatrix} 0.715 & 0.706 & 0.713 & 0.711 & 0.694 & 0.684 & 0.7 \\ 0.71 & 0.707 & 0.689 & 0.695 & 0.709 & 0.642 & 0.703 \\ 0.714 & 0.664 & 0.71 & 0.681 & 0.709 & 0.623 & 0.666 \\ 0.717 & 0.593 & 0.713 & 0.623 & 0.712 & 0.71 & 0.556 \\ 0.717 & 0.693 & 0.716 & 0.713 & 0.715 & 0.713 & 0.676 \\ 0.709 & 0.708 & 0.72 & 0.718 & 0.717 & 0.719 & 0.667 \\ 0.718 & 0.707 & 0.719 & 0.72 & 0.719 & 0.716 & 0.672 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

$Pit_{20_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$

$Pit_{23_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$

$Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{28_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\quad Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D5232_96.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.712 & 0.712 & 0.714 & 0.711 & 0.7 & 0.687 & 0.687 \\ 0.709 & 0.712 & 0.688 & 0.725 & 0.712 & 0.668 & 0.701 \\ 0.714 & 0.692 & 0.71 & 0.709 & 0.71 & 0.622 & 0.675 \\ 0.717 & 0.586 & 0.711 & 0.618 & 0.713 & 0.712 & 0.589 \\ 0.715 & 0.7 & 0.715 & 0.712 & 0.713 & 0.716 & 0.678 \\ 0.71 & 0.71 & 0.719 & 0.717 & 0.715 & 0.716 & 0.647 \\ 0.718 & 0.708 & 0.717 & 0.745 & 0.733 & 0.717 & 0.708 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

$Pit20_d := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$ $\quad Pit25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit23_d := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$ $\quad Pit28_d := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $\quad No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $\quad low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\quad \mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\quad \sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \dfrac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $\quad Standardlow_{error_d} := \dfrac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

or 5/15/5

For Sept. 16 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D5232_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 16, 2000)$

Data

$$Points_{49} = \begin{bmatrix} 0.715 & 0.71 & 0.715 & 0.712 & 0.696 & 0.685 & 0.705 \\ 0.713 & 0.71 & 0.691 & 0.686 & 0.712 & 0.642 & 0.703 \\ 0.718 & 0.668 & 0.713 & 0.684 & 0.711 & 0.624 & 0.67 \\ 0.721 & 0.588 & 0.714 & 0.624 & 0.714 & 0.711 & 0.56 \\ 0.719 & 0.697 & 0.718 & 0.717 & 0.718 & 0.716 & 0.679 \\ 0.711 & 0.71 & 0.721 & 0.72 & 0.719 & 0.72 & 0.644 \\ 0.72 & 0.706 & 0.72 & 0.722 & 0.719 & 0.718 & 0.679 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit\,20_d := Get\_Pit_{data}(nnn, No_{DataCells}, 20)$ $Pit\,25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit\,23_d := Get\_Pit_{data}(nnn, No_{DataCells}, 23)$ $Pit\,28_d := Get\_Pit_{data}(nnn, No_{DataCells}, 28)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 20)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 23)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 28)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$ $No_{Cells} := length(Cells)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$high_{points} := Moremean(Cells, No_{Cells}, Split)$ $low_{points} := lessmean(Cells, No_{Cells}, Split)$

$\mu high_{measured_d} := mean(high_{points})$ $\mu low_{measured_d} := mean(low_{points})$

$\sigma high_{measured_d} := Stdev(high_{points})$ $\sigma low_{measured_d} := Stdev(low_{points})$

$Standardhigh_{error_d} := \frac{\sigma high_{measured_d}}{\sqrt{length(high_{points})}}$ $Standardlow_{error_d} := \frac{\sigma low_{measured_d}}{\sqrt{length(low_{points})}}$

Bay 13 Area 32

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 01 5/15/15	187	A5 -20 of 31

For Nov 9, 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5232_00.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$

$\text{Dates}_d := \text{Day}_{\text{year}}(11, 9, 2004)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.709 & 0.707 & 0.714 & 0.712 & 0.697 & 0.684 & 0.706 \\ 0.71 & 0.71 & 0.715 & 0.697 & 0.715 & 0.672 & 0.703 \\ 0.714 & 0.687 & 0.711 & 0.681 & 0.708 & 0.621 & 0.67 \\ 0.717 & 0.646 & 0.713 & 0.621 & 0.713 & 0.711 & 0.562 \\ 0.716 & 0.694 & 0.717 & 0.714 & 0.715 & 0.714 & 0.674 \\ 0.708 & 0.707 & 0.718 & 0.719 & 0.716 & 0.717 & 0.706 \\ 0.716 & 0.7 & 0.717 & 0.718 & 0.717 & 0.716 & 0.71 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\qquad \text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\text{Pit }20_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 20)$ $\qquad \text{Pit }25_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{Pit }23_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 23)$ $\qquad \text{Pit }28_d := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 28)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 20)$ $\qquad \text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 23)$ $\qquad \text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 28)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$ $\qquad \text{No}_{\text{Cells}} := \text{length}(\text{Cells})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\qquad \sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\qquad \text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

$\text{high}_{\text{points}} := \text{Moremean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$ $\qquad \text{low}_{\text{points}} := \text{lessmean}(\text{Cells}, \text{No}_{\text{Cells}}, \text{Split})$

$\mu\text{high}_{\text{measured}_d} := \text{mean}(\text{high}_{\text{points}})$ $\qquad \mu\text{low}_{\text{measured}_d} := \text{mean}(\text{low}_{\text{points}})$

$\sigma\text{high}_{\text{measured}_d} := \text{Stdev}(\text{high}_{\text{points}})$ $\qquad \sigma\text{low}_{\text{measured}_d} := \text{Stdev}(\text{low}_{\text{points}})$

$\text{Standardhigh}_{\text{error}_d} := \dfrac{\sigma\text{high}_{\text{measured}_d}}{\sqrt{\text{length}(\text{high}_{\text{points}})}}$ $\qquad \text{Standardlow}_{\text{error}_d} := \dfrac{\sigma\text{low}_{\text{measured}_d}}{\sqrt{\text{length}(\text{low}_{\text{points}})}}$

Bay 13 Area 32
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	0	187	A5 -21 of 31

Below are the results

Dates =

$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$
$2.001 \cdot 10^3$
$2.005 \cdot 10^3$

$\mu_{measured}$ =

706.455
705.545
704.977
711.222
708.644
708.178
703.244
707.333
704.711
706.778

$\sigma_{measured}$ =

17.31
18.322
18.081
17.716
17.885
19.737
18.394
16.762
19.761
13.04

$Standard_{error}$ =

2.473
2.617
2.583
2.531
2.555
2.82
2.628
2.395
2.823
1.863

$\mu high_{measured}$ =

716.067
715.097
715.2
719.543
717.059
717.257
713.548
714.912
715.25
713.118

$\sigma high_{measured}$ =

3.868
5.205
4.122
5.606
5.359
5.343
4.273
7.246
4.544
3.852

$Standardhigh_{error}$ =

0.706
0.935
0.753
0.948
0.919
0.903
0.767
1.243
0.803
0.661

$$\mu low_{measured} = \begin{pmatrix} 685.857 \\ 682.769 \\ 683.071 \\ 682.1 \\ 682.636 \\ 676.4 \\ 680.429 \\ 683.909 \\ 678.769 \\ 687.182 \end{pmatrix} \quad \sigma low_{measured} = \begin{pmatrix} 16.961 \\ 18.372 \\ 16.895 \\ 14.286 \\ 18.107 \\ 18.816 \\ 17.005 \\ 16.251 \\ 18.793 \\ 11.839 \end{pmatrix} \quad Standardlow_{error} = \begin{pmatrix} 4.533 \\ 5.095 \\ 4.515 \\ 4.518 \\ 5.459 \\ 5.95 \\ 4.545 \\ 4.9 \\ 5.212 \\ 3.57 \end{pmatrix}$$

$Total_{means} := rows(\mu_{measured})$ $\quad Total_{means} = 10$

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2$$

$$SSE_{low} := \sum_{i=0}^{last(Dates)} \left(\mu low_{measured_i} - yhat(Dates, \mu low_{measured})_i\right)^2$$

$$SSE_{high} := \sum_{i=0}^{last(Dates)} \left(\mu high_{measured_i} - yhat(Dates, \mu high_{measured})_i\right)^2$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2$$

$$SSR_{low} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu low_{measured})_i - mean(\mu low_{measured})\right)^2$$

$$SSR_{high} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu high_{measured})_i - mean(\mu high_{measured})\right)^2$$

01 5/15/15

$DegreeFree_{ss} := Total_{means} - 2$ $DegreeFree_{reg} := 1$

$MSE := \frac{SSE}{DegreeFree_{ss}}$ $MSE_{low} := \frac{SSE_{low}}{DegreeFree_{ss}}$ $MSE_{high} := \frac{SSE_{high}}{DegreeFree_{ss}}$

$Standard_{error} := \sqrt{MSE}$ $Standard_{lowerror} := \sqrt{MSE_{low}}$ $Standard_{higherror} := \sqrt{MSE_{high}}$

$MSR := \frac{SSR}{DegreeFree_{reg}}$ $MSR_{low} := \frac{SSR_{low}}{DegreeFree_{reg}}$ $MSR_{high} := \frac{SSR_{high}}{DegreeFree_{reg}}$

$F_{actaul} := \frac{MSR}{MSE}$ $F\_low_{actaul} := \frac{MSR_{low}}{MSE_{low}}$ $F\_high_{actaul} := \frac{MSR_{high}}{MSE_{high}}$

For 95% confidence level the F Critical is calculated as follows

$\alpha := 0.05$ $F_{critical} := qF(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss})$ $F_{critical} = 5.318$

The "F" ratio for 95% confidence is calculated:

$F_{ratio} := \frac{F_{actaul}}{F_{critical}}$ $F\_low_{ratio} := \frac{F\_low_{actaul}}{F_{critical}}$ $F\_high_{ratio} := \frac{F\_high_{actaul}}{F_{critical}}$

$F_{ratio} = 0.06$ $F\_low_{ratio} = 0.041$ $F\_high_{ratio} = 0.695$

Therefore the curve fit for the overall mean, the mean of thinner points, and the mean of points with thicker points do not have slopes.

The following will plot the results for the overall mean, the mean of thinner points, and the mean of thicker points

$$i := 0..Total_{means} - 1$$

$$\mu grand_{measured_i} := mean(\mu_{measured}) \qquad \sigma grand_{measured} := Stdev(\mu_{measured})$$

$$GrandStandard_{error} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$$

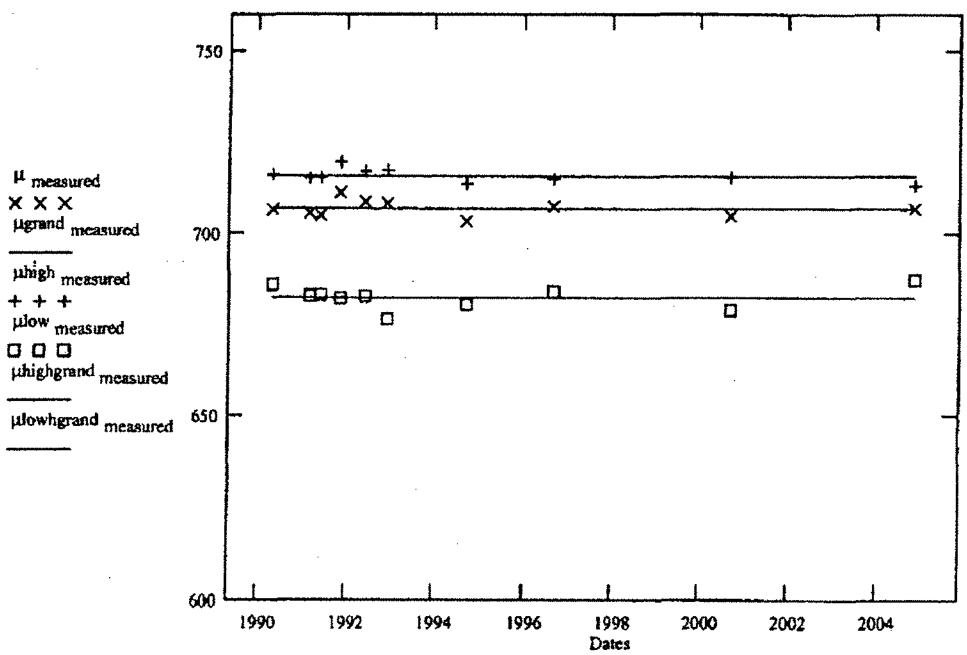
$$\sigma grand_{lowmeasured} := Stdev(\mu low_{measured}) \qquad \mu lowhgrand_{measured_i} := mean(\mu low_{measured})$$

$$GrandStandard_{lowerror} := \frac{\sigma grand_{lowmeasured}}{\sqrt{Total_{means}}}$$

$$\sigma grand_{highmeasured} := Stdev(\mu high_{measured}) \qquad \mu highgrand_{measured_i} := mean(\mu high_{measured})$$

$$GrandStandard_{higherror} := \frac{\sigma grand_{highmeasured}}{\sqrt{Total_{means}}}$$

$$max(\mu_{measured}) + 50 = 761.222 \qquad min(\mu_{measured}) - 100 = 603.244$$



$$\mu grand_{measured_0} = 706.709 \qquad GrandStandard_{error} = 0.723$$

$$mean(\mu low_{measured}) = 682.312 \qquad GrandStandard_{lowerror} = 1.005$$

$$mean(\mu high_{measured}) = 715.705 \qquad GrandStandard_{higherror} = 0.595$$

The F Test indicates that the regression model does not hold for all three data sets. However, the slopes and 95% Confidence curves are generated for all three cases.

$m_s := \text{slope}(\text{Dates}, \mu_{measured})$ $\qquad y_b := \text{intercept}(\text{Dates}, \mu_{measured})$

$m_{lows} := \text{slope}(\text{Dates}, \mu\text{low}_{measured})$ $\qquad y_{lowb} := \text{intercept}(\text{Dates}, \mu\text{low}_{measured})$

$m_{highs} := \text{slope}(\text{Dates}, \mu\text{high}_{measured})$ $\qquad y_{highb} := \text{intercept}(\text{Dates}, \mu\text{high}_{measured})$

$\alpha_t := 0.05 \qquad k := 23 \qquad f := 0..k-1$

$\text{year}_{predict_f} := 1985 + f \cdot 2$

$\text{Thick}_{predict} := m_s \cdot \text{year}_{predict} + y_b$

$\text{Thick}_{lowpredict} := m_{lows} \cdot \text{year}_{predict} + y_{lowb}$

$\text{Thick}_{highpredict} := m_{highs} \cdot \text{year}_{predict} + y_{highb}$

$\text{Thick}_{actualmean} := \text{mean}(\text{Dates})$

$\text{sum} := \sum_i (\text{Dates}_d - \text{mean}(\text{Dates}))^2$

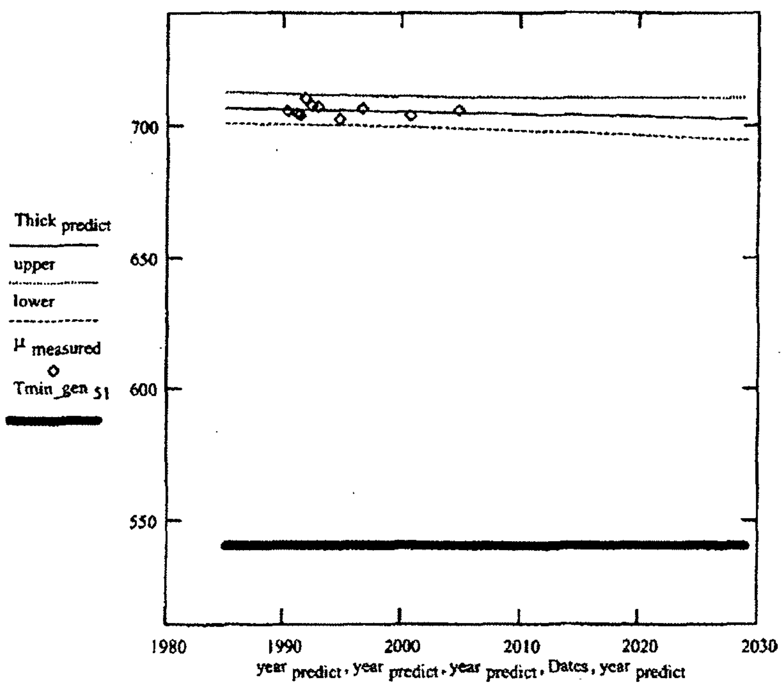
5/15/05

$$upper_f := Thick_{predict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}$$

$$lower_f := Thick_{predict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{error} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualmean}\right)^2}{sum}}\right.$$

General area Tmin for this elevation in the Drywell

$Tmin\_gen_{51_f} := 541$ (Ref. Calc. SE-000243-002)



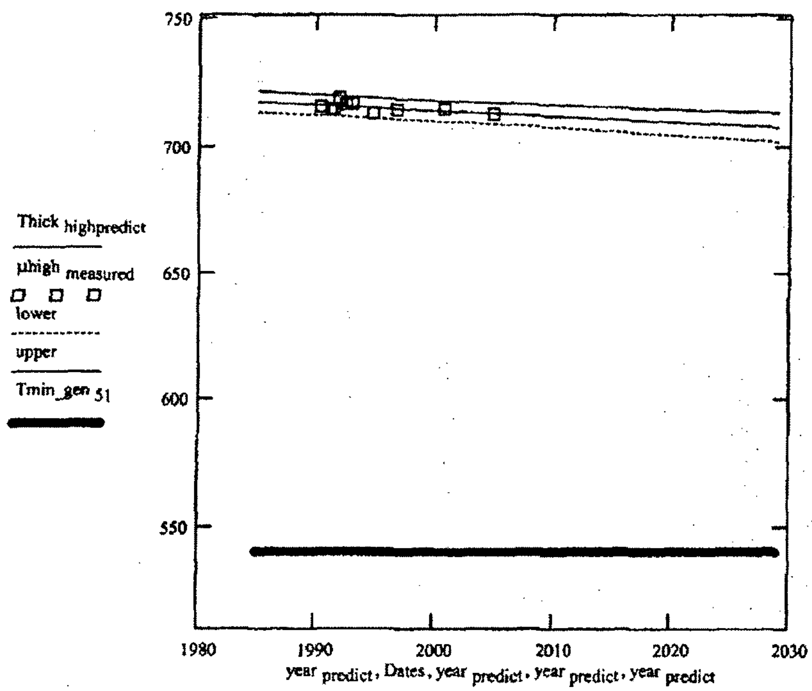
$m_s = -0.094$

5/15/05

For the thicker points

$$upper_f := Thick_{highpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{(year_{predict_f} - Thick_{actualme}}{sum}}$$

$$lower_f := Thick_{highpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{higherror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{(year_{predict_f} - Thick_{actualn}}{sum}}\right.$$



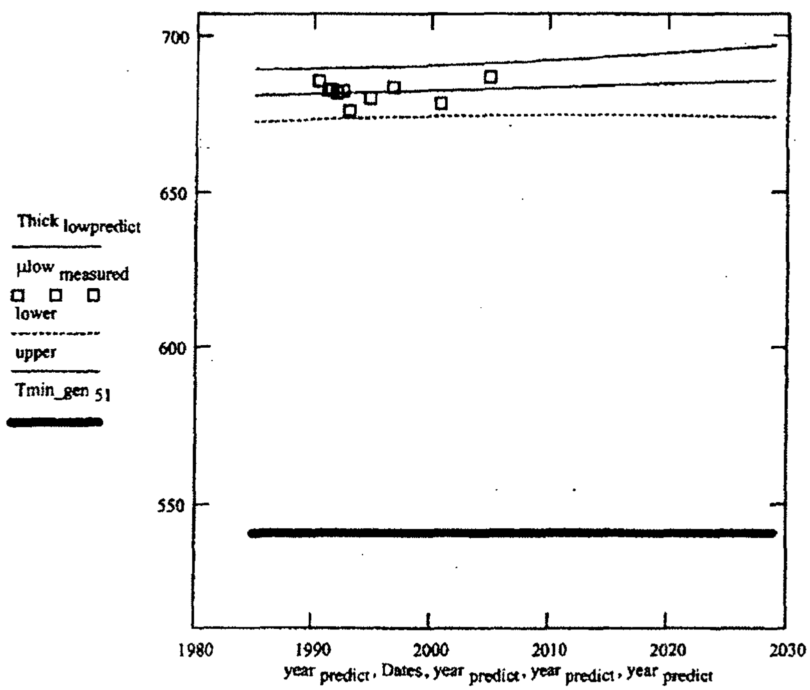
$m_{highs} = -0.223$

PT 5/19/05

For the thinner points

$$upper_f := Thick_{lowpredict_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actualm}\right.}{sum}}$$

$$lower_f := Thick_{lowpredict_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot Standard_{lowerror} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Thick_{actual}\right.}{sum}}\right.$$



$m_{lows} = 0.109$

The following trends are shown for each of the pits

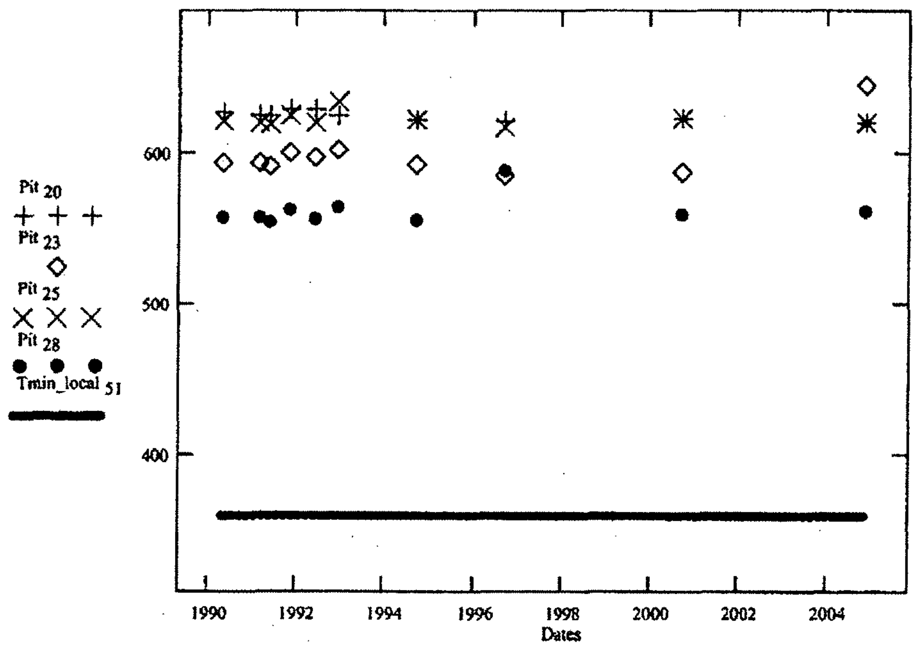
Local Tmin for this elevation in the Drywell $Tmin\_local_{51_f} := 360$ (Ref. Calc. SE-000243-002)

$A_i :=$

max(Pit$_{20}$)
max(Pit$_{23}$)
max(Pit$_{25}$)
max(Pit$_{28}$)

$B_i :=$

min(Pit$_{20}$)
min(Pit$_{23}$)
min(Pit$_{25}$)
min(Pit$_{28}$)



The F-Ratio is calculated for the worse pit (#20) $Pit_{worse} := Pit_{20}$

$$SSE_{pit} := \sum_{i=0}^{last(Dates)} \left(Pit_{worse_i} - yhat(Dates, Pit_{worse})_i\right)^2 \qquad SSE_{pit} = 38.89$$

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, Pit_{worse})_i - mean(Pit_{worse})\right)^2 \qquad SSR_{pit} = 49.51$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 1.915$$

Therefore pit 20 is not presently corroding. However, to provide a conservative result the regression model is generated for this pit.

$m_{pit} := slope(Dates, Pit_{worse})$ $m_{pit} = -0.494$ $y_{pit} := intercept(Dates, Pit_{worse})$ $y_{pit} = 1.612 \cdot 10^3$

The 95% Confidence curves are calculated

$Pit_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$

$Pit_{actualmean} := mean(Dates)$ $sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$

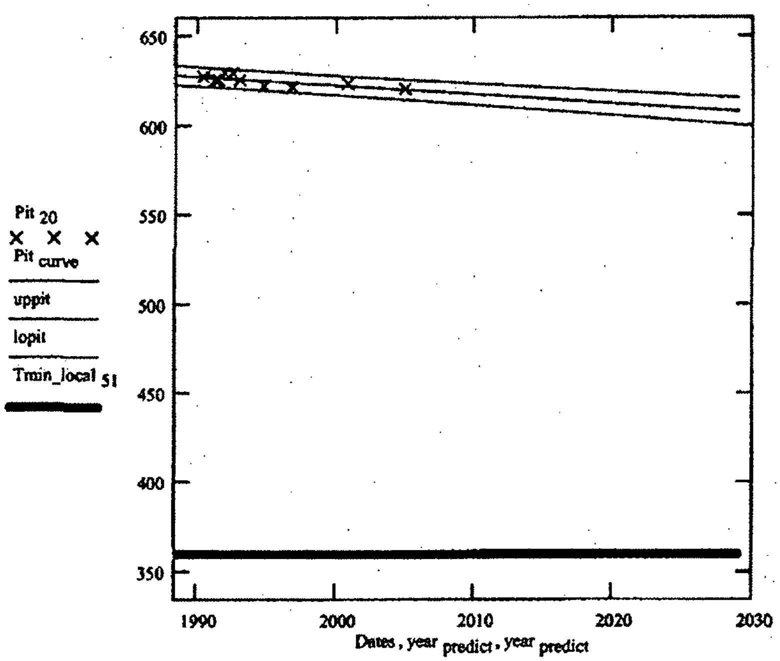
5/15/05

$$uppit_f := Pit_{curve_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

$$lopit_f := Pit_{curve_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}\right]$$

Local Tmin for this elevation in the Drywell $Tmin\_local_{50_f} := 360$ (Ref. SE-000243-002)

Curve Fit For Pit 20 Projected to Plant End Of Life



$m_{pit} = -0.494$

Therefore based on regression model the above curve shows that this pit will not corrode to below minimum required thickness by the plant end of life.

$minpoint = 0.562$ $year_{predict_{22}} = 2.029 \cdot 10^3$ $Tmin\_local_{51_{22}} = 360$

$$required_{rate.} := \frac{\left(1000 \cdot minpoint - Tmin\_local_{51_{22}}\right)}{\left(2005 - year_{predict}\right)_{22}}$$

$1000 \cdot minpoint - Tmin\_local_{51_{22}} = 202$

$required_{rate.} = -8.417$

5/19/05

Appendix 6 - Elevation 60' 10" Bay 1, Area 50-22

NOV. 9, 2004 Data

The data shown below was collected on 11/9/2000.

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D5022_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Points_{49} =$

0.709	0.704	0.683	0.689	0.686	0.603	0.713
0.713	0.699	0.703	0.706	0.719	0.722	0.716
0.723	0.712	0.704	0.698	0.721	0.717	0.717
0.714	0.668	0.721	0.684	0.728	0.713	0.624
0.677	0.638	0.689	0.692	0.687	0.698	0.692
0.656	0.633	0.69	0.697	0.654	0.686	0.681
0.697	0.724	0.723	0.701	0.662	0.55	0.668

$Cells := convert(Points_{49}, 7)$ $No_{DataCells} := length(Cells)$

For this location point 48 has been determined to be pit (reference 3.22) and has been omitted from the overall mean calculation for his location and is trend separately as a pit.

$Cells := Zero_{one}(Cells, No_{DataCells}, 48)$ $Cells := deletezero_{cells}(Cells, No_{DataCells})$

$No_{DataCells} := length(Cells)$

The thinnest point at this location is shown below

$minpoint := min(Points_{49})$

$minpoint = 0.55$

Mean and Standard Deviation

$\mu_{actual} := mean(Cells)$ $\mu_{actual} = 692.792$ $\sigma_{actual} := Stdev(Cells)$ $\sigma_{actual} = 28.075$

Standard Error

$$Standard_{error} := \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}}$$ $Standard_{error} = 4.052$

Skewness

$$Skewness := \frac{(No_{DataCells}) \cdot \overrightarrow{\Sigma(Cells - \mu_{actual})^3}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (\sigma_{actual})^3}$$ $Skewness = -1.297$

Kurtosis

$$Kurtosis := \frac{No_{DataCells} \cdot (No_{DataCells} + 1) \cdot \overrightarrow{\Sigma(Cells - \mu_{actual})^4}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (No_{DataCells} - 3) \cdot (\sigma_{actual})^4} + -\frac{3 \cdot (No_{DataCells} - 1)^2}{(No_{DataCells} - 2) \cdot (No_{DataCells} - 3)}$$ $Kurtosis = 1.609$

CS 5/15/07

Normal Probability Plot

In a normal plot, each data value is plotted against what its value would be if it actually came from a normal distribution. The expected normal values, called normal scores, and can be estimated by first calculating the rank scores of the sorted data.

$j := 0 .. \text{last}(\text{Cells}) \qquad srt := \text{sort}(\text{Cells})$

Then each data point is ranked. The array rank captures these ranks

$$r_j := j + 1 \qquad rank_j := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt = srt_j}\right) \cdot r}}{\Sigma \overrightarrow{srt = srt_j}}$$

$$p_j := \frac{rank_j}{\text{rows}(\text{Cells}) + 1}$$

The normal scores are the corresponding *p*th percentile points from the standard normal distribution:

$x := 1 \qquad N\_Score_j := \text{root}\left[\text{cnorm}(x) - \left(p_j\right), x\right]$

RF 5/15/05

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$\alpha := .05 \qquad T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 684.644$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 700.939$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$Bins := Make_{bins}(\mu_{actual}, \sigma_{actual})$

$Distribution := hist(Bins, Cells)$

Distribution =

0
2
1
3
3
11
10
10
7
0
0
0

The mid points of the Bins are calculated

$k := 0..11 \qquad Midpoints_k := \frac{(Bins_k + Bins_{k+1})}{2}$

The Mathcad function pnorm calculates a portion of normal distribution curve based on a given mean and standard deviation

$normal_{curve_0} := pnorm(Bins_1, \mu_{actual}, \sigma_{actual})$

$normal_{curve_k} := pnorm(Bins_{k+1}, \mu_{actual}, \sigma_{actual}) - pnorm(Bins_k, \mu_{actual}, \sigma_{actual})$

$normal_{curve} := No_{DataCells} \cdot normal_{curve}$

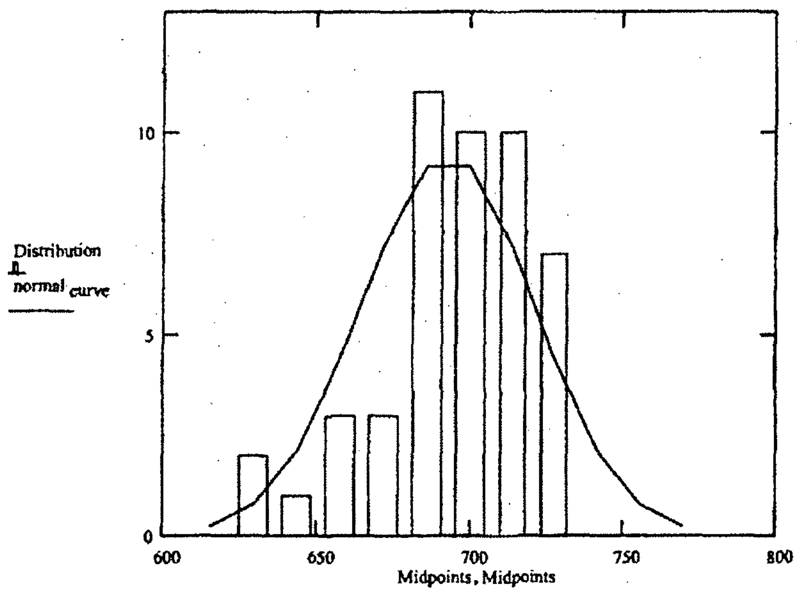
Bay 1 Area 50-22				
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A6- 5 of 16

5/15/05

Results For Elevation 60' 10" Bay 1, Area 50-22
Sept. 17, 2000

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values. Below is the Normal Plot for the data.

Data Distribution



μ_{actual} = 692.792

σ_{actual} = 28.075

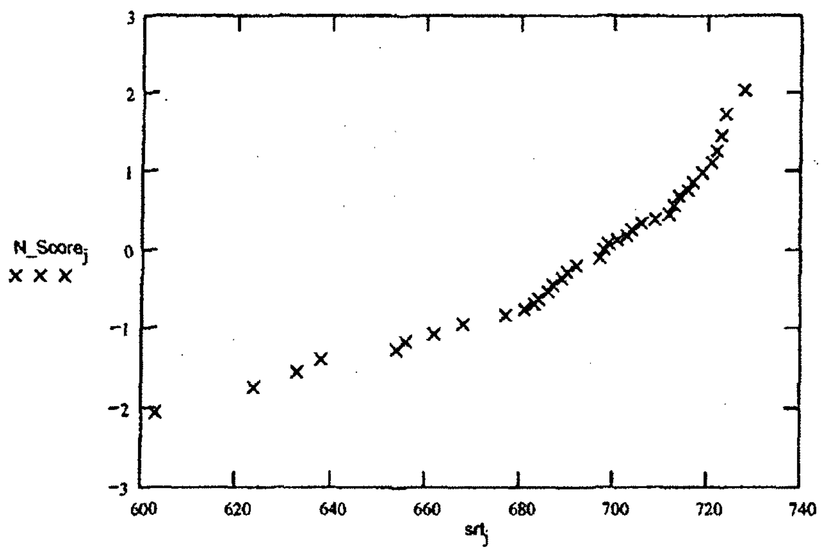
$Standard_{error}$ = 4.052

Skewness = −1.297

Kurtosis = 1.609

$Lower_{95\%Con}$ = 684.644 $Upper_{95\%Con}$ = 700.939

Normal Probability Plot



The data is slightly skewed. However, based on the Normal Probability Plot and the Kurtosis this data is normally distributed.

Bay 1 Area 50-22
Subject: Drywell Corrosion

Calc. No. C-1301-187-E310-037 | Rev. No. ~~1~~ 2 | System No. 187 | Sheet No. A6- 6 of 16

PT 5/15/05

Elevation 60' 10" Bay 1, Area 50-22 Trend

Data from the 1992, 1994 and 1996 (ref calcs) is retrieved.

$d := 0$

For 1992

$Dates_d := Day_{year}(1, 6, 1993)$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D5022_D92.txt")

$Points_{49} := showcells(page, 7, 0)$

Data

$Points_{49} =$

0.707	0.711	0.683	0.702	0.686	0.646	0.676
0.723	0.717	0.717	0.704	0.726	0.722	0.674
0.723	0.7	0.687	0.681	0.718	0.705	0.718
0.711	0.661	0.679	0.7	0.728	0.71	0.654
0.713	0.677	0.692	0.701	0.691	0.67	0.703
0.67	0.661	0.689	0.712	0.674	0.649	0.653
0.699	0.702	0.722	0.697	0.683	0.589	0.66

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location point 48 is a pit and is therefore omitted from calculation of the mean (ref. 3.22)

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/5

For 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D5022_94.txt")

$Dates_d := Day_{year}(9, 14, 1994)$

$Points_{49} := showcells(page, 7, 0)$

Data

$$Points_{49} = \begin{bmatrix} 0.72 & 0.728 & 0.708 & 0.718 & 0.73 & 0.658 & 0.703 \\ 0.746 & 0.737 & 0.726 & 0.705 & 0.741 & 0.742 & 0.705 \\ 0.757 & 0.73 & 0.74 & 0.732 & 0.743 & 0.729 & 0.731 \\ 0.738 & 0.692 & 0.737 & 0.713 & 0.748 & 0.73 & 0.673 \\ 0.729 & 0.71 & 0.712 & 0.733 & 0.699 & 0.695 & 0.713 \\ 0.701 & 0.663 & 0.69 & 0.705 & 0.675 & 0.654 & 0.658 \\ 0.7 & 0.704 & 0.723 & 0.704 & 0.675 & 0.588 & 0.637 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Pit\,48_d := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells) \quad \sigma_{measured_d} := Stdev(Cells) \quad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

05 5/15/5

For 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D5022_96.txt")

$Dates_d := Day_{year}(9, 14, 1996)$

$Points_{49} := showcells(page, 7, 0)$

Data

$Points_{49} =$

0.703	0.713	0.679	0.684	0.682	0.634	0.677
0.721	0.711	0.704	0.694	0.717	0.722	0.671
0.728	0.701	0.695	0.681	0.727	0.71	0.717
0.708	0.662	0.679	0.717	0.737	0.714	0.646
0.7	0.664	0.696	0.702	0.705	0.672	0.696
0.668	0.662	0.69	0.707	0.677	0.641	0.663
0.704	0.702	0.725	0.699	0.673	0.573	0.662

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells) \quad \sigma_{measured_d} := Stdev(Cells) \quad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 1 Area 50-22

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1/2	187	A6- 9 of 16

5/15/05

For 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D5022_00.txt")

$Dates_d := Day_{year}(9, 16, 2000)$

$Points_{49} := showcells(page, 7, 0)$

Data

$$Points_{49} = \begin{bmatrix} 0.68 & 0.715 & 0.681 & 0.687 & 0.69 & 0.612 & 0.683 \\ 0.716 & 0.703 & 0.7 & 0.689 & 0.72 & 0.728 & 0.665 \\ 0.729 & 0.712 & 0.696 & 0.706 & 0.725 & 0.71 & 0.718 \\ 0.705 & 0.649 & 0.683 & 0.691 & 0.733 & 0.712 & 0.631 \\ 0.675 & 0.651 & 0.694 & 0.694 & 0.673 & 0.678 & 0.697 \\ 0.668 & 0.647 & 0.684 & 0.707 & 0.649 & 0.644 & 0.657 \\ 0.689 & 0.725 & 0.728 & 0.708 & 0.678 & 0.556 & 0.635 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells) \quad \sigma_{measured_d} := Stdev(Cells) \quad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/05

For Nov 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D5022_00.txt")

$Dates_d := Day_{year}(11, 9, 2004)$

$Points_{49} := showcells(page, 7, 0)$

Data

$Points_{49} =$

0.68	0.715	0.681	0.687	0.69	0.612	0.683
0.716	0.703	0.7	0.689	0.72	0.728	0.665
0.729	0.712	0.696	0.706	0.725	0.71	0.718
0.705	0.649	0.683	0.691	0.733	0.712	0.631
0.675	0.651	0.694	0.694	0.673	0.678	0.697
0.668	0.647	0.684	0.707	0.649	0.644	0.657
0.689	0.725	0.728	0.708	0.678	0.556	0.635

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/05

Below are matrices which contain the date when the data was collected, Mean, Standard Deviation, Standard Error for each date.

$$Dates = \begin{bmatrix} 1.993 \cdot 10^3 \\ 1.995 \cdot 10^3 \\ 1.997 \cdot 10^3 \\ 2.001 \cdot 10^3 \\ 2.005 \cdot 10^3 \end{bmatrix}$$

$$\mu_{measured} = \begin{bmatrix} 693.479 \\ 711.25 \\ 692.542 \\ 688.542 \\ 688.542 \end{bmatrix} \quad Standard_{error} = \begin{bmatrix} 3.241 \\ 3.995 \\ 3.462 \\ 4.126 \\ 4.126 \end{bmatrix} \quad \sigma_{measured} = \begin{bmatrix} 22.689 \\ 27.964 \\ 24.236 \\ 28.881 \\ 28.881 \end{bmatrix}$$

$$Total_{means} := rows\left(\mu_{measured}\right) \qquad Total_{means} = 5$$

The F-Ratio is calculated

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat\left(Dates, \mu_{measured}\right)_i\right)^2 \qquad SSE = 236.541$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat\left(Dates, \mu_{measured}\right)_i - mean\left(\mu_{measured}\right)\right)^2 \qquad SSR = 119.214$$

$$DegreeFree_{ss} := Total_{means} - 2 \qquad DegreeFree_{reg} := 1$$

$$MSE := \frac{SSE}{DegreeFree_{ss}} \qquad MSE = 78.847 \qquad MSR := \frac{SSR}{DegreeFree_{reg}} \qquad MSR = 119.214$$

$$StGrand_{err} := \sqrt{MSE} \qquad StGrand_{err} = 8.88$$

RR 5/15/05

$$F_{actaul} := \frac{MSR}{MSE}$$

$$\alpha := 0.05 \qquad F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right)$$

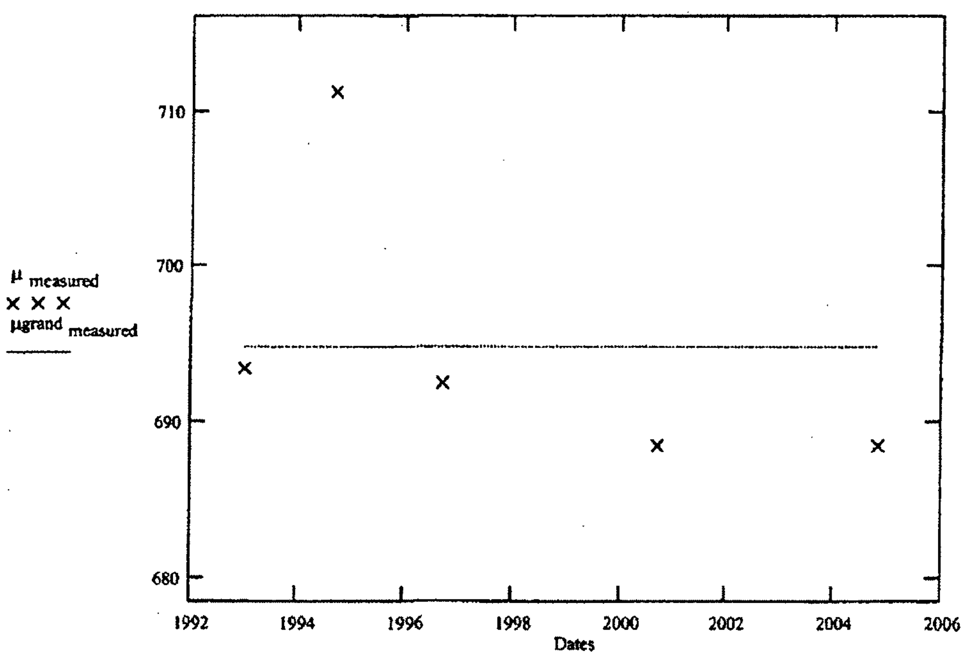
$$F_{ratio} := \frac{F_{actaul}}{F_{critical}} \qquad F_{ratio} = 0.149$$

Therefore the curve fit of the means does not have a slope and the grandmean is an accurate measure of the thickness at this location

$$i := 0 .. Total_{means} - 1 \qquad \mu grand_{measured_i} := mean\left(\mu_{measured}\right)$$

$$\sigma grand_{measured} := Stdev\left(\mu_{measured}\right) \qquad GrandStandard_{error_0} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$$

Plot of the grand mean and the actual means over time



$$\mu grand_{measured_0} = 694.871 \qquad GrandStandard_{error} = 4.218$$

To conservatively address the location, the apparent corrosion rate is calculated and compared to the minimum required wall thickness at this elevation

$$m_s := \text{slope}(\text{Dates}, \mu_{\text{measured}}) \quad m_s = -1.14 \qquad y_b := \text{intercept}(\text{Dates}, \mu_{\text{measured}}) \; y_b = 2.972 \cdot 10^3$$

The 95% Confidence curves are calculated

$$\alpha_t := 0.05 \quad k := 2029 - 1985 \qquad f := 0 .. k - 1$$

$$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2 \quad \text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$$

$$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates}) \qquad \text{sum} := \sum_i \left(\text{Dates}_d - \text{mean}(\text{Dates})\right)^2$$

$$\text{upper}_f := \text{Thick}_{\text{predict}_f} \cdots + \text{qt}\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}$$

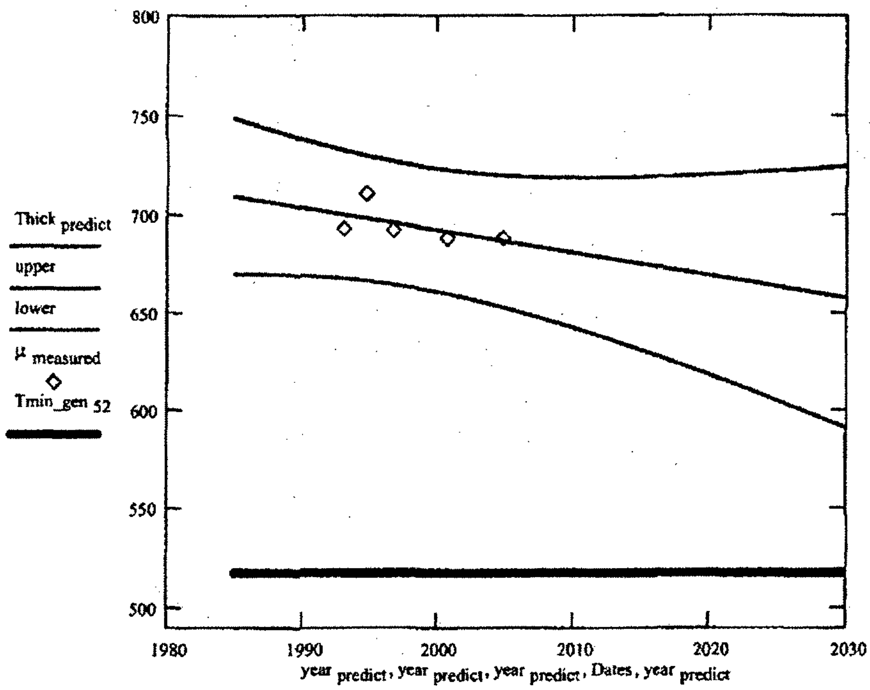
$$\text{lower}_f := \text{Thick}_{\text{predict}_f} \cdots + -\left[\text{qt}\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}\right]$$

Bay 1 Area 50-22

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1	187	A6- 14 of 16

The minimum required thickness at this elevation is $Tmin\_gen_{52_f} := 518$ (Ref. Calc. SE-000243-002)

Location Curve Fit Projected to Plant End Of Life



$m_s = -1.14$

Therefore even though F-ratio does not support the regression model the above curve shows that even at the lower 95% confidence band this location will not corrode to below Drywell Vessel Minimum required thickness by the plant end of life.

15 7/15/05

The following addresses the pit identified at this location

The F-Ratio is calculated for the pit as follows

$$SSE_{pit} := \sum_{i=0}^{last(Dates)} \left(Pit_{48_i} - yhat\left(Dates, Pit_{48}\right)_i\right)^2 \qquad SSE_{pit} = 128.986$$

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat\left(Dates, Pit_{48}\right)_i - mean\left(Pit_{48}\right)\right)^2 \qquad SSR_{pit} = 928.214$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 2.132$$

Therefore this pit may be experiencing corrosion

$$m_{pit} := slope\left(Dates, Pit_{48}\right) \qquad m_{pit} = -3.181 \qquad y_{pit} := intercept\left(Dates, Pit_{48}\right) \qquad y_{pit} = 6.928 \cdot 10^3$$

The 95% Confidence curves are calculated

$$Pit_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$$

$$Pit_{actualmean} := mean(Dates) \qquad sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$$

$$uppit_f := Pit_{curve_f} \cdots$$

$$+ qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

Bay 1 Area 50-22

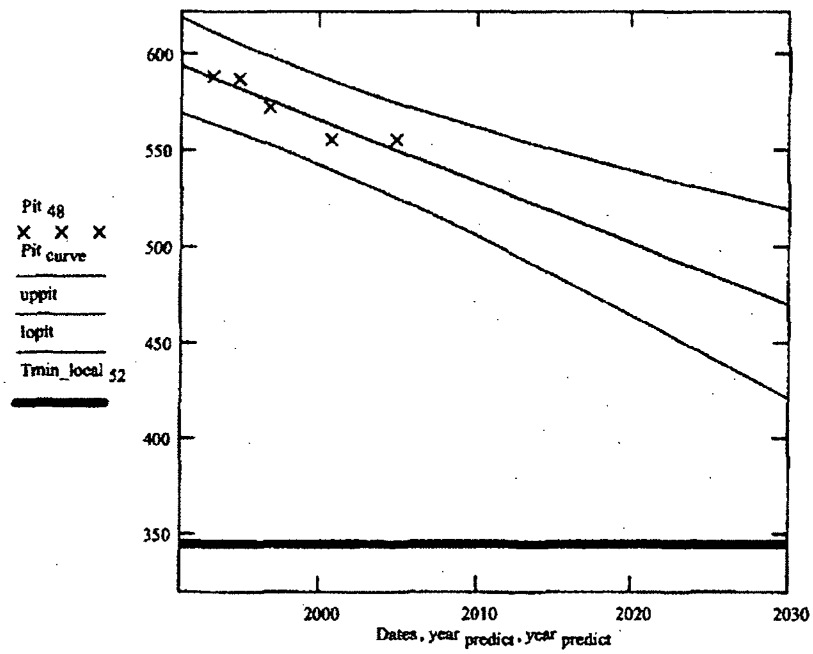
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A6-16 of 16

PF 5/19/05

$$lopit_f := Pit_{curve_f} \cdots + -\left[qt\left(1-\frac{\alpha_t}{2}, Total_{means}-2\right)\cdot StPit_{err}\cdot\sqrt{1+\frac{1}{(d+1)}+\frac{\left(year_{predict_f}-Pit_{actualmean}\right)^2}{sum}}\right]$$

Local Tmin for this elevation in the Drywell $Tmin\_local_{52_f} := 345$ (Ref. Calc. SE-000243-002)

Curve Fit For Pit 48 Projected to Plant End Of Life



$m_{pit} = -3.181$

$lopit_{22} = 425.816$ $year_{predict_{22}} = 2.029\cdot10^3$

Therefore based on regression model the above curve shows that this pit will not corrode to below minimum required thickness by the plant end of life.

$minpoint = 0.55$ $year_{predict_{22}} = 2.029\cdot10^3$ $Tmin\_local_{52_{22}} = 345$

$$required_{rate.} := \frac{\left(1000\cdot minpoint - Tmin\_local_{52_{22}}\right)}{\left(2005 - year_{predict}\right)_{22}}$$ $1000\cdot minpoint - Tmin\_local_{52_{22}} = 205$

$required_{rate.} = -8.542$

Appendix 7 Elevation 87' 5" Bay 9, Area 20

Nov 9, 2004 Data

The data shown below was collected on 11/9/2004

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D8620_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$$Points_{49} = \begin{bmatrix} 0.625 & 0.625 & 0.627 & 0.607 & 0.607 & 0.605 & 0.623 \\ 0.598 & 0.611 & 0.623 & 0.608 & 0.631 & 0.592 & 0.636 \\ 0.604 & 0.601 & 0.587 & 0.612 & 0.625 & 0.622 & 0.619 \\ 0.603 & 0.601 & 0.611 & 0.584 & 0.617 & 0.62 & 0.615 \\ 0.618 & 0.595 & 0.641 & 0.601 & 0.612 & 0.624 & 0.598 \\ 0.602 & 0.611 & 0.61 & 0.631 & 0.613 & 0.624 & 0.638 \\ 0.591 & 0.595 & 0.596 & 0.594 & 0.622 & 0.63 & 0.616 \end{bmatrix}$$

$Cells := convert(Points_{49}, 7)$

$No_{DataCells} := length(Cells)$

There are no pits for this location (reference 3.22).

$Cells := deletezero_{cells}(Cells, No_{DataCells})$

$No_{DataCells} := length(Cells)$

The thinnest point at this location is shown below

$minpoint := min(Points_{49})$

$minpoint = 0.584$

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(\text{Cells})$ $\mu_{actual} = 612.265$ $\sigma_{actual} := \text{Stdev}(\text{Cells})$ $\sigma_{actual} = 13.94$

Standard Error

$$\text{Standard}_{error} := \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}}$$

$\text{Standard}_{error} = 1.991$

Skewness

$$\text{Skewness} := \frac{(No_{DataCells}) \cdot \overrightarrow{\Sigma(\text{Cells} - \mu_{actual})^3}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (\sigma_{actual})^3}$$

$\text{Skewness} = 2.438 \cdot 10^{-3}$

Kurtosis

$$\text{Kurtosis} := \frac{No_{DataCells} \cdot (No_{DataCells} + 1) \cdot \overrightarrow{\Sigma(\text{Cells} - \mu_{actual})^4}}{(No_{DataCells} - 1) \cdot (No_{DataCells} - 2) \cdot (No_{DataCells} - 3) \cdot (\sigma_{actual})^4} + -\frac{3 \cdot (No_{DataCells} - 1)^2}{(No_{DataCells} - 2) \cdot (No_{DataCells} - 3)}$$

$\text{Kurtosis} = -0.736$

Normal Probability Plot

In a normal plot, each data value is plotted against what its value would be if it actually came from a normal distribution. The expected normal values, called normal scores, and can be estimated by first calculating the rank scores of the sorted data.

$j := 0 .. \text{last}(\text{Cells}) \qquad srt := \text{sort}(\text{Cells})$

Then each data point is ranked. The array rank captures these ranks

$$r_j := j + 1 \qquad rank_j := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt = srt_j}\right) \cdot r}}{\Sigma \overrightarrow{srt = srt_j}}$$

$$p_j := \frac{rank_j}{\text{rows}(\text{Cells}) + 1}$$

The normal scores are the corresponding *p*th percentile points from the standard normal distribution:

$x := 1 \qquad N\_Score_j := \text{root}\left[\text{cnorm}(x) - (p_j), x\right]$

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$$\alpha := .05 \qquad T\alpha := qt\left[\left(1-\frac{\alpha}{2}\right), 48\right] \qquad T\alpha = 2.011$$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha\cdot\frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 608.261$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha\cdot\frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 616.269$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$$Bins := Make_{bins}\left(\mu_{actual}, \sigma_{actual}\right)$$

$$Distribution := hist(Bins, Cells)$$

Distribution =

0	0
1	1
2	2
3	7
4	7
5	9
6	6
7	10
8	4
9	2
10	1
11	0

The mid points of the Bins are calculated

$$k := 0..11 \qquad Midpoints_k := \frac{\left(Bins_k + Bins_{k+1}\right)}{2}$$

The Mathcad function pnorm calculates a portion of normal distribution curve based on a given mean and standard deviation

$$normal_{curve_0} := pnorm\left(Bins_1, \mu_{actual}, \sigma_{actual}\right)$$

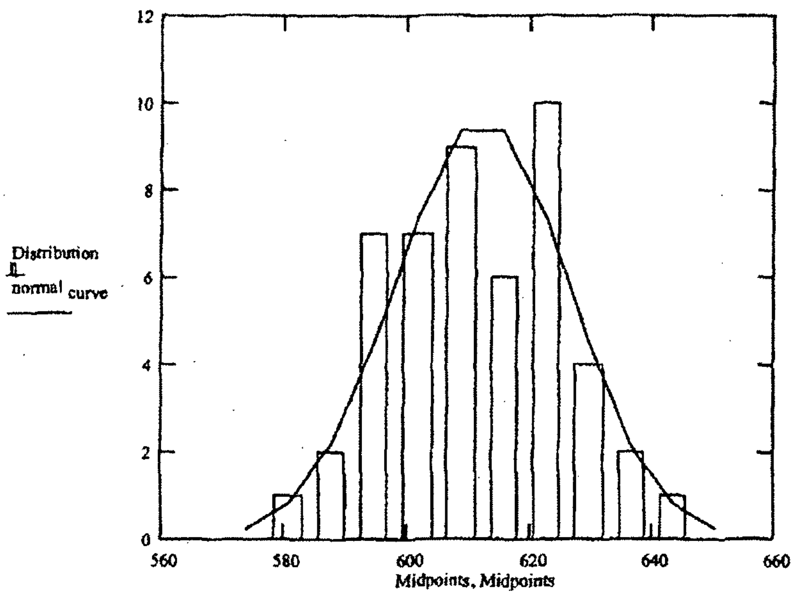
$$normal_{curve_k} := pnorm\left(Bins_{k+1}, \mu_{actual}, \sigma_{actual}\right) - pnorm\left(Bins_k, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve} := No_{DataCells}\cdot normal_{curve}$$

Results For Elevation 86' 5" Bay 9, Area 20
Sept. 17, 2000

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values. Below is the Normal Plot for the data.

Data Distribution



$\mu_{actual} = 612.265$

$\sigma_{actual} = 13.94$

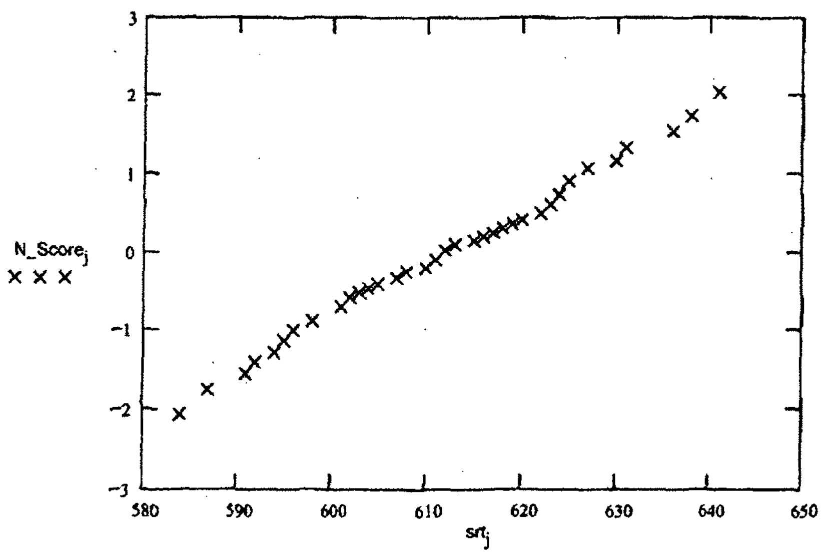
$\text{Standard}_{error} = 1.991$

$\text{Skewness} = 2.438 \cdot 10^{-3}$

$\text{Kurtosis} = -0.736$

$\text{Lower}_{95\%Con} = 608.261$ $\text{Upper}_{95\%Con} = 616.269$

Normal Probability Plot



Based on the Normal Probability Plot, Skewness, and the Kurtosis this data is normally distributed.

Bay 9 Area 20 Subject: Drywell Corrosion	Calc. No. C-1301-187-E310-037	Rev. No. ~~1~~ 2	System No. 187	Sheet No. A7- 6 of 23

PT 5/15/05

Elevation 86' 5" Bay 9, Area 20 Trend

Data from Feb 1990 to Sept 2000 is retrieved.

$d := 0$

For Nov. 6 1987

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov 1987 Data\DATA ONLY\D8620_N87.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(11, 06, 1987)$

Data

$$Points_{49} = \begin{bmatrix} 0.622 & 0.628 & 0.629 & 0.604 & 0.627 & 0.601 & 0.634 \\ 0.608 & 0.615 & 0.618 & 0.617 & 0.621 & 0.585 & 0.639 \\ 0.618 & 0.614 & 0.615 & 0.628 & 0.628 & 0.604 & 0.631 \\ 0.616 & 0.604 & 0.62 & 0.585 & 0.627 & 0.626 & 0.623 \\ 0.624 & 0.607 & 0.666 & 0.641 & 0.618 & 0.641 & 0.61 \\ 0.624 & 0.618 & 0.617 & 0.622 & 0.616 & 0.629 & 0.641 \\ 0.608 & 0.609 & 0.593 & 0.598 & 0.621 & 0.626 & 0.611 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20
Subject:
Drywell Corrosion

Calc. No. C-1301-187-E310-037 Rev. No. 1 ~~0~~ 5/15/05 System No. 187

For July 20 1988

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\July 1988 Data\DATA ONLY\D8620_J88.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(7, 20, 1988)$

Data

$$Points_{49} = \begin{bmatrix} 0.633 & 0.625 & 0.625 & 0.627 & 0.625 & 0.601 & 0.631 \\ 0.605 & 0.614 & 0.619 & 0.617 & 0.638 & 0.638 & 0.638 \\ 0.612 & 0.628 & 0.615 & 0.623 & 0.628 & 0.627 & 0.622 \\ 0.623 & 0.66 & 0.628 & 0.585 & 0.633 & 0.627 & 0.619 \\ 0.623 & 0.603 & 0.647 & 0.639 & 0.616 & 0.633 & 0.599 \\ 0.623 & 0.617 & 0.62 & 0.638 & 0.614 & 0.625 & 0.637 \\ 0.615 & 0.603 & 0.592 & 0.597 & 0.622 & 0.643 & 0.622 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

For Oct. 8 1988

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 1988 Data\DATA ONLY\D8620_O88.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(10, 8, 1988)$

Data

$$Points_{49} = \begin{bmatrix} 0.636 & 0.629 & 0.629 & 0.607 & 0.633 & 0.601 & 0.634 \\ 0.606 & 0.616 & 0.618 & 0.617 & 0.623 & 0.587 & 0.639 \\ 0.609 & 0.62 & 0.619 & 0.626 & 0.627 & 0.61 & 0.623 \\ 0.62 & 0.6 & 0.623 & 0.584 & 0.63 & 0.637 & 0.624 \\ 0.626 & 0.615 & 0.644 & 0.64 & 0.618 & 0.635 & 0.6 \\ 0.629 & 0.617 & 0.617 & 0.624 & 0.615 & 0.628 & 0.639 \\ 0.614 & 0.608 & 0.593 & 0.598 & 0.622 & 0.634 & 0.616 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

PS 5/15/05

$d := d + 1$

For June 26 1989

page := READPRN("U:\MSOFFICE\Drywell Program data\June 1989 Data\DATA ONLY\D8620_June89.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(6, 26, 1989)$

Data

$$Points_{49} = \begin{bmatrix} 0.628 & 0.628 & 0.627 & 0.605 & 0.625 & 0.601 & 0.634 \\ 0.61 & 0.613 & 0.62 & 0.621 & 0.626 & 0.59 & 0.654 \\ 0.611 & 0.612 & 0.615 & 0.623 & 0.628 & 0.61 & 0.622 \\ 0.622 & 0.603 & 0.615 & 0.583 & 0.627 & 0.625 & 0.623 \\ 0.623 & 0.606 & 0.631 & 0.64 & 0.619 & 0.636 & 0.6 \\ 0.621 & 0.618 & 0.616 & 0.626 & 0.616 & 0.628 & 0.64 \\ 0.641 & 0.609 & 0.593 & 0.597 & 0.62 & 0.635 & 0.618 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

KPS 5/15/05

For March 28 1990

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D8620_March90.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\text{Dates}_d := \text{Day}_{\text{year}}(3, 28, 1990)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.624 & 0.625 & 0.631 & 0.607 & 0.63 & 0.602 & 0.635 \\ 0.608 & 0.615 & 0.622 & 0.619 & 0.628 & 0.59 & 0.641 \\ 0.614 & 0.619 & 0.622 & 0.626 & 0.628 & 0.611 & 0.622 \\ 0.621 & 0.604 & 0.615 & 0.586 & 0.631 & 0.628 & 0.626 \\ 0.632 & 0.607 & 0.642 & 0.608 & 0.622 & 0.64 & 0.599 \\ 0.612 & 0.618 & 0.632 & 0.625 & 0.624 & 0.63 & 0.642 \\ 0.613 & 0.608 & 0.595 & 0.601 & 0.625 & 0.644 & 0.619 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

Bay 9 Area 20

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1 2	187	A7- 11 of 23

5/15/05

For Feb, 23 1991

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D8620_F91.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.619 & 0.623 & 0.626 & 0.605 & 0.633 & 0.601 & 0.634 \\ 0.602 & 0.612 & 0.616 & 0.615 & 0.619 & 0.584 & 0.638 \\ 0.607 & 0.609 & 0.614 & 0.62 & 0.624 & 0.604 & 0.619 \\ 0.612 & 0.598 & 0.61 & 0.58 & 0.619 & 0.621 & 0.619 \\ 0.617 & 0.6 & 0.638 & 0.604 & 0.624 & 0.634 & 0.604 \\ 0.608 & 0.612 & 0.615 & 0.619 & 0.615 & 0.623 & 0.638 \\ 0.609 & 0.602 & 0.595 & 0.594 & 0.619 & 0.628 & 0.611 \end{bmatrix}$$

$nnn := convert\left(Points_{49}, 7\right)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}\left(nnn, No_{DataCells}\right)$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2 00	187	A7- 12 of 23

5/15/05

$d := d + 1$

For May 23, 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D8620_M91.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\text{Dates}_d := \text{Day}_{\text{year}}(5, 23, 1991)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.624 & 0.623 & 0.624 & 0.606 & 0.627 & 0.598 & 0.63 \\ 0.603 & 0.612 & 0.616 & 0.613 & 0.618 & 0.586 & 0.636 \\ 0.609 & 0.602 & 0.61 & 0.618 & 0.621 & 0.609 & 0.618 \\ 0.615 & 0.595 & 0.61 & 0.581 & 0.622 & 0.59 & 0.604 \\ 0.622 & 0.601 & 0.615 & 0.602 & 0.615 & 0.631 & 0.595 \\ 0.609 & 0.614 & 0.608 & 0.619 & 0.608 & 0.624 & 0.636 \\ 0.606 & 0.602 & 0.592 & 0.593 & 0.62 & 0.625 & 0.614 \end{bmatrix}$$

$\text{nnn} := \text{convert}\left(\text{Points}_{49}, 7\right)$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\text{Cells} := \text{deletezero}_{\text{cells}}\left(\text{nnn}, \text{No}_{\text{DataCells}}\right)$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

$d := d + 1$

For May 30 1992

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D8620_M92.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\text{Dates}_d := \text{Day}_{\text{year}}(5, 30, 1992)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.623 & 0.664 & 0.63 & 0.606 & 0.631 & 0.603 & 0.637 \\ 0.61 & 0.618 & 0.623 & 0.622 & 0.63 & 0.694 & 0.645 \\ 0.618 & 0.617 & 0.621 & 0.631 & 0.638 & 0.632 & 0.634 \\ 0.628 & 0.644 & 0.625 & 0.593 & 0.635 & 0.635 & 0.633 \\ 0.631 & 0.617 & 0.653 & 0.65 & 0.629 & 0.65 & 0.643 \\ 0.636 & 0.626 & 0.623 & 0.641 & 0.628 & 0.637 & 0.649 \\ 0.619 & 0.615 & 0.605 & 0.61 & 0.628 & 0.645 & 0.627 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

Point 13 was deleted for this date (reference 30 calc.)

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 13)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\text{Standard}_{\text{error}_d} := \frac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

Bay 9 Area 20
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2	187	A7- 14 of 23

5/14/05

For Dec. 5 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D8620_D92.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.628 & 0.623 & 0.623 & 0.624 & 0.623 & 0.602 & 0.633 \\ 0.602 & 0.615 & 0.62 & 0.611 & 0.62 & 0.589 & 0.657 \\ 0.608 & 0.599 & 0.605 & 0.617 & 0.615 & 0.617 & 0.649 \\ 0.607 & 0.611 & 0.598 & 0.585 & 0.627 & 0.591 & 0.606 \\ 0.62 & 0.6 & 0.614 & 0.6 & 0.616 & 0.627 & 0.597 \\ 0.613 & 0.616 & 0.606 & 0.624 & 0.607 & 0.626 & 0.641 \\ 0.602 & 0.6 & 0.597 & 0.596 & 0.627 & 0.622 & 0.617 \end{bmatrix}$$

$nnn := convert\left(Points_{49}, 7\right)$ $\qquad$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}\left(nnn, No_{DataCells}\right)$

$\mu_{measured_d} := mean(Cells)$ $\quad$ $\sigma_{measured_d} := Stdev(Cells)$ $\quad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1 2	187	A7- 15 of 23

5/15/05

$d := d + 1$

For Sept. 14 1994

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D8620_94.txt")

$Dates_d := Day_{year}(9, 14, 1994)$

$Points_{49} := showcells(page, 7, 0)$

Data

$$Points_{49} = \begin{bmatrix} 0.629 & 0.623 & 0.623 & 0.61 & 0.623 & 0.599 & 0.632 \\ 0.602 & 0.616 & 0.613 & 0.615 & 0.621 & 0.592 & 0.635 \\ 0.605 & 0.601 & 0.605 & 0.616 & 0.618 & 0.62 & 0.623 \\ 0.61 & 0.603 & 0.605 & 0.586 & 0.624 & 0.59 & 0.605 \\ 0.622 & 0.601 & 0.613 & 0.602 & 0.617 & 0.63 & 0.598 \\ 0.612 & 0.618 & 0.608 & 0.625 & 0.608 & 0.627 & 0.639 \\ 0.604 & 0.603 & 0.598 & 0.597 & 0.625 & 0.618 & 0.616 \end{bmatrix}$$

$nnn := convert\left(Points_{49}, 7\right)$ $\qquad No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}\left(nnn, No_{DataCells}\right)$

$\mu_{measured_d} := mean(Cells) \qquad \sigma_{measured_d} := Stdev(Cells) \qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2	187	A7- 16 of 23

5/18/05

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D8620_96.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.616 & 0.616 & 0.62 & 0.623 & 0.624 & 0.597 & 0.627 \\ 0.597 & 0.609 & 0.614 & 0.614 & 0.622 & 0.581 & 0.634 \\ 0.606 & 0.607 & 0.619 & 0.617 & 0.622 & 0.598 & 0.616 \\ 0.578 & 0.591 & 0.613 & 0.58 & 0.6 & 0.612 & 0.618 \\ 0.618 & 0.605 & 0.625 & 0.63 & 0.608 & 0.63 & 0.595 \\ 0.598 & 0.61 & 0.613 & 0.619 & 0.616 & 0.623 & 0.633 \\ 0.608 & 0.607 & 0.591 & 0.624 & 0.651 & 0.647 & 0.611 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A7- 17 of 23

11 5/19/05

For Sept. 16 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D8620_00.txt")

$Points_{49} :=$ showcells(page , 7 , 0) $Dates_d := Day_{year}(9, 16, 2000)$

Data

$$Points_{49} = \begin{bmatrix} 0.626 & 0.62 & 0.621 & 0.613 & 0.595 & 0.599 & 0.599 \\ 0.598 & 0.61 & 0.6 & 0.577 & 0.616 & 0.59 & 0.63 \\ 0.609 & 0.594 & 0.581 & 0.609 & 0.616 & 0.617 & 0.617 \\ 0.603 & 0.604 & 0.584 & 0.582 & 0.617 & 0.587 & 0.6 \\ 0.612 & 0.592 & 0.599 & 0.596 & 0.61 & 0.62 & 0.592 \\ 0.581 & 0.607 & 0.597 & 0.617 & 0.608 & 0.62 & 0.633 \\ 0.573 & 0.599 & 0.591 & 0.592 & 0.622 & 0.612 & 0.6 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A7- 18 of 23

5/15/05

For Nov 9 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D8620_00.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(11, 9, 2004)$

Data

$$Points_{49} = \begin{bmatrix} 0.625 & 0.625 & 0.627 & 0.607 & 0.607 & 0.605 & 0.623 \\ 0.598 & 0.611 & 0.623 & 0.608 & 0.631 & 0.592 & 0.636 \\ 0.604 & 0.601 & 0.587 & 0.612 & 0.625 & 0.622 & 0.619 \\ 0.603 & 0.601 & 0.611 & 0.584 & 0.617 & 0.62 & 0.615 \\ 0.618 & 0.595 & 0.641 & 0.601 & 0.612 & 0.624 & 0.598 \\ 0.602 & 0.611 & 0.61 & 0.631 & 0.613 & 0.624 & 0.638 \\ 0.591 & 0.595 & 0.596 & 0.594 & 0.622 & 0.63 & 0.616 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 9 Area 20

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	2	187	A7- 19 of 23

5/15/05

Below are matrices which contain the date when the data was collected, Mean, Standard Deviation, Standard Error for each date.

Dates =

$1.988 \cdot 10^3$
$1.989 \cdot 10^3$
$1.989 \cdot 10^3$
$1.989 \cdot 10^3$
$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$

$\mu_{measured}$ =	$Standard_{error}$ =	$\sigma_{measured}$ =
618.918	2.096	14.675
622.327	2.064	14.447
619.571	1.984	13.885
619.061	1.985	13.896
619.755	1.939	13.575
614.122	1.861	13.027
611.653	1.809	12.66
628.917	2.024	14.166
613.735	2.105	14.733
612.755	1.74	12.18
612.918	2.184	15.285
603.816	2.051	14.359
612.265	1.991	13.94

$Total_{means} := rows(\mu_{measured})$ $Total_{means} = 13$

The F-Ratio is calculated

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2$$ $SSE = 286.631$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2$$ $SSR = 174.693$

$DegreeFree_{ss} := Total_{means} - 2$ $DegreeFree_{reg} := 1$

$MSE := \frac{SSE}{DegreeFree_{ss}}$ $MSE = 26.057$ $MSR := \frac{SSR}{DegreeFree_{reg}}$ $MSR = 174.693$

$StGrand_{err} := \sqrt{MSE}$ $StGrand_{err} = 5.105$

Bay 9 Area 20
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2	187	A7- 21 of 23

5/14/05

$F_{actaul} := \frac{MSR}{MSE}$

$\alpha := 0.05$

$F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right)$

$F_{ratio} := \frac{F_{actaul}}{F_{critical}}$

$F_{ratio} = 1.384$

Therefore the curve fit of the means seems to have a slope and the grandmean is not an accurate measure of the thickness at this location

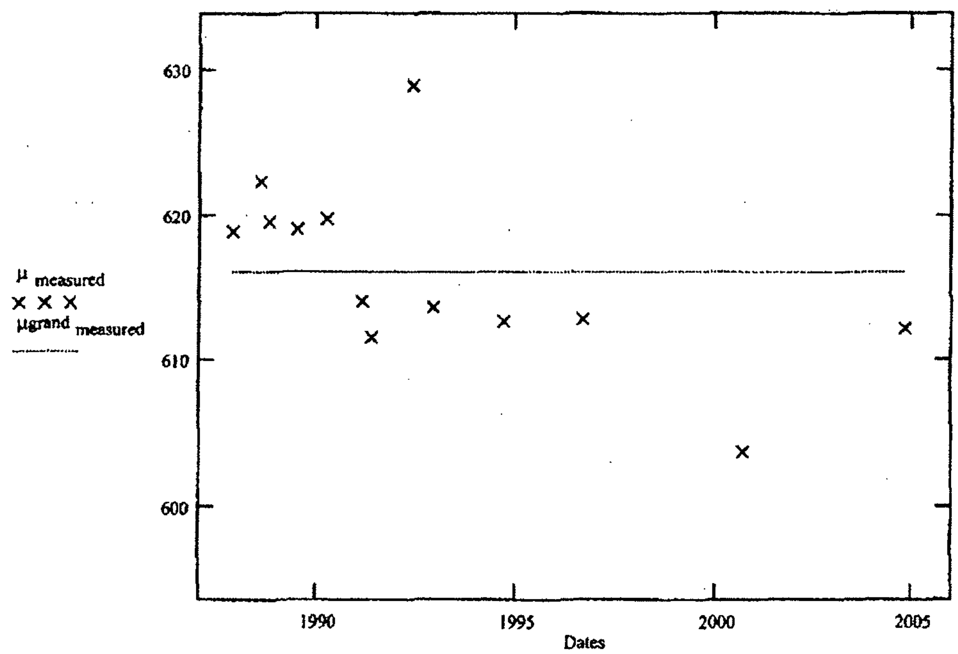
$i := 0 .. Total_{means} - 1$

$\mu grand_{measured_i} := mean\left(\mu_{measured}\right)$

$\sigma grand_{measured} := Stdev\left(\mu_{measured}\right)$

$GrandStandard_{error_0} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$

Plot of the grand mean and the actual means over time



$\mu grand_{measured_0} = 616.14$

$GrandStandard_{error} = 1.72$

Therefore the corrosion rate is calculated and compared to the minimum required wall thickness at this elevation

$m_s := \text{slope}(\text{Dates}, \mu_{\text{measured}})$ $\quad m_s = -0.754$ $\quad y_b := \text{intercept}(\text{Dates}, \mu_{\text{measured}})$ $\quad y_b = 2.119 \cdot 10^3$

The 95% Confidence curves are calculated

$\alpha_t := 0.05 \quad k := 23 \quad f := 0 .. k - 1$

$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2 \quad \text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$

$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates}) \qquad \text{sum} := \sum_i (\text{Dates}_d - \text{mean}(\text{Dates}))^2$

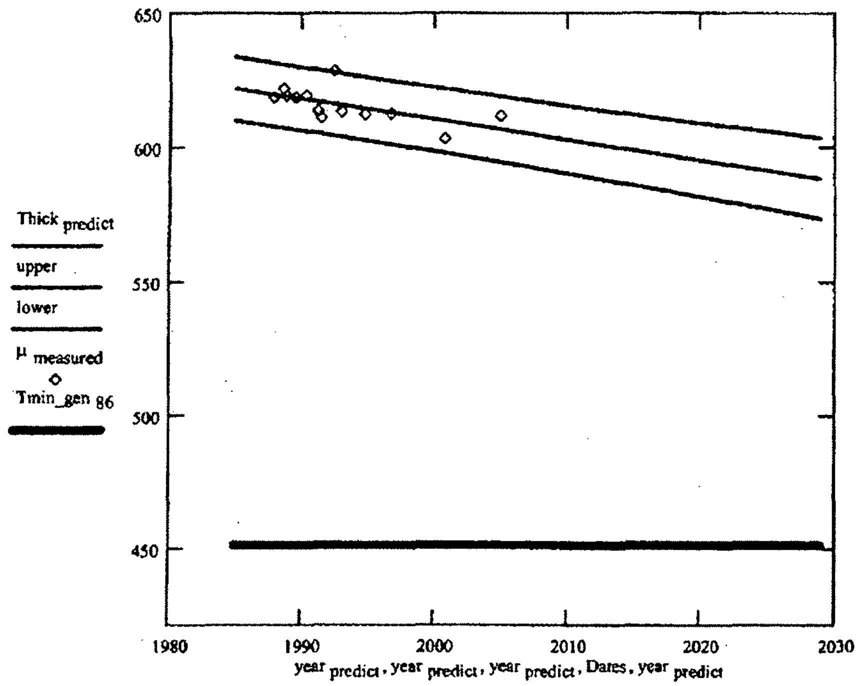
$$\text{upper}_f := \text{Thick}_{\text{predict}_f} \cdots + \text{qt}\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}$$

$$\text{lower}_f := \text{Thick}_{\text{predict}_f} \cdots + -\left[\text{qt}\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}\right]$$

5/15/05

The minimum required thickness at this elevation is $Tmin\_gen_{86_f} := 452$ (Ref. Calc. SE-000243-002)

Location Curve Fit Projected to Plant End Of Life



$m_s = -0.754$

$year_{predict_{12}} = 2.009 \cdot 10^3$ $\quad Thick_{predict_{12}} = 604.115$

Therefore the regression model shows that even at the lower 95% confidence band this location will not corrode to below Drywell Vessel Minimum required thickness by the plant end of life.

No Pits have been identified for this location

5/18/05

Appendix 8 - Elevation 87' 5" Bay 13, Area 28

Nov 9, 2004 Data

The data shown below was collected on 11/9/2004 (reference NDE data sheet 2000-034-007).

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D8628_00.txt")

$Points_{49} := showcells(page, 7, 0)$

$Points_{49}$ =

0.596	0.611	0.643	0.642	0.648	0.653	0.618
0.63	0.639	0.647	0.65	0.624	0.64	0.618
0.628	0.644	0.642	0.612	0.645	0.651	0.652
0.61	0.628	0.634	0.571	0.609	0.654	0.648
0.625	0.617	0.639	0.624	0.641	0.657	0.655
0.601	0.64	0.655	0.654	0.649	0.637	0.652
0.634	0.634	0.623	0.653	0.648	0.615	0.648

$Cells := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(Cells)$

For the D8628 location points 1,2,22,25,26,36 and 48 were omitted for the data (Ref. 3.22)

$Cells := Zero_{one}(Cells, No_{DataCells}, 1)$ $\quad Cells := Zero_{one}(Cells, No_{DataCells}, 25)$

$Cells := Zero_{one}(Cells, No_{DataCells}, 2)$ $\quad Cells := Zero_{one}(Cells, No_{DataCells}, 26)$

$Cells := Zero_{one}(Cells, No_{DataCells}, 22)$ $\quad Cells := Zero_{one}(Cells, No_{DataCells}, 36)$

$Cells := Zero_{one}(Cells, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(Cells, No_{DataCells})$

$No_{DataCells} := length(Cells)$

The thinnest point at this location is shown below

$minpoint := min(Points_{49})$

$minpoint = 0.571$

Bay 13 Area 28

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A8- 2 of 26

5/15/05

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(Cells)$ $\mu_{actual} = 639.881$ $\sigma_{actual} := \text{Stdev}(Cells)$ $\sigma_{actual} = 12.333$

Standard Error

$$Standard_{error} := \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}}$$ $Standard_{error} = 1.903$

Skewness

$$Skewness := \frac{(No_{DataCells})\cdot\sum\overrightarrow{(Cells - \mu_{actual})^3}}{(No_{DataCells} - 1)\cdot(No_{DataCells} - 2)\cdot(\sigma_{actual})^3}$$ $Skewness = -0.602$

Kurtosis

$$Kurtosis := \frac{No_{DataCells}\cdot(No_{DataCells} + 1)\cdot\sum\overrightarrow{(Cells - \mu_{actual})^4}}{(No_{DataCells} - 1)\cdot(No_{DataCells} - 2)\cdot(No_{DataCells} - 3)\cdot(\sigma_{actual})^4} + -\frac{3\cdot(No_{DataCells} - 1)^2}{(No_{DataCells} - 2)\cdot(No_{DataCells} - 3)}$$ $Kurtosis = -0.702$

Normal Probability Plot

In a normal plot, each data value is plotted against what its value would be if it actually came from a normal distribution. The expected normal values, called normal scores, and can be estimated by first calculating the rank scores of the sorted data.

$j := 0 .. \mathrm{last}(Cells) \qquad srt := \mathrm{sort}(Cells)$

Then each data point is ranked. The array rank captures these ranks

$$r_j := j + 1 \qquad rank_j := \frac{\overrightarrow{\Sigma\left(\overrightarrow{srt = srt_j}\right)\cdot r}}{\Sigma \overrightarrow{srt = srt_j}}$$

$$p_j := \frac{rank_j}{\mathrm{rows}(Cells) + 1}$$

The normal scores are the corresponding *p*th percentile points from the standard *normal distribution:*

$x := 1 \qquad N\_Score_j := \mathrm{root}\left[\mathrm{cnorm}(x) - \left(p_j\right), x\right]$

1 5/15/05

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$\alpha := .05$ $T\alpha := qt\left[\left(1 - \frac{\alpha}{2}\right), 48\right]$ $T\alpha = 2.011$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 636.055$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 643.707$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$Bins := Make_{bins}\left(\mu_{actual}, \sigma_{actual}\right)$

$Distribution := hist(Bins, Cells)$

Distribution =

0
1
3
4
3
6
8
10
7
0
0
0

The mid points of the Bins are calculated

$k := 0..11$ $Midpoints_k := \frac{\left(Bins_k + Bins_{k+1}\right)}{2}$

The Mathcad function pnorm calculates a portion of normal distribution curve based on a given mean and standard deviation

$$normal_{curve_0} := pnorm\left(Bins_1, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve_k} := pnorm\left(Bins_{k+1}, \mu_{actual}, \sigma_{actual}\right) - pnorm\left(Bins_k, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve} := No_{DataCells} \cdot normal_{curve}$$

Bay 13 Area 28

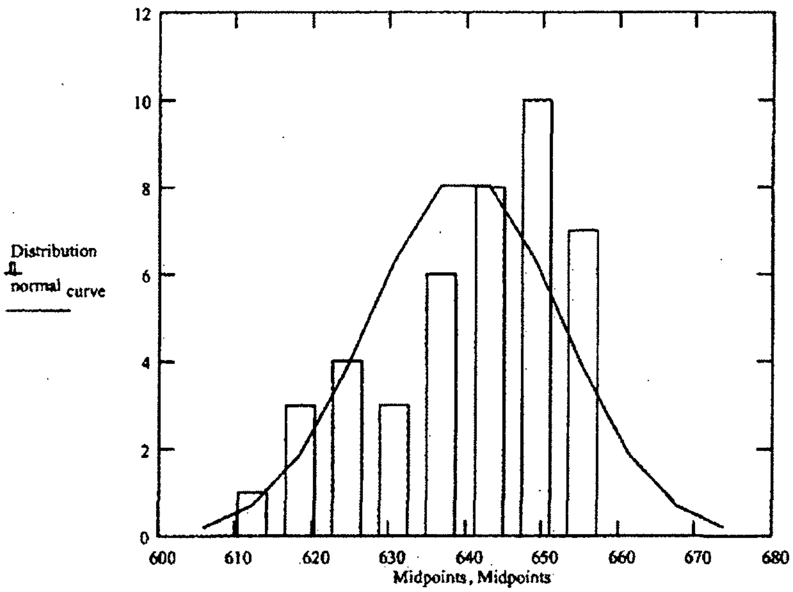
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2	187	A8- 5 of 26

PF 5/15/05

Results For Elevation 86' 5" Bay 13, Area 28
Sept. 17, 2000

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values. Below is the Normal Plot for the data.

Data Distribution



$\mu_{actual} = 639.881$

$\sigma_{actual} = 12.333$

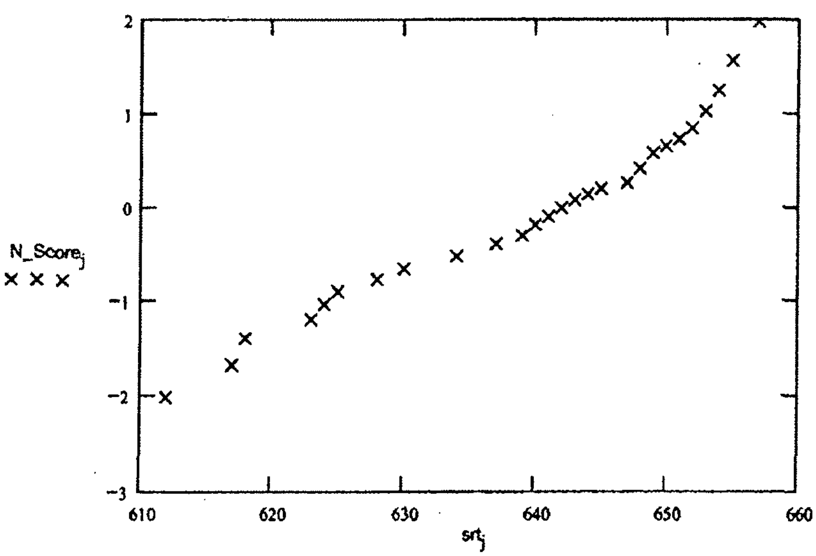
$\text{Standard}_{error} = 1.903$

Skewness = −0.602

Kurtosis = −0.702

$\text{Lower}_{95\%Con} = 636.055$ $\text{Upper}_{95\%Con} = 643.707$

Normal Probability Plot



Based on the Normal Probability Plot, Skewness, and the Kurtosis this data is normally distributed.

PTS/15/05

Elevation 86' 5" Bay 13, Area 28 Trend

Data from Feb 1990 to Sept 2000 is retrieved.

$d := 0$

For Nov. 10 1987

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov 1987 Data\DATA ONLY\D8628_N87.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\qquad \text{Dates}_d := \text{Day}_{\text{year}}(11, 10, 1987)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.602 & 0.613 & 0.645 & 0.643 & 0.643 & 0.653 & 0.633 \\ 0.627 & 0.639 & 0.652 & 0.653 & 0.625 & 0.642 & 0.62 \\ 0.623 & 0.64 & 0.649 & 0.621 & 0.646 & 0.651 & 0.655 \\ 0.602 & 0.637 & 0.63 & 0.575 & 0.61 & 0.656 & 0.654 \\ 0.629 & 0.627 & 0.652 & 0.629 & 0.649 & 0.655 & 0.66 \\ 0.59 & 0.639 & 0.638 & 0.662 & 0.651 & 0.641 & 0.661 \\ 0.641 & 0.639 & 0.628 & 0.66 & 0.653 & 0.618 & 0.652 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7) \qquad \text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$\text{Pit}_{1_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 1) \qquad \text{Pit}_{25_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{Pit}_{2_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 2) \qquad \text{Pit}_{26_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 26)$

$\text{Pit}_{22_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 22) \qquad \text{Pit}_{36_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 36)$

$\text{Pit}_{48_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 48)$

These points are deleted from the mean calculation

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 1) \qquad \text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 25)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 2) \qquad \text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 26)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 22) \qquad \text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 36)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 48)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells}) \qquad \sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells}) \qquad \text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

$d := d + 1$

For July 20 1988

page := READPRN("U:\MSOFFICE\Drywell Program data\July 1988 Data\DATA ONLY\D8628_J88.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(7, 20, 1988)$

Data

$$Points_{49} = \begin{bmatrix} 0.596 & 0.608 & 0.643 & 0.64 & 0.643 & 0.645 & 0.627 \\ 0.626 & 0.638 & 0.648 & 0.648 & 0 & 0 & 0.621 \\ 0.624 & 0.641 & 0.647 & 0.617 & 0.646 & 0.649 & 0.652 \\ 0.596 & 0.635 & 0.633 & 0.572 & 0.602 & 0.655 & 0.651 \\ 0.627 & 0.624 & 0.647 & 0.626 & 0.646 & 0.652 & 0.657 \\ 0.587 & 0.643 & 0.64 & 0.657 & 0.654 & 0.636 & 0.652 \\ 0.636 & 0.632 & 0.621 & 0.658 & 0.65 & 0.62 & 0.646 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $\qquad$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $\qquad$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $\qquad$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For Oct. 8 1988

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 1988 Data\DATA ONLY\D8628_O88.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(10, 8, 1988)$

Data

$Points_{49}$ =

0.595	0.611	0.647	0.647	0.646	0.656	0.623
0.632	0.643	0.65	0.651	0.63	0.64	0.626
0.628	0.645	0.651	0.62	0.646	0.649	0.656
0.6	0.636	0.638	0.579	0.601	0.657	0.654
0.631	0.626	0.642	0.627	0.649	0.657	0.659
0.585	0.639	0.639	0.657	0.642	0.639	0.652
0.638	0.633	0.628	0.637	0.634	0.612	0.648

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 13 Area 28

Subject: Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	1 2	187	A8- 9 of 26

5/15/05

For June 26 1989

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\June 1989 Data\DATA ONLY\D8628_June89.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(6, 26, 1989)$

Data

$$Points_{49} = \begin{bmatrix} 0.598 & 0.611 & 0.646 & 0.645 & 0.643 & 0.659 & 0.627 \\ 0.637 & 0.644 & 0.652 & 0.654 & 0.628 & 0.641 & 0.624 \\ 0.623 & 0.648 & 0.653 & 0.618 & 0.648 & 0.653 & 0.661 \\ 0.629 & 0.636 & 0.638 & 0.576 & 0.604 & 0.659 & 0.654 \\ 0.632 & 0.627 & 0.648 & 0.632 & 0.65 & 0.66 & 0.662 \\ 0.597 & 0.637 & 0.638 & 0.661 & 0.65 & 0.641 & 0.658 \\ 0.639 & 0.637 & 0.626 & 0.67 & 0.663 & 0.626 & 0.657 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

PA 5/11/05

For March 28 1990

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D8628_March90.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(3, 28, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.595 & 0.611 & 0.642 & 0.643 & 0.638 & 0.649 & 0.627 \\ 0.63 & 0.644 & 0.654 & 0.654 & 0.624 & 0.639 & 0.62 \\ 0.624 & 0.642 & 0.651 & 0.623 & 0.648 & 0.65 & 0.657 \\ 0.601 & 0.641 & 0.636 & 0.55 & 0.608 & 0.658 & 0.649 \\ 0.636 & 0.627 & 0.64 & 0.628 & 0.648 & 0.654 & 0.661 \\ 0.604 & 0.624 & 0.636 & 0.66 & 0.646 & 0.64 & 0.658 \\ 0.638 & 0.635 & 0.642 & 0.662 & 0.66 & 0.619 & 0.652 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit\,1_d := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $Pit\,25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit\,2_d := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $Pit\,26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit\,22_d := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $Pit\,36_d := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit\,48_d := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/05

$d := d + 1$

For Feb, 23 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D8628_F91.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.593 & 0.606 & 0.64 & 0.637 & 0.636 & 0.644 & 0.622 \\ 0.622 & 0.634 & 0.645 & 0.648 & 0.619 & 0.633 & 0.616 \\ 0.615 & 0.633 & 0.646 & 0.62 & 0.642 & 0.646 & 0.65 \\ 0.594 & 0.63 & 0.629 & 0.577 & 0.598 & 0.649 & 0.644 \\ 0.622 & 0.619 & 0.631 & 0.625 & 0.642 & 0.648 & 0.654 \\ 0.578 & 0.626 & 0.63 & 0.652 & 0.638 & 0.632 & 0.648 \\ 0.632 & 0.63 & 0.614 & 0.632 & 0.654 & 0.607 & 0.643 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit\,1_d := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$

$Pit\,25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit\,2_d := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$

$Pit\,26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit\,22_d := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$

$Pit\,36_d := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit\,48_d := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$

$\sigma_{measured_d} := Stdev(Cells)$

$$Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$$

Bay 13 Area 28

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	~~1~~ 2 01 5/19/05	187	A8- 12 of 26

$d := d + 1$

For May 23, 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D8628_M91.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.633 & 0.629 & 0.619 & 0.631 & 0.628 & 0.608 & 0.644 \\ 0.596 & 0.608 & 0.642 & 0.638 & 0.637 & 0.646 & 0.622 \\ 0.625 & 0.636 & 0.646 & 0.648 & 0.62 & 0.635 & 0.616 \\ 0.615 & 0.636 & 0.645 & 0.612 & 0.642 & 0.644 & 0.649 \\ 0.595 & 0.629 & 0.629 & 0.549 & 0.598 & 0.65 & 0.644 \\ 0.625 & 0.62 & 0.637 & 0.623 & 0.644 & 0.651 & 0.654 \\ 0.578 & 0.616 & 0.632 & 0.654 & 0.641 & 0.634 & 0.649 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $\qquad$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $\qquad$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $\qquad$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/05

For May 30 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D8628_M92.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(5, 30, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.602 & 0.614 & 0.643 & 0.638 & 0.641 & 0.65 & 0.625 \\ 0.625 & 0.639 & 0.647 & 0.649 & 0.624 & 0.638 & 0.621 \\ 0.616 & 0.639 & 0.646 & 0.616 & 0.644 & 0.647 & 0.654 \\ 0.6 & 0.633 & 0.634 & 0.573 & 0.604 & 0.654 & 0.65 \\ 0.63 & 0.626 & 0.639 & 0.627 & 0.648 & 0.656 & 0.66 \\ 0.585 & 0.644 & 0.641 & 0.656 & 0.651 & 0.638 & 0.66 \\ 0.638 & 0.633 & 0.627 & 0.659 & 0.653 & 0.621 & 0.65 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $\qquad Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $\qquad Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $\qquad Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

For Dec. 5 1992

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D8628_D92.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.583 & 0.605 & 0.642 & 0.64 & 0.637 & 0.642 & 0.622 \\ 0.633 & 0.631 & 0.649 & 0.651 & 0.619 & 0.632 & 0.616 \\ 0.622 & 0.634 & 0.64 & 0.608 & 0.644 & 0.647 & 0.652 \\ 0.61 & 0.627 & 0.634 & 0.548 & 0.602 & 0.649 & 0.644 \\ 0.635 & 0.619 & 0.635 & 0.627 & 0.642 & 0.653 & 0.656 \\ 0.586 & 0.632 & 0.63 & 0.656 & 0.65 & 0.636 & 0.652 \\ 0.619 & 0.636 & 0.618 & 0.656 & 0.646 & 0.613 & 0.648 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 13 Area 28
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-E310-037	~~1~~ 2	187	A8- 15 of 26

05/15/05

For Sept. 14 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D8628_94.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(9, 14, 1994)$

Data

$$Points_{49} = \begin{bmatrix} 0.58 & 0.608 & 0.644 & 0.644 & 0.639 & 0.647 & 0.624 \\ 0.629 & 0.64 & 0.651 & 0.653 & 0.624 & 0.635 & 0.622 \\ 0.621 & 0.639 & 0.647 & 0.614 & 0.648 & 0.65 & 0.655 \\ 0.604 & 0.632 & 0.636 & 0.551 & 0.603 & 0.656 & 0.648 \\ 0.628 & 0.624 & 0.637 & 0.629 & 0.647 & 0.659 & 0.661 \\ 0.583 & 0.629 & 0.633 & 0.659 & 0.649 & 0.639 & 0.652 \\ 0.635 & 0.634 & 0.62 & 0.635 & 0.651 & 0.615 & 0.651 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit1_d := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $\qquad$ $Pit25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit2_d := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $\qquad$ $Pit26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit22_d := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $\qquad$ $Pit36_d := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit48_d := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/05

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D8628_96.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.587 & 0.609 & 0.641 & 0.636 & 0.635 & 0.646 & 0.619 \\ 0.622 & 0.634 & 0.645 & 0.647 & 0.62 & 0.634 & 0.615 \\ 0.618 & 0.638 & 0.644 & 0.611 & 0.644 & 0.646 & 0.65 \\ 0.592 & 0.634 & 0.632 & 0.546 & 0.598 & 0.65 & 0.646 \\ 0.628 & 0.627 & 0.635 & 0.623 & 0.645 & 0.653 & 0.656 \\ 0.579 & 0.614 & 0.638 & 0.653 & 0.648 & 0.636 & 0.651 \\ 0.634 & 0.621 & 0.626 & 0.631 & 0.638 & 0.627 & 0.647 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/19/05

$d := d + 1$

For Sept 16, 2000

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D8628_00.txt")

$Points_{49} := showcells(page, 7, 0)$ $\quad Dates_d := Day_{year}(09, 16, 2000)$

Data

$$Points_{49} = \begin{bmatrix} 0.584 & 0.6 & 0.638 & 0.638 & 0.637 & 0.64 & 0.617 \\ 0.629 & 0.63 & 0.646 & 0.647 & 0.618 & 0.633 & 0.616 \\ 0.618 & 0.634 & 0.641 & 0.61 & 0.643 & 0.647 & 0.648 \\ 0.61 & 0.629 & 0.632 & 0.545 & 0.601 & 0.649 & 0.644 \\ 0.624 & 0.616 & 0.634 & 0.623 & 0.639 & 0.649 & 0.654 \\ 0.583 & 0.622 & 0.628 & 0.655 & 0.647 & 0.633 & 0.651 \\ 0.618 & 0.633 & 0.616 & 0.651 & 0.646 & 0.612 & 0.645 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\quad No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit1_d := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $\quad Pit25_d := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit2_d := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $\quad Pit26_d := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit22_d := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $\quad Pit36_d := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit48_d := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $\quad nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\quad \sigma_{measured_d} := Stdev(Cells)$ $\quad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 13 Area 28
Subject:
Drywell Corrosion

Calc. No. C-1301-187-E310-037 | Rev. No. 1/2 5/15/05 | System No. 187 | Sheet No. A8- 18 of 26

For Nov 9 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D8628_00.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(11, 9, 2004)$

Data

$$Points_{49} = \begin{bmatrix} 0.596 & 0.611 & 0.643 & 0.642 & 0.648 & 0.653 & 0.618 \\ 0.63 & 0.639 & 0.647 & 0.65 & 0.624 & 0.64 & 0.618 \\ 0.628 & 0.644 & 0.642 & 0.612 & 0.645 & 0.651 & 0.652 \\ 0.61 & 0.628 & 0.634 & 0.571 & 0.609 & 0.654 & 0.648 \\ 0.625 & 0.617 & 0.639 & 0.624 & 0.641 & 0.657 & 0.655 \\ 0.601 & 0.64 & 0.655 & 0.654 & 0.649 & 0.637 & 0.652 \\ 0.634 & 0.634 & 0.623 & 0.653 & 0.648 & 0.615 & 0.648 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

For this location points 1,2,22,25,26,36 and 48 are pits. Therefore these points are trended separately

$Pit_{1_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 1)$ $\qquad$ $Pit_{25_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 25)$

$Pit_{2_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 2)$ $\qquad$ $Pit_{26_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 26)$

$Pit_{22_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 22)$ $\qquad$ $Pit_{36_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 36)$

$Pit_{48_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 48)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 1)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 25)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 2)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 26)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 22)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 36)$

$nnn := Zero_{one}(nnn, No_{DataCells}, 48)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Below are matrices which contain the date when the data was collected, Mean, Standard Deviation, Standard Error for each date.

Dates =

$1.988 \cdot 10^3$
$1.989 \cdot 10^3$
$1.989 \cdot 10^3$
$1.989 \cdot 10^3$
$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$
$2.001 \cdot 10^3$
$2.005 \cdot 10^3$

$\mu_{measured}$ = , $Standard_{error}$ = , $\sigma_{measured}$ =

$\mu_{measured}$	$Standard_{error}$	$\sigma_{measured}$
642.929	1.708	11.954
640.825	1.631	11.417
641.619	1.522	10.654
644.738	1.844	12.905
642.619	1.701	11.906
635.048	1.645	11.512
628.857	3.118	21.825
640.69	1.723	12.06
637.167	1.782	12.472
639.762	1.742	12.191
635.976	1.717	12.017
634.952	1.778	12.449
639.881	1.762	12.333

$Total_{means} := rows(\mu_{measured})$ $Total_{means} = 13$

The F-Ratio is calculated

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2 \qquad SSE = 203.496$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2 \qquad SSR = 19.464$$

$DegreeFree_{ss} := Total_{means} - 2$ $DegreeFree_{reg} := 1$

$$MSE := \frac{SSE}{DegreeFree_{ss}} \qquad MSE = 18.5 \qquad MSR := \frac{SSR}{DegreeFree_{reg}} \qquad MSR = 19.464$$

$StGrand_{err} := \sqrt{MSE}$ $StGrand_{err} = 4.301$

$F_{actaul} := \frac{MSR}{MSE}$

$\alpha := 0.05$

$F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right)$

$F_{ratio} := \frac{F_{actaul}}{F_{critical}}$

$F_{ratio} = 0.217$

Therefore the there is no ongoing corrosion

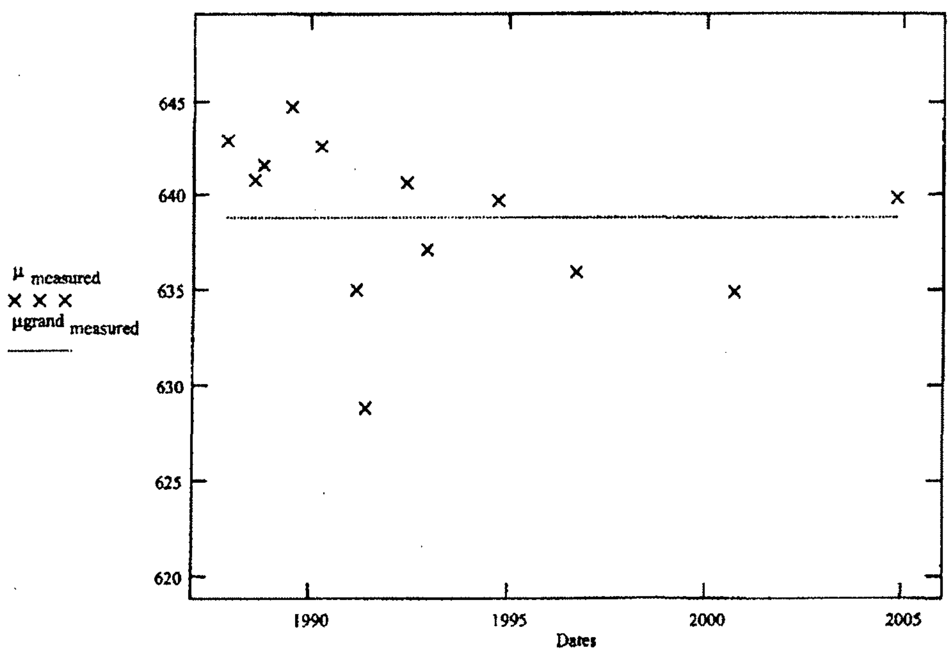
$i := 0 .. Total_{means} - 1$

$\mu grand_{measured_i} := mean\left(\mu_{measured}\right)$

$\sigma grand_{measured} := Stdev\left(\mu_{measured}\right)$

$GrandStandard_{error_0} := \frac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$

Plot of the grand mean and the actual means over time



$\mu grand_{measured_0} = 638.851$

$GrandStandard_{error} = 1.196$

Bay 13 Area 28				
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	2	187	A8- 22 of 26

However to ensure conservatism the apparent corrosion rate is calculated and compared to the minimum required wall thickness at this elevation

$$m_s := \text{slope}\left(\text{Dates}, \mu_{\text{measured}}\right) \quad m_s = -0.252 \quad y_b := \text{intercept}\left(\text{Dates}, \mu_{\text{measured}}\right) \; y_b = 1.141 \cdot 10^3$$

The 95% Confidence curves are calculated

$$\alpha_t := 0.05 \quad k := 23 \quad f := 0..k-1$$

$$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2 \quad \text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$$

$$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates}) \qquad \text{sum} := \sum_i \left(\text{Dates}_d - \text{mean}(\text{Dates})\right)^2$$

$$\text{upper}_f := \text{Thick}_{\text{predict}_f} \cdots + \text{qt}\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}$$

$$\text{lower}_f := \text{Thick}_{\text{predict}_f} \cdots + -\left[\text{qt}\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}\right]$$

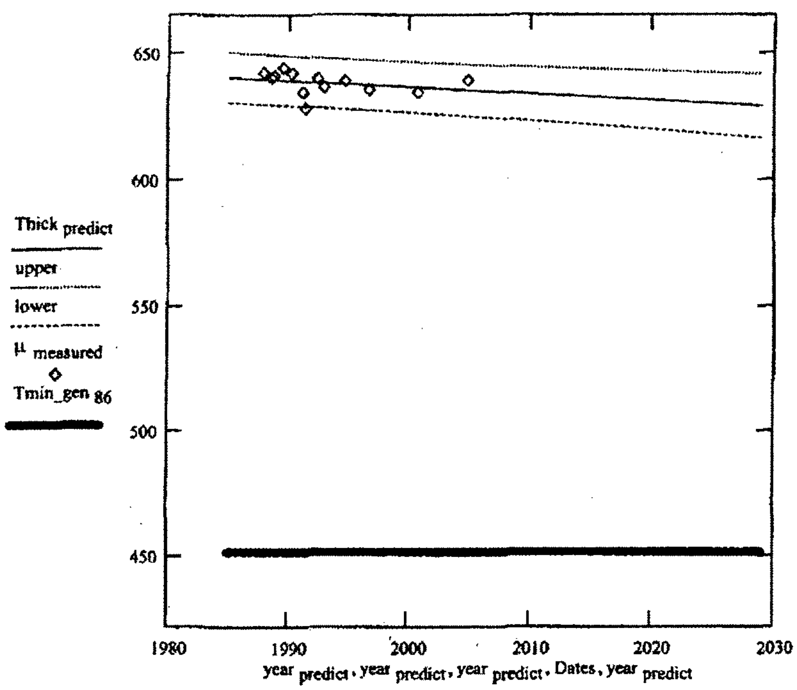
Bay 13 Area 28

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-E310-037	1/2	187	A8- 23 of 26

RS 5/15/05

The minimum required thickness at this elevation is $Tmin\_gen_{86_r} := 452$ (Ref. Calc. SE-000243-002)

Location Curve Fit Projected to Plant End Of Life



$m_s = -0.252$

Therefore even though the regression model does not apply it still shows that the lower 95% confidence band will not corrode to below Drywell Vessel Minimum required thickness by the plant end of life.

$lower_{22} = 617.133$ $year_{predict_{22}} = 2.029 \cdot 10^3$

The Following trends are shown for the pits

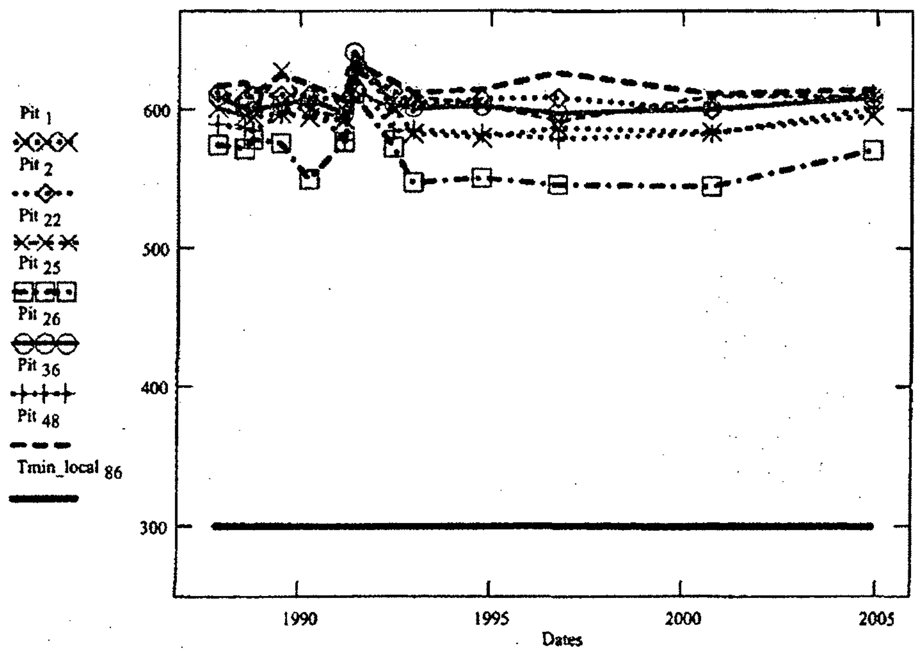
Local Tmin for this elevation in the Drywell $Tmin\_local_{86_r} := 300$ (Ref. Calc. SE-000243-002)

$A_i :=$

max(Pit 1)
max(Pit 2)
max(Pit 22)
max(Pit 25)
max(Pit 26)
max(Pit 36)
max(Pit 48)

$B_i :=$

min(Pit 1)
min(Pit 2)
min(Pit 22)
min(Pit 25)
min(Pit 26)
min(Pit 36)
min(Pit 48)



Pit w

02 5/15/05

The following addresses possible corrosion in these pits

The F-Ratio is calculated for the worse pit (pit # 25)

$$SSE_{pit} := \sum_{i=0}^{last(Dates)} \left(Pit_{25_i} - yhat\left(Dates, Pit_{25}\right)_i\right)^2 \qquad SSE_{pit} = 3.749 \cdot 10^3$$

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat\left(Dates, Pit_{25}\right)_i - mean\left(Pit_{25}\right)\right)^2 \qquad SSR_{pit} = 572.064$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 0.347$$

Therefore this pit is not experiencing corrosion

$$m_{pit} := slope\left(Dates, Pit_{25}\right) \qquad m_{pit} = -1.365 \qquad y_{pit} := intercept\left(Dates, Pit_{25}\right) \qquad y_{pit} = 3.288 \cdot 10^3$$

The 95% Confidence curves are calculated

$$Pit_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$$

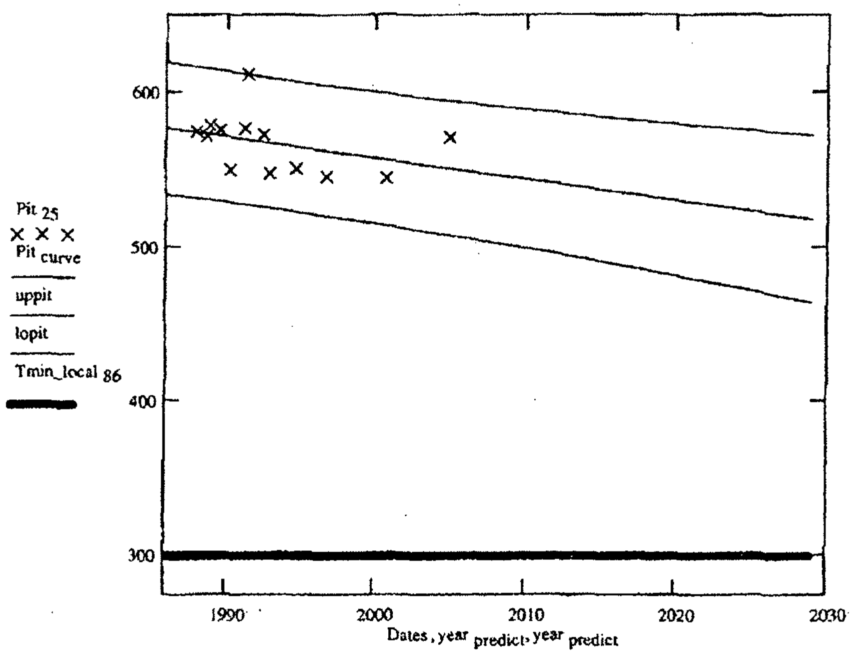
$$Pit_{actualmean} := mean(Dates) \qquad sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$$

$$uppit_f := Pit_{curve_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

$$lopit_f := Pit_{curve_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}\right]$$

11/5/18/05

Curve Fit For Pit 25 Projected to Plant End Of Life



$m_{pit} = -1.365$

Therefore even though the regression model does not apply, it shows that this pit will not corrode to below minimum required thickness by the plant end of life.

$minpoint = 0.571$ $\quad year_{predict_{22}} = 2.029 \cdot 10^3$ $\quad Tmin\_local_{86_{22}} = 300$

$$required_{rate.} := \frac{\left(1000 \cdot minpoint - Tmin\_local_{86_{22}}\right)}{\left(2005 - year_{predict}\right)_{22}}$$

$1000 \cdot minpoint - Tmin\_local_{86_{22}} = 271$

$required_{rate.} = -11.292$

5/15/05

Appendix 9 - Elevation 87' 5" Bay 15, Area 31

Nov 9, 2004 Data

The data shown below was collected on 11/9/2004 (reference NDE data sheet 2000-034-009).

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D8631_00.txt")

$$Points_{49} := showcells(page, 7, 0)$$

$$Points_{49} = \begin{bmatrix} 0.648 & 0.641 & 0.637 & 0.646 & 0.608 & 0.62 & 0.633 \\ 0.653 & 0.642 & 0.639 & 0.636 & 0.642 & 0.641 & 0.633 \\ 0.641 & 0.647 & 0.632 & 0.629 & 0.64 & 0.616 & 0.629 \\ 0.651 & 0.651 & 0.628 & 0.634 & 0.616 & 0.627 & 0.635 \\ 0.648 & 0.631 & 0.634 & 0.619 & 0.626 & 0.565 & 0.614 \\ 0.656 & 0.621 & 0.622 & 0.607 & 0.617 & 0.603 & 0.606 \\ 0.642 & 0.64 & 0.616 & 0.635 & 0.618 & 0.616 & 0.569 \end{bmatrix}$$

$Cells := convert(Points_{49}, 7)$ $No_{DataCells} := length(Cells)$

The pits at point 34 and 35 are removed from the data an will be trended separately (ref. 3.22).

$Cells := Zero_{one}(Cells, No_{DataCells}, 34)$ $Cells := Zero_{one}(Cells, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(Cells, No_{DataCells})$

$No_{DataCells} := length(Cells)$

The thinnest point at this location is shown below

$minpoint := min(Points_{49})$

$minpoint = 0.565$

10 5/15/05

Mean and Standard Deviation

$\mu_{actual} := \text{mean}(\text{Cells}) \quad \mu_{actual} = 630.234 \qquad \sigma_{actual} := \text{Stdev}(\text{Cells}) \quad \sigma_{actual} = 16.203$

Standard Error

$$\text{Standard}_{error} := \frac{\sigma_{actual}}{\sqrt{\text{No}_{DataCells}}} \qquad \text{Standard}_{error} = 2.363$$

Skewness

$$\text{Skewness} := \frac{(\text{No}_{DataCells})\cdot\overrightarrow{\Sigma(\text{Cells} - \mu_{actual})^3}}{(\text{No}_{DataCells} - 1)\cdot(\text{No}_{DataCells} - 2)\cdot(\sigma_{actual})^3} \qquad \text{Skewness} = -1.22$$

Kurtosis

$$\text{Kurtosis} := \frac{\text{No}_{DataCells}\cdot(\text{No}_{DataCells} + 1)\cdot\overrightarrow{\Sigma(\text{Cells} - \mu_{actual})^4}}{(\text{No}_{DataCells} - 1)\cdot(\text{No}_{DataCells} - 2)\cdot(\text{No}_{DataCells} - 3)\cdot(\sigma_{actual})^4} + -\frac{3\cdot(\text{No}_{DataCells} - 1)^2}{(\text{No}_{DataCells} - 2)\cdot(\text{No}_{DataCells} - 3)} \qquad \text{Kurtosis} = 3.009$$

Normal Probability Plot

In a normal plot, each data value is plotted against what its value would be if it actually came from a normal distribution. The expected normal values, called normal scores, and can be estimated by first calculating the rank scores of the sorted data.

$j := 0..\text{last(Cells)}$ $\quad srt := \text{sort(Cells)}$

Then each data point is ranked. The array rank captures these ranks

$r_j := j + 1$ $\quad rank_j := \dfrac{\overrightarrow{\Sigma\left(\overrightarrow{srt = srt_j}\right)\cdot r}}{\Sigma\overrightarrow{srt = srt_j}}$

$$p_j := \frac{rank_j}{\text{rows(Cells)} + 1}$$

The normal scores are the corresponding *p*th percentile points from the standard normal distribution:

$x := 1$ $\quad N\_Score_j := \text{root}\left[\text{cnorm}(x) - \left(p_j\right), x\right]$

5/15/05

Upper and Lower Confidence Values

The Upper and Lower confidence values are calculated based on .05 degree of confidence "α"

$\alpha := .05$ $\quad T\alpha := qt\left[\left(1-\frac{\alpha}{2}\right), 48\right]$ $\quad T\alpha = 2.011$

$$Lower_{95\%Con} := \mu_{actual} - T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Lower_{95\%Con} = 625.482$$

$$Upper_{95\%Con} := \mu_{actual} + T\alpha \cdot \frac{\sigma_{actual}}{\sqrt{No_{DataCells}}} \qquad Upper_{95\%Con} = 634.986$$

These values represent a range on the calculated mean in which there is 95% confidence.

Graphical Representation

Distribution of the "Cells" data points are sorted in 1/2 standard deviation increments (bins) within +/- 3 standard deviations

$Bins := Make_{bins}\left(\mu_{actual}, \sigma_{actual}\right)$

$Distribution := hist(Bins, Cells)$

Distribution =

0
0
1
3
10
5
10
10
6
1
0
0

The mid points of the Bins are calculated

$k := 0..11$ $\quad Midpoints_k := \frac{\left(Bins_k + Bins_{k+1}\right)}{2}$

The Mathcad function pnorm calculates a portion of normal distribution curve based on a given mean and standard deviation

$$normal_{curve_0} := pnorm\left(Bins_1, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve_k} := pnorm\left(Bins_{k+1}, \mu_{actual}, \sigma_{actual}\right) - pnorm\left(Bins_k, \mu_{actual}, \sigma_{actual}\right)$$

$$normal_{curve} := No_{DataCells} \cdot normal_{curve}$$

Bay 15 Area 31

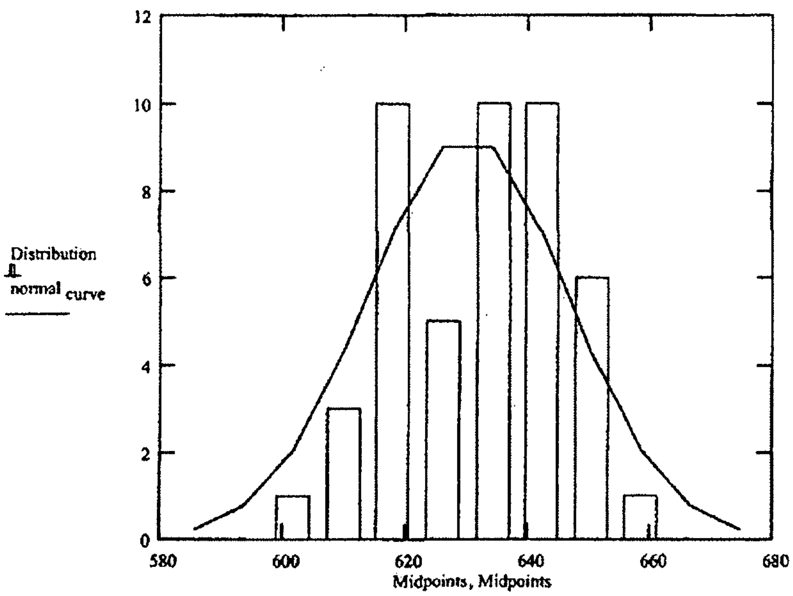
Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-e310-037	~~1~~ 2	187	A9 -5 of 26

PT 5/19/05

Results For Elevation 86' 5" Bay 15, Area 31
Sept. 17, 2000

The following schematic shows: the the distribution of the samples, the normal curve based on the actual mean and standard deviation, the kurtosis, the skewness, the number of data points, and the the lower and upper 95% confidence values. Below is the Normal Plot for the data.

Data Distribution



$\mu_{actual} = 630.234$

$\sigma_{actual} = 16.203$

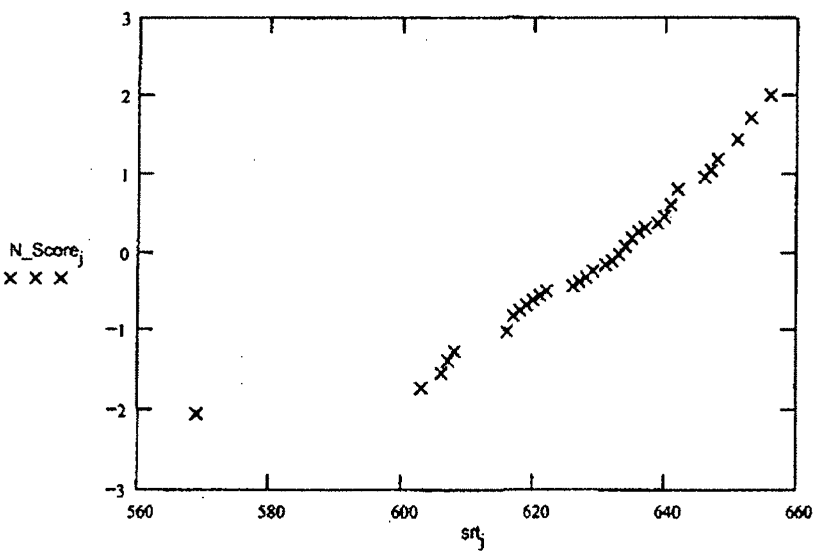
$Standard_{error} = 2.363$

$Skewness = -1.22$

$Kurtosis = 3.009$

$Lower_{95\%Con} = 625.482$ $Upper_{95\%Con} = 634.986$

Normal Probability Plot



This data set is slighlty skewed do to point 49. Area 49 is significantly less than past values for this area.

Elevation 86' 5" Bay 15, Area 31 Trend

Data from Feb 1990 to Sept 2000 is retrieved.

$d := 0$

For Nov. 10 1987

page := READPRN("U:\MSOFFICE\Drywell Program data\Nov 1987 Data\DATA ONLY\D8631_N87.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(11, 10, 1987)$

Data

$$Points_{49} = \begin{bmatrix} 0.655 & 0.648 & 0.639 & 0.65 & 0.62 & 0.627 & 0.641 \\ 0.659 & 0.643 & 0.646 & 0.64 & 0.634 & 0.651 & 0.641 \\ 0.628 & 0.657 & 0.673 & 0.638 & 0.654 & 0.629 & 0.632 \\ 0.65 & 0.652 & 0.646 & 0.638 & 0.619 & 0.633 & 0.634 \\ 0.656 & 0.633 & 0.637 & 0.623 & 0.634 & 0.568 & 0.62 \\ 0.65 & 0.63 & 0.625 & 0.607 & 0.625 & 0.606 & 0.614 \\ 0.649 & 0.648 & 0.615 & 0.649 & 0.628 & 0.628 & 0.647 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

The pits at points 34 and 35 are removed from the data and will be trended separately (ref 3.22).

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $\quad$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$$Cells := deletezero_{cells}(nnn, No_{DataCells})$$

$\mu_{measured_d} := mean(Cells)$ $\quad$ $\sigma_{measured_d} := Stdev(Cells)$ $\quad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31 Subject: Drywell Corrosion	Calc. No.	Rev. No.	System No.	Sheet No.
	C-1301-187-e310-037	~~1~~ 2 PT 5/15/05	187	A9 -7 of 26

For July 20 1988

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\July 1988 Data\DATA ONLY\D8631_J88.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$ $\qquad$ $\text{Dates}_d := \text{Day}_{\text{year}}(7, 20, 1988)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.651 & 0.645 & 0.633 & 0.643 & 0.615 & 0.626 & 0.634 \\ 0.651 & 0.642 & 0.643 & 0.641 & 0.651 & 0.644 & 0.638 \\ 0.627 & 0.654 & 0.654 & 0.633 & 0.65 & 0.652 & 0.634 \\ 0.644 & 0.652 & 0.654 & 0.635 & 0.616 & 0.634 & 0.632 \\ 0.652 & 0.63 & 0.64 & 0.622 & 0.635 & 0.566 & 0.623 \\ 0.645 & 0.627 & 0.619 & 0.604 & 0.624 & 0.605 & 0.617 \\ 0.648 & 0.646 & 0.613 & 0.639 & 0.622 & 0.619 & 0.643 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$ $\qquad$ $\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\text{Pit}_{34_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 34)$ $\qquad$ $\text{Pit}_{35_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 35)$

These points are deleted from the mean calculation

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 34)$ $\qquad$ $\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 35)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$ $\qquad$ $\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$ $\qquad$ $\text{Standard}_{\text{error}_d} := \dfrac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$

5/15/05

For Oct. 8 1988

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 1988 Data\DATA ONLY\D8631_O88.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(10, 8, 1988)$

Data

$$Points_{49} = \begin{bmatrix} 0.651 & 0.645 & 0.632 & 0.642 & 0.618 & 0.622 & 0.636 \\ 0.655 & 0.641 & 0.644 & 0.638 & 0.63 & 0.643 & 0.637 \\ 0.629 & 0.654 & 0.645 & 0.635 & 0.649 & 0.649 & 0.643 \\ 0.651 & 0.65 & 0.619 & 0.636 & 0.616 & 0.632 & 0.636 \\ 0.664 & 0.63 & 0.635 & 0.619 & 0.634 & 0.562 & 0.626 \\ 0.65 & 0.646 & 0.622 & 0.605 & 0.63 & 0.608 & 0.622 \\ 0.654 & 0.645 & 0.612 & 0.642 & 0.628 & 0.622 & 0.643 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

5/15/05

For June 26 1989

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\June 1989 Data\DATA ONLY\D8631_June89.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d :=$ Day_{year}(6 , 26 , 1989)

Data

$Points_{49} =$

0.654	0.649	0.636	0.643	0.619	0.629	0.637
0.656	0.644	0.649	0.641	0.651	0.649	0.642
0.63	0.658	0.651	0.641	0.654	0.629	0.636
0.647	0.648	0.623	0.637	0.617	0.631	0.636
0.655	0.633	0.641	0.623	0.632	0.576	0.619
0.648	0.636	0.624	0.611	0.627	0.61	0.618
0.653	0.667	0.629	0.649	0.627	0.621	0.647

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-e310-037	~~Ø~~ 2	187	A9 -10 of 26

05 5/15/05

For March 28 1990

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\March 1990 Data\DATA ONLY\D8631_March90.txt"

$Points_{49} := showcells(page, 7, 0)$ $\qquad Dates_d := Day_{year}(3, 28, 1990)$

Data

$$Points_{49} = \begin{bmatrix} 0.653 & 0.646 & 0.644 & 0.644 & 0.621 & 0.626 & 0.635 \\ 0.654 & 0.643 & 0.647 & 0.64 & 0.637 & 0.649 & 0.639 \\ 0.638 & 0.658 & 0.653 & 0.656 & 0.676 & 0.63 & 0.642 \\ 0.646 & 0.65 & 0.631 & 0.644 & 0.633 & 0.652 & 0.636 \\ 0.682 & 0.657 & 0.66 & 0.634 & 0.635 & 0.573 & 0.624 \\ 0.65 & 0.644 & 0.636 & 0.613 & 0.627 & 0.61 & 0.616 \\ 0.651 & 0.648 & 0.614 & 0.646 & 0.655 & 0.622 & 0.647 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $\qquad Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $\qquad nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad \sigma_{measured_d} := Stdev(Cells)$ $\qquad Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For Feb, 23 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\Feb 1991 Data\DATA ONLY\D8631_F91.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(2, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.645 & 0.641 & 0.629 & 0.639 & 0.613 & 0.624 & 0.631 \\ 0.646 & 0.637 & 0.639 & 0.633 & 0.629 & 0.641 & 0.634 \\ 0.62 & 0.648 & 0.63 & 0.629 & 0.645 & 0.624 & 0.626 \\ 0.637 & 0.637 & 0.597 & 0.629 & 0.611 & 0.625 & 0.629 \\ 0.644 & 0.624 & 0.631 & 0.615 & 0.626 & 0.556 & 0.615 \\ 0.642 & 0.623 & 0.616 & 0.602 & 0.619 & 0.601 & 0.611 \\ 0.644 & 0.624 & 0.606 & 0.636 & 0.619 & 0.611 & 0.639 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-e310-037	~~1~~ 2	187	A9 -12 of 26

5/15/05

$d := d + 1$

For May 23, 1991

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1991 Data\DATA ONLY\D8631_M91.txt")

$Points_{49} := showcells(page, 7, 0)$ $\qquad$ $Dates_d := Day_{year}(5, 23, 1991)$

Data

$$Points_{49} = \begin{bmatrix} 0.647 & 0.641 & 0.631 & 0.636 & 0.613 & 0.621 & 0.63 \\ 0.649 & 0.637 & 0.641 & 0.634 & 0.633 & 0.641 & 0.633 \\ 0.62 & 0.649 & 0.628 & 0.629 & 0.624 & 0.622 & 0.626 \\ 0.639 & 0.642 & 0.595 & 0.629 & 0.611 & 0.625 & 0.629 \\ 0.646 & 0.624 & 0.632 & 0.614 & 0.627 & 0.556 & 0.615 \\ 0.642 & 0.623 & 0.616 & 0.601 & 0.621 & 0.603 & 0.61 \\ 0.645 & 0.624 & 0.607 & 0.636 & 0.619 & 0.612 & 0.613 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $\qquad$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $\qquad$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $\qquad$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\qquad$ $\sigma_{measured_d} := Stdev(Cells)$ $\qquad$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-e310-037	2 5/18/05	187	A9 -13 of 26

$d := d + 1$

For May 30 1992

page := READPRN("U:\MSOFFICE\Drywell Program data\May 1992 Data\DATA ONLY\D8631_M92.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(5, 30, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.65 & 0.639 & 0.627 & 0.635 & 0.614 & 0.621 & 0.629 \\ 0.651 & 0.635 & 0.64 & 0.635 & 0.608 & 0.642 & 0.635 \\ 0.622 & 0.65 & 0.633 & 0.631 & 0.65 & 0.627 & 0.634 \\ 0.64 & 0.643 & 0.665 & 0.632 & 0.616 & 0.629 & 0.63 \\ 0.651 & 0.628 & 0.635 & 0.617 & 0.629 & 0.565 & 0.613 \\ 0.645 & 0.639 & 0.619 & 0.604 & 0.623 & 0.607 & 0.611 \\ 0.64 & 0.639 & 0.607 & 0.635 & 0.619 & 0.611 & 0.638 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

$d := d + 1$

For Dec. 5 1992

page := READPRN("U:\MSOFFICE\Drywell Program data\Dec. 1992 Data\DATA ONLY\D8631_D92.txt")

$Points_{49} := showcells(page, 7, 0)$ $Dates_d := Day_{year}(12, 5, 1992)$

Data

$$Points_{49} = \begin{bmatrix} 0.644 & 0.643 & 0.632 & 0.634 & 0.612 & 0.622 & 0.632 \\ 0.649 & 0.64 & 0.642 & 0.629 & 0.642 & 0.639 & 0.633 \\ 0.633 & 0.647 & 0.632 & 0.63 & 0.643 & 0.614 & 0.627 \\ 0.641 & 0.647 & 0.601 & 0.634 & 0.612 & 0.629 & 0.631 \\ 0.648 & 0.628 & 0.634 & 0.623 & 0.625 & 0.567 & 0.615 \\ 0.643 & 0.621 & 0.623 & 0.604 & 0.62 & 0.602 & 0.606 \\ 0.645 & 0.643 & 0.615 & 0.638 & 0.617 & 0.618 & 0.643 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \dfrac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-e310-037	~~1~~ 2	187	A9 -15 of 26

00 5/15/05

For Sept. 14 1994

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1994 Data\DATA ONLY\D8631_94.txt")

$Points_{49} :=$ showcells(page , 7 , 0) $Dates_d := Day_{year}(9, 14, 1994)$

Data

$$Points_{49} = \begin{bmatrix} 0.648 & 0.643 & 0.614 & 0.638 & 0.614 & 0.626 & 0.633 \\ 0.654 & 0.645 & 0.643 & 0.633 & 0.643 & 0.645 & 0.637 \\ 0.63 & 0.653 & 0.634 & 0.633 & 0.646 & 0.619 & 0.632 \\ 0.642 & 0.65 & 0.6 & 0.636 & 0.617 & 0.63 & 0.636 \\ 0.651 & 0.635 & 0.639 & 0.623 & 0.629 & 0.564 & 0.617 \\ 0.656 & 0.623 & 0.624 & 0.609 & 0.622 & 0.605 & 0.611 \\ 0.674 & 0.644 & 0.616 & 0.641 & 0.622 & 0.617 & 0.646 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-e310-037	~~1~~ 2 e1 5/15/05	187	A9 -16 of 26

For Sept. 9 1996

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept.1996 Data\DATA ONLY\D8631_96.txt")

$Points_{49} := showcells(page, 7, 0)$

$Dates_d := Day_{year}(9, 9, 1996)$

Data

$$Points_{49} = \begin{bmatrix} 0.647 & 0.64 & 0.627 & 0.636 & 0.61 & 0.622 & 0.636 \\ 0.653 & 0.639 & 0.642 & 0.637 & 0.629 & 0.644 & 0.635 \\ 0.623 & 0.653 & 0.635 & 0.634 & 0.644 & 0.625 & 0.629 \\ 0.643 & 0.643 & 0.601 & 0.633 & 0.615 & 0.628 & 0.634 \\ 0.651 & 0.628 & 0.635 & 0.618 & 0.631 & 0.562 & 0.521 \\ 0.644 & 0.627 & 0.622 & 0.605 & 0.627 & 0.608 & 0.619 \\ 0.649 & 0.646 & 0.612 & 0.641 & 0.624 & 0.616 & 0.647 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$

$No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31
Subject:
Drywell Corrosion

Calc. No. C-1301-187-e310-037 | Rev. No. ~~1~~ 2 5/15/05 | System No. 187 | Sheet No. A9 -17 of 26

For Sept. 16 2000

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Sept 2000 Data\DATA ONLY\D8631_00.txt")

$\text{Points}_{49} := \text{showcells}(\text{page}, 7, 0)$

$\text{Dates}_d := \text{Day}_{\text{year}}(9, 16, 2000)$

Data

$$\text{Points}_{49} = \begin{bmatrix} 0.639 & 0.639 & 0.627 & 0.631 & 0.606 & 0.614 & 0.631 \\ 0.647 & 0.639 & 0.637 & 0.629 & 0.639 & 0.637 & 0.63 \\ 0.631 & 0.65 & 0.629 & 0.628 & 0.64 & 0.619 & 0.627 \\ 0.638 & 0.645 & 0.594 & 0.627 & 0.613 & 0.623 & 0.63 \\ 0.643 & 0.63 & 0.632 & 0.615 & 0.624 & 0.564 & 0.614 \\ 0.649 & 0.619 & 0.617 & 0.602 & 0.616 & 0.602 & 0.609 \\ 0.643 & 0.639 & 0.61 & 0.636 & 0.617 & 0.612 & 0.64 \end{bmatrix}$$

$\text{nnn} := \text{convert}(\text{Points}_{49}, 7)$

$\text{No}_{\text{DataCells}} := \text{length}(\text{nnn})$

$\text{Pit}_{34_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 34)$

$\text{Pit}_{35_d} := \text{Get\_Pit}_{\text{data}}(\text{nnn}, \text{No}_{\text{DataCells}}, 35)$

These points are deleted from the mean calculation

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 34)$

$\text{nnn} := \text{Zero}_{\text{one}}(\text{nnn}, \text{No}_{\text{DataCells}}, 35)$

$\text{Cells} := \text{deletezero}_{\text{cells}}(\text{nnn}, \text{No}_{\text{DataCells}})$

$\mu_{\text{measured}_d} := \text{mean}(\text{Cells})$

$\sigma_{\text{measured}_d} := \text{Stdev}(\text{Cells})$

$$\text{Standard}_{\text{error}_d} := \frac{\sigma_{\text{measured}_d}}{\sqrt{\text{No}_{\text{DataCells}}}}$$

Bay 15 Area 31
Subject:
Drywell Corrosion

Calc. No.	Rev. No.	System No.	Sheet No.
C-1301-187-e310-037	1 2	187	A9 -18 of 26

5/15/05

For Nov. 9 2004

$d := d + 1$

page := READPRN("U:\MSOFFICE\Drywell Program data\Oct 2004\DATA ONLY\D8631_00.txt")

$Points_{49} :=$ showcells(page , 7 , 0)

$Dates_d := Day_{year}(11, 9, 2004)$

Data

$$Points_{49} = \begin{bmatrix} 0.648 & 0.641 & 0.637 & 0.646 & 0.608 & 0.62 & 0.633 \\ 0.653 & 0.642 & 0.639 & 0.636 & 0.642 & 0.641 & 0.633 \\ 0.641 & 0.647 & 0.632 & 0.629 & 0.64 & 0.616 & 0.629 \\ 0.651 & 0.651 & 0.628 & 0.634 & 0.616 & 0.627 & 0.635 \\ 0.648 & 0.631 & 0.634 & 0.619 & 0.626 & 0.565 & 0.614 \\ 0.656 & 0.621 & 0.622 & 0.607 & 0.617 & 0.603 & 0.606 \\ 0.642 & 0.64 & 0.616 & 0.635 & 0.618 & 0.616 & 0.569 \end{bmatrix}$$

$nnn := convert(Points_{49}, 7)$ $No_{DataCells} := length(nnn)$

$Pit_{34_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 34)$ $Pit_{35_d} := Get\_Pit_{data}(nnn, No_{DataCells}, 35)$

These points are deleted from the mean calculation

$nnn := Zero_{one}(nnn, No_{DataCells}, 34)$ $nnn := Zero_{one}(nnn, No_{DataCells}, 35)$

$Cells := deletezero_{cells}(nnn, No_{DataCells})$

$\mu_{measured_d} := mean(Cells)$ $\sigma_{measured_d} := Stdev(Cells)$ $Standard_{error_d} := \frac{\sigma_{measured_d}}{\sqrt{No_{DataCells}}}$

Bay 15 Area 31

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-e310-037	R2	187	A9 -19 of 26

er 5/15/05

Below are matrices which contain the date when the data was collected, Mean, Standard Deviation, Standard Error for each date.

Dates =

$1.988 \cdot 10^3$
$1.989 \cdot 10^3$
$1.989 \cdot 10^3$
$1.989 \cdot 10^3$
$1.99 \cdot 10^3$
$1.991 \cdot 10^3$
$1.991 \cdot 10^3$
$1.992 \cdot 10^3$
$1.993 \cdot 10^3$
$1.995 \cdot 10^3$
$1.997 \cdot 10^3$
$2.001 \cdot 10^3$
$2.005 \cdot 10^3$

$\mu_{measured}$ =

637.894
635.702
635.936
638.043
641.915
627.681
627.021
631.064
630
633.213
631.638
627.532
630.234

Standard_{error} =

2.045
1.948
1.918
1.908
2.117
1.847
1.892
1.953
1.88
2.152
1.862
1.931
2.315

$\sigma_{measured}$ =

14.318
13.636
13.428
13.356
14.819
12.928
13.243
13.674
13.158
15.064
13.032
13.518
16.203

$Total_{means} := rows(\mu_{measured})$ $Total_{means} = 13$

The F-Ratio is calculated

$$SSE := \sum_{i=0}^{last(Dates)} \left(\mu_{measured_i} - yhat(Dates, \mu_{measured})_i\right)^2 \qquad SSE = 186.96$$

$$SSR := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, \mu_{measured})_i - mean(\mu_{measured})\right)^2 \qquad SSR = 73.953$$

$DegreeFree_{ss} := Total_{means} - 2$ $DegreeFree_{reg} := 1$

$MSE := \frac{SSE}{DegreeFree_{ss}}$ $MSE = 16.996$ $MSR := \frac{SSR}{DegreeFree_{reg}}$ $MSR = 73.953$

$StGrand_{err} := \sqrt{MSE}$ $StGrand_{err} = 4.123$

5/13/05

$$F_{actaul} := \frac{MSR}{MSE}$$

$\alpha := 0.05$ $\qquad$ $F_{critical} := qF\left(1 - \alpha, DegreeFree_{reg}, DegreeFree_{ss}\right)$

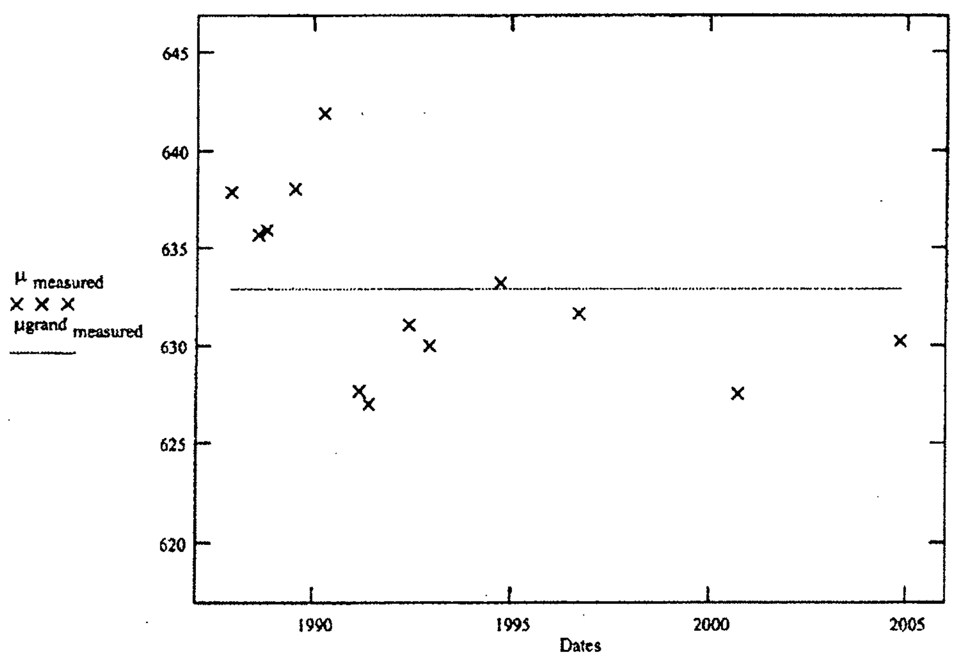
$$F_{ratio} := \frac{F_{actaul}}{F_{critical}} \qquad F_{ratio} = 0.898$$

Therefore the curve fit of the means seems to have a slope and the grandmean is not an accurate measure of the thickness at this location

$i := 0 .. Total_{means} - 1$ $\qquad$ $\mu grand_{measured_i} := mean\left(\mu_{measured}\right)$

$\sigma grand_{measured} := Stdev\left(\mu_{measured}\right)$ $\qquad$ $GrandStandard_{error_0} := \dfrac{\sigma grand_{measured}}{\sqrt{Total_{means}}}$

Plot of the grand mean and the actual means over time



$\mu grand_{measured_0} = 632.913$ $\qquad$ $GrandStandard_{error} = 1.293$

Bay 15 Area 31

Subject:	Calc. No.	Rev. No.	System No.	Sheet No.
Drywell Corrosion	C-1301-187-e310-037	2	187	A9 -22 of 26

5/15/05

Therefore the corrosion rate is calculated and compared to the minimum required wall thickness at this elevation

$$m_s := \text{slope}(\text{Dates}, \mu_{measured}) \quad m_s = -0.491 \quad y_b := \text{intercept}(\text{Dates}, \mu_{measured}) \quad y_b = 1.611 \cdot 10^3$$

The 95% Confidence curves are calculated

$$\alpha_t := 0.05 \quad k := 23 \quad f := 0..k-1$$

$$\text{year}_{\text{predict}_f} := 1985 + f \cdot 2 \quad \text{Thick}_{\text{predict}} := m_s \cdot \text{year}_{\text{predict}} + y_b$$

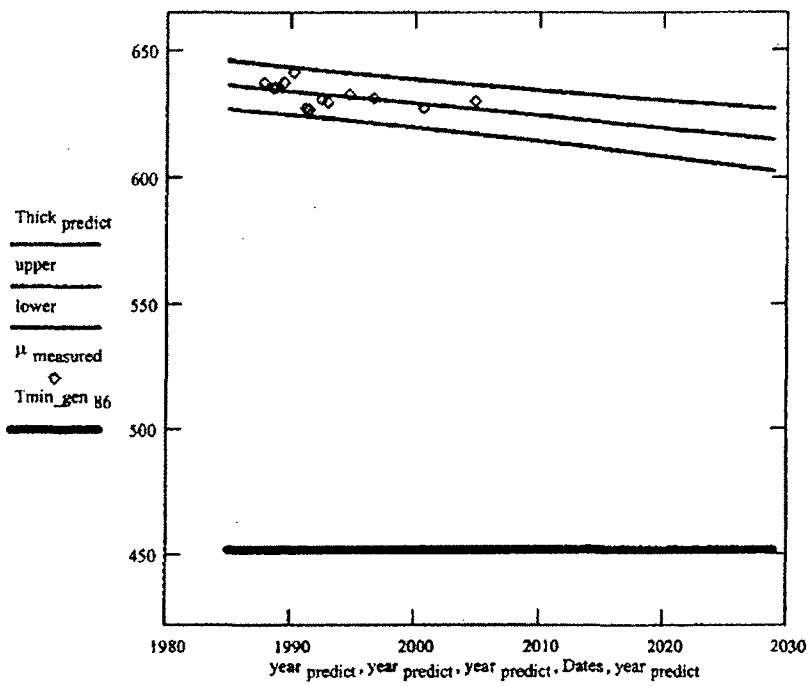
$$\text{Thick}_{\text{actualmean}} := \text{mean}(\text{Dates}) \qquad \text{sum} := \sum_i \left(\text{Dates}_d - \text{mean}(\text{Dates})\right)^2$$

$$\text{upper}_f := \text{Thick}_{\text{predict}_f} \cdots + qt\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}$$

$$\text{lower}_f := \text{Thick}_{\text{predict}_f} \cdots + -\left[qt\left(1 - \frac{\alpha_t}{2}, \text{Total}_{\text{means}} - 2\right) \cdot \text{StGrand}_{\text{err}} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(\text{year}_{\text{predict}_f} - \text{Thick}_{\text{actualmean}}\right)^2}{\text{sum}}}\right]$$

The minimum required thickness at this elevation is $Tmin\_gen_{86_f} := 452$ (Ref. Calc. SE-000243-002)

Location Curve Fit Projected to Plant End Of Life



$m_s = -0.491$

Therefore the regression model shows that even at the lower 95% confidence band this location will not corrode to below Drywell Vessel Minimum required thickness by the plant end of life.

$year_{predict_{22}} = 2.029 \cdot 10^3$ $Thick_{predict_{22}} = 615.272$

Bay 15 Area 31 Subject: Drywell Corrosion	Calc. No.	Rev. No.	System No.	Sheet No.
	C-1301-187-e310-037	2	187	A9 -24 of 26

5/15/05

The Following trends are shown for the pits

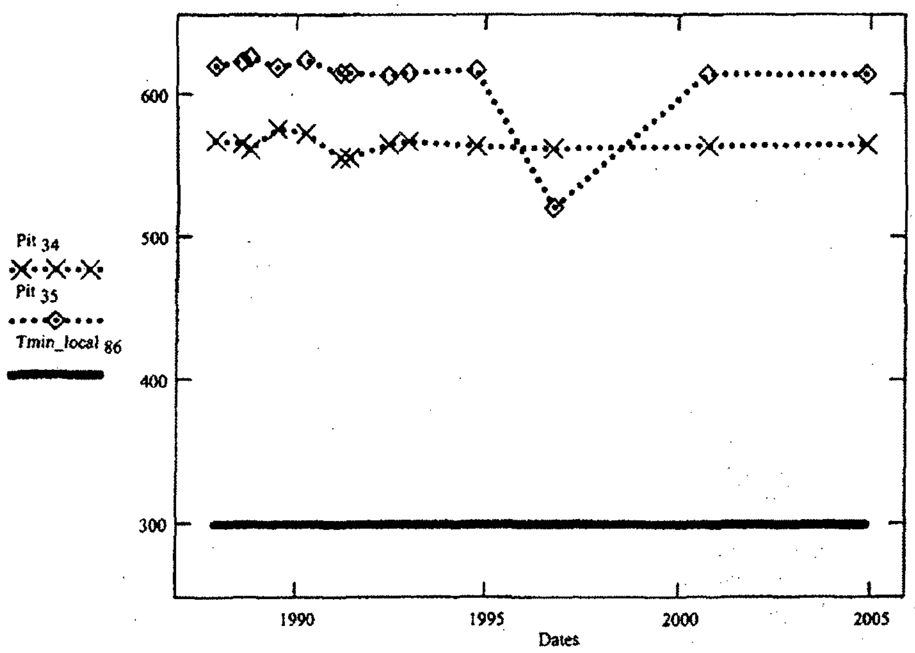
Local Tmin for this elevation in the Drywell $Tmin\_local_{86_f} := 300$ (Ref. Calc. SE-000243-002)

$A_i :=$

max(Pit 34)
max(Pit 35)

$B_i :=$

min(Pit 34)
min(Pit 35)



The following addresses possible corrosion in these pits

The F-Ratio is calculated for the worse pit

$$SSE_{pit} := \sum_{i=0}^{last(Dates)} \left(Pit_{35_i} - yhat(Dates, Pit_{35})_i\right)^2 \qquad SSE_{pit} = 8.054 \cdot 10^3$$

$$SSR_{pit} := \sum_{i=0}^{last(Dates)} \left(yhat(Dates, Pit_{35})_i - mean(Pit_{35})\right)^2 \qquad SSR_{pit} = 831.542$$

$$MSE_{pit} := \frac{SSE_{pit}}{DegreeFree_{ss}} \qquad StPit_{err} := \sqrt{MSE_{pit}} \qquad MSR_{pit} := \frac{SSR_{pit}}{DegreeFree_{reg}}$$

$$Fpit_{actaul} := \frac{MSR_{pit}}{MSE_{pit}} \qquad Fpit_{ratio} := \frac{Fpit_{actaul}}{F_{critical}} \qquad Fpit_{ratio} = 0.234$$

Therefore this pit is not experiencing corrosion

$$m_{pit} := slope(Dates, Pit_{35}) \qquad m_{pit} = -1.646 \qquad y_{pit} := intercept(Dates, Pit_{35}) \qquad y_{pit} = 3.891 \cdot 10^3$$

The 95% Confidence curves are calculated

$$Pit_{curve} := m_{pit} \cdot year_{predict} + y_{pit}$$

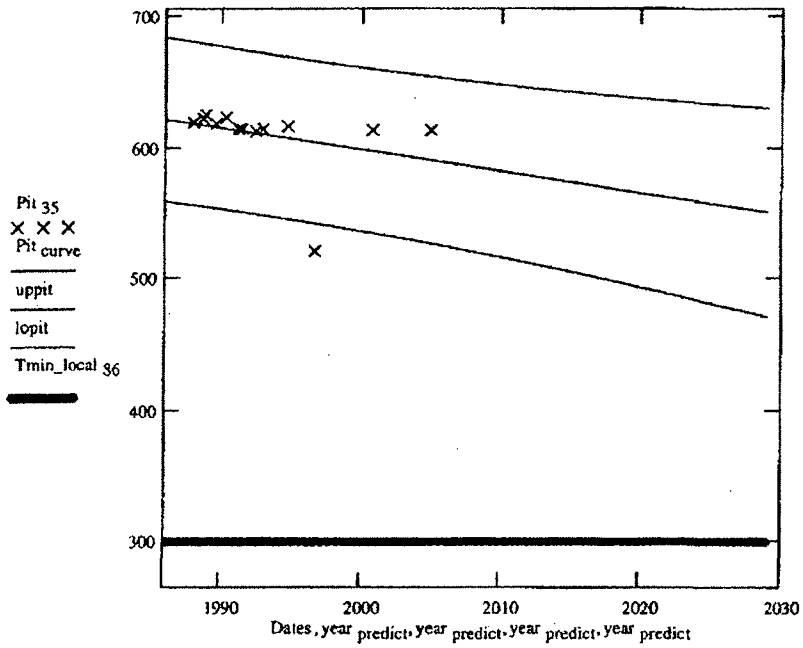
$$Pit_{actualmean} := mean(Dates) \qquad sum := \sum_i \left(Dates_d - mean(Dates)\right)^2$$

$$uppit_f := Pit_{curve_f} \ldots + qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}$$

$$lopit_f := Pit_{curve_f} \ldots + -\left[qt\left(1 - \frac{\alpha_t}{2}, Total_{means} - 2\right) \cdot StPit_{err} \cdot \sqrt{1 + \frac{1}{(d+1)} + \frac{\left(year_{predict_f} - Pit_{actualmean}\right)^2}{sum}}\right]$$

5/15/05

Curve Fit For Pit 35 Projected to Plant End Of Life



$m_{pit} = -1.646$

Therefore based on regression model the above curve shows that this pit will not corrode to below minimum required thickness by the plant end of life.

$\text{minpoint} = 0.565$ $\quad$ $\text{year}_{\text{predict}_{22}} = 2.029 \cdot 10^3$ $\quad$ $\text{Tmin\_local}_{86_{22}} = 300$

$$1000 \cdot \text{minpoint} - \text{Tmin\_local}_{86_{22}} = 265$$

$$\text{required}_{\text{rate.}} := \frac{\left(1000 \cdot \text{minpoint} - \text{Tmin\_local}_{86_{22}}\right)}{\left(2005 - \text{year}_{\text{predict}}\right)_{22}}$$

$$\text{required}_{\text{rate.}} = -11.042$$

Appendix 10 – September 2000 Data – NDE Report 2000-34-001 through 009

Page 1 of 10
5/15/05

AmerGen

NDE Data Report

Ultrasonic Thickness

Att. 10
Page 201

Request Title: Drywell Liner Thickness Examination

Component: 6" x 6" Grids (49 Readings)

Code / Spec: Eng. Direction

Procedure: NDE-UT-03 Rev 0

System: Drywell Liner

Material: C/S

Report # 2000-034- 001

Station: Oyster Creek   Unit # 1

Drawing #: N/A

Surface Condition: Clean

Thermometer: NDE-93-005   Part Temp: 70 F

Results

Inspection Point	Results	Date Inspected
50-22	Informational	10/16/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 51'   BAY#   AREA 50.22

	A	B	C	D	E	F	G	
1	0.680	0.715	0.681	0.687	0.690	0.612	0.683	7
8	0.716	0.703	0.700	0.689	0.720	0.728	0.665	14
15	0.729	0.712	0.696	0.706	0.725	0.710	0.718	21
22	0.705	0.649	0.683	0.691	0.733	0.712	0.631	28
29	0.675	0.651	0.694	0.694	0.673	0.678	0.697	35
36	0.668	0.647	0.684	0.707	0.649	0.644	0.657	42
43	0.689	0.725	0.728	0.708	0.678	0.556	0.635	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	.101
Mid:	0.500	.500
Max:	1.001	1.000

BlockTemp: 70 F

Couplant: 19620

Design"t": N/A

Velocity: N/A

Equipment

Unit S/N: NDE-88-036

Transducer: NDE-84-009

Step Wedge: 208 / 87

Ref Block: N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/16/00
Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	[signature]	III	10/17/00

12/08/05 12:05:34

[redacted]Gen

NDE Data Report

Ultrasonic Thickness

A4.10
Page 3 of

Page 1 of Last

Request Title :	Drywell Liner Thickness Examination
Component :	6" x 6" Grids (49 Readings)
Code / Spec:	Eng. Direction
Procedure:	NDE-UT-03 Rev 0
System:	Drywell Liner
Material:	C/S

Report # 2000-034- 002

Station:	Oyster Creek	Unit #	1
Drawing # :	N/A		
Surface Condition :	Clean		
Thermometer:	NDE-93-005	Part Temp:	70 F

Results

Inspection Point	Results	Date Inspected
13/31 (51-13)	Informational	10/16/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 51' BAY# AREA 51.13

	A	B	C	D	E	F	G	
1	0.689	0.644	0.768	0.753	0.763	0.773	0.761	7
8	0.694	0.640	0.769	0.749	0.733	0.758	0.772	14
15	0.651	0.663	0.762	0.723	0.716	0.764	0.753	21
22	0.691	0.690	0.751	0.689	0.769	0.781	0.762	28
29	0.635	0.756	0.688	0.759	0.768	0.769	0.757	35
36	0.732	0.707	0.683	0.768	0.777	0.784	0.770	42
43	0.763	0.773	0.753	0.768	0.760	0.709	0.762	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	.101
Mid:	0.500	.500
Max:	1.001	1.000

BlockTemp:	70 F
Couplant:	19620
Design"t"	N/A
Velocity:	N/A

Equipment

Unit S/N:	NDE-88-036
Transducer:	NDE-84-009
Step Wedge:	208 / 87
Ref Block:	N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[illegible]	III	[illegible]
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	M McAllister	III	10/17/00

AmerGen

NDE Data Report

Ultrasonic Thickness

A#10
Pg 4

Request Title : Drywell Liner Thickness Examination
Component : 6" x 6" Grids (49 Readings)
Code / Spec: Eng. Direction
Procedure: NDE-UT-03 Rev 0
System: Drywell Liner
Material: C/S

Report # 2000-034- 003

Station: Oyster Creek Unit # 1
Drawing # : N/A
Surface Condition : Clean
Thermometer: NDE-93-005 Part Temp: 70 F

Results

Inspection Point	Results	Date Inspected
15/23 (51-15)	Informational	10/16/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 51 BAY#   AREA 51-15

	A	B	C	D	E	F	G	
1	0.735	0.746	0.758	0.757	0.761	0.753	0.761	7
8	0.768	0.756	0.757	0.763	0.738	0.720	0.744	14
15	0.740	0.760	0.726	0.747	0.744	0.739	0.740	21
22	0.770	0.757	0.760	0.753	0.634	0.757	0.761	28
29	0.754	0.736	0.769	0.753	0.695	0.750	0.749	35
36	0.763	0.764	0.734	0.749	0.719	0.717	0.769	42
43	0.756	0.759	0.753	0.758	0.704	0.739	0.759	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	0.101
Mid:	0.500	0.500
Max:	1.001	1.000

BlockTemp: 70 F
Couplant: 19820
Design"t": N/A
Velocity: N/A

Equipment

Unit S/N: NDE-88-036
Transducer: NDE-84-009
Step Wedge: 208/87
Ref Block: N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/17/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	[signature]	III	10-17-00

[redacted] Gen

NDE Data Report

Ultrasonic Thickness

Att 10
pcs 5 of

Request Title :	Drywell Liner Thickness Examination
Component :	6" x 6" Grids (49 Readings)
Code / Spec:	Eng. Direction
Procedure:	NDE-UT-03 Rev 0
System:	Drywell Liner
Material:	C/S

Report # 2000-034- 004

Station:	Oyster Creek	Unit #	1
Drawing # :	N/A		
Surface Condition :	Clean		
Thermometer:	NDE-93-005	Part Temp:	70 F

Results

Inspection Point	Results	Date Inspected
5/5 (51-5)	Informational	10/16/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. **51** BAY# AREA **51-5**

	A	B	C	D	E	F	G	
1	0.740	0.650	0.733	0.764	0.761	0.765	0.716	7
8	0.755	0.745	0.749	0.743	0.727	0.734	0.737	14
15	0.762	0.755	0.632	0.676	0.739	0.735	0.738	21
22	0.734	0.753	0.690	0.662	0.705	0.757	0.765	28
29	0.693	0.754	0.703	0.760	0.747	0.769	0.742	35
36	0.769	0.748	0.710	0.703	0.741	0.760	0.727	42
43	0.757	0.765	0.762	0.734	0.769	0.758	0.767	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	0.101
Mid:	0.500	0.500
Max:	1.001	1.000

BlockTemp:	70 F
Couplant:	19620
Design"t"	N/A
Velocity:	N/A

Equipment

Unit S/N:	NDE-88-036
Transducer:	NDE-84-009
Step Wedge:	208/87
Ref Block:	N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-·529	Stan McCaulley	III	10/17/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	M McAllister	III	10-17-00

12/08/05 12:05:34

AmerGen

NDE Data Report

Ultrasonic Thickness

Att. 10
pese 6

Request Title : Drywell Liner Thickness Examination

Component : 6" x 6" Grids (49 Readings)

Code / Spec: Eng. Direction

Procedure: NDE-UT-03 Rev 0

System: Drywell Liner

Material: C/S

Report # 2000-034- 005

Station: Oyster Creek Unit # 1

Drawing # : N/A

Surface Condition : Clean

Thermometer: NDE-93-005 Part Temp: 70 F

Results

Inspection Point	Results	Date Inspected
5/D12 (51-D1)	Informational	10/16/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 51 BAY# AREA 51-D1

	A	B	C	D	E	F	G	
1	0.748	0.718	0.743	0.735	0.744	0.759	0.738	7
8	0.743	0.675	0.747	0.731	0.752	0.703	0.734	14
15	0.751	0.750	0.752	0.713	0.745	0.320	0.741	21
22	0.750	0.741	0.735	0.687	0.278	no #	0.266	28
29	0.752	0.755	0.754	0.744	0.733	0.308	0.729	35
36	0.766	0.726	0.742	0.727	0.731	0.735	0.722	42
43	0.747	0.740	0.724	0.747	0.740	0.742	0.744	49

Comments: Location #27 is the location of a plug that was removed in a previous outage

Calibration

	Cal. Block	Readings
Min:	0.101	0.101
Mid:	0.500	0.500
Max:	1.001	1.000

BlockTemp: 70 F

Couplant: 19620

Design"t": N/A

Velocity: N/A

Equipment

Unit S/N: NDE-88-036

Transducer: NDE-84-009

Step Wedge: 208/87

Ref Block: N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/16/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	[signature]	III	10-17-00

12/08/05 12:05:34

NDE Data Report

Ultrasonic Thickness

AH 10
Page 7

Request Title :	Drywell Liner Thickness Examination
Component :	6" x 6" Grids (49 Readings)
Code / Spec:	Eng. Direction
Procedure:	NDE-UT-03 Rev 0
System:	Drywell Liner
Material:	C/S

Report # 2000-034- 006

Station:	Oyster Creek	Unit #	1
Drawing # :	N/A		
Surface Condition :	Clean		
Thermometer:	NDE-93-005	Part Temp:	70 F

Results

Inspection Point	Results	Date Inspected
13/31 (52-13)	Informational	10/16/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 52 BAY# AREA 52-13

	A	B	C	D	E	F	G	
1	0.715	0.710	0.715	0.712	0.696	0.685	0.705	7
8	0.713	0.710	0.691	0.686	0.712	0.642	0.703	14
15	0.718	0.668	0.713	0.684	0.711	0.624	0.670	21
22	0.721	0.588	0.714	0.624	0.714	0.711	0.560	28
29	0.719	0.697	0.718	0.717	0.718	0.716	0.679	35
36	0.711	0.710	0.721	0.720	0.719	0.720	0.644	42
43	0.720	0.706	0.720	0.722	0.719	0.718	0.679	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	0.101
Mid:	0.500	.500
Max:	1.001	1.000

BlockTemp:	70 F
Couplant:	19620
Design"t"	N/A
Velocity:	N/A

Equipment

Unit S/N:	NDE-88-036
Transducer:	NDE-84-009
Step Wedge:	208/87
Ref Block:	N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/17/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	[signature]	III	10-17-00

NDE Data Report

Ultrasonic Thickness

Att 10
pcs-8

Request Title :	Drywell Liner Thickness Examination
Component :	6" x 6" Grids (49 Readings)
Code / Spec:	Eng. Direction
Procedure:	NDE-UT-03 Rev 0
System:	Drywell Liner
Material:	C/S

Report # 2000-034- 007

Station:	Oyster Creek
Unit #:	1
Drawing # :	N/A
Surface Condition :	Clean
Thermometer:	NDE-93-005
Part Temp:	80 F

Results

Inspection Point	Results	Date Inspected
13/28 (86-28)	Informational	10/17/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 86 BAY# AREA 86.28

	A	B	C	D	E	F	G	
1	0.584	0.600	0.638	0.638	0.637	0.640	0.617	7
8	0.629	0.630	0.646	0.647	0.618	0.633	0.616	14
15	0.618	0.634	0.641	0.610	0.643	0.647	0.648	21
22	0.610	0.629	0.632	0.545	0.601	0.649	0.644	28
29	0.624	0.616	0.634	0.623	0.639	0.649	0.654	35
36	0.583	0.622	0.628	0.655	0.647	0.633	0.651	42
43	0.618	0.633	0.616	0.651	0.646	0.612	0.645	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	.101
Mid:	0.500	.500
Max:	1.001	1.000

BlockTemp:	80 F
Couplant:	19620
Design"t"	N/A
Velocity:	N/A

Equipment

Unit S/N:	NDE-88-036
Transducer:	NDE-84-009
Step Wedge:	208 / 87
Ref Block:	N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/17/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	M McAllister	III	10-17-00

12/08/05 12:05:34

[redacted]Gen

NDE Data Report

Ultrasonic Thickness

A# 10
Case 9

Page 1 of Last

Request Title : Drywell Liner Thickness Examination

Component : 6" x 6" Grids (49 Readings)

Code / Spec: Eng. Direction

Procedure: NDE-UT-03 Rev 0

System: Drywell Liner

Material: C/S

Report # 2000-034- 008

Station: Oyster Creek Unit # 1

Drawing # : N/A

Surface Condition : Clean

Thermometer: NDE-93-005 Part Temp: 80 F

Results

Inspection Point	Results	Date Inspected
9/20 (86-20)	Informational	10/17/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 86 BAY# AREA 86.2

	A	B	C	D	E	F	G	
1	0.626	0.620	0.621	0.613	0.595	0.599	0.599	7
8	0.598	0.610	0.600	0.577	0.616	0.590	0.630	14
15	0.609	0.594	0.581	0.609	0.616	0.617	0.617	21
22	0.603	0.604	0.584	0.582	0.617	0.587	0.600	28
29	0.612	0.592	0.599	0.596	0.610	0.620	0.592	35
36	0.581	0.607	0.597	0.617	0.608	0.620	0.633	42
43	0.573	0.599	0.591	0.592	0.622	0.612	0.600	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	.101
Mid:	0.500	.500
Max:	1.001	1.000

BlockTemp: 80 F

Couplant: 19620

Design"t" N/A

Velocity: N/A

Equipment

Unit S/N: NDE-88-036

Transducer: NDE-84-009

Step Wedge: 208 / 87

Ref Block: N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/17/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	[signature]	III	10-17-00

12/08/05 12:05:34

AmerGen

NDE Data Report

Ultrasonic Thickness

Att. 10
Page 10 of 10

Request Title : Drywell Liner Thickness Examination
Component : 6" x 6" Grids (49 Readings)
Code / Spec: Eng. Direction
Procedure: NDE-UT-03 Rev 0
System: Drywell Liner
Material: C/S

Report # 2000-034- 009

Station: Oyster Creek Unit # 1
Drawing # : N/A
Surface Condition : Clean
Thermometer: NDE-93-005 Part Temp: 80 F

Results

Inspection Point	Results	Date Inspected
15/31 (86-31)	Informational	10/17/00

DRYWELL SHELL WALL THICKNESS GRID

ELEV. 86 BAY# AREA 86.31

	A	B	C	D	E	F	G	
1	0.639	0.639	0.627	0.631	0.606	0.614	0.631	7
8	0.647	0.639	0.637	0.629	0.639	0.637	0.630	14
15	0.631	0.650	0.629	0.628	0.640	0.619	0.627	21
22	0.638	0.645	0.594	0.627	0.613	0.623	0.630	28
29	0.643	0.630	0.632	0.615	0.624	0.564	0.614	35
36	0.649	0.619	0.617	0.602	0.616	0.602	0.609	42
43	0.643	0.639	0.610	0.636	0.617	0.612	0.640	49

Comments: N/A

Calibration

	Cal. Block	Readings
Min:	0.101	.101
Mid:	0.500	.500
Max:	1.001	1.000

BlockTemp: 80 F
Couplant: 19620
Design"t": N/A
Velocity: N/A

Equipment

Unit S/N: NDE-88-036
Transducer: NDE-84-009
Step Wedge: 208 / 87
Ref Block: N/A

	Print		SSN	Signature	Level	Date
Examiner:	Stan	McCaulley	174-38-1529	[signature]	III	10/17/00
Asst.Examiner:	N/A	N/A	N/A			
Reviewer:	Martin	McAllister	183-52-0140	[signature]	III	10/17/00

General Electric

CALIBRATION DATA SHEET

CDS# 065
EDS# 065
Pages 1 of 4

FAC
EROSION / CORROSION

Site: Oyster Creek
Project: 1R20
Unit: 1

Procedure: GE-UT-601
Revision: 1

Grid Procedure: ER-AA-430-1001

WO: C2007170
Activity 2
Component: Drywell liner
Component Type: Liner
Material Type: C/S
Nominal Wall Thickness: 0.5
Nominal Pipe Size: n/a

Couplant: Soundsafe
Batch #: 19620

Calibration Temp.: 79°
Thermometer S/N: 235317

Date: 11/09/04
Cal. In Time: 2214
Cal. Out Time: 2335
Cal. Chk. Time: N/A
Cal. Block S/N: Cal-Step-142
Cal. Block Min/Max: .050" - 4.0"
Instrument Mfr.: Panametrics
Instrument S/N: 31124909
Transducer Mfr.: Panametrics
Tranducer S/N: 73215
Transducer Size: 0.312
Transducer Freq.: 5.0 Mhz

Instrument Settings

Frequency: FIXED
Range (Inches): 2.0
Material Velocity: ..2342
Delay: FIXED
Pluse: FIXED
Damping FIXED
Reject: FIXED
Filtering: FIXED

Reflector	Max Amplitude	Sweep	Gain (Db)
0.500	80%	2.5	56 db
1.000	80%	5.0	56 db

Component Examined	File Name	Comments:
Drywell liner	Multiple	N/A

Examined by: Dave Wolford || Date: 11/9/2004

Reviewed by: Lee Stone || Date: 11/11/2004

Approved by: Date:

Attachment 11
Page 1 of 4

12/08/05 12:05:34

Site: Oyster Creek
Project: 1R20
Unit: 1

DryWell
Liner UT Thickness Examination

Location 51-13 — D5131_00

	A	B	C	D	E	F	G
1	0.694	0.649	0.764	0.753	0.761	0.773	0.764
2	0.708	0.657	0.766	0.748	0.744	0.761	0.769
3	0.743	0.659	0.757	0.711	0.716	0.759	0.754
4	0.706	0.703	0.750	0.683	0.766	0.768	0.760
5	0.721	0.753	0.695	0.760	0.762	0.763	0.743
6	0.726	0.719	0.677	0.762	0.765	0.747	0.760
7	0.761	0.768	0.737	0.770	0.759	0.704	0.763

Location 51-15 — D515_00

	A	B	C	D	E	F	G
1	0.731	0.737	0.747	0.754	0.759	0.757	0.759
2	0.765	0.745	0.755	0.758	0.734	0.714	0.741
3	0.743	0.756	0.722	0.743	0.738	0.725	0.758
4	0.768	0.755	0.753	0.749	0.632	0.751	0.754
5	0.753	0.731	0.768	0.751	0.705	0.743	0.743
6	0.759	0.764	0.724	0.772	0.715	0.701	0.763
7	0.752	0.766	0.733	0.753	0.694	0.732	0.760

Location 51-B5 — D5123_00

	A	B	C	D	E	F	G
1	0.743	0.648	0.732	0.762	0.765	0.764	0.713
2	0.757	0.739	0.749	0.744	0.769	0.767	0.714
3	0.760	0.752	0.658	0.674	0.741	0.756	0.757
4	0.734	0.757	0.689	0.659	0.741	0.758	0.764
5	0.756	0.754	0.756	0.763	0.749	0.769	0.743
6	0.753	0.747	0.713	0.740	0.751	0.762	0.759
7	0.754	0.762	0.761	0.729	0.768	0.759	0.763

Location 51-B1 — D5112_00

	A	B	C	D	E	F	G
1	0.750	0.720	0.752	0.741	0.745	0.756	0.758
2	0.751	0.676	0.746	0.728	0.752	0.708	0.737
3	0.752	0.751	0.751	0.706	0.746	0.737	0.740
4	0.747	0.740	0.736	0.689	0.745	0.000	0.740
5	0.753	0.755	0.756	0.741	0.731	1.154	0.727
6	0.765	0.748	0.742	0.725	0.733	0.735	0.721
7	0.746	0.740	0.743	0.745	0.737	0.738	0.742

Appendix 11

Page 2

12/08/05 12:05:34

Site: Oyster Creek
Project: 1R20
Unit: 1

DryWell
Liner UT Thickness Examination

Location 52-13 D5232_00

	A	B	C	D	E	F	G
1	0.709	0.707	0.714	0.712	0.697	0.684	0.706
2	0.710	0.710	0.715	0.697	0.715	0.672	0.703
3	0.714	0.687	0.711	0.681	0.708	0.621	0.670
4	0.717	0.646	0.713	0.621	0.713	0.711	0.562
5	0.716	0.694	0.717	0.714	0.715	0.714	0.674
6	0.708	0.707	0.718	0.719	0.716	0.717	0.706
7	0.716	0.700	0.717	0.718	0.717	0.716	0.710

Location 50-22 D5022_00

	A	B	C	D	E	F	G
1	0.709	0.704	0.683	0.689	0.686	0.603	0.713
2	0.713	0.699	0.703	0.706	0.719	0.722	0.716
3	0.723	0.712	0.704	0.698	0.721	0.717	0.717
4	0.714	0.668	0.721	0.684	0.728	0.713	0.624
5	0.677	0.638	0.689	0.692	0.687	0.698	0.692
6	0.656	0.633	0.690	0.697	0.654	0.686	0.681
7	0.697	0.724	0.723	0.701	0.662	0.550	0.668

Location 86-20 D8620_00

	A	B	C	D	E	F	G
1	0.625	0.625	0.627	0.607	0.607	0.605	0.623
2	0.598	0.611	0.623	0.608	0.631	0.592	0.636
3	0.604	0.601	0.587	0.612	0.625	0.622	0.619
4	0.603	0.601	0.611	0.584	0.617	0.620	0.615
5	0.618	0.595	0.641	0.601	0.612	0.624	0.598
6	0.602	0.611	0.610	0.631	0.613	0.624	0.638
7	0.591	0.595	0.596	0.594	0.622	0.630	0.616

Location 86-28 D8628

	A	B	C	D	E	F	G
1	0.596	0.611	0.643	0.642	0.648	0.653	0.618
2	0.630	0.639	0.647	0.650	0.624	0.640	0.618
3	0.628	0.644	0.642	0.612	0.645	0.651	0.652
4	0.610	0.628	0.634	0.571	0.609	0.654	0.648
5	0.625	0.617	0.639	0.624	0.641	0.657	0.655
6	0.601	0.640	0.655	0.654	0.649	0.637	0.652
7	0.634	0.634	0.623	0.653	0.648	0.615	0.648

Appendix 11
Page 3 of

Site: Oyster Creek
Project: 1R20
Unit: 1

DryWell
Liner UT Thickness Examination

Location 86-31

	A	B	C	D	E	F	G
1	0.648	0.641	0.637	0.646	0.608	0.620	0.633
2	0.653	0.642	0.639	0.636	0.642	0.641	0.633
3	0.641	0.647	0.632	0.629	0.640	0.616	0.629
4	0.651	0.651	0.628	0.634	0.616	0.627	0.635
5	0.648	0.631	0.634	0.619	0.626	0.565	0.614
6	0.656	0.621	0.622	0.607	0.617	0.603	0.606
7	0.642	0.640	0.616	0.635	0.618	0.616	0.569

Append 11
Page 4 of 4