547971

Generation of the LHS Samples for the AP-137 Revision 0 (CRA09) PA Calculations

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Introduction

The program LHS is used to sample the subjective distributions of parameters using a Latin Hypercube sampling design. PRELHS is run prior to LHS and is used to obtain from the WIPP database the data describing the distributions and to create an input file to LHS based on that data. The user creates an input file for PRELHS that specifies which parameters are to be sampled using their "material" and "property" identifiers. PRELHS performs limited error checking on the data extracted from the database. LHS can reorder sampled data to induce or restrict correlations among the parameters. However, for one pair of parameters another conditional relationship was specified by the code analysts. This conditional relationship restricted the value for one parameter to be less than the sampled value of the other parameter of the pair. This conditional relationship was enforced using the utility LHS_EDIT Version 1.0 (Appendix VIII) to modify the output file generated by LHS. This report documents the use of PRELHS Version 2.30, LHS Version 2.42 and LHS_EDIT to provide three sets of sampled data for use in the AP-137 Performance Assessment Calculation (CRA-2009 PA) (Clayton 2007). These three sets represent three replicates of one hundred samples for each of 75 variables. For the most part these variables are associated with model parameters. However, there are also 19 "placeholder" variables sampled. These placeholders are included to enable users to add additional parameters and run LHS while preserving the ability to regenerate the values previously sampled for the model parameters.

The execution of LHS was verified by:

1. Checking the LHS input files to ensure that the headers properly document the analysis and that the random number seeds are correct.
2. Verifying that the proper set of parameters is being sampled. This was done by comparing the set to the specifications of the AP for the analysis, although the AP only lists changes from a previous analysis.
3. Checking the EVAL script input files to ensure that any conditional relationships imposed using LHS_EDIT.EXE are properly specified.
4. Examining the LHS log files for any obvious errors or failures.
5. Examining the PRELHS transfer (output) file to verify that the data were properly extracted from the database.
6. Examining the correlation matrices for "significant" values and to verify that non-zero correlations specified in the input file were properly generated.
7. Checking the values generated to ensure that they do not exceed the specified range.
8. Checking that the distributions match those specified in the parameter database.
9. Plotting the empirical Cumulative Distribution Function (CDF) against the expected CDF and looking for anomalies.

Run Control

The script EVAL_LHS.COM was used to execute PRELHS, LHS and LHS_EDIT. This script processes an input file which lists the specific information required to run these codes. The details of run control are documented in Long (2007). The script and its input files are stored in LIBCRA09_EVAL (PACMS2:[CMS_CRA09.CRA09_EVAL]).

PRELHS Input Files

The three input files for PRELHS are listed in appendices I to III. Except for the title and random seed these three files are identical. Different random seeds are assigned in each input file to cause LHS to generate three unique sets of values. The corresponding output (transfer) files from PRELHS for the three replicates are listed in appendices IV to VI. The three transfer files are also identical except for titles and the random seed values. These files were inspected to verify that the data used to construct the distributions were properly extracted from the library.

LHS Output files

The LHS output files were examined for errors. The ranges of the sampled variables were compared to the range specified as input for the distribution. No values were found to exceed the specified ranges of the distributions. The LHS output file lists the correlation coefficients between the sampled variables. No significant ($\alpha = 0.01$) spurious correlations were observed among the uncorrelated variables, although in replicate 2 the correlation between the ranks of the variables CASTILER:PRESSURE (material:property) and WAS_AREA:PROBDEG was 0.234 which is significant at $\alpha = 0.05$. However, WAS_AREA:PROBDEG is a discrete user-specified distribution (delta distribution) having only 2 possible values (Figure 49). This restriction undoubtedly limits the ability of LHS to shuffle the values to enforce a correlation near zero. In addition, the significance test on the correlation coefficient is questionable in any case because the data fails to even come close to meeting the assumptions of normality of the data. To evaluate the frequency with which high correlation coefficients would be expected, 1000 LHS samples were generated and the correlation coefficients greater than 0.197 (the test statistic for the correlation coefficient for n=100) were tabulated. To generate these values, the LHS2_LHS.FOR code was modified to 1) run 1000 iterations of LHS sampling and 2) to output the data that exceeded 0.197. The modified code was named LHS2_LHS_TEST.FOR and stored with the executable and input files in library LIBCRA09_LHSCORR (PACMS2:[CMS_CRA09.CRA09_LHSCORR). For this informal test, all correlations were specified to be zero. Out of the 1000 samples, 502 ($\alpha = 0.05$) and 2 ($\alpha = 0.01$) "significant" correlations were generated. All of these correlations involved either WAS_AREA:PROBDEG or S_MB139:RELP_MOD, both of which have discrete distributions having only two possible values. These results suggest that the number of values exceeding the standard test statistics for correlation coefficients may be relatively high when LHS samples discrete distributions having few possible values.

The sampled data for those variables for which a correlation matrix was entered showed correlations that were close to those specified (Tables 1 and 2). Variable 53 is S_HALITE:PRMX_LOG and variable 54 is S_HALITE:COMP_RCK. Variable 61 is CASTILER:PRMX_LOG and variable 54 is CASTILER:COMP_RCK (Appendix I).

Table 1. Correlation observed between variables 53 and 54 in replicate 1. A value of -0.99 was specified.

	49	50	51	52	53
49	1.0000				
50	-0.0156	1.0000			
51	0.0547	-0.0943	1.0000		
52	-0.0177	-0.0160	-0.0743	1.0000	
53	-0.0022	0.0287	-0.0094	-0.0409	1.0000
54	0.0119	-0.0249	-0.0066	0.0248	-0.9863

Table 2. Correlation observed between variables 61 and 62 in replicate 1. A value of -0.75 was specified.

	61	62	63	64
61	1.0000			
62	-0.7362	1.0000		
63	0.0365	-0.0414	1.0000	
64	-0.0292	0.0630	0.0081	1.0000

The sampled distributions were compared to the expected distributions. Cumulative distribution functions for the sampled data were constructed by ordering the data from smallest to largest value and assigning the probability $i/100\text{-}0.005$ to the i^{th} ordered value, i.e. the midpoint of the interval containing the value based on order statistics (Figures 1 through 168). With the exception of the variable modified using LHS_EDIT (Figures 47, 103 and 159), the differences between the CDFs of the sampled values and the CDFs of the expected distributions are due to the differences between the estimated probability assigned to the values and the true probability associated with the data.

Most of the distributions used for the CRA-2009 analysis were identical to those used in the CRA-2004 PABC. One exception was S_HALITE:POROSITY which had its maximum value changed from 0.03 to 0.0519 (Ismail 2007).

A conditional relationship had previously been enforced between WAS_AREA:GRAMICH and WAS_AREA:GRAMICI using ALGEBRA prior to running the BRAGFLO code (Nemer and Stein 2005). This relationship was implemented by setting WAS_AREA:GRAMICH to the value of WAS_AREA:GRAMICI if WAS_AREA:GRAMICH exceeded WAS_AREA:GRAMICI in any particular vector. Changing these values in this way introduced a small error into the sensitivity analysis for WAS_AREA:GRAMICH because the regression analysis was based on the sampled values rather than the conditional values used in the code. LHS_EDIT was used to enforce a conditional relationship between WAS_AREA:GRAMICH and WAS_AREA:GRAMICI in the LHS transfer file, thus making the conditioned values available for use in the sensitivity analysis. However, the method used to enforce the conditional relationship was different than that used previously. For the CRA-2009 PA it was assumed that WAS_AREA:GRAMICH was uniformly distributed between 0 and the minimum of either 1.02717E-9 (the upper level of the uniform distribution specified in the parameter data base for the variable) and the value selected for WAS_AREA:GRAMICI. LHS_EDIT rescaled the

sampled value of WAS_AREA:GRAMICH from the range 0 to 1.02717E-9 to the new range using the equation

$$v_i' = \frac{v_i - U_{V,lower}}{U_{V,upper} - U_{V,lower}} \times \left(Min(x_i, U_{V,upper}) - U_{V,lower} \right) + U_{V,lower} \quad (1)$$

Where v_i' is the conditioned value of WAS_AREA:GRAMICH, v_i is the sampled value of WAS_AREA:GRAMICH, x_i is the sampled value of WAS_AREA:GRAMICI, and $U_{V,lower}$ and $U_{V,upper}$ are the bounds of the uniform distribution assigned to WAS_AREA:GRAMICH. This method preserves the probability associated with the value of WAS_AREA:GRAMICH. The CDFs for the sampled values, the CRABC conditioned values and the CRA-2009 conditioned values are shown in Figures 48, 105 and 162 for replicates 1, 2 and 3, respectively. This conditional relationship results in a positive correlation between the two variables. This correlation was computed for Replicate 1 using Excel and found to be 0.74 (Figure 169). The nature of the correlation is fundamentally different than that which LHS could induce between the variables. If instead of limiting the value of WAS_AREA:GRAMICH a correlation of 0.74 had been specified between the variables in the input file to LHS then LHS would have generated values for WAS_AREA:GRAMICH that exceeded the corresponding value for WAS_AREA:GRAMICI.

Summary and Conclusions

LHS was used to generate one hundred vectors of sampled parameter values for each of three replicates. A unique random number seed was assigned to each of the three replicates. These seed values were identical to those used in the CRA1-PABC analysis. The resulting sampled data had the expected correlation structure and the values fell within the expected ranges. The LHS results were subsequently modified to enforce a conditional relationship between WAS_AREA:GRAMICH and WAS_AREA:GRAMICI.

References

Ismail, A. 2007. Revised porosity estimates for the DRZ. Sandia National Laboratories. Carlsbad, NM. ERMS #545755

Long, J. J. 2008. Execution of Performance Assessment Codes for the 2009 Compliance Recertification Application Performance Assessment, Revision 0. Sandia National Laboratories, Carlsbad, N.M.

Nemer, M. B. and J. S. Stein. 2005. "Analysis Package for BRAGFLO: 2004 Compliance Recertification Application Performance Assessment Baseline Calculation." Analysis Report, June 28, 2005. Carlsbad, NM: Sandia National Laboratories. ERMS 540527.

Clayton, D. J. 2007. Analysis plan for the 2009 Compliance Recertification Application Performance Assessment (AP137). Sandia National Laboratories. Carlsbad, NM. ERMS #547515

Figure 1. Observed and Expected CDFs for S_MB139:PORE_DIS
Student Distribution

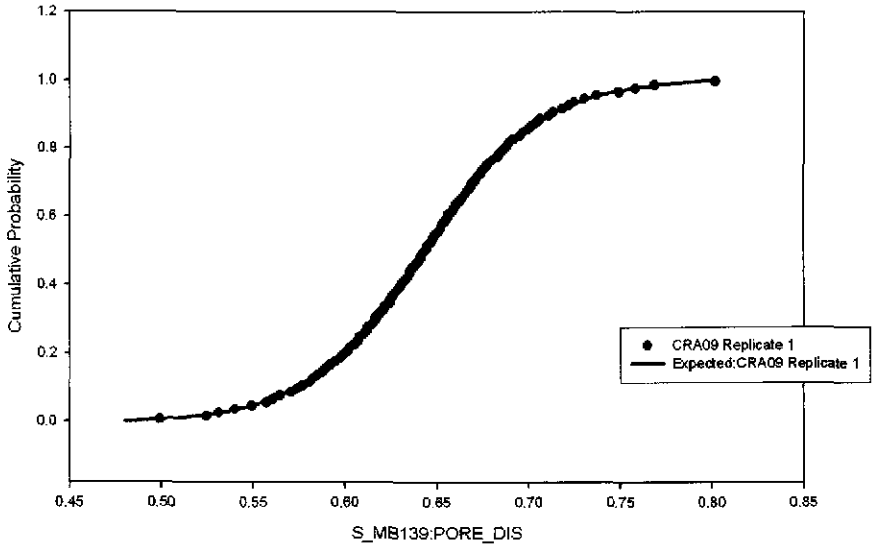

Figure 2. Observed and Expected CDFs for S_MB139:RELP_MOD
User Discrete (Delta) Distribution

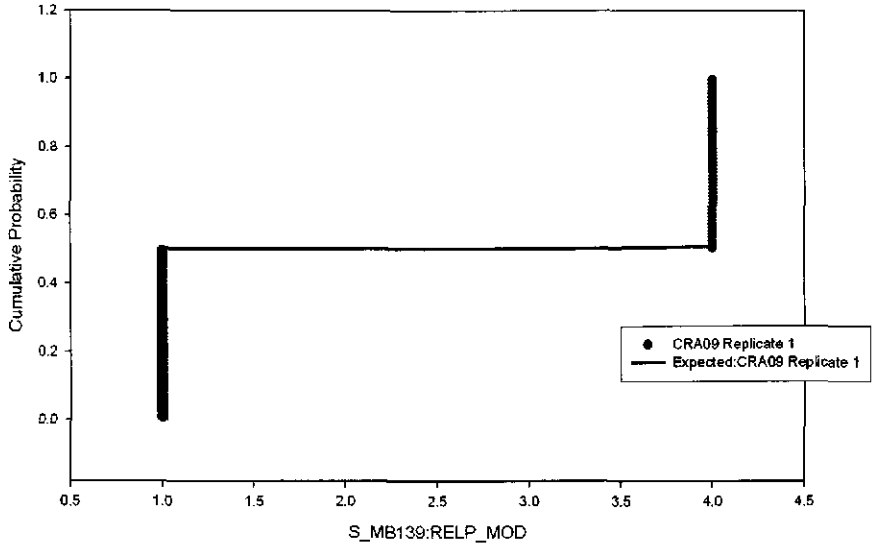

Figure 3. Observed and Expected CDFs for S_MB139:PRMX_LOG Student Distribution

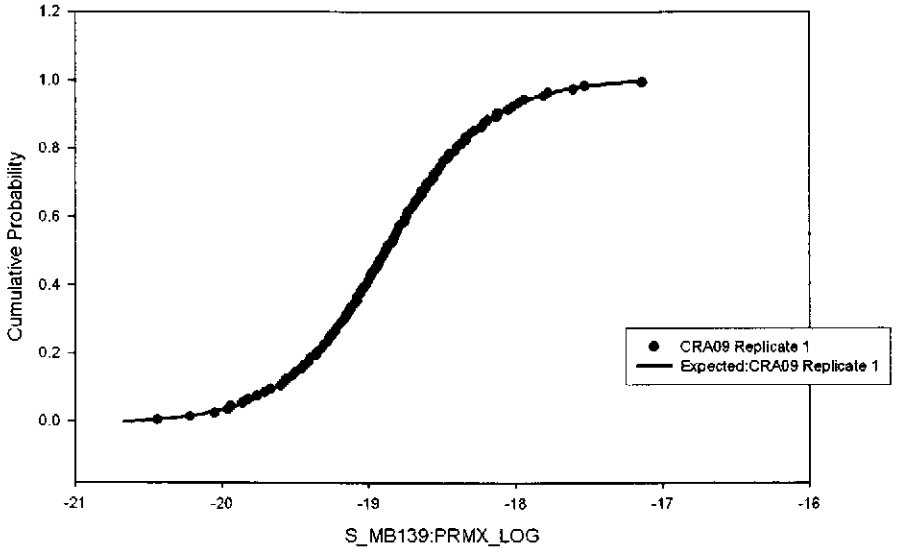

Figure 4. Observed and Expected CDFs for S_MB139:SAT_RBRN Student Distribution

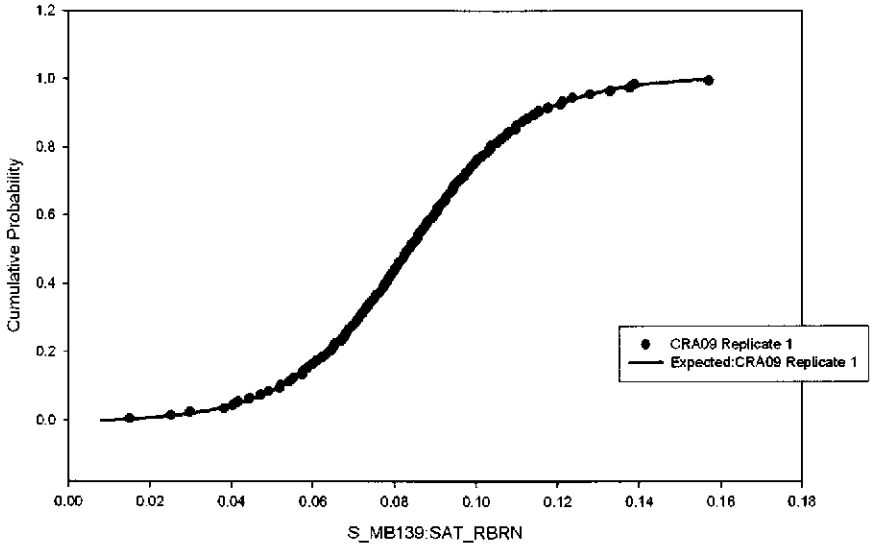

Figure 5. Observed and Expected CDFs for BH_SAND:PRMX_LOG
Uniform Distribution

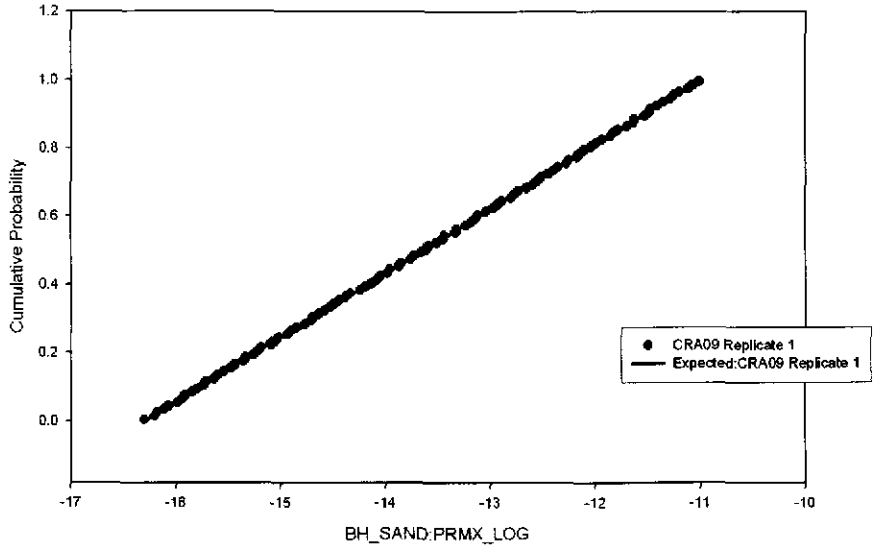

Figure 6. Observed and Expected CDFs for CASTILER:COMP_RCK
Triangular Distribution

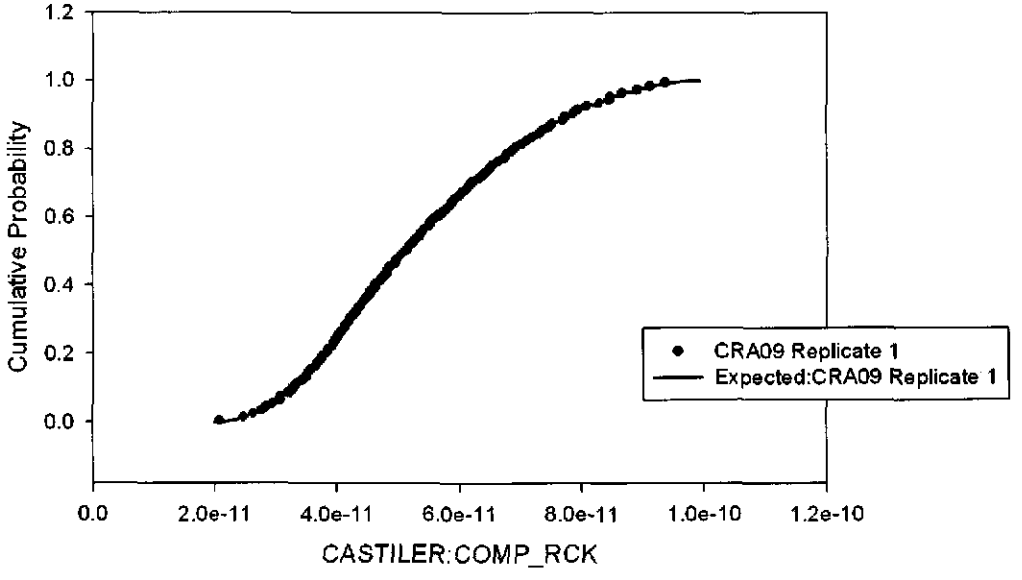

Figure 7. Observed and Expected CDFs for CASTILER:PRESSURE
Triangular Distribution

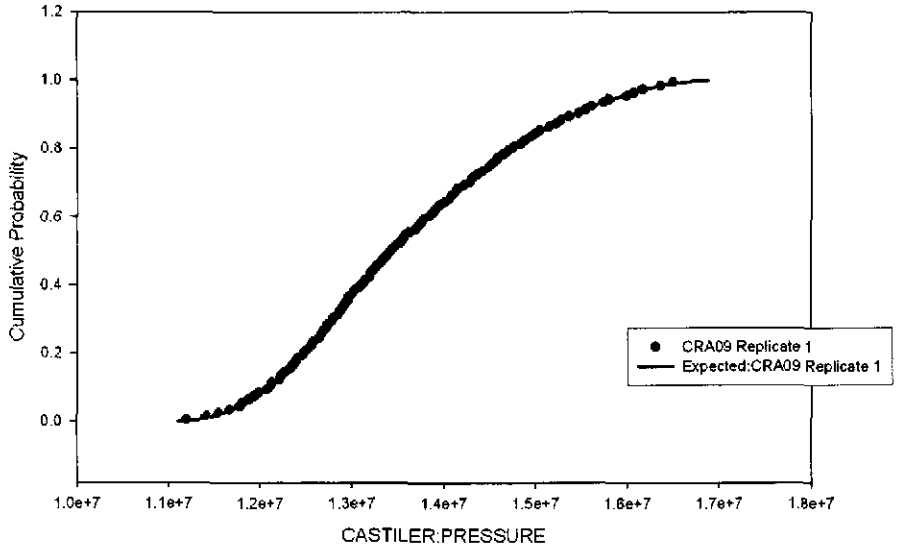

Figure 8. Observed and Expected CDFs for CASTILER:PRMX_LOG
Triangular Distribution

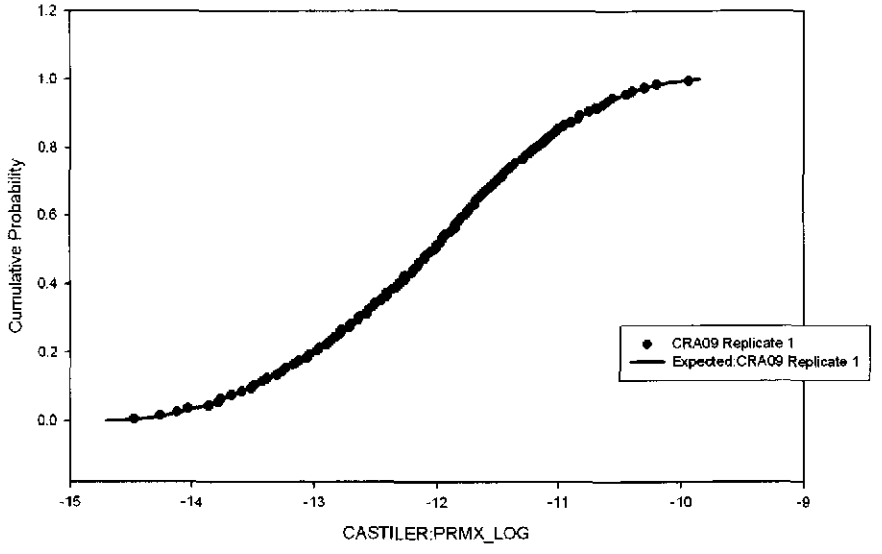

Figure 9. Observed and Expected CDFs for GLOBAL:PBRINE
Uniform Distribution

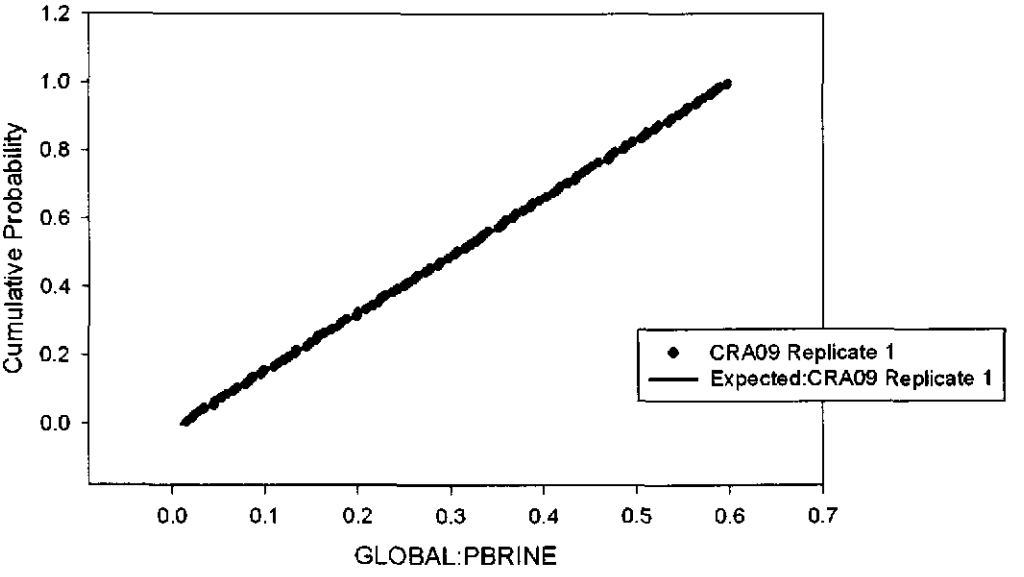

Figure 10. Observed and Expected CDFs for GLOBAL:CLIMTIDX
User Continuous Distribution

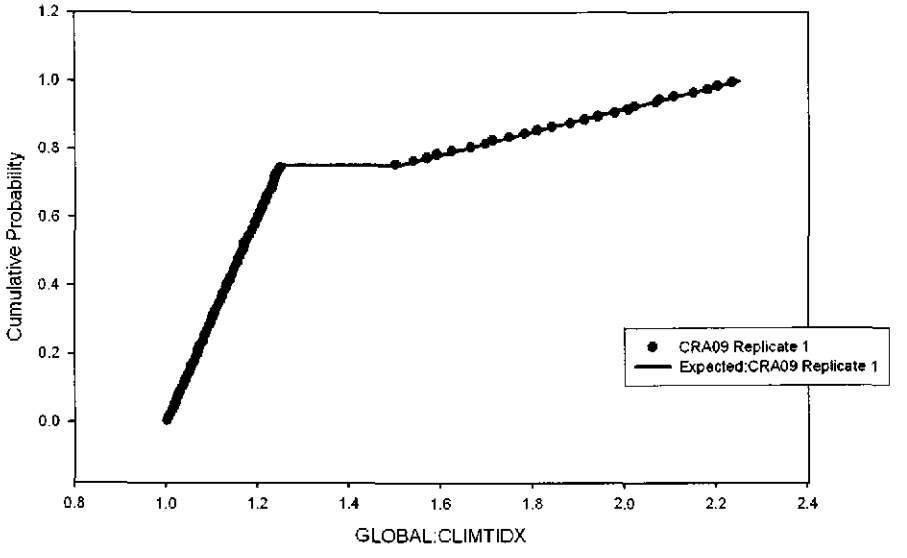

Figure 11. Observed and Expected CDFs for CULEBRA:APOROS Loguniform Distribution

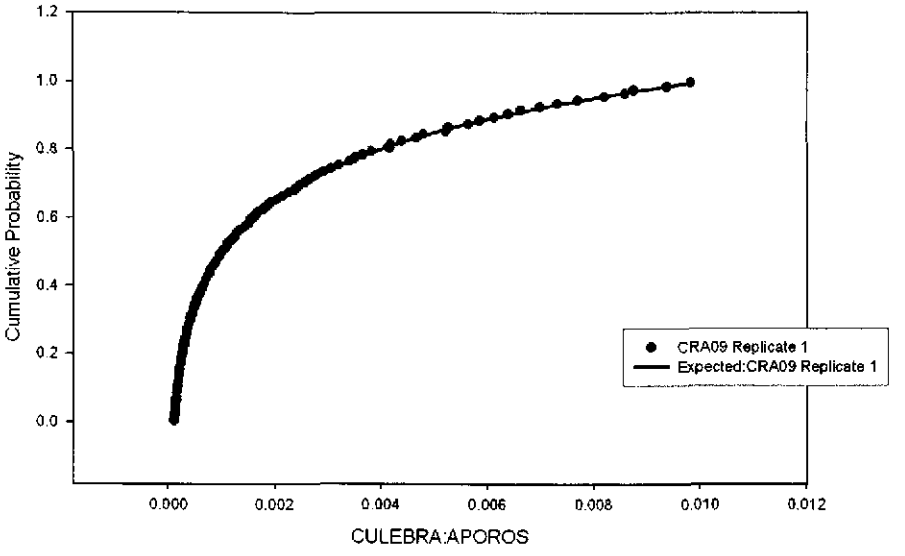

Figure 12. Observed and Expected CDFs for CULEBRA:HMBLKLT Uniform Distribution

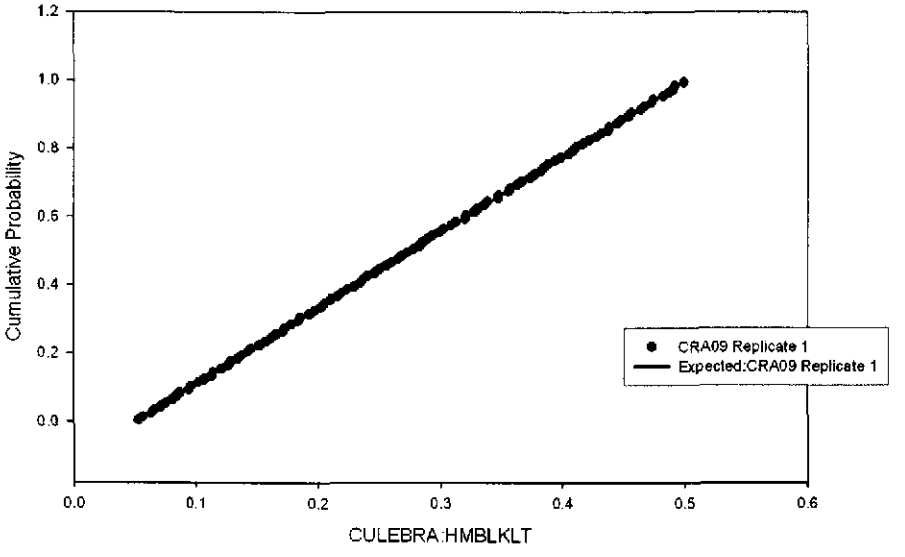

Figure 13. Observed and Expected CDFs for AM+3:MKD_AM
Loguniform Distribution

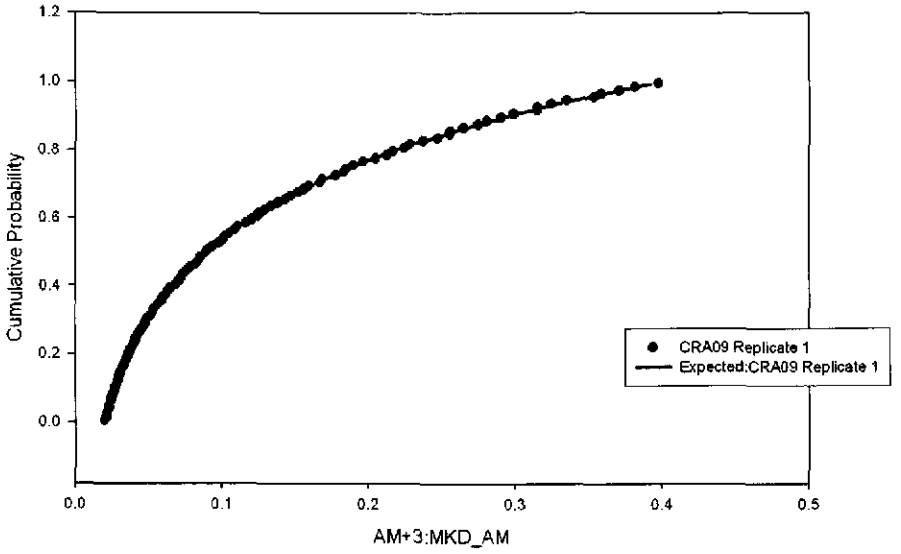

Figure 14. Observed and Expected CDFs for PU+3:MKD_PU
Loguniform Distribution

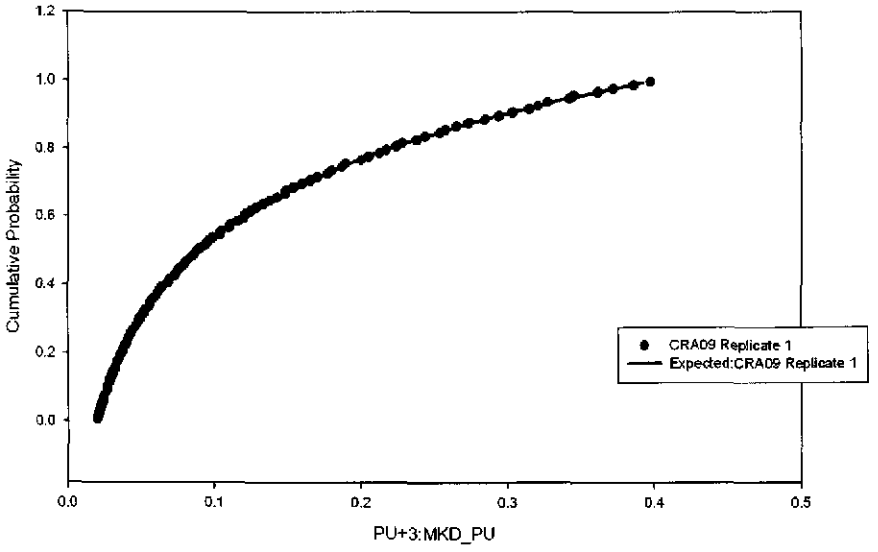

Figure 15. Observed and Expected CDFs for PU+4:MKD_PU
Loguniform Distribution

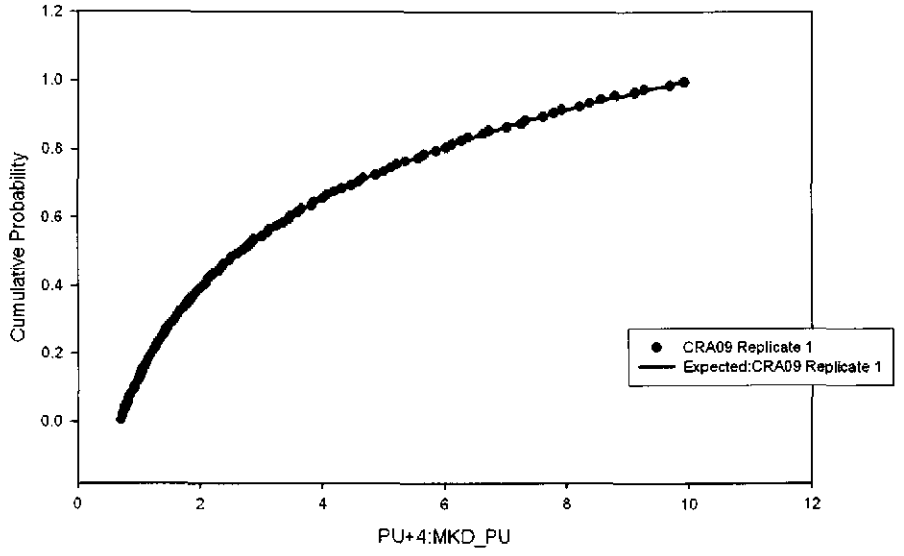

Figure 16. Observed and Expected CDFs for TH+4:MKD_TH
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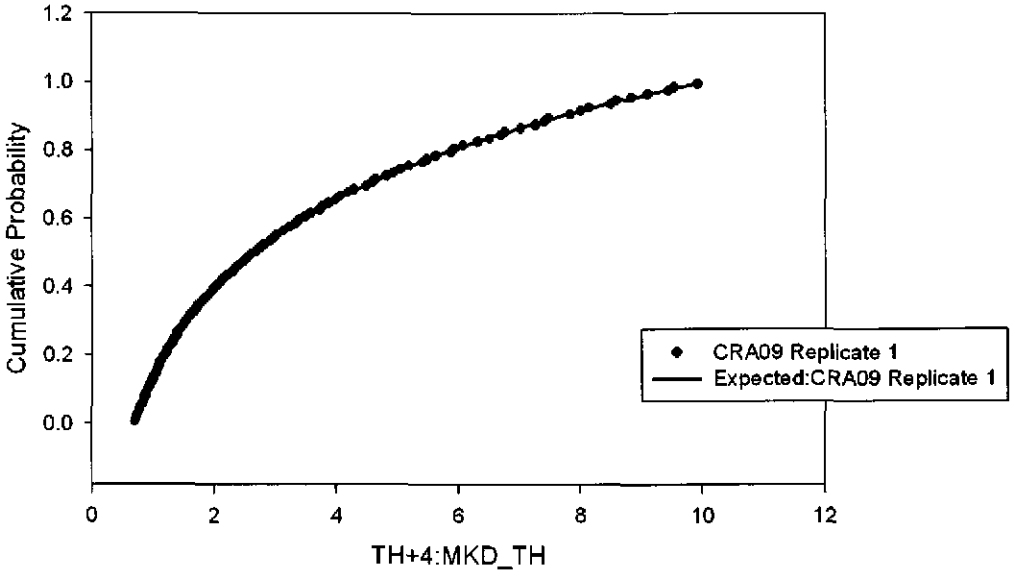


Figure 17. Observed and Expected CDFs for U+4:MKD_U
Loguniform Distribution

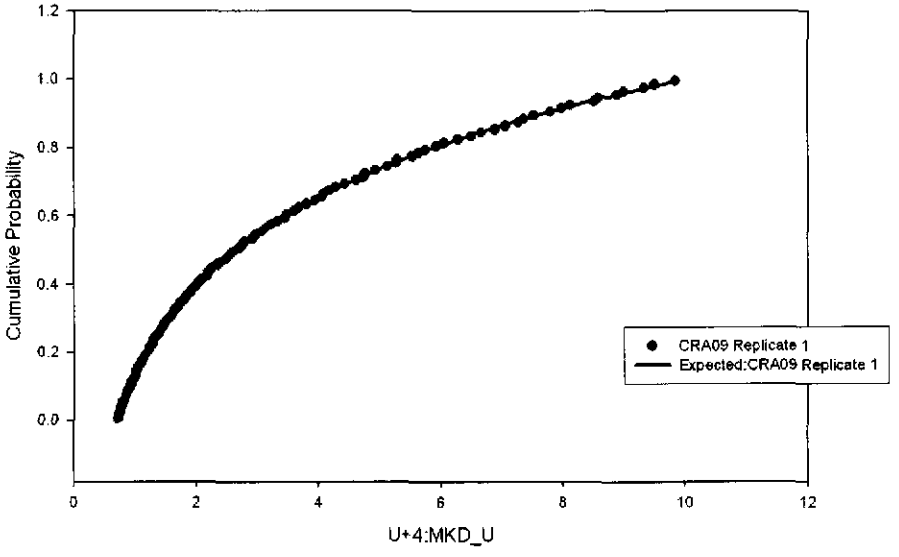


Figure 18. Observed and Expected CDFs for U+6:MKD_U
Loguniform Distribution

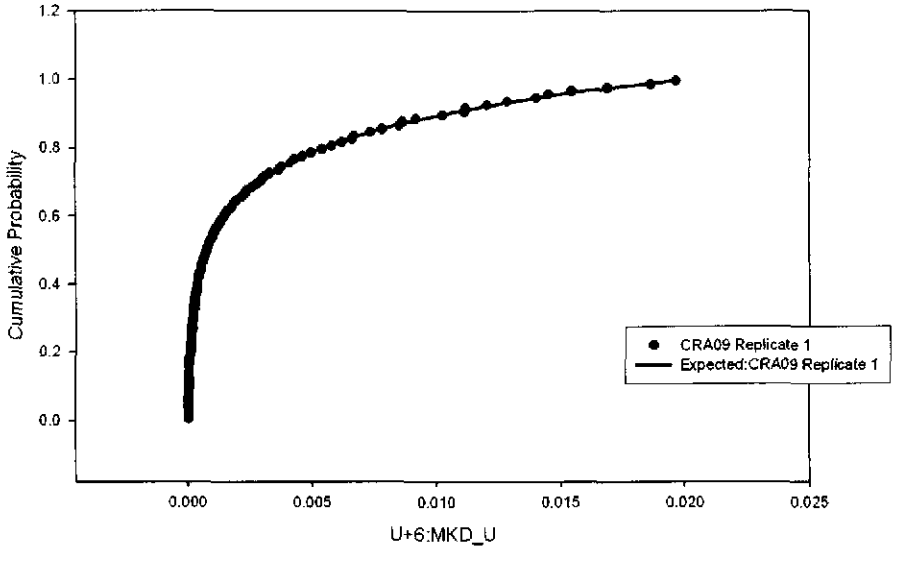


Figure 19. Observed and Expected CDFs for CULEBRA:DPOROS User Continuous Distribution

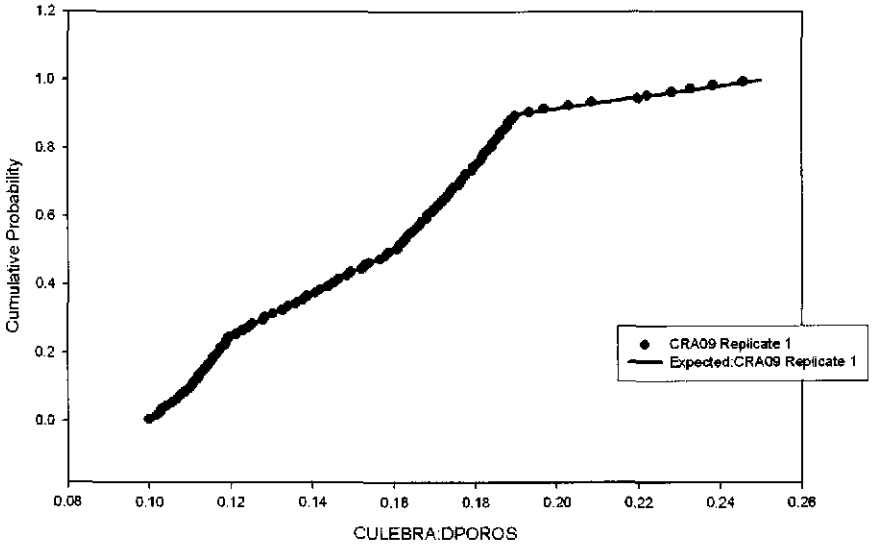


Figure 20. Observed and Expected CDFs for CONC_PCS:PORE_DIS User Continuous Distribution

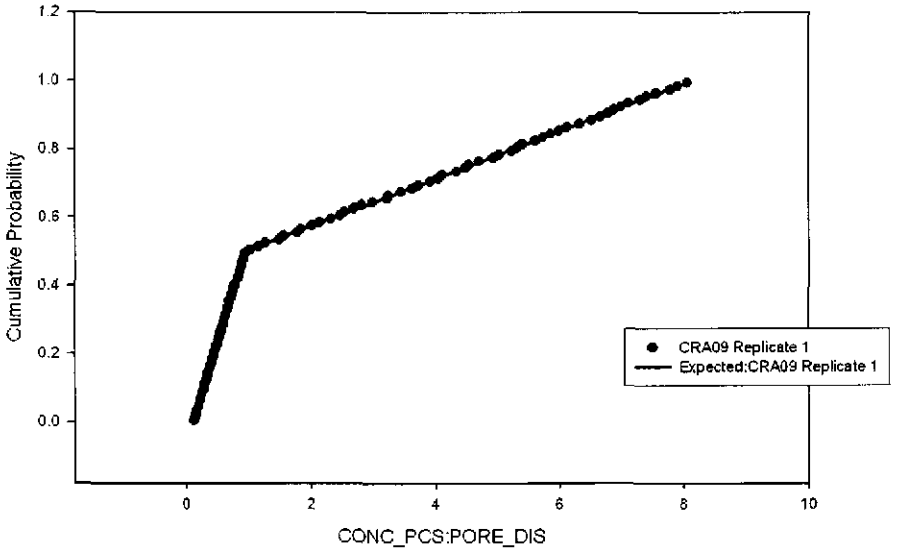


Figure 21. Observed and Expected CDFs for CONC_PCS:SAT_RBRN
User Continuous Distribution

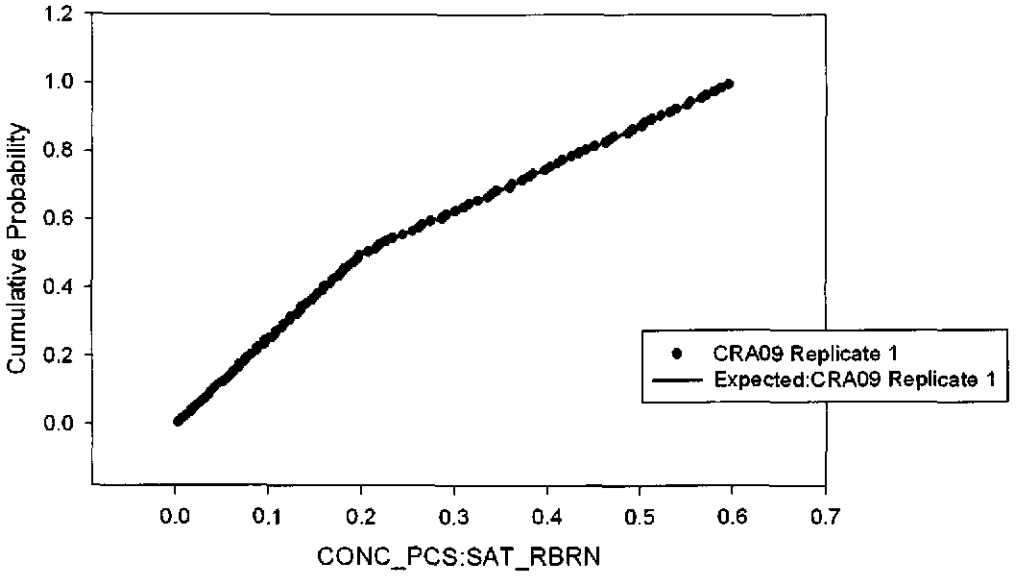


Figure 22. Observed and Expected CDFs for CONC_PCS:SAT_RGAS
Uniform Distribution

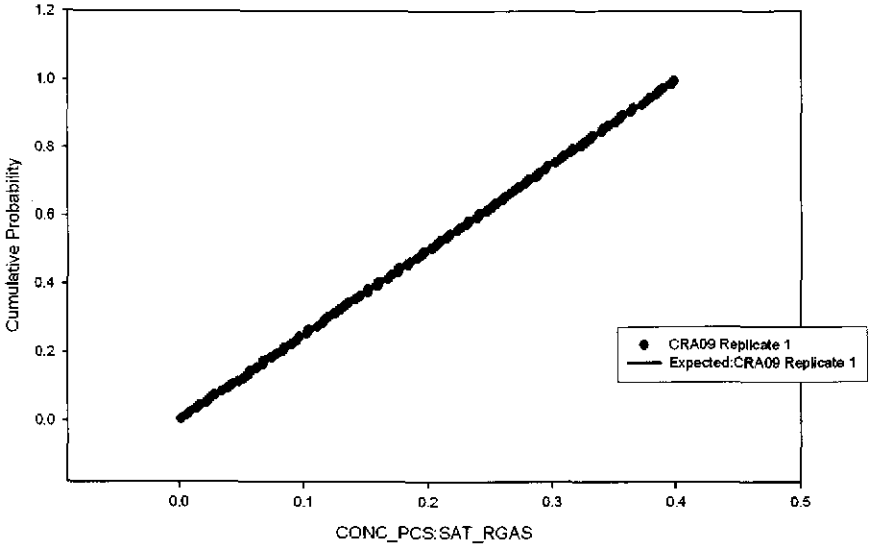


Figure 23. Observed and Expected CDFs for CONC_PCS:PRMX_LOG
Triangular Distribution

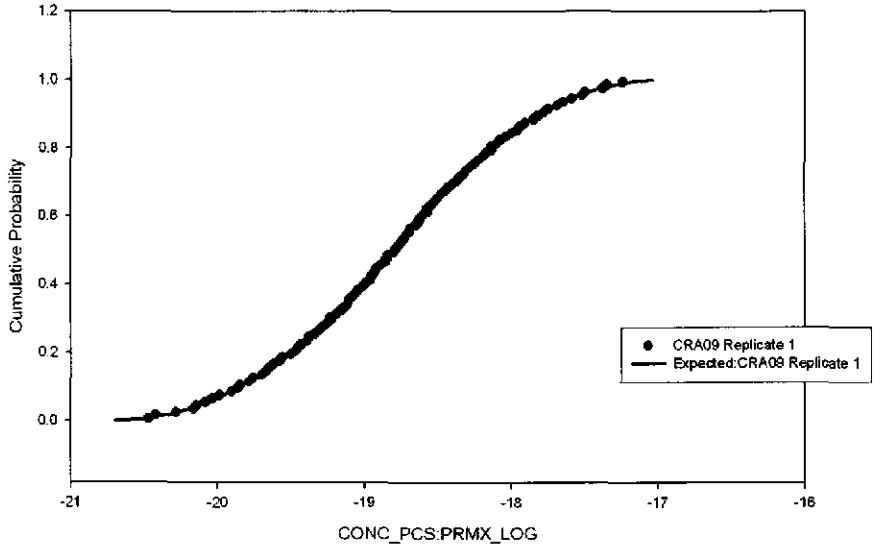


Figure 24. Observed and Expected CDFs for GLOBAL:TRANSIDX
Uniform Distribution

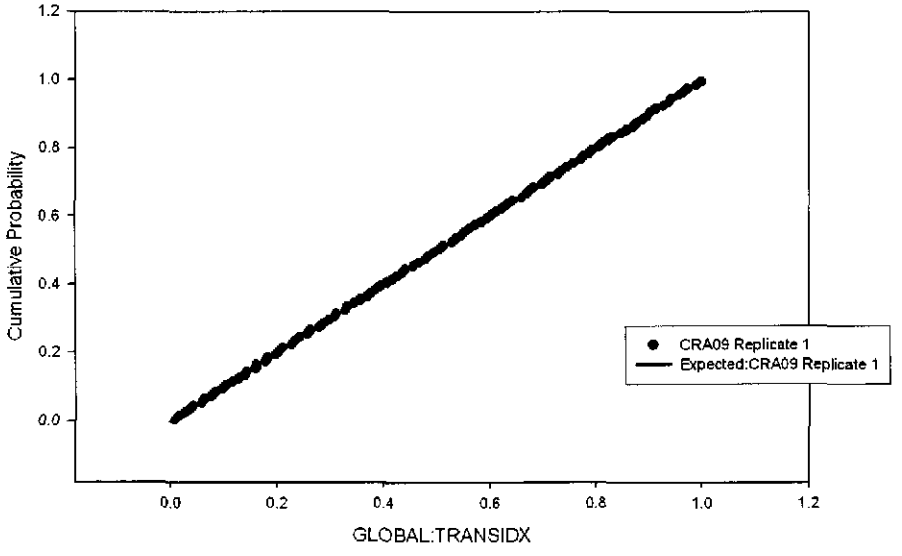


Figure 25. Observed and Expected CDFs for CULEBRA:MINP_FAC
Uniform Distribution

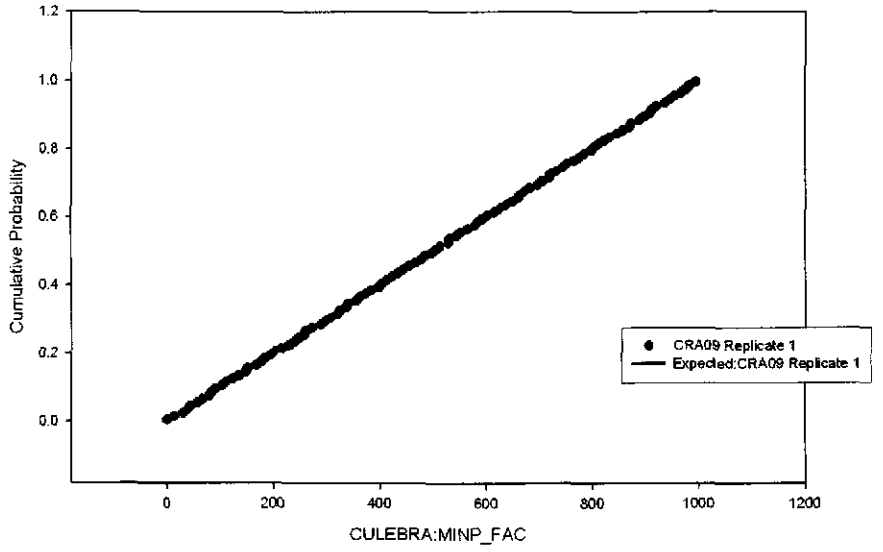


Figure 26. Observed and Expected CDFs for BOREHOLE:DOMEGA
User Continuous Distribution

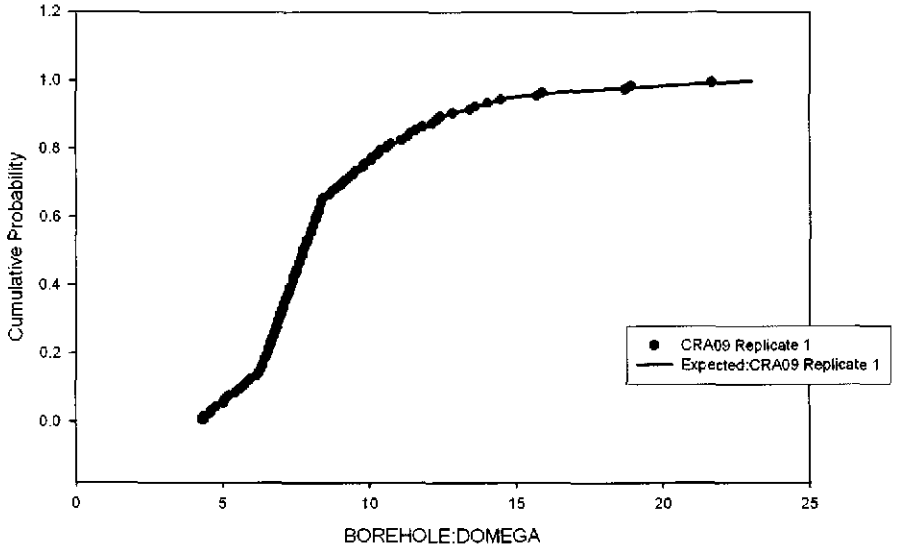


Figure 27. Observed and Expected CDFs for DRZ_PCS:PRMX_LOG
Triangular Distribution

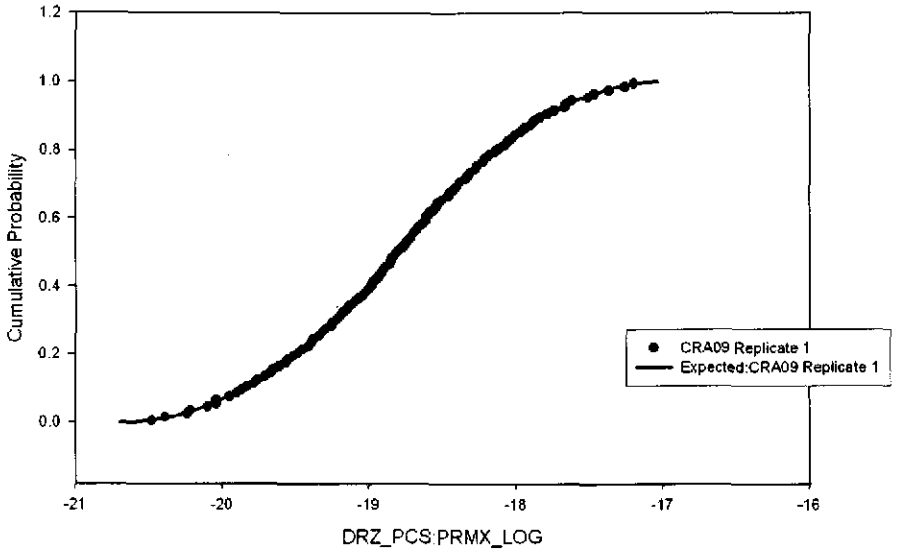


Figure 28. Observed and Expected CDFs for DRZ_1:PRMX_LOG
Uniform Distribution

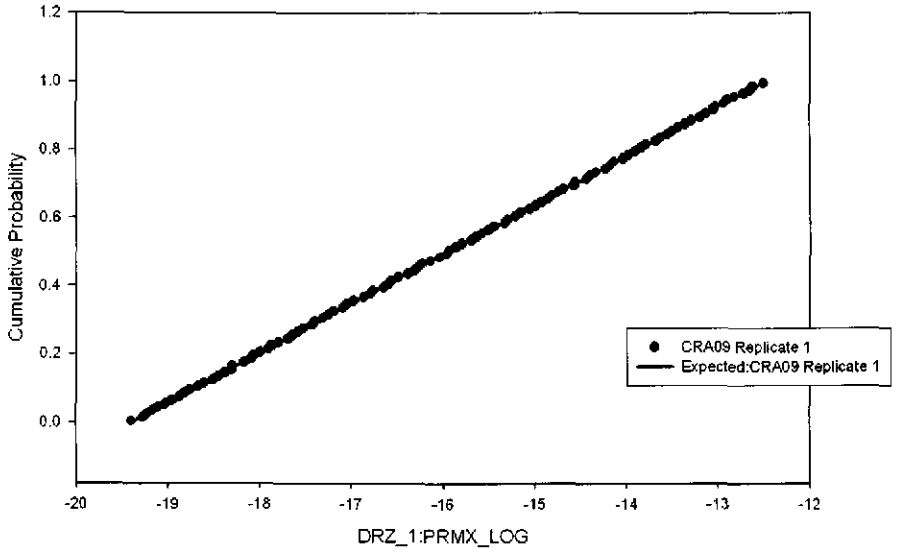


Figure 29. Observed and Expected CDFs for S_HALITE:COMP_RCK
Uniform Distribution

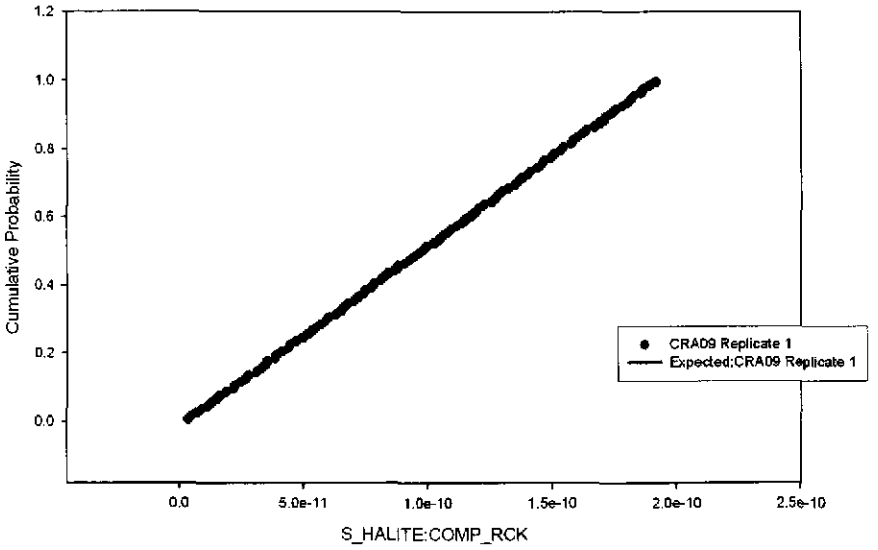


Figure 30. Observed and Expected CDFs for S_HALITE:POROSITY
User Continuous Distribution

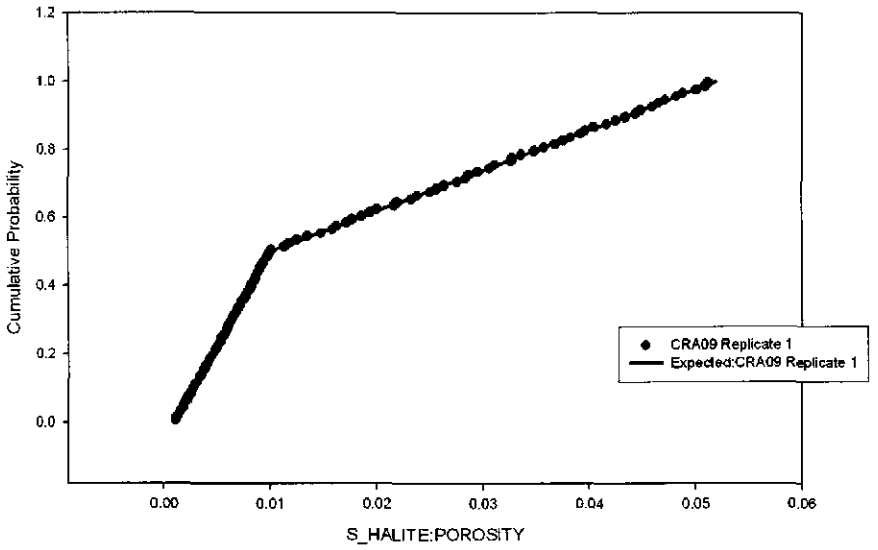


Figure 31. Observed and Expected CDFs for S_HALITE:PRMX_LOG
Uniform Distribution

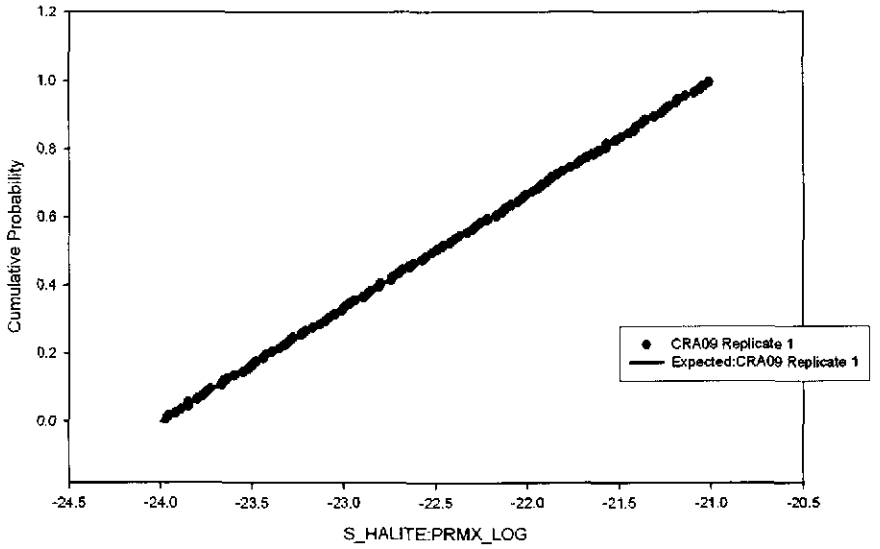


Figure 32. Observed and Expected CDFs for CONC_PLG:PRMX_LOG
Uniform Distribution

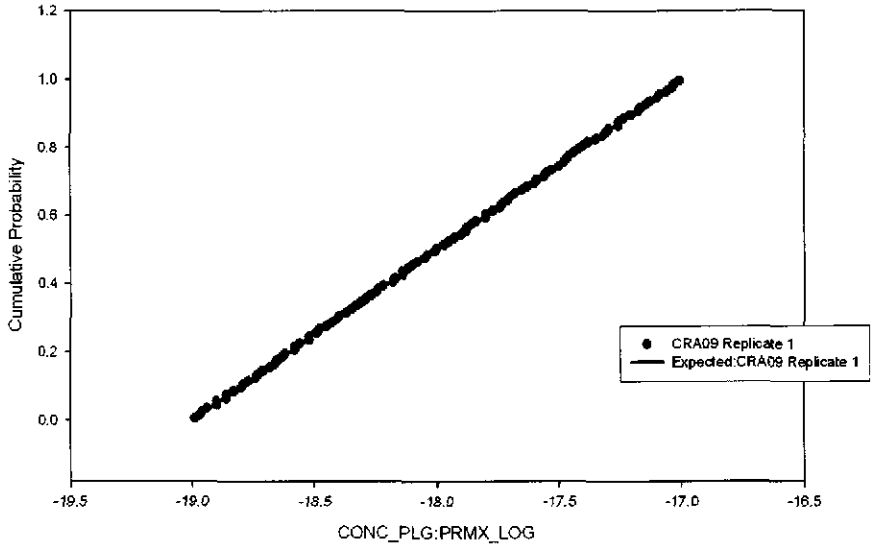


Figure 33. Observed and Expected CDFs for SPALLMOD:REPIPERM
Loguniform Distribution

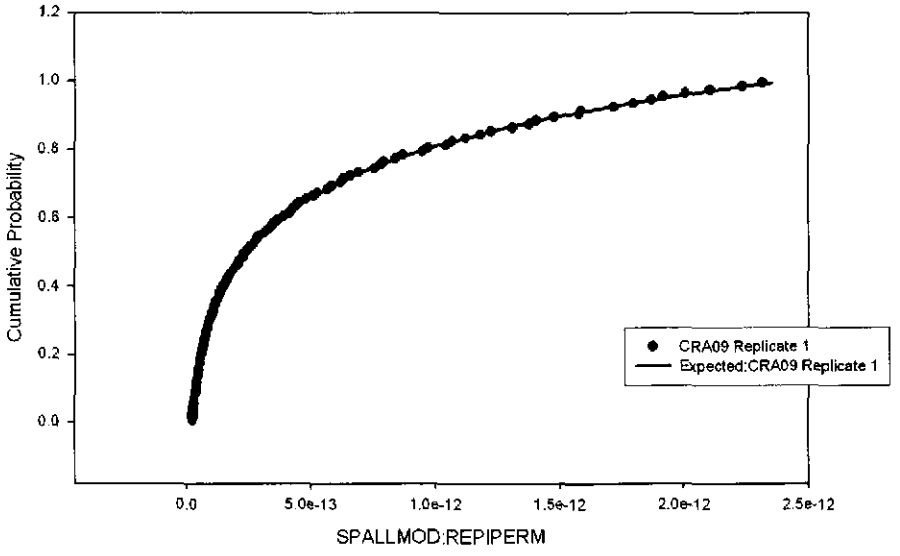


Figure 34. Observed and Expected CDFs for S_HALITE:PRESSURE
Uniform Distribution

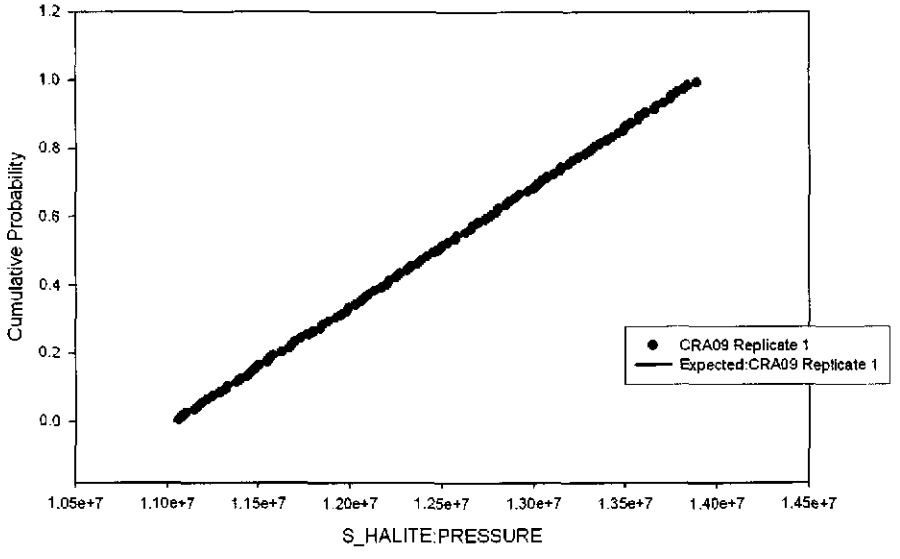


Figure 35. Observed and Expected CDFs for SHFTL_T1:PRMX_LOG
User Continuous Distribution

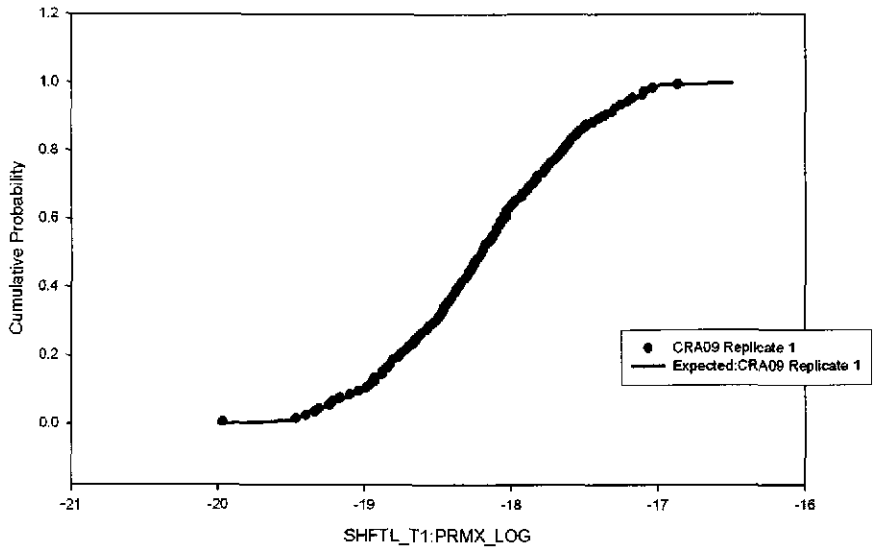


Figure 36. Observed and Expected CDFs for SHFTL_T2:PRMX_LOG
User Continuous Distribution

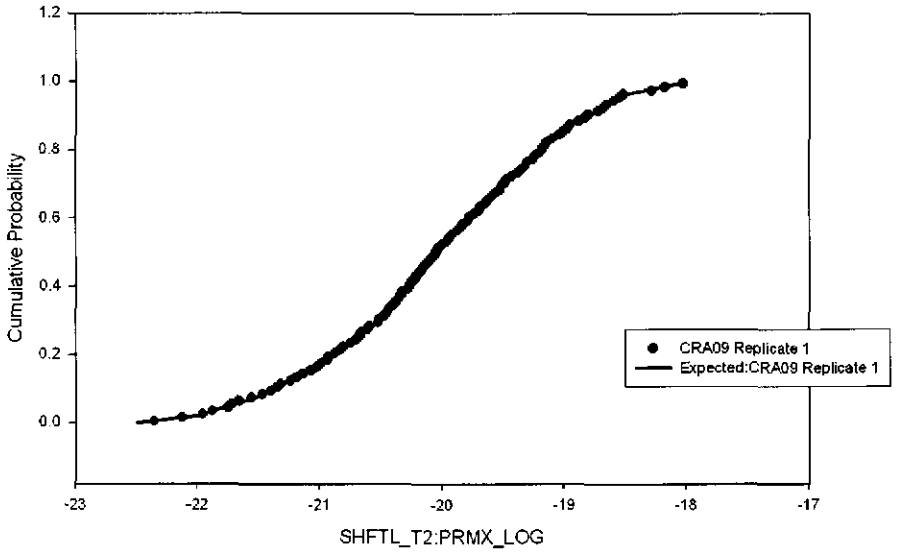


Figure 37. Observed and Expected CDFs for SHFTU:PRMX_LOG User Continuous Distribution

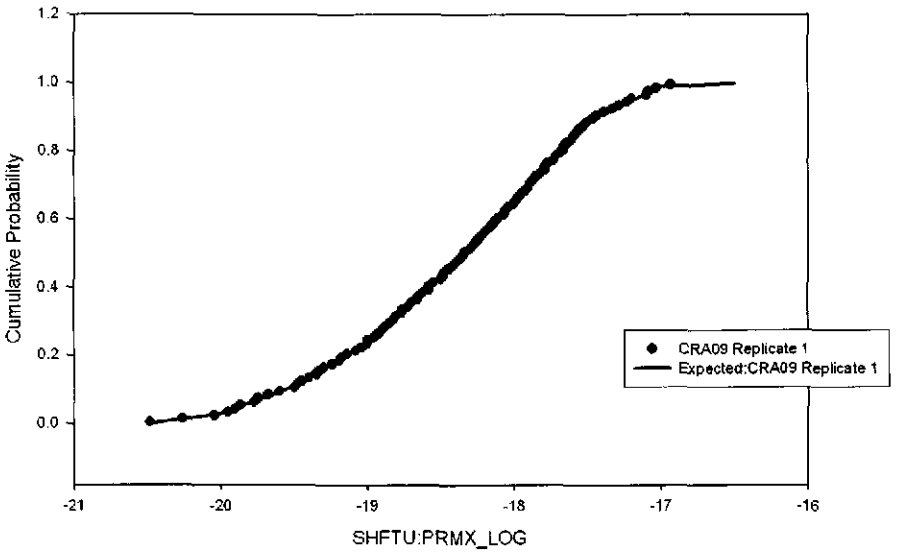


Figure 38. Observed and Expected CDFs for SHFTU:SAT_RBRN User Continuous Distribution

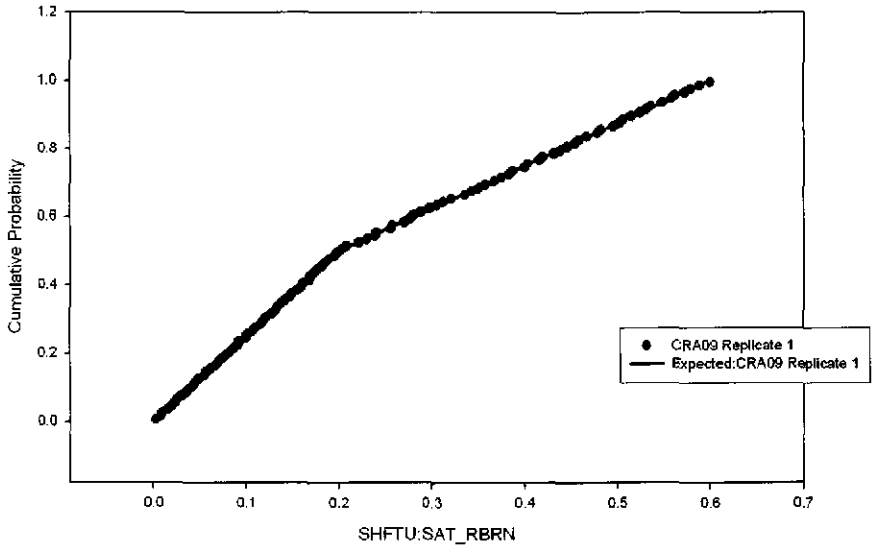


Figure 39. Observed and Expected CDFs for SHFTU:SAT_RGAS
Uniform Distribution

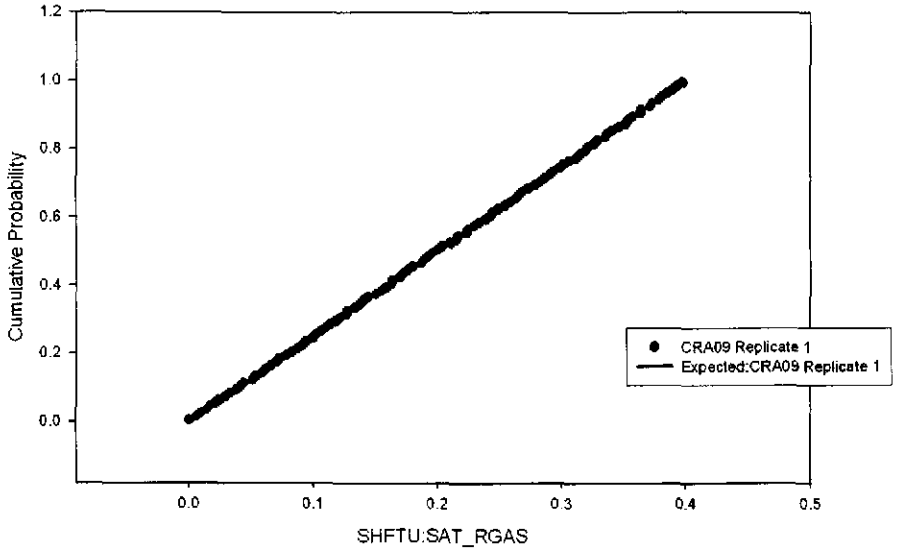


Figure 40. Observed and Expected CDFs for SPALLMOD:PARTDIAM
Loguniform Distribution

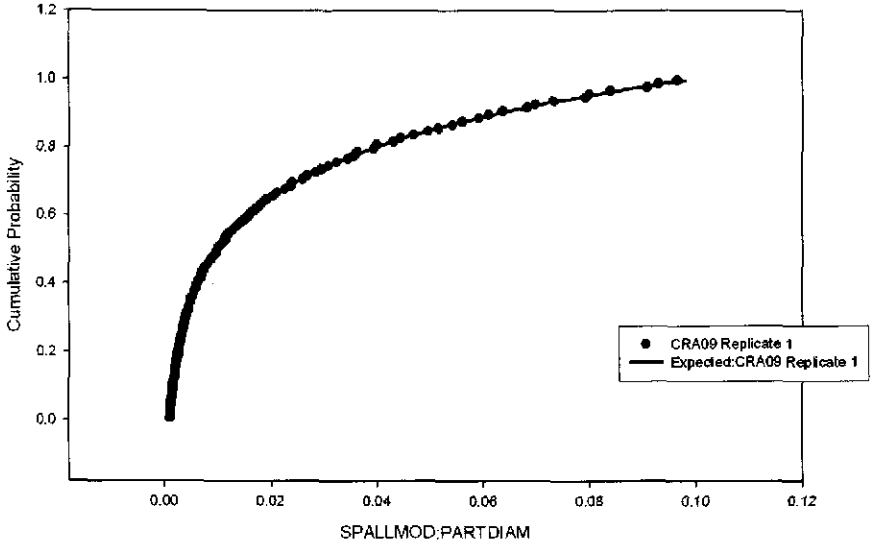


Figure 41. Observed and Expected CDFs for SPALLMOD:REPIPOR
Uniform Distribution

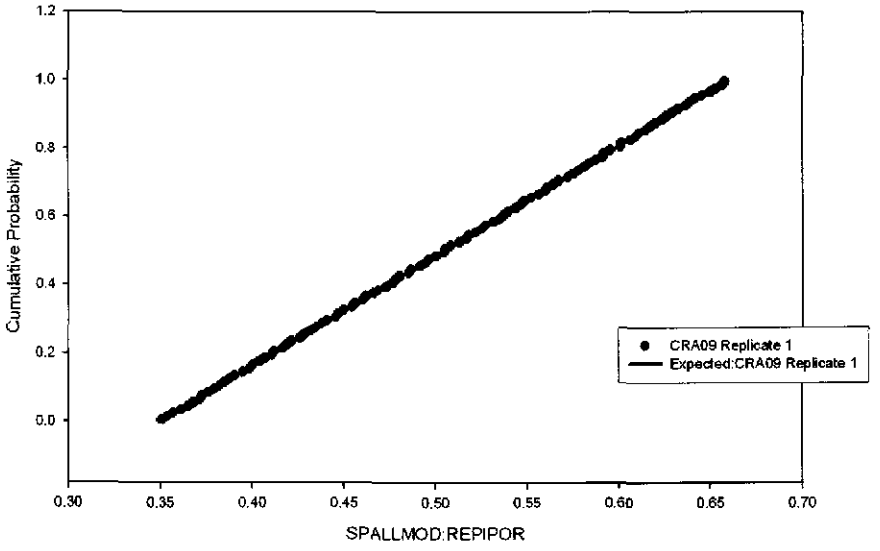


Figure 42. Observed and Expected CDFs for SPALLMOD:TENSLSTR
Uniform Distribution

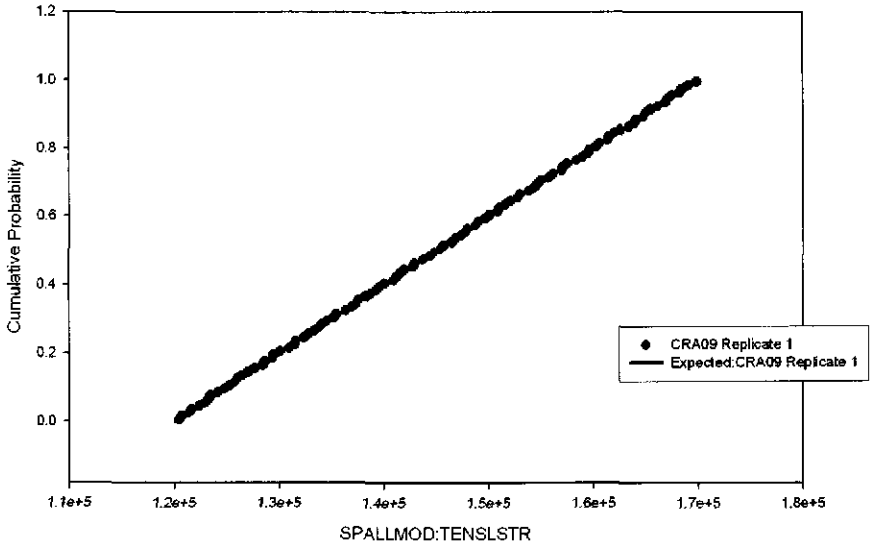


Figure 43. Observed and Expected CDFs for WAS_AREA:SAT_WICK
Uniform Distribution

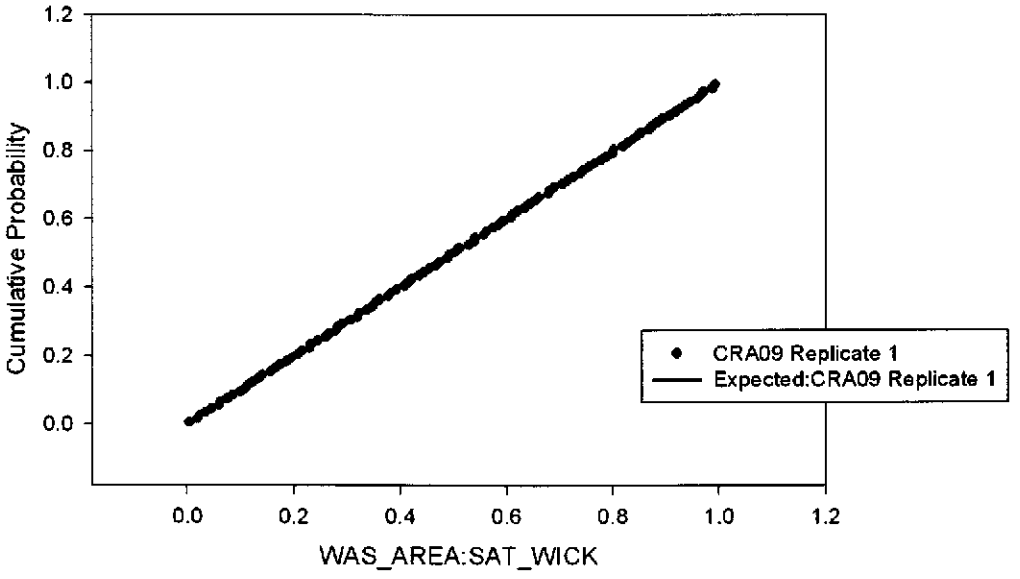


Figure 44. Observed and Expected CDFs for WAS_AREA:BIOGENFC
Uniform Distribution

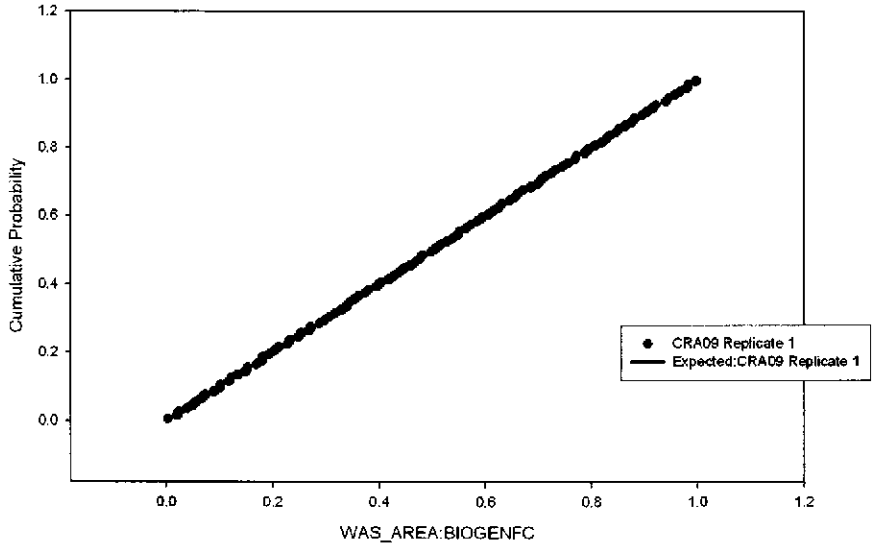


Figure 45. Observed and Expected CDFs for CELLULS:FBETA
Uniform Distribution

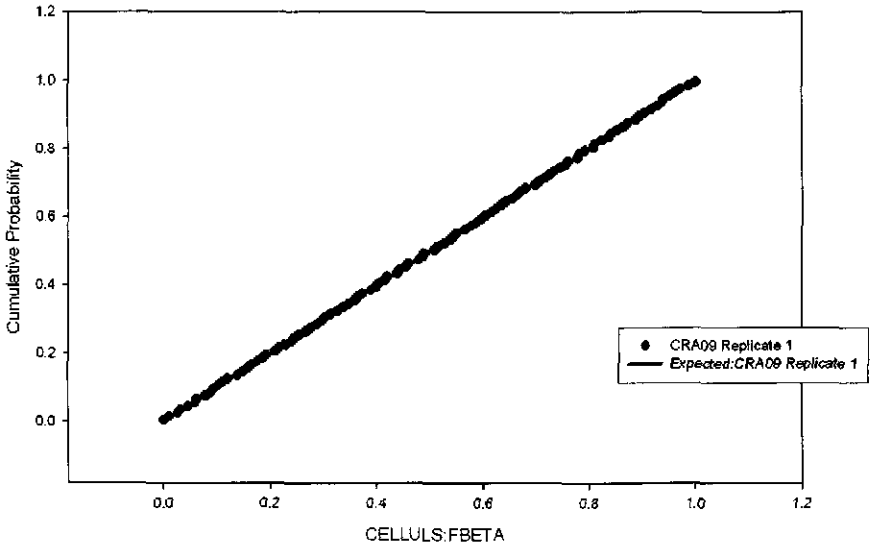


Figure 46. Observed and Expected CDFs for STEEL:CORRMCO2
Uniform Distribution

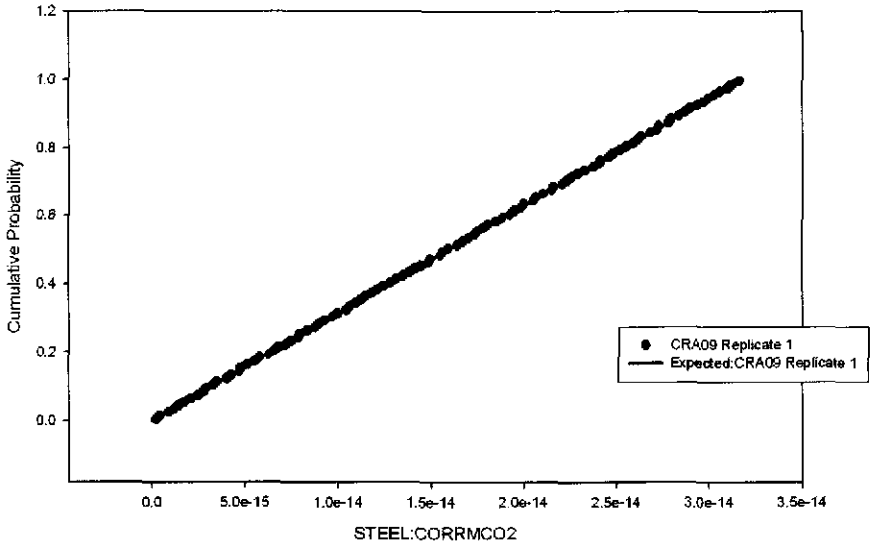


Figure 47. Observed and Expected CDFs for WAS_AREA:GRATMICH
Uniform Distribution

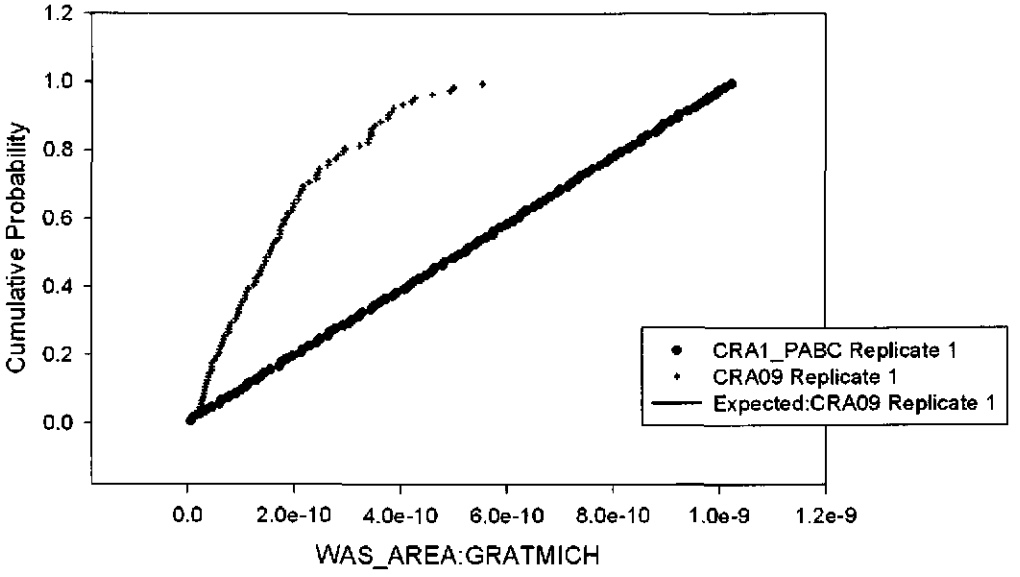


Figure 48. Observed and Expected CDFs for WAS_AREA:GRATMICI
Uniform Distribution

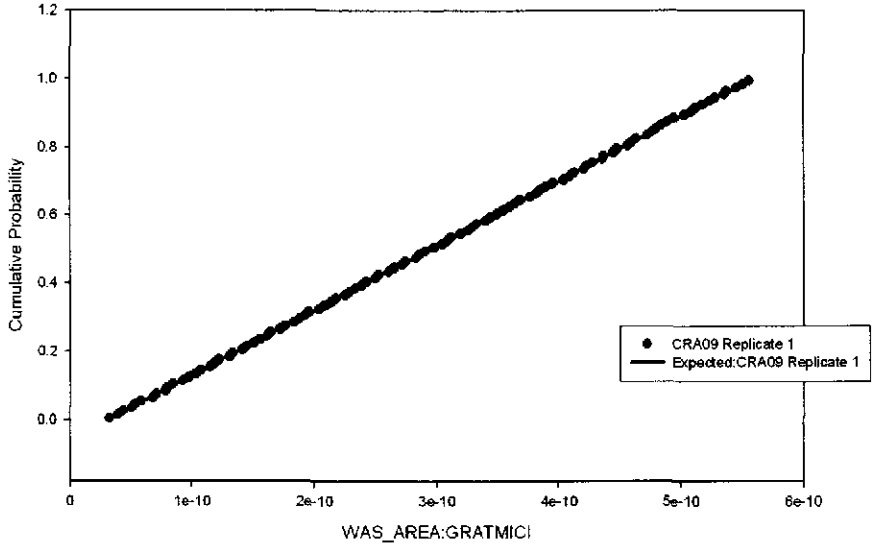


Figure 49. Observed and Expected CDFs for WAS_AREA:PROBDEG
User Discrete (Delta) Distribution

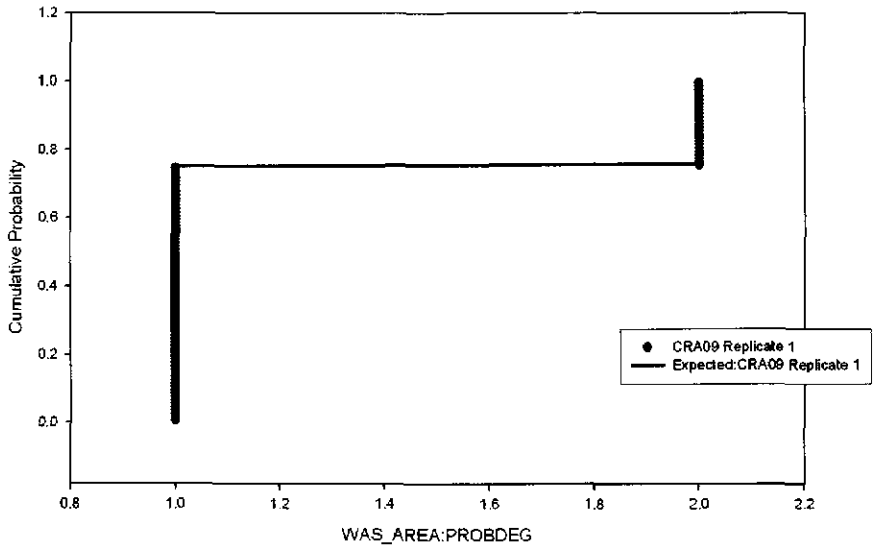


Figure 50. Observed and Expected CDFs for GLOBAL:OXSTAT
Uniform Distribution

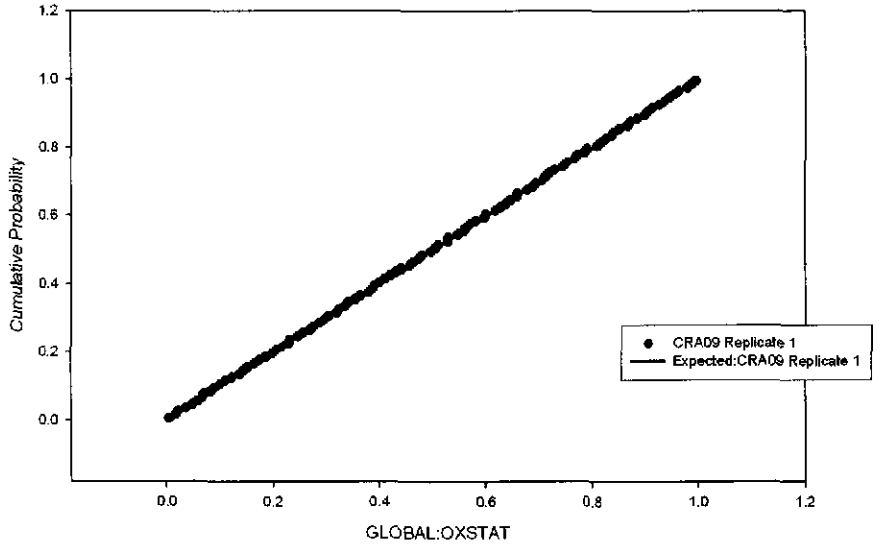


Figure 51. Observed and Expected CDFs for PHUMOX3:PHUMCIM User Continuous Distribution

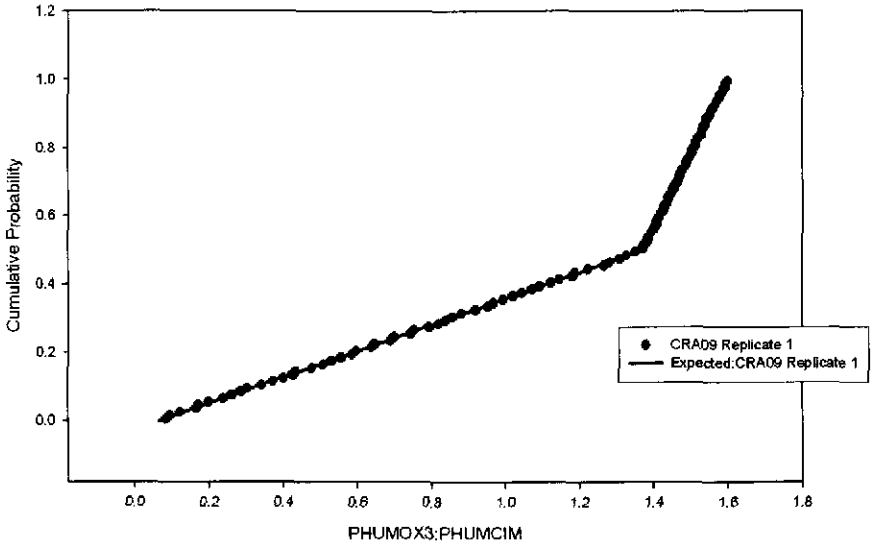


Figure 52. Observed and Expected CDFs for WAS_AREA:SAT_RBRN Uniform Distribution

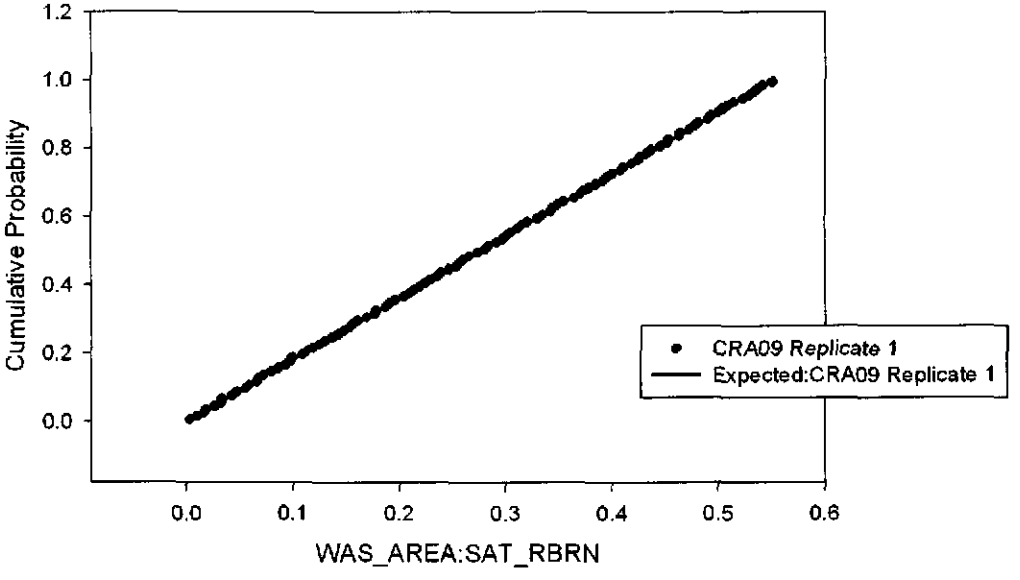


Figure 53. Observed and Expected CDFs for WAS_AREA:SAT_RGAS
Uniform Distribution

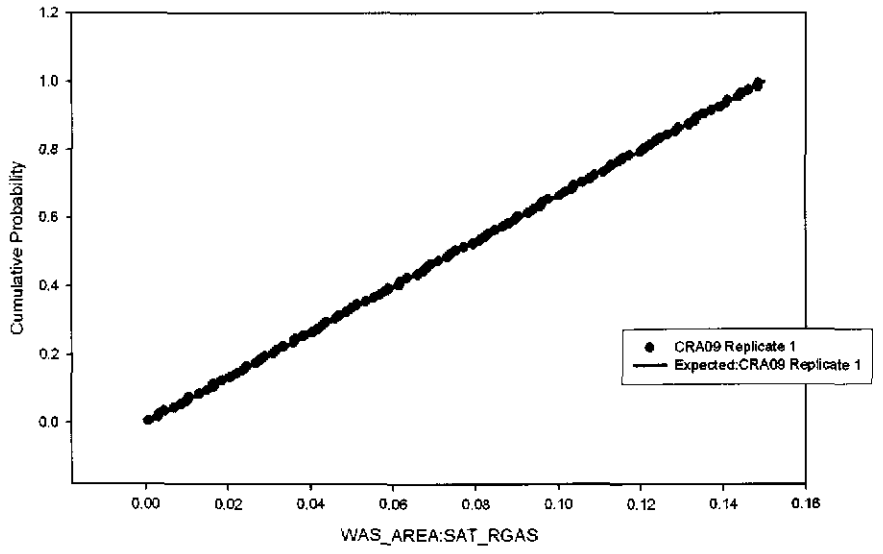


Figure 54. Observed and Expected CDFs for SOLMOD3:SOLVAR
User Continuous Distribution

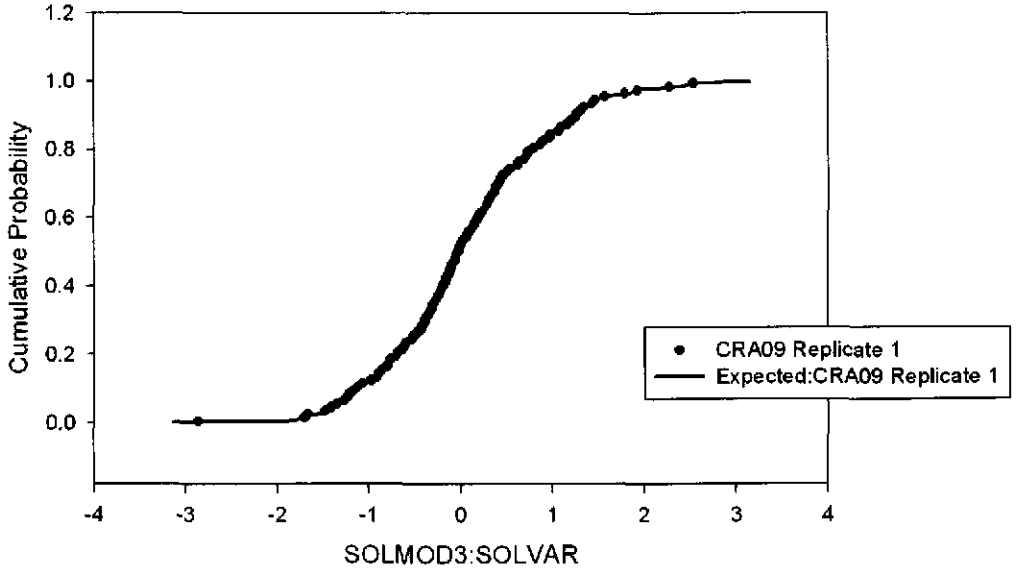


Figure 55. Observed and Expected CDFs for SOLMOD4:SOLVAR
User Continuous Distribution

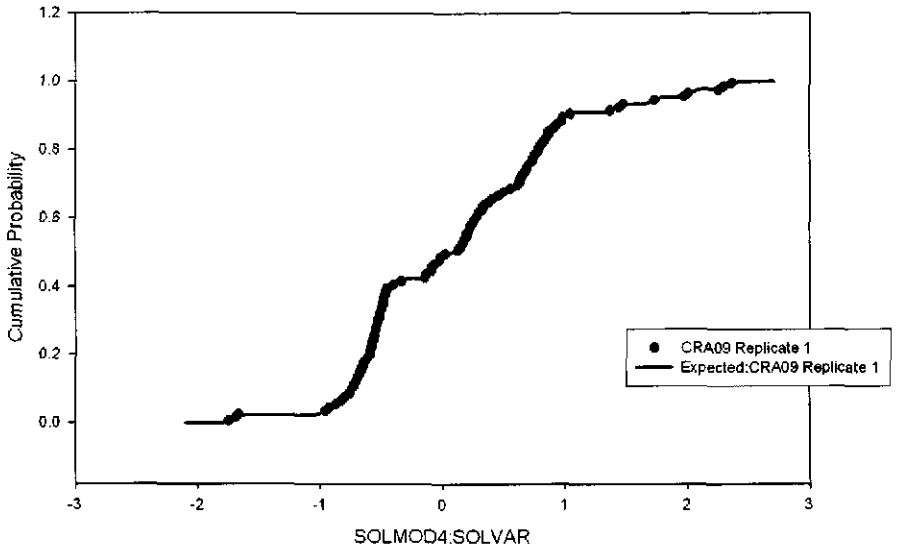


Figure 56. Observed and Expected CDFs for BOREHOLE:TAUFAIL
Loguniform Distribution

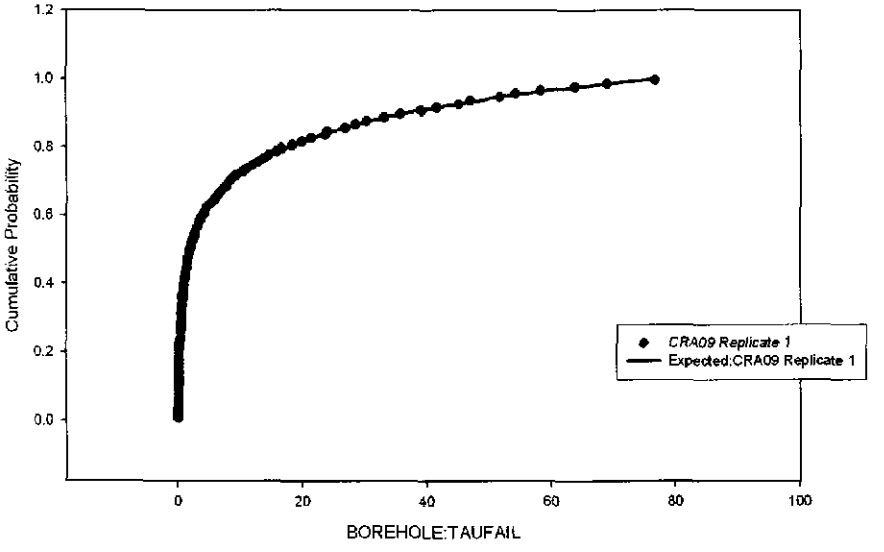


Figure 57. Observed and Expected CDFs for S_MB139:PORE_DIS
Student Distribution

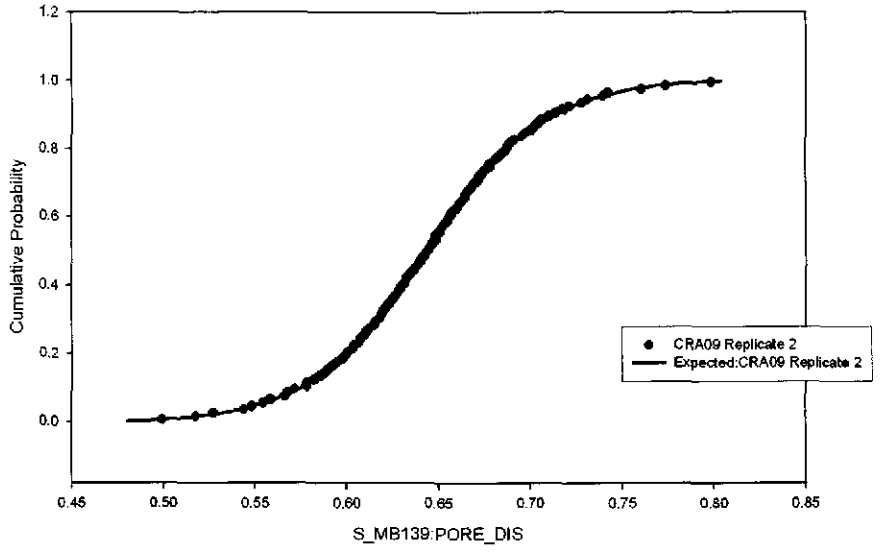


Figure 58. Observed and Expected CDFs for S_MB139:RELP_MOD
User Discrete (Delta) Distribution

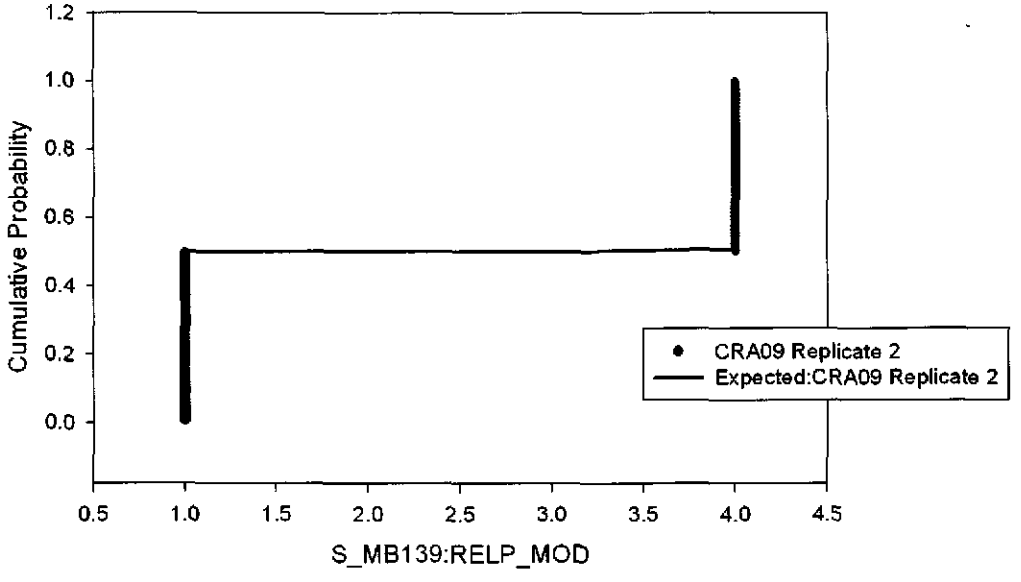


Figure 59. Observed and Expected CDFs for S_MB139:PRMX_LOG Student Distribution

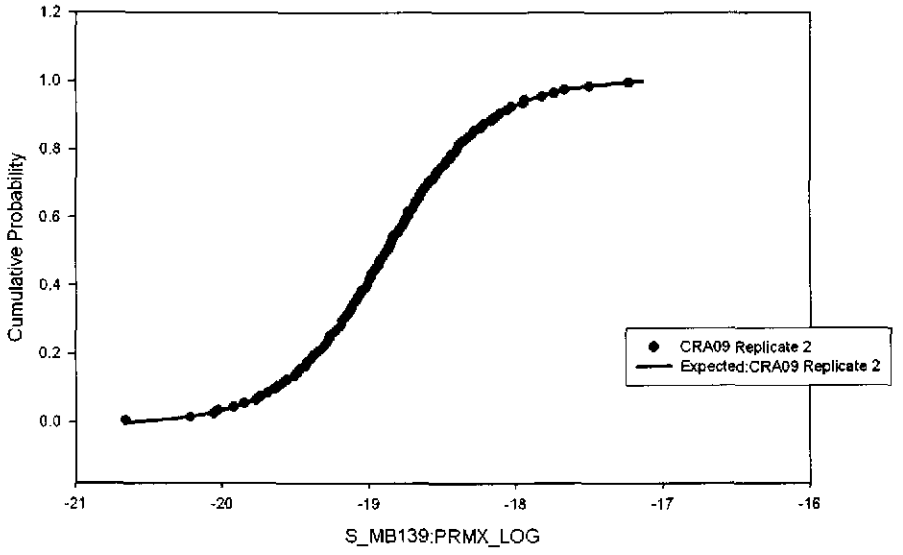


Figure 60. Observed and Expected CDFs for S_MB139:SAT_RBRN Student Distribution

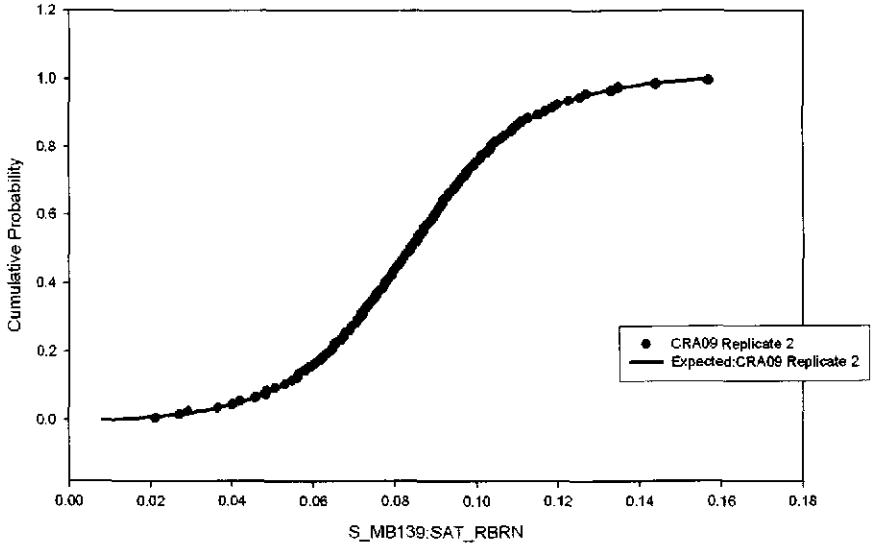


Figure 61. Observed and Expected CDFs for BH_SAND:PRMX_LOG
Uniform Distribution

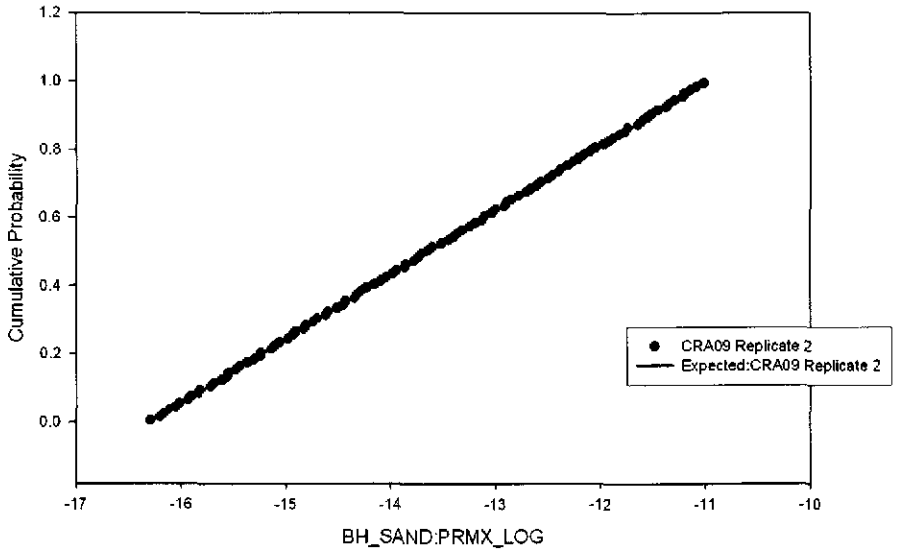


Figure 62. Observed and Expected CDFs for CASTILER:COMP_RCK
Triangular Distribution

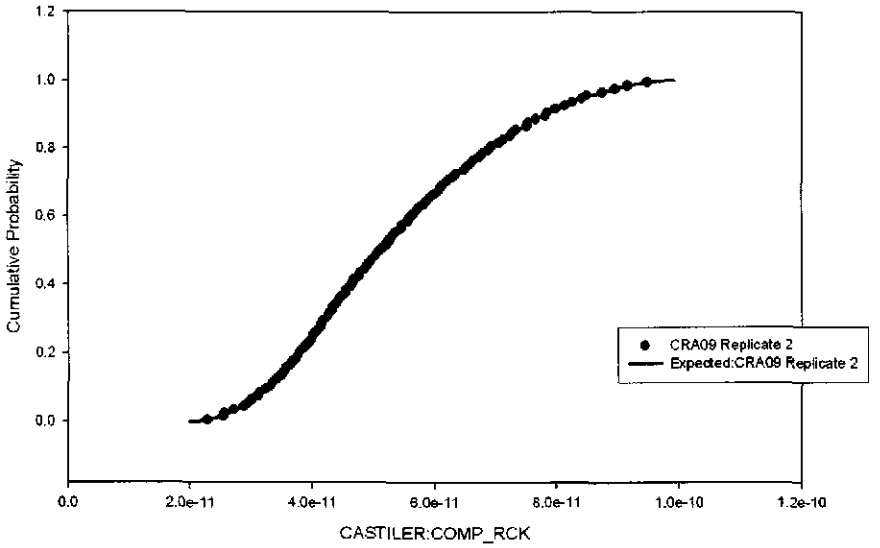


Figure 63. Observed and Expected CDFs for CASTILER:PRESSURE
Triangular Distribution

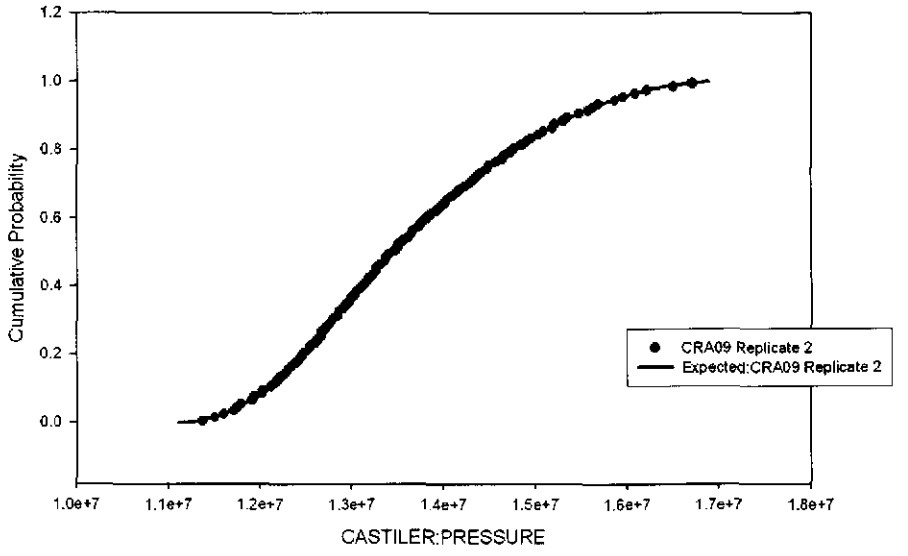


Figure 64. Observed and Expected CDFs for CASTILER:PRMX_LOG
Triangular Distribution

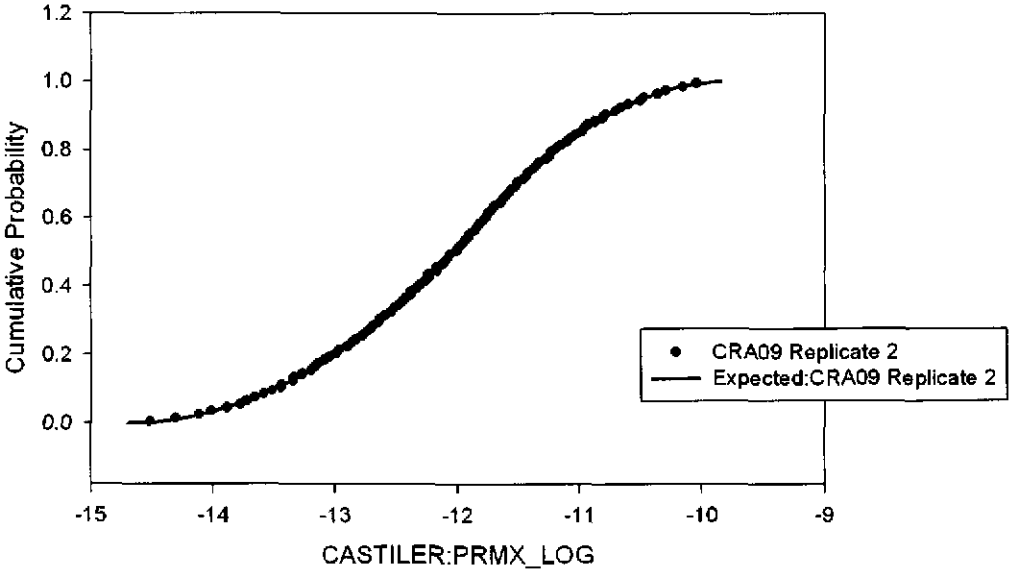


Figure 65. Observed and Expected CDFs for GLOBAL:PBRINE
Uniform Distribution

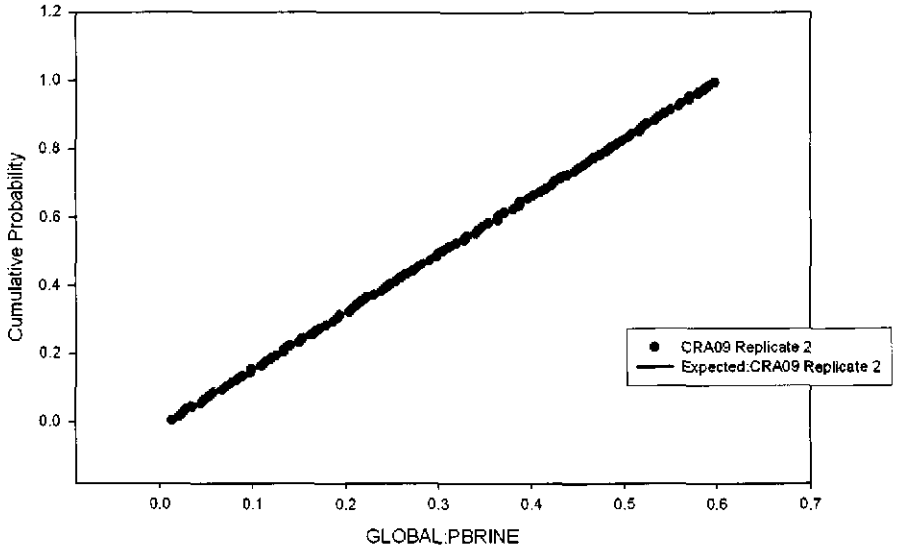


Figure 66. Observed and Expected CDFs for GLOBAL:CLIMTIDX
User Continuous Distribution

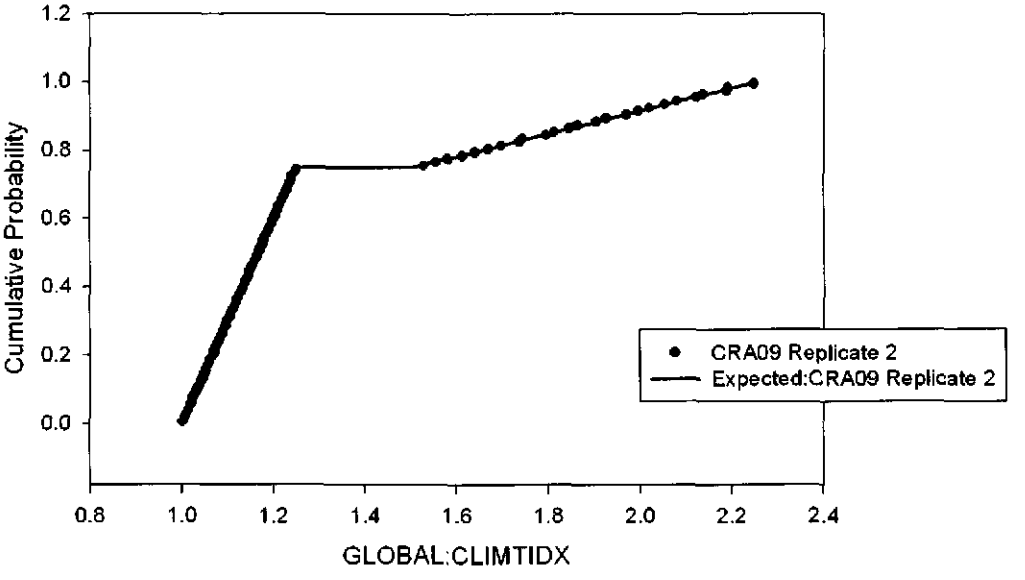


Figure 67. Observed and Expected CDFs for CULEBRA:APOROS Loguniform Distribution

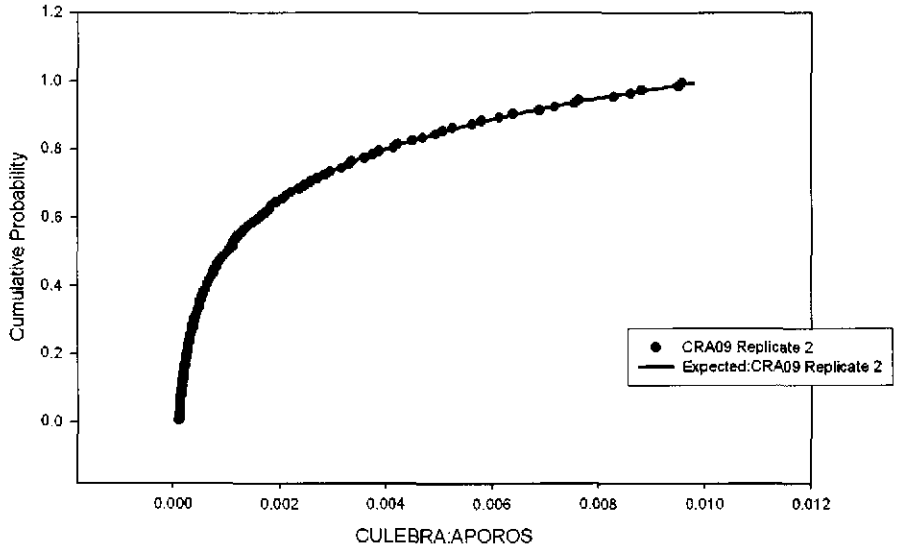


Figure 68. Observed and Expected CDFs for CULEBRA:HMBLKLT Uniform Distribution

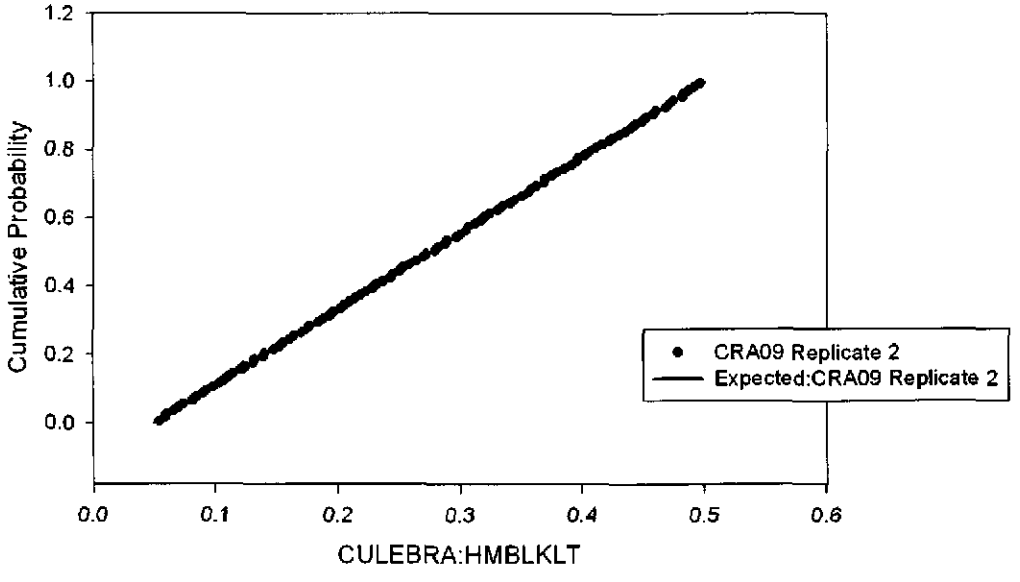


Figure 69. Observed and Expected CDFs for AM+3:MKD_AM
Loguniform Distribution

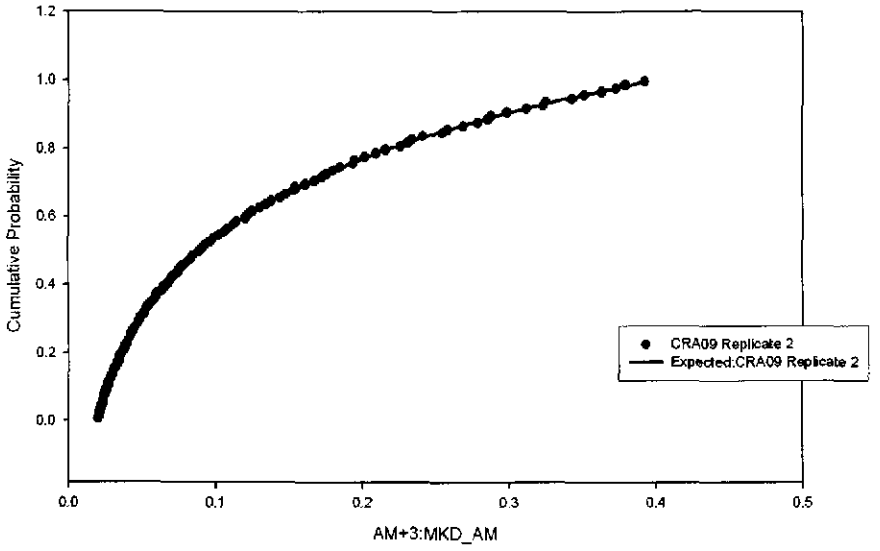


Figure 70. Observed and Expected CDFs for PU+3:MKD_PU
Loguniform Distribution

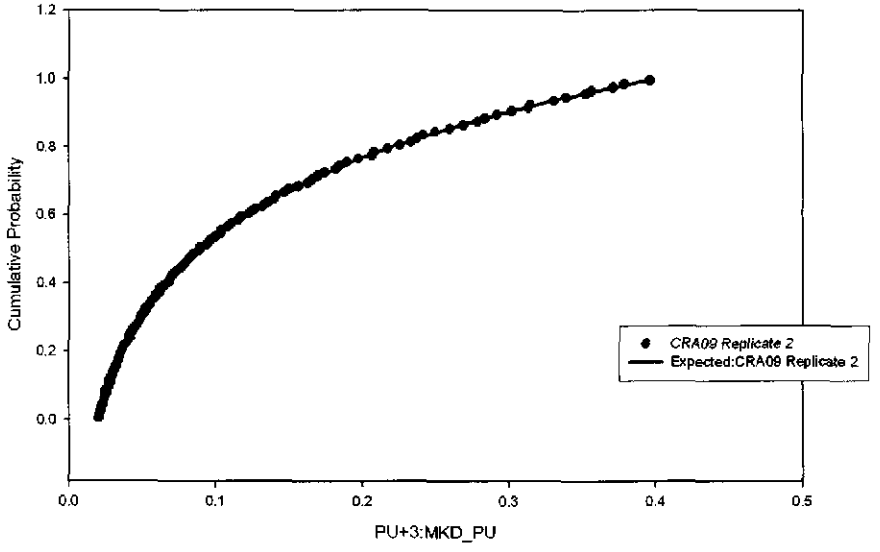


Figure 71. Observed and Expected CDFs for PU+4:MKD_PU
Loguniform Distribution

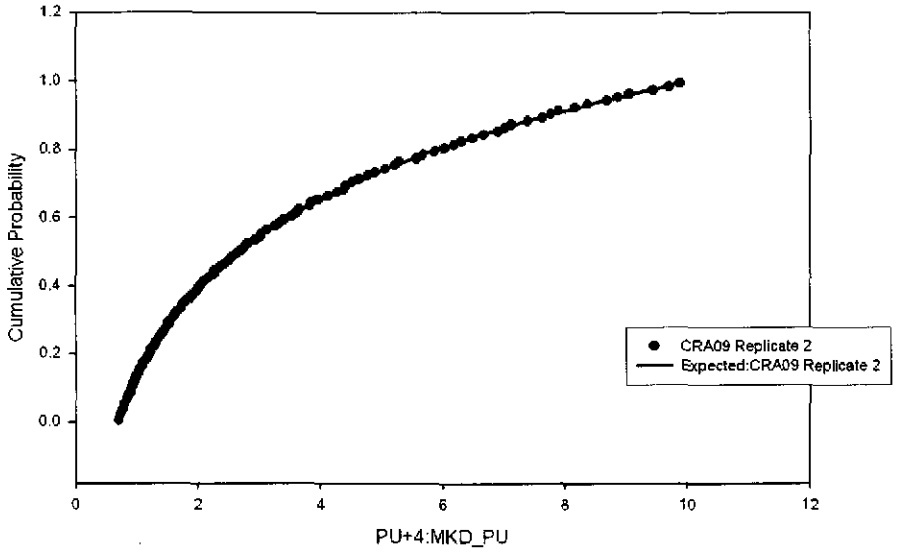


Figure 72. Observed and Expected CDFs for TH+4:MKD_TH
Loguniform Distribution

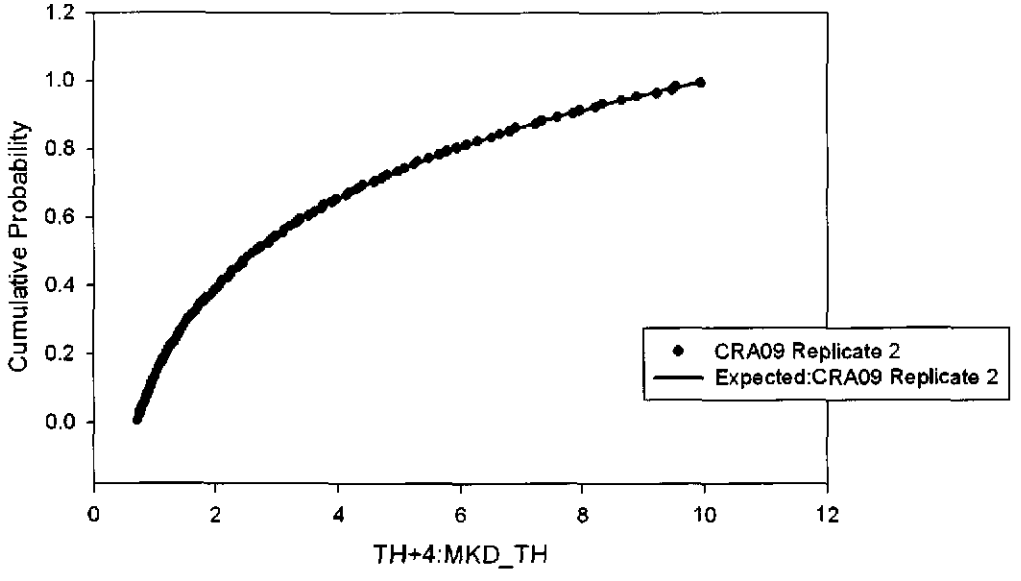


Figure 73. Observed and Expected CDFs for U+4:MKD_U
Loguniform Distribution

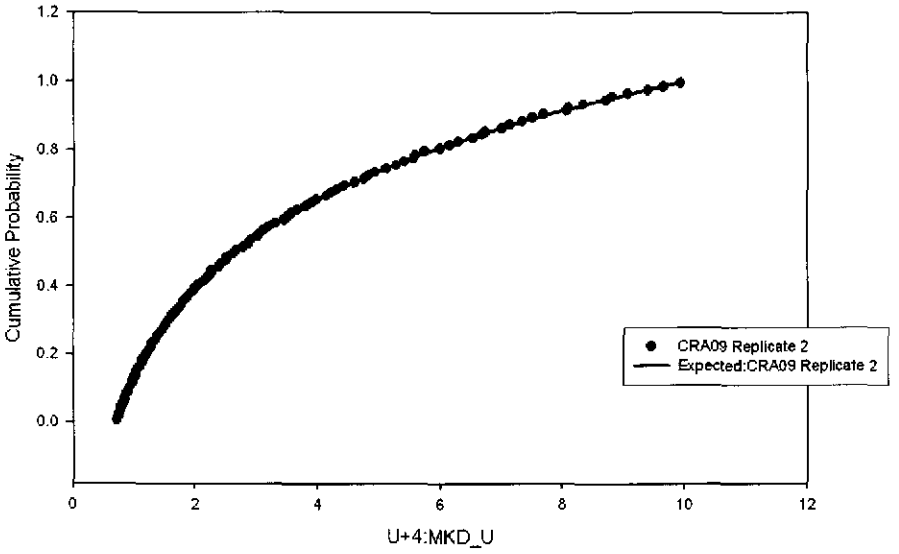


Figure 74. Observed and Expected CDFs for U+6:MKD_U
Loguniform Distribution

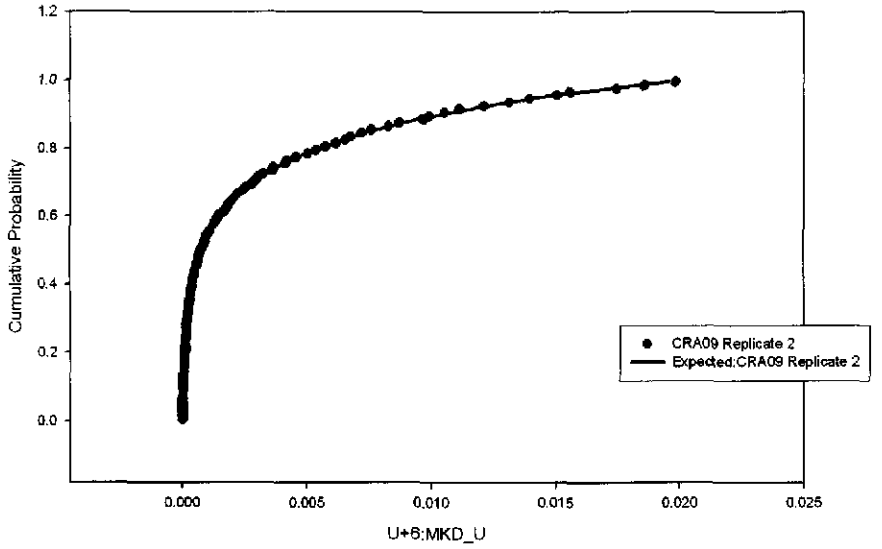


Figure 75. Observed and Expected CDFs for CULEBRA:DPOROS
User Continuous Distribution

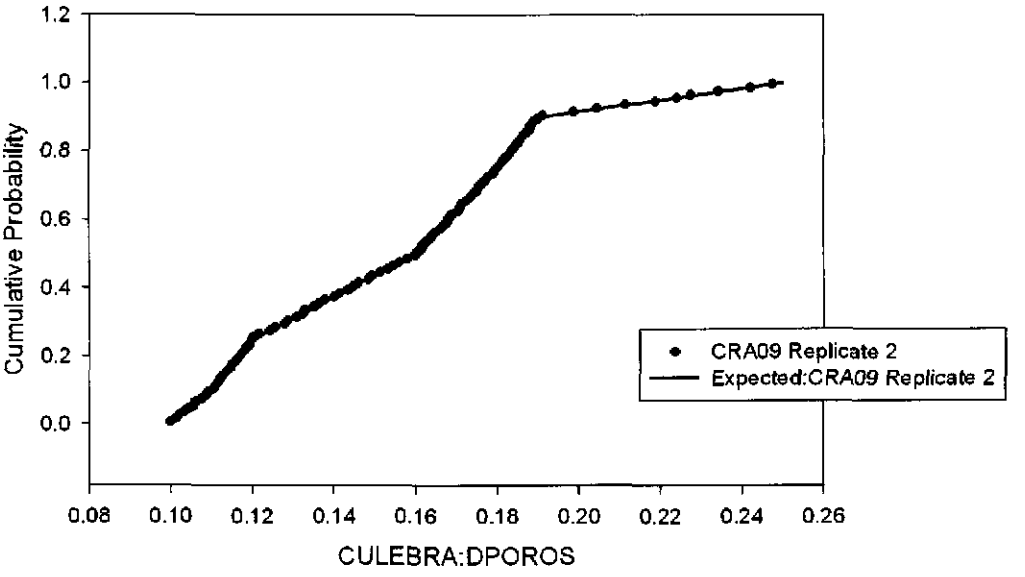


Figure 76. Observed and Expected CDFs for CONC_PCS:PORE_DIS
User Continuous Distribution

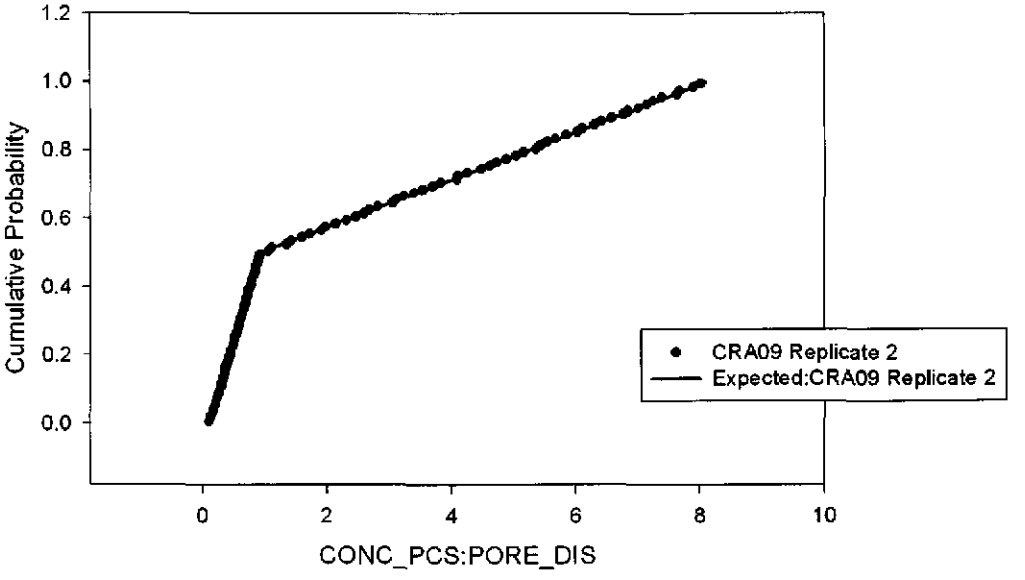


Figure 77. Observed and Expected CDFs for CONC_PCS:SAT_RBRN
User Continuous Distribution

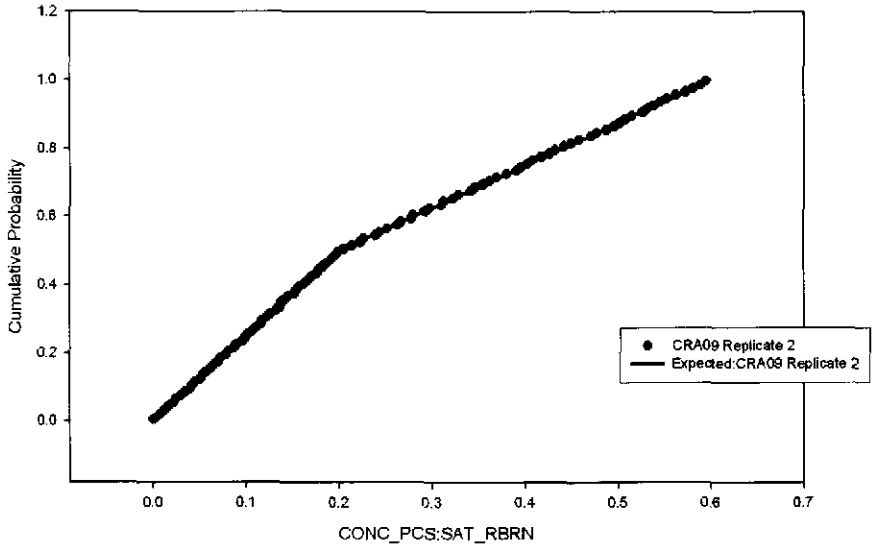


Figure 78. Observed and Expected CDFs for CONC_PCS:SAT_RGAS
Uniform Distribution

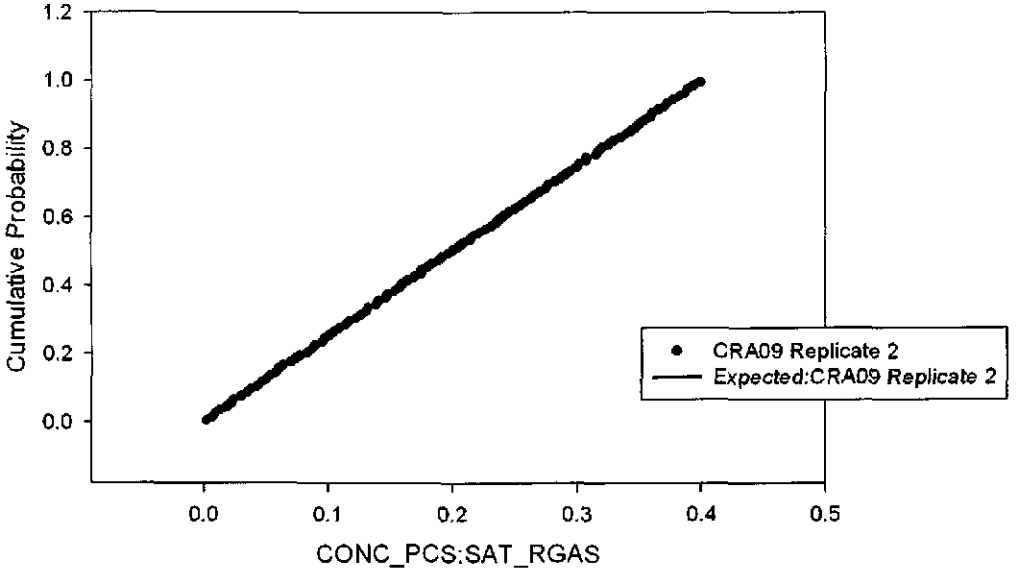


Figure 79. Observed and Expected CDFs for CONC_PCS:PRMX_LOG
Triangular Distribution

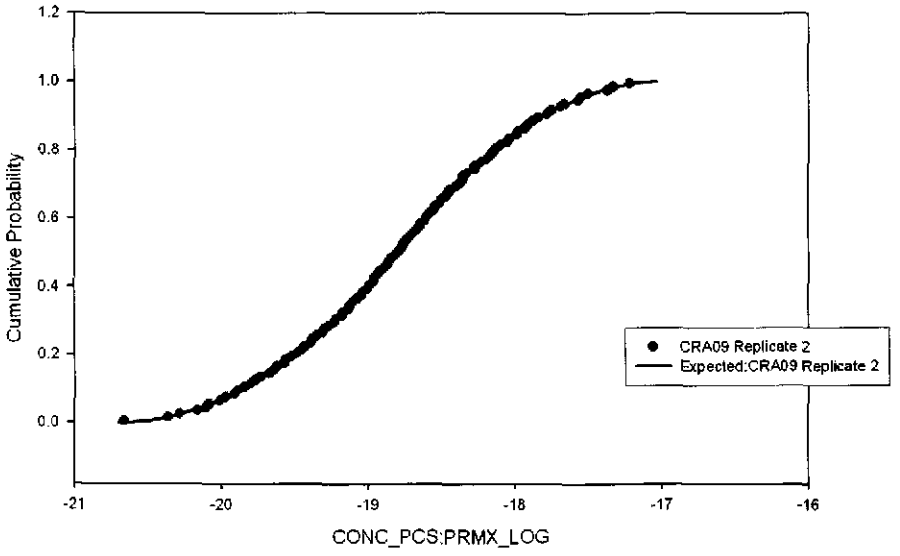


Figure 80. Observed and Expected CDFs for GLOBAL:TRANSIDX
Uniform Distribution

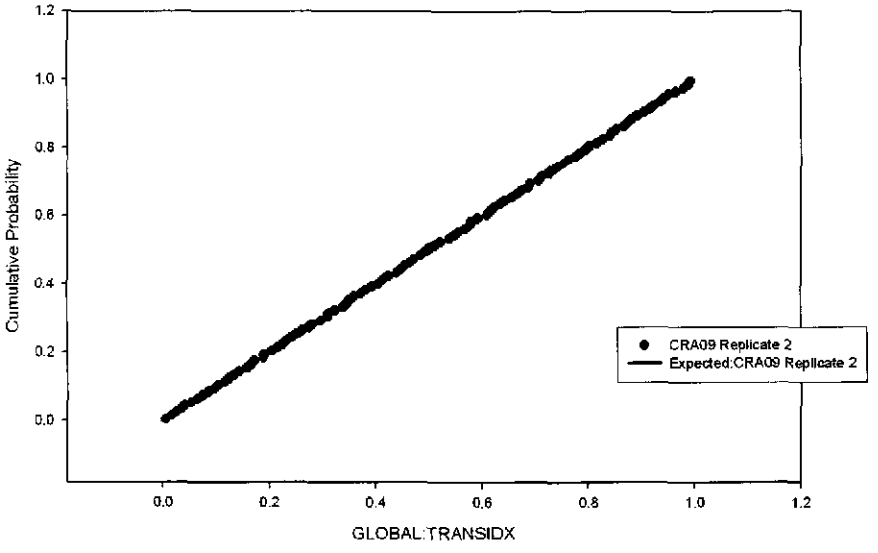


Figure 81. Observed and Expected CDFs for CULEBRA:MINP_FAC
Uniform Distribution

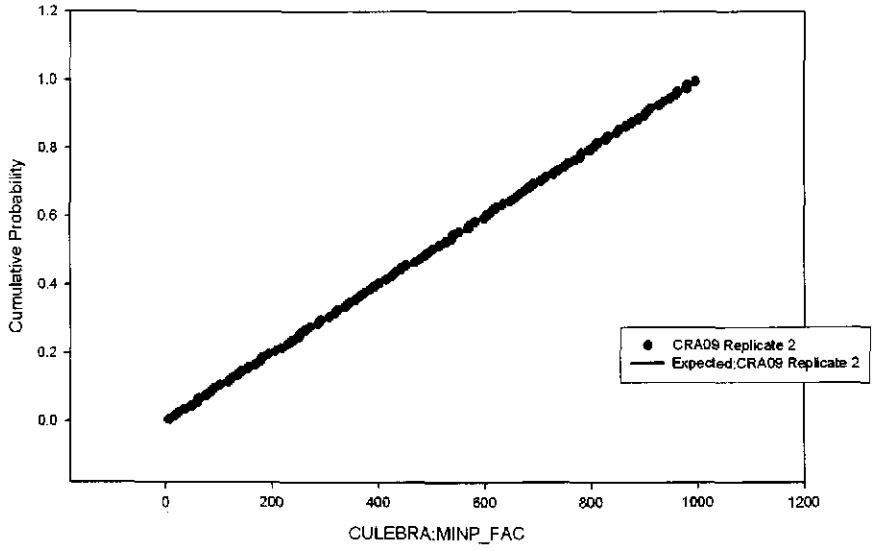


Figure 82. Observed and Expected CDFs for BOREHOLE:DOMEGA
User Continuous Distribution

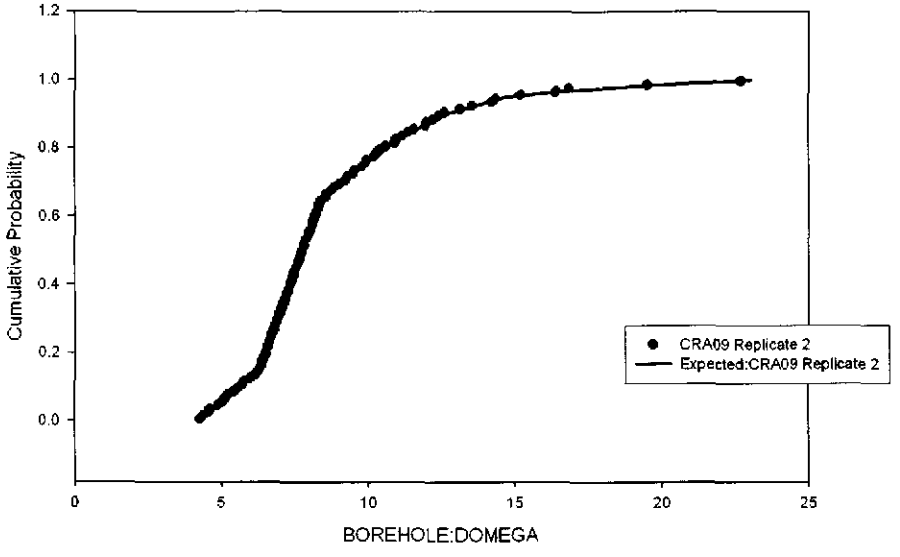


Figure 83. Observed and Expected CDFs for DRZ_PCS:PRMX_LOG
Triangular Distribution

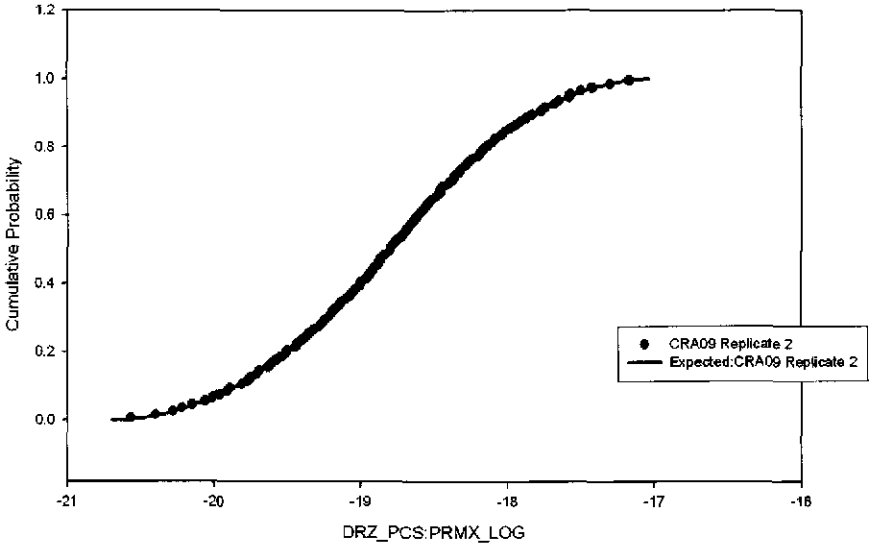


Figure 84. Observed and Expected CDFs for DRZ_1:PRMX_LOG
Uniform Distribution

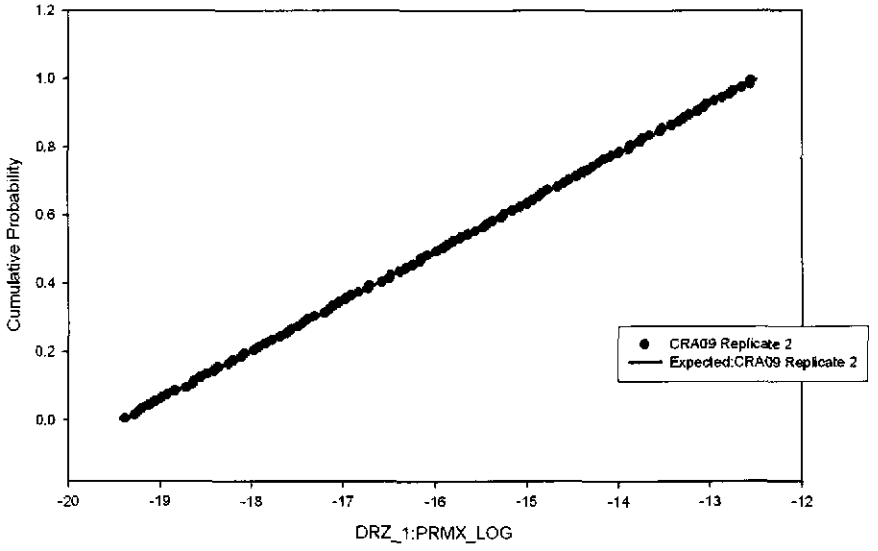


Figure 85. Observed and Expected CDFs for S_HALITE:COMP_RCK
Uniform Distribution

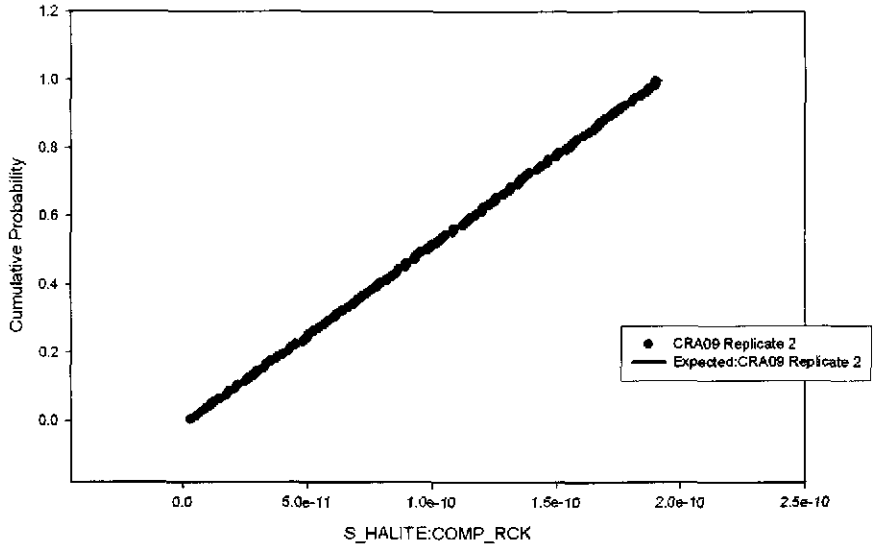


Figure 86. Observed and Expected CDFs for S_HALITE:POROSITY
User Continuous Distribution

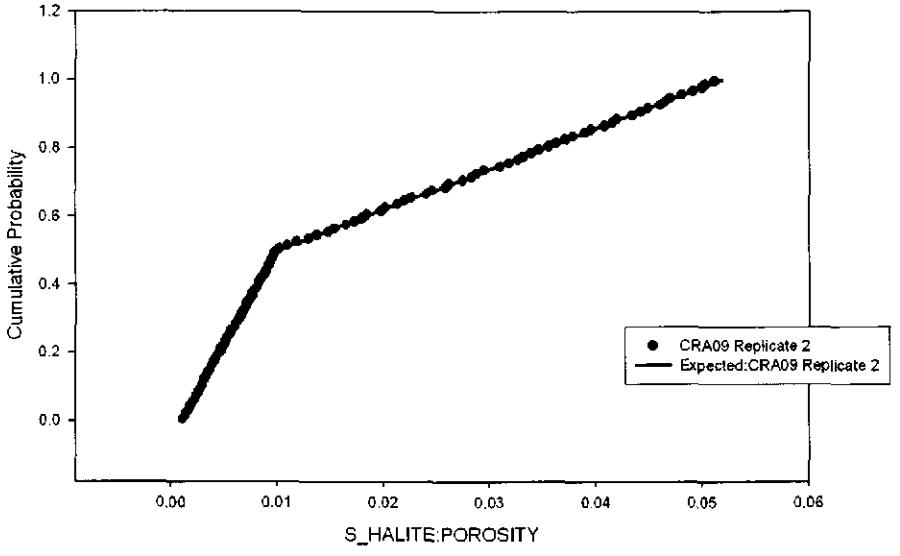


Figure 87. Observed and Expected CDFs for S_HALITE:PRMX_LOG
Uniform Distribution

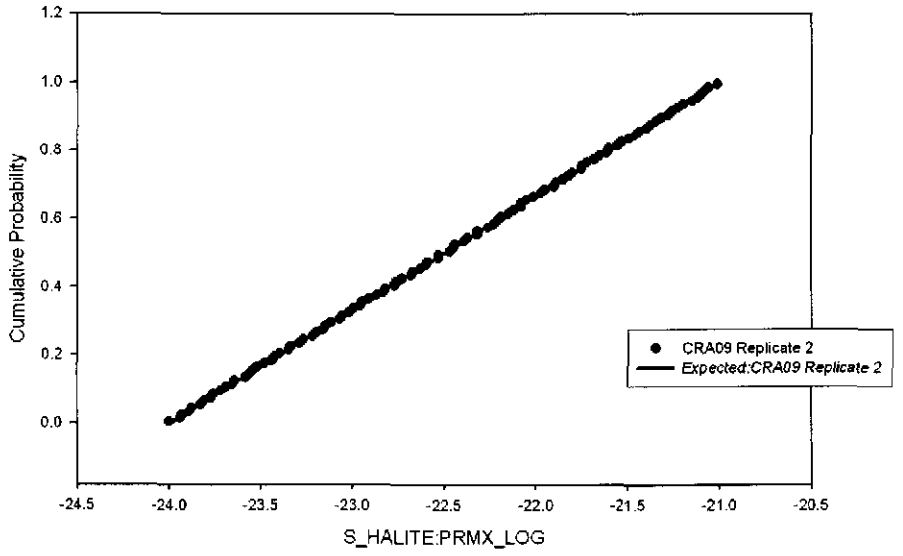


Figure 88. Observed and Expected CDFs for CONC_PLG:PRMX_LOG
Uniform Distribution

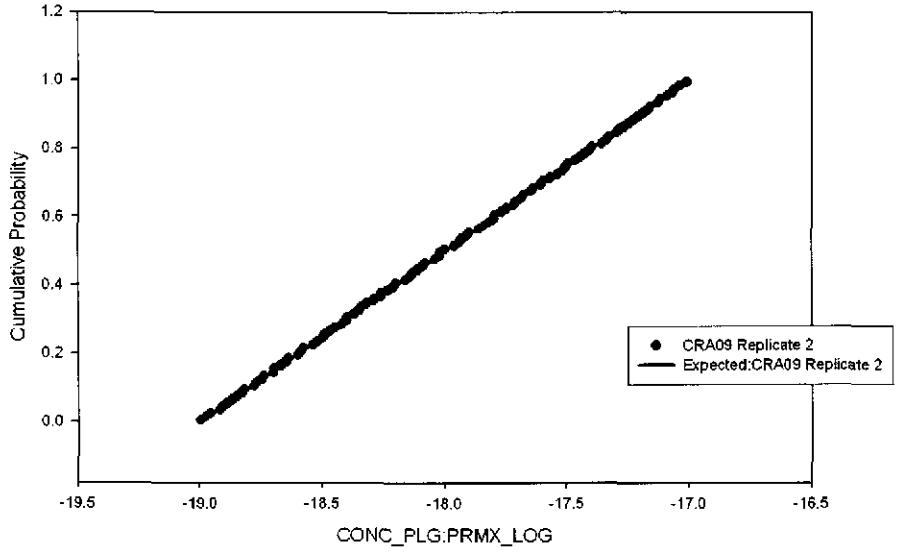


Figure 89. Observed and Expected CDFs for SPALLMOD:REPIPERM
Loguniform Distribution

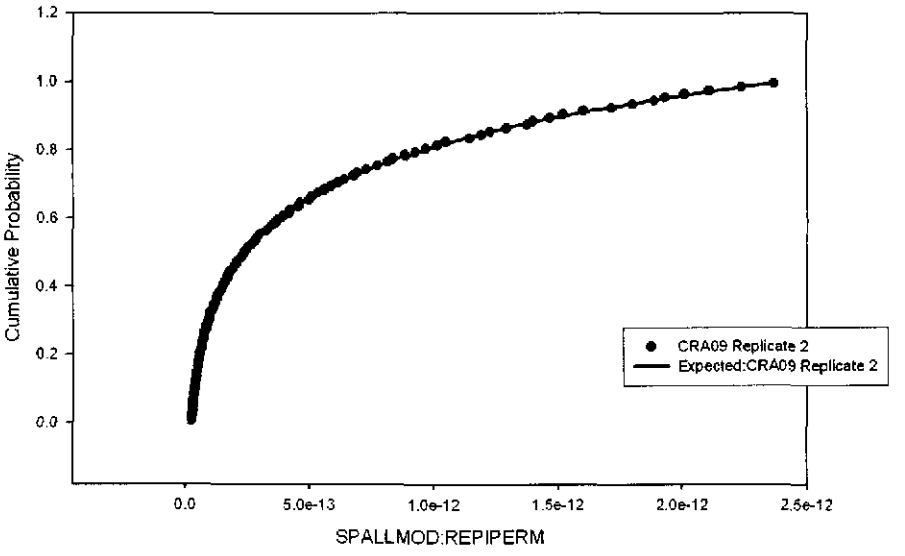


Figure 90. Observed and Expected CDFs for S_HALITE:PRESSURE
Uniform Distribution

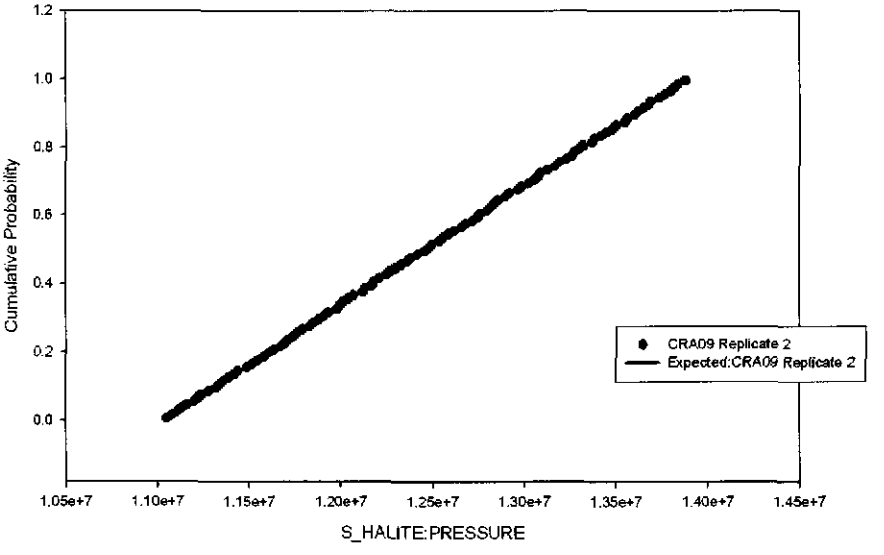


Figure 91. Observed and Expected CDFs for SHFTL_T1:PRMX_LOG
User Continuous Distribution

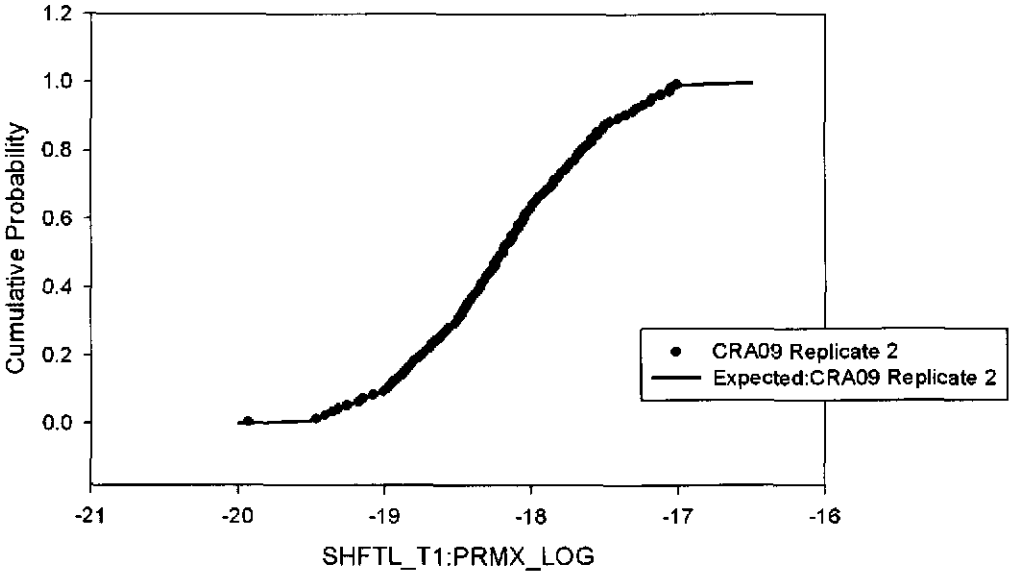


Figure 92. Observed and Expected CDFs for SHFTL_T2:PRMX_LOG
User Continuous Distribution

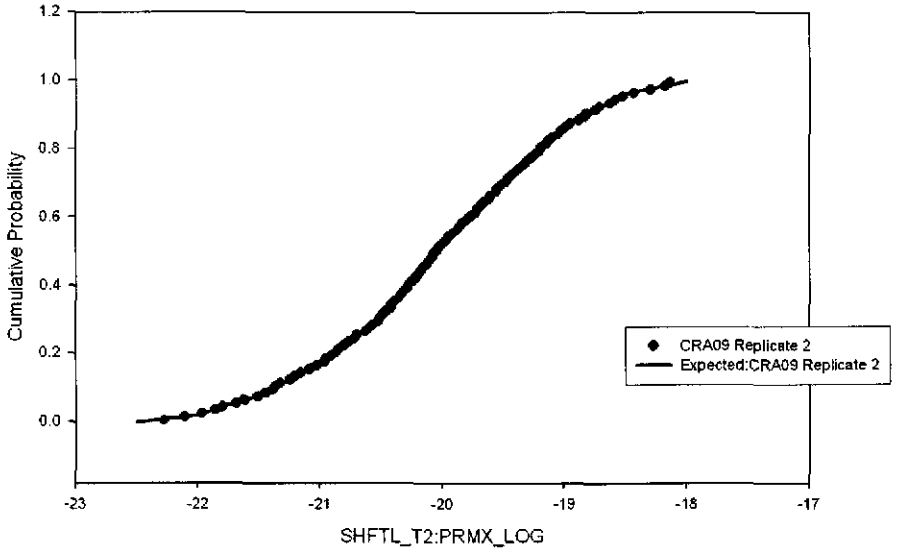


Figure 93. Observed and Expected CDFs for SHFTU:PRMX_LOG
User Continuous Distribution

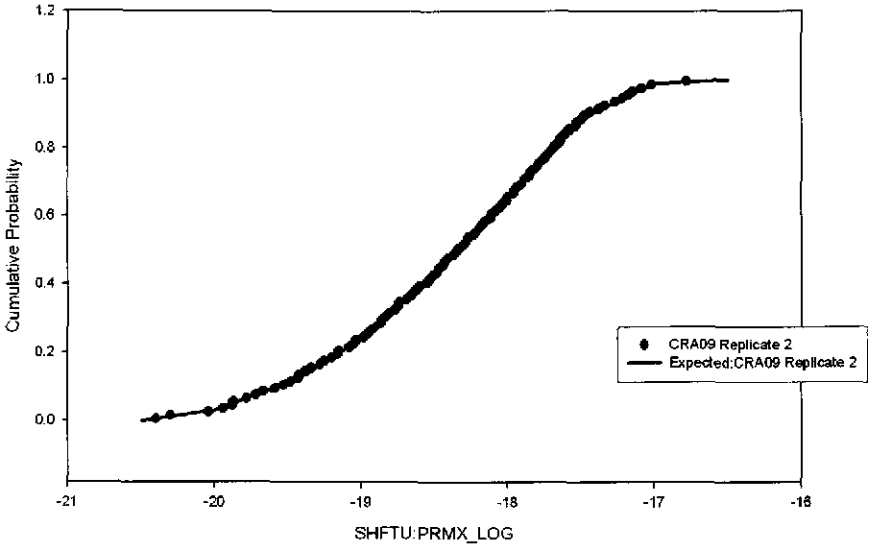


Figure 94. Observed and Expected CDFs for SHFTU:SAT_RBRN
User Continuous Distribution

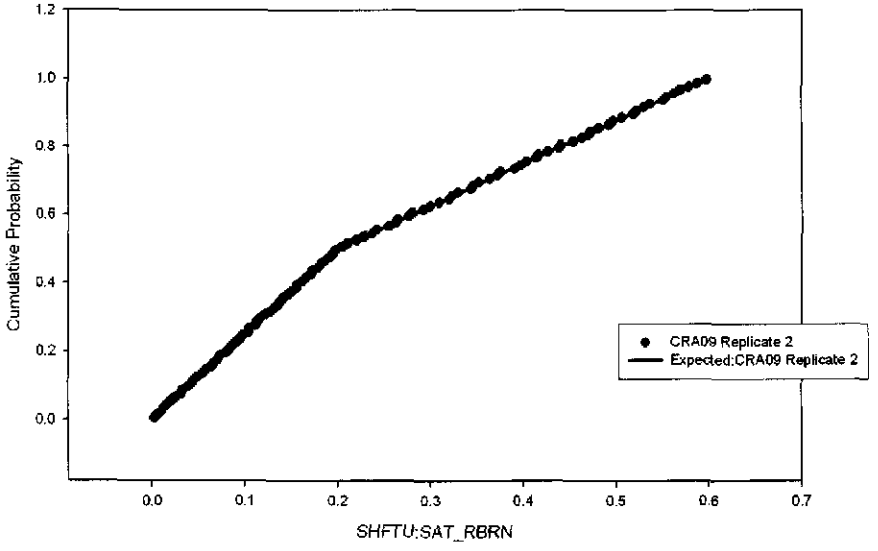


Figure 95. Observed and Expected CDFs for SHFTU:SAT_RGAS
Uniform Distribution

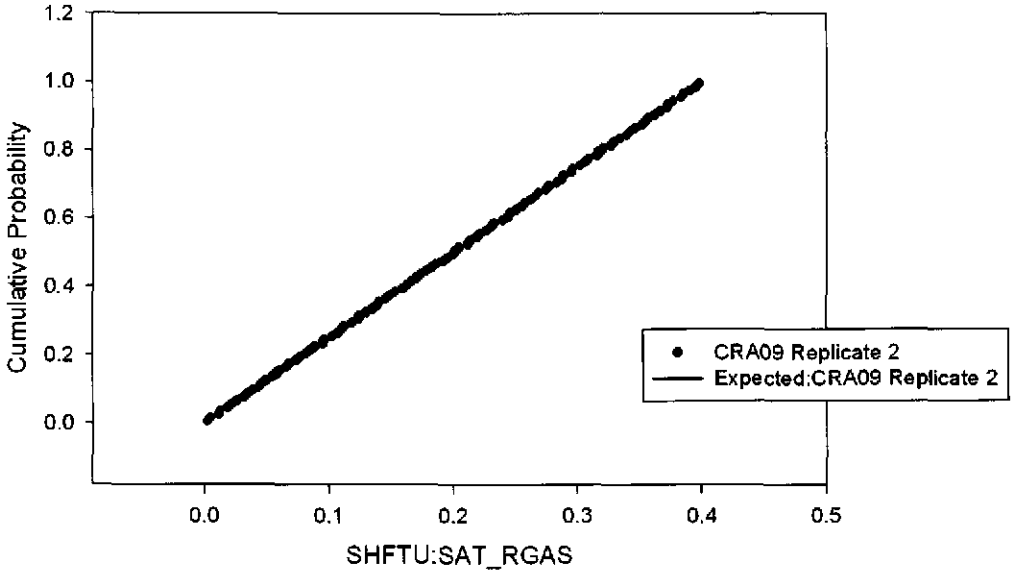


Figure 96. Observed and Expected CDFs for SPALLMOD:PARTDIAM
Loguniform Distribution

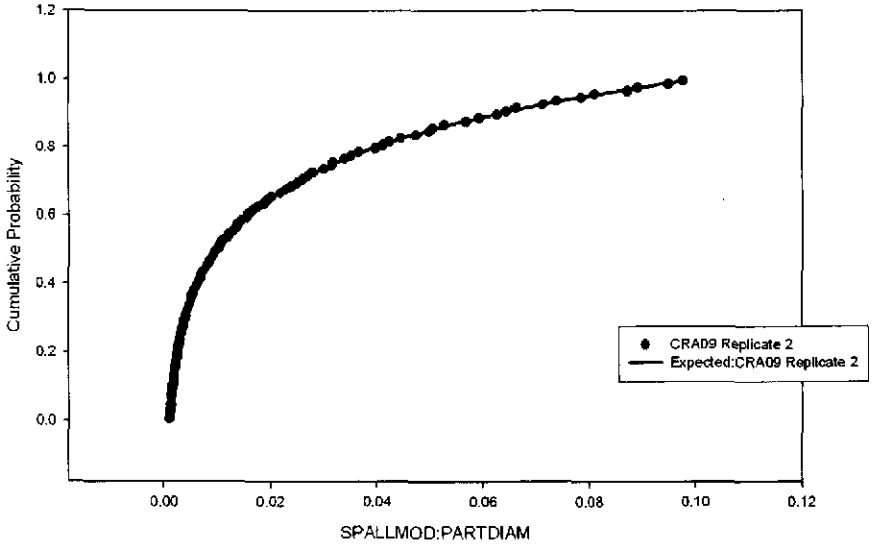


Figure 97. Observed and Expected CDFs for SPALLMOD:REPIPOR
Uniform Distribution

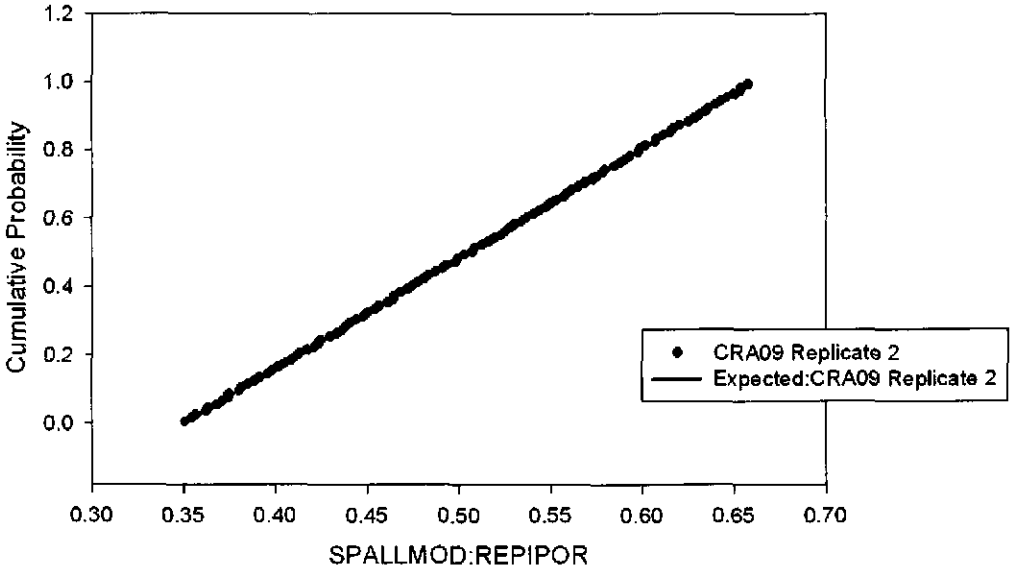


Figure 98. Observed and Expected CDFs for SPALLMOD:TENSLSTR
Uniform Distribution

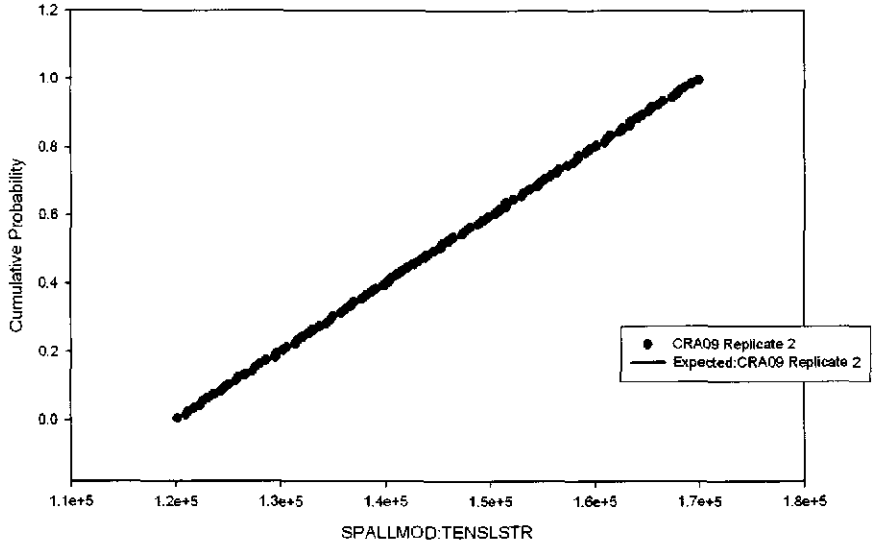


Figure 99. Observed and Expected CDFs for WAS_AREA:SAT_WICK
Uniform Distribution

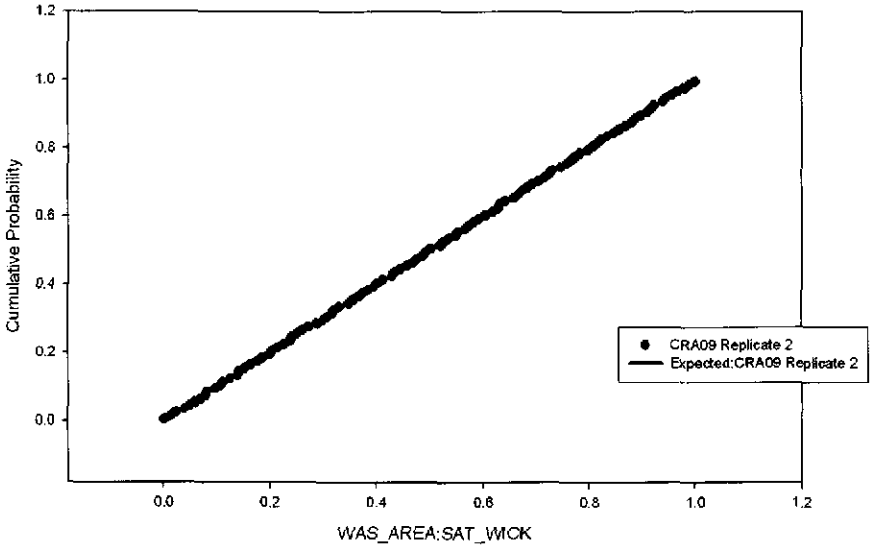


Figure 100. Observed and Expected CDFs for WAS_AREA:BIOGENFC
Uniform Distribution

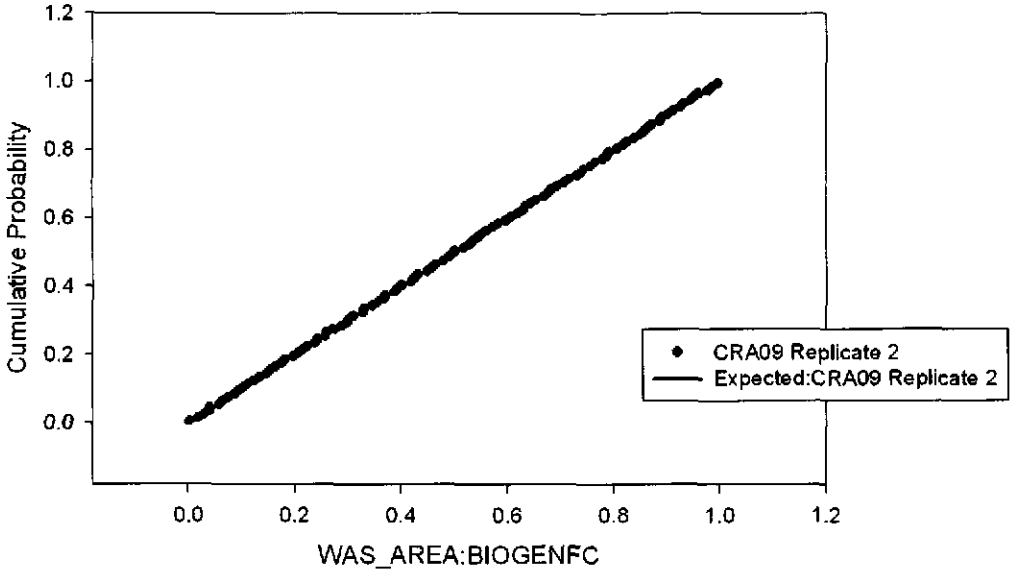


Figure 101. Observed and Expected CDFs for CELLULS:FBETA
Uniform Distribution

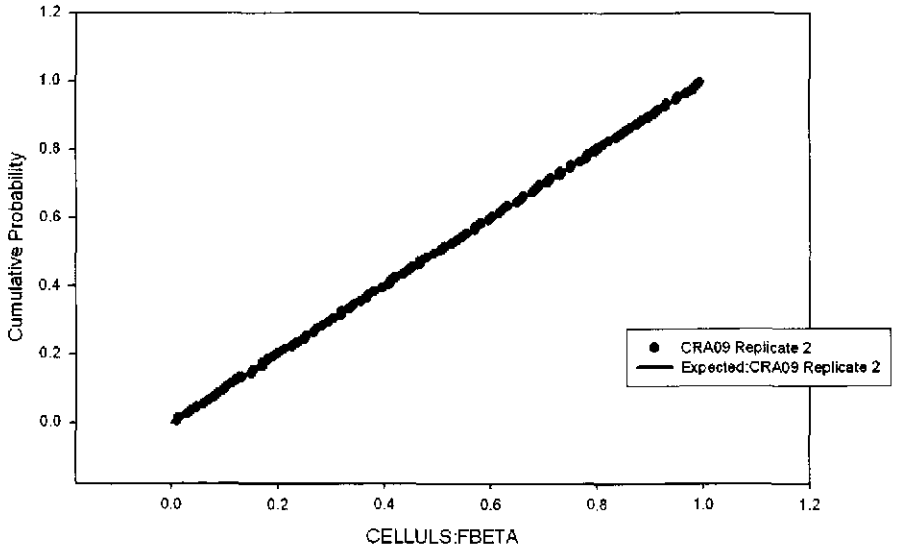


Figure 102. Observed and Expected CDFs for STEEL:CORRMCO2
Uniform Distribution

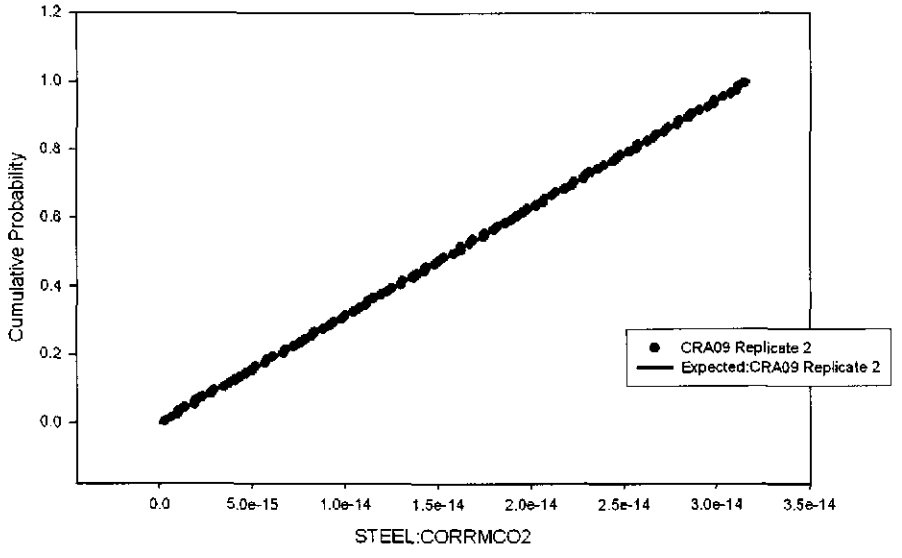


Figure 103. Observed and Expected CDFs for WAS_AREA:GRATMICH
Uniform Distribution

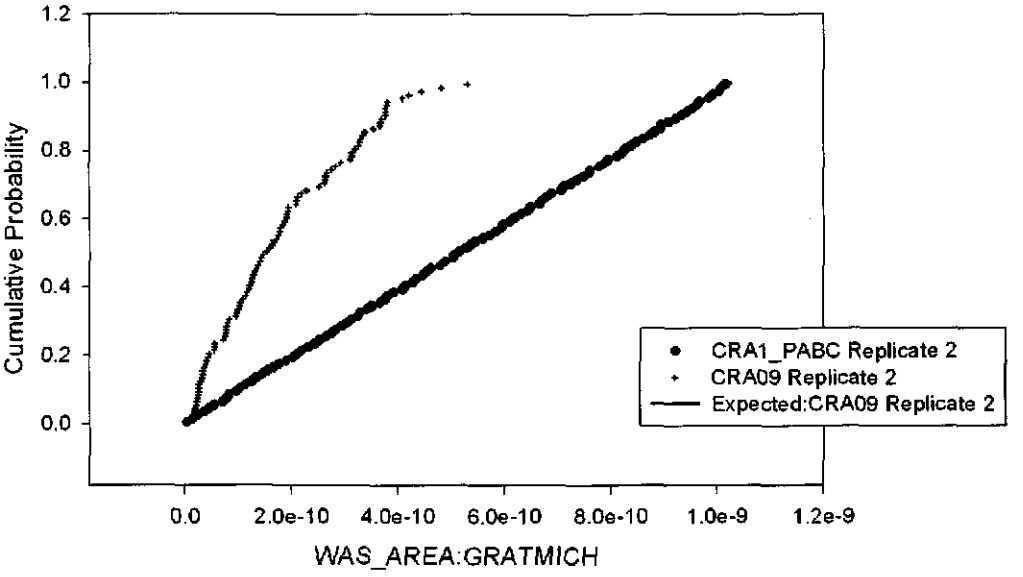


Figure 104. Observed and Expected CDFs for WAS_AREA:GRATMICI
Uniform Distribution

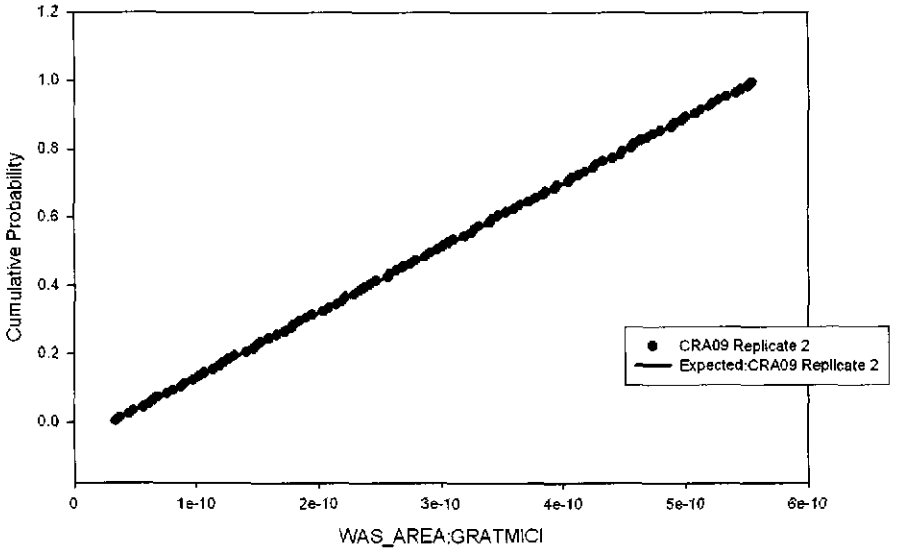


Figure 105. Observed and Expected CDFs for WAS_AREA:PROBDEG
User Discrete (Delta) Distribution

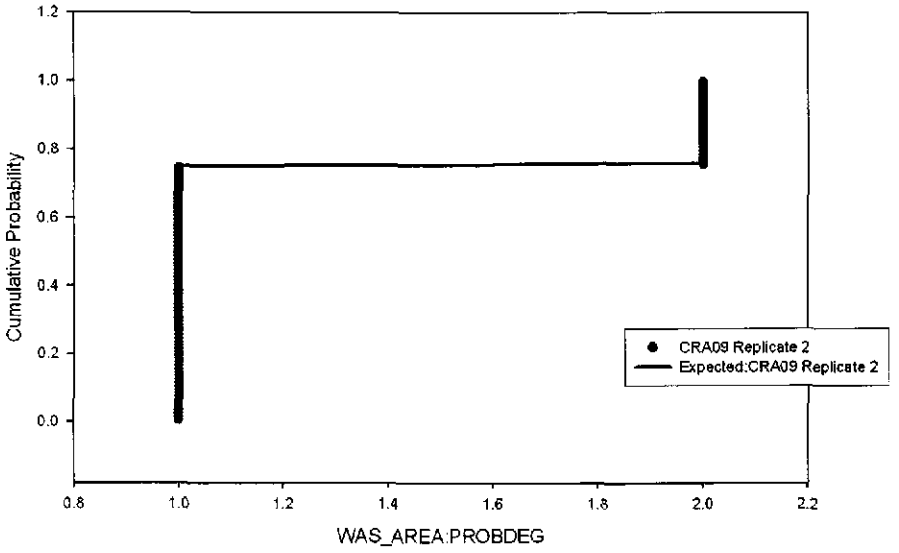


Figure 106. Observed and Expected CDFs for GLOBAL:OXSTAT
Uniform Distribution

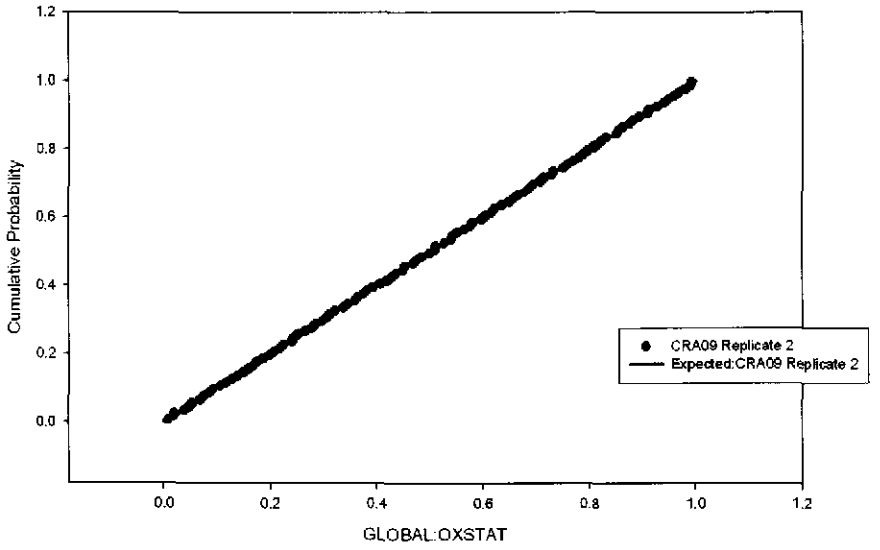


Figure 107. Observed and Expected CDFs for PHUMOX3:PHUMCIM User Continuous Distribution

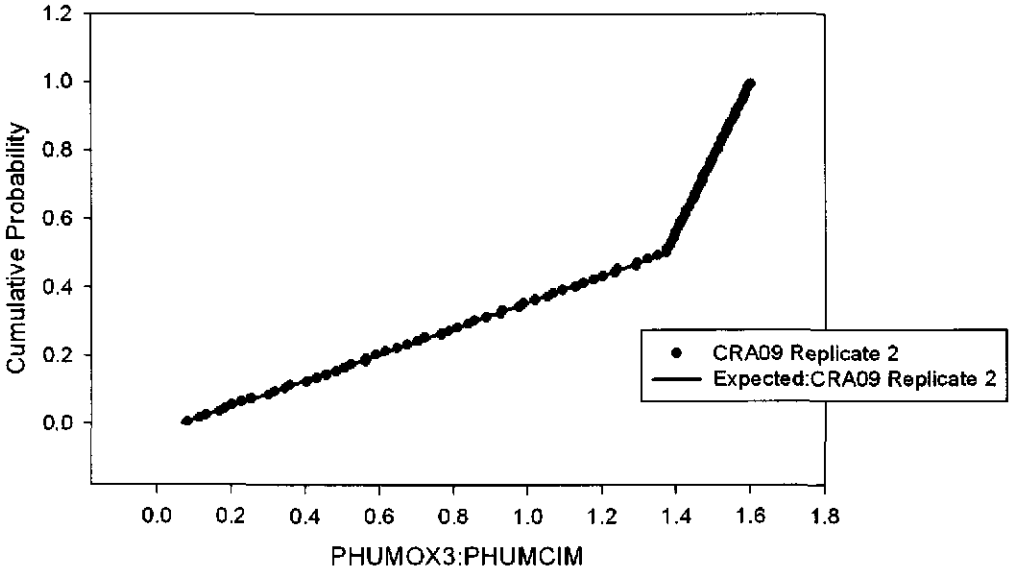


Figure 108. Observed and Expected CDFs for WAS_AREA:SAT_RBRN Uniform Distribution

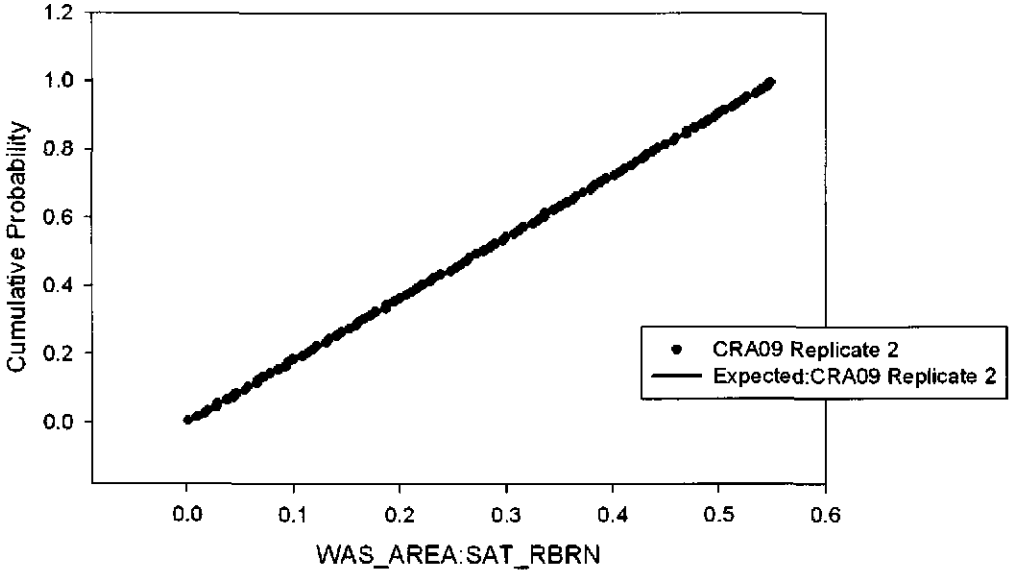


Figure 109. Observed and Expected CDFs for WAS_AREA:SAT_RGAS
Uniform Distribution

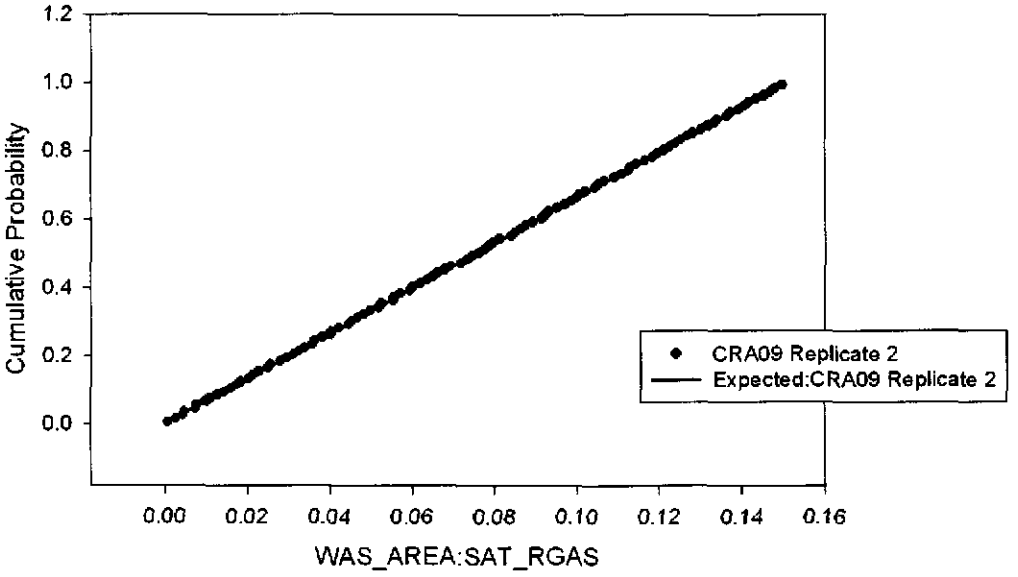


Figure 110. Observed and Expected CDFs for SOLMOD3:SOLVAR
User Continuous Distribution

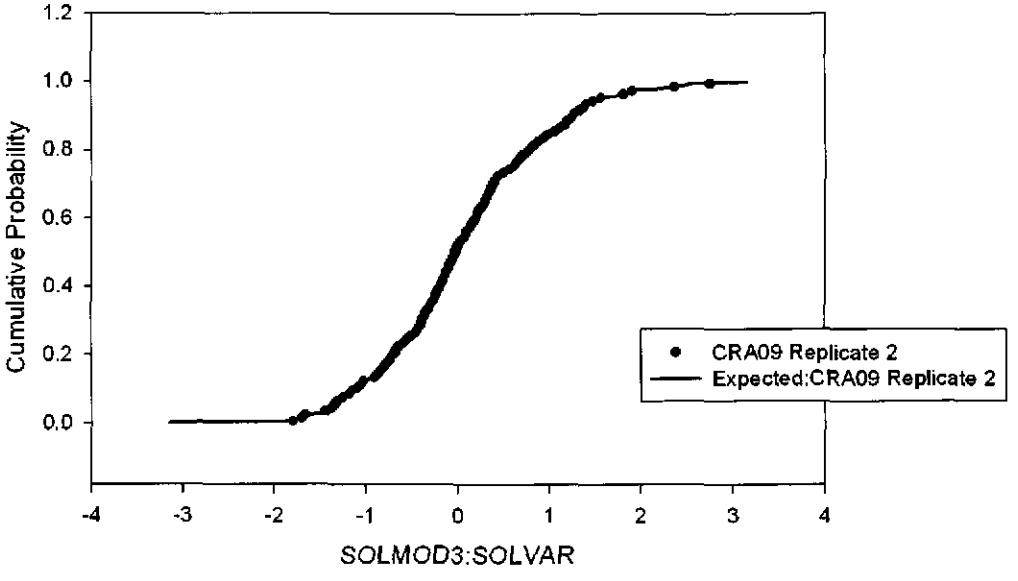


Figure 111. Observed and Expected CDFs for SOLMOD4:SOLVAR User Continuous Distribution

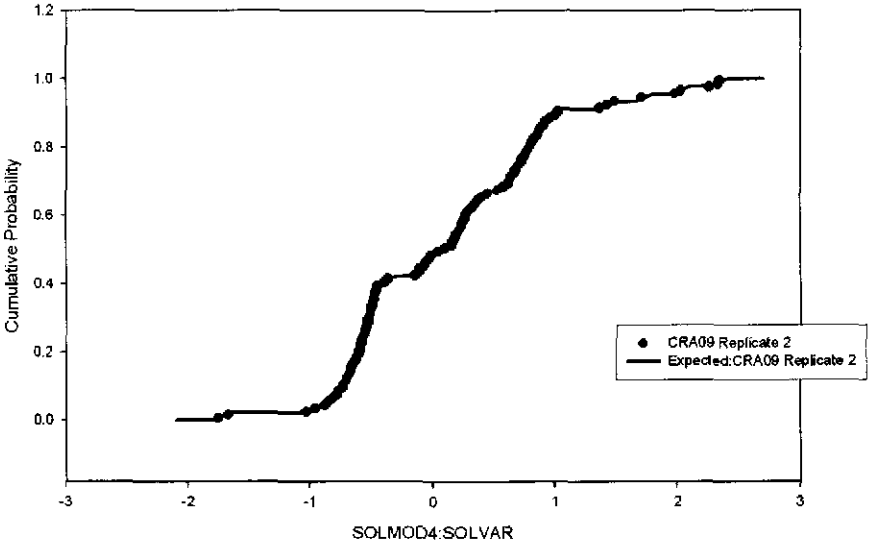


Figure 112. Observed and Expected CDFs for BOREHOLE:TAUFAIL Loguniform Distribution

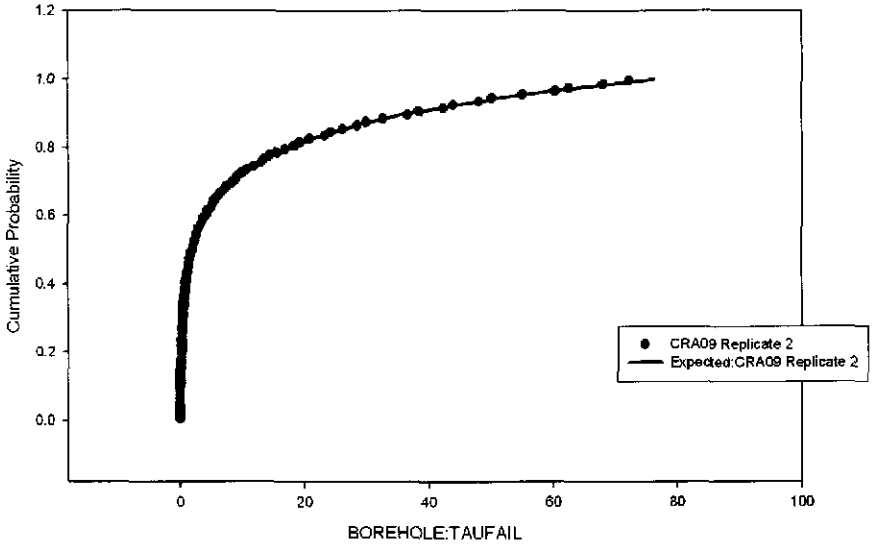


Figure 113. Observed and Expected CDFs for S_MB139:PORE_DIS
Student Distribution

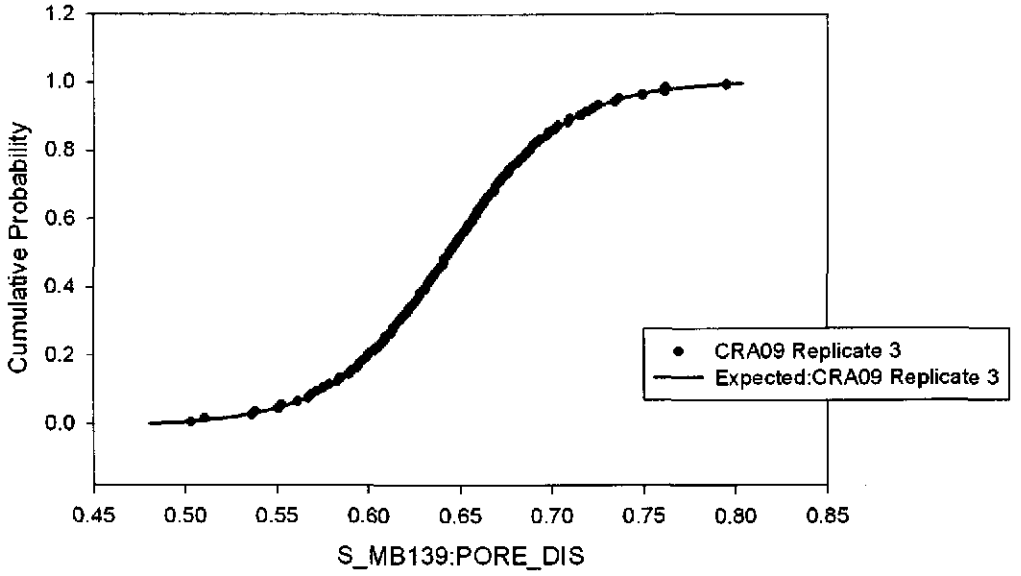


Figure 114. Observed and Expected CDFs for S_MB139:RELP_MOD
User Discrete (Delta) Distribution

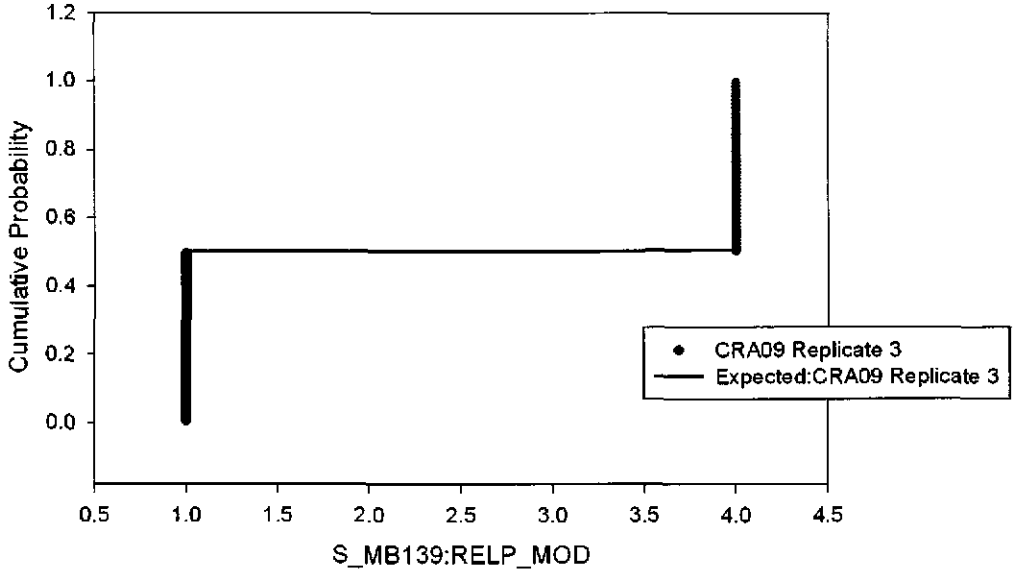


Figure 115. Observed and Expected CDFs for S_MB139:PRMX_LOG Student Distribution

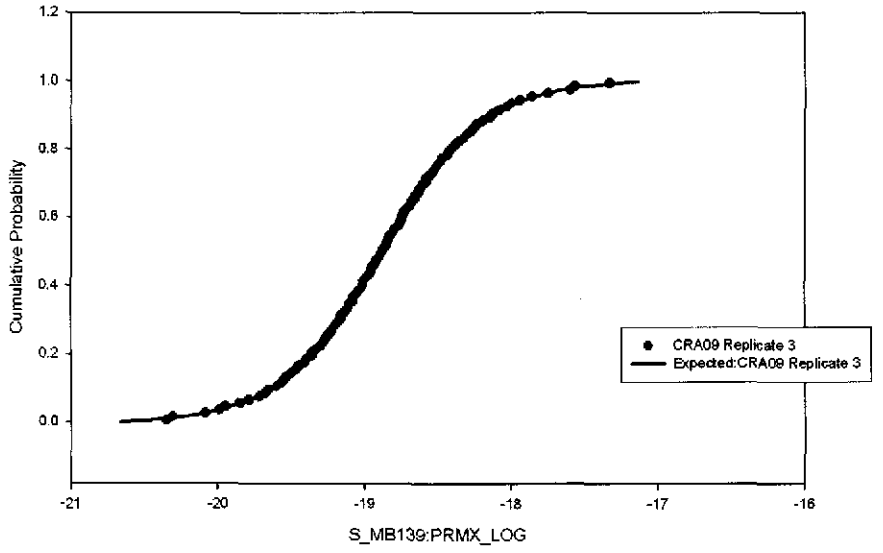


Figure 116. Observed and Expected CDFs for S_MB139:SAT_RBRN Student Distribution

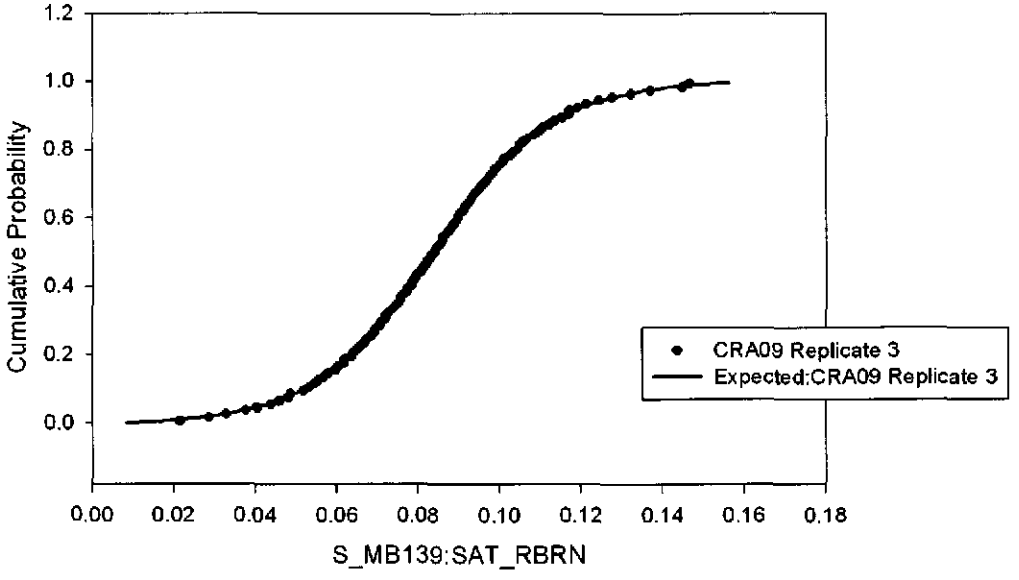


Figure 117. Observed and Expected CDFs for BH_SAND:PRMX_LOG
Uniform Distribution

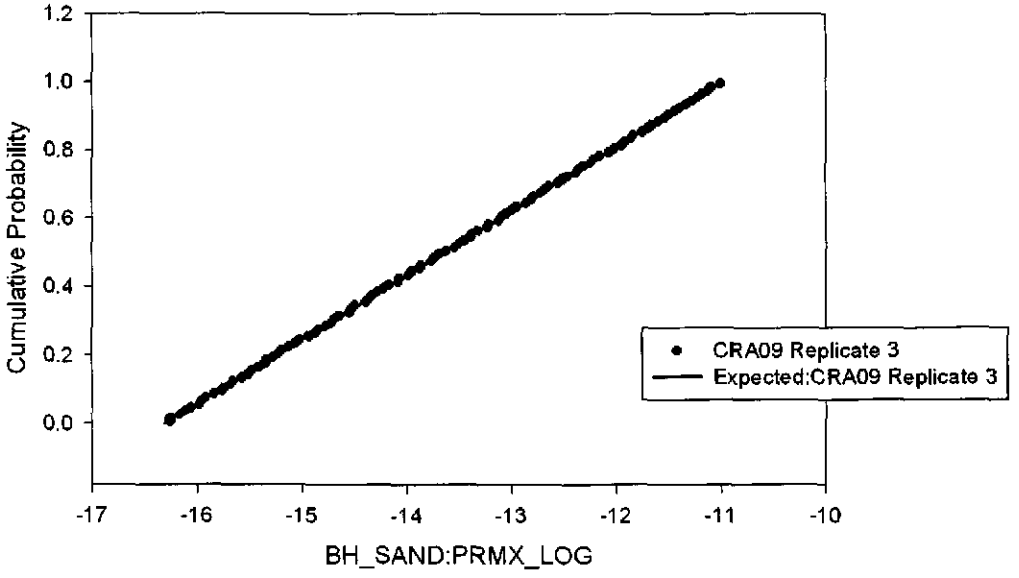


Figure 118. Observed and Expected CDFs for CASTILER:COMP_RCK
Triangular Distribution

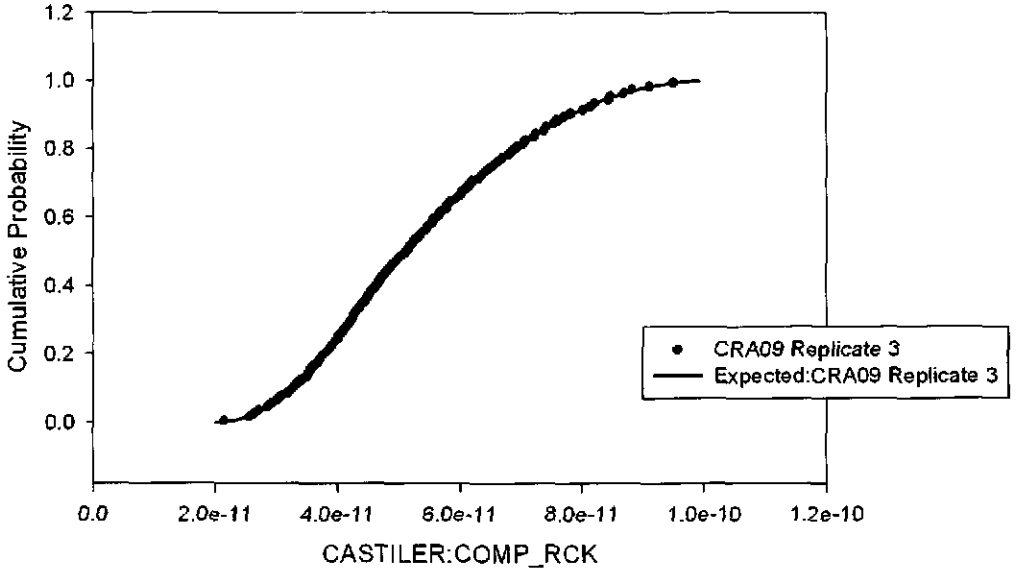


Figure 119. Observed and Expected CDFs for CASTILER:PRESSURE
Triangular Distribution

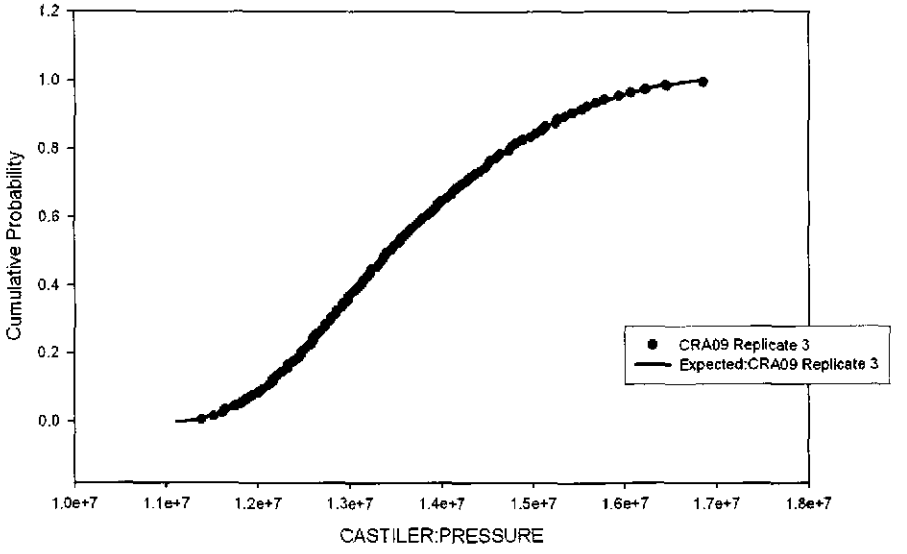


Figure 120. Observed and Expected CDFs for CASTILER:PRMX_LOG
Triangular Distribution

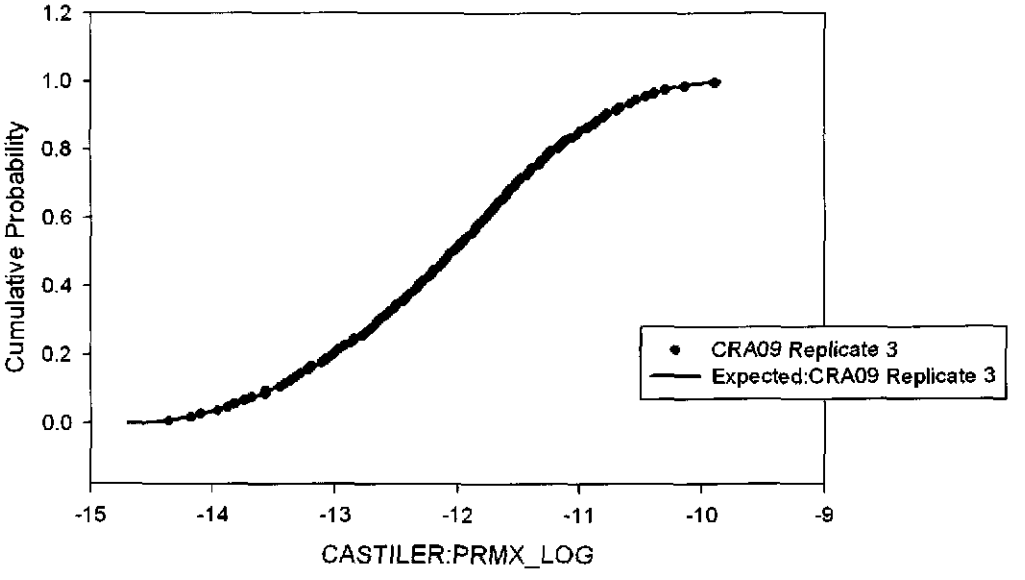


Figure 121. Observed and Expected CDFs for GLOBAL:PBRINE
Uniform Distribution

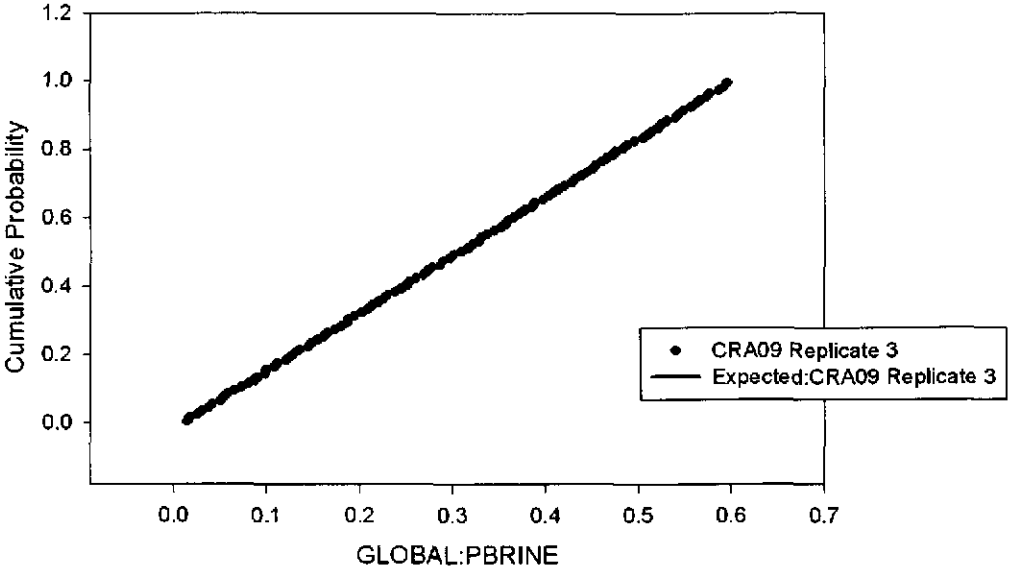


Figure 122. Observed and Expected CDFs for GLOBAL:CLIMTIDX
User Continuous Distribution

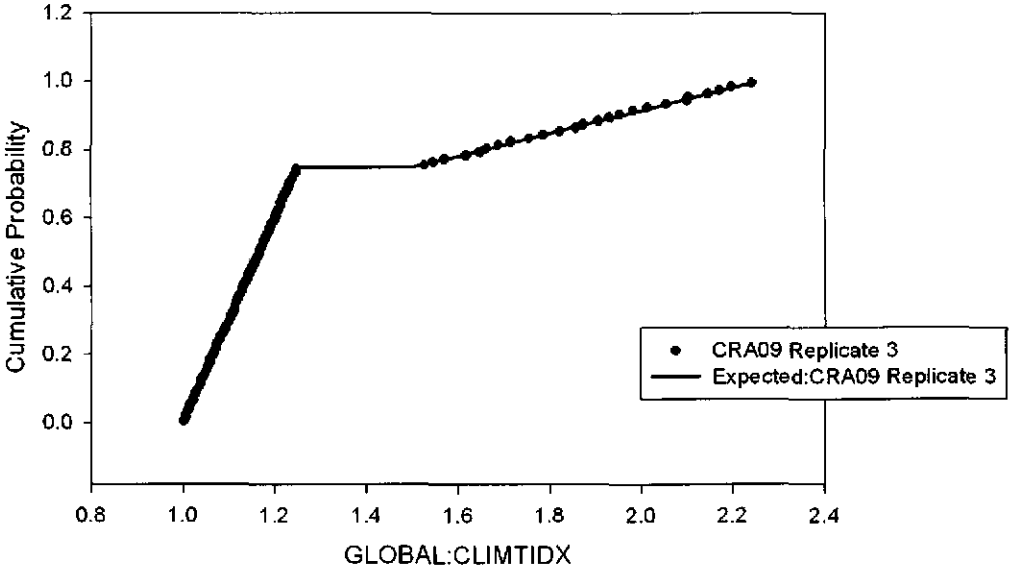


Figure 123. Observed and Expected CDFs for CULEBRA:APOROS
Loguniform Distribution

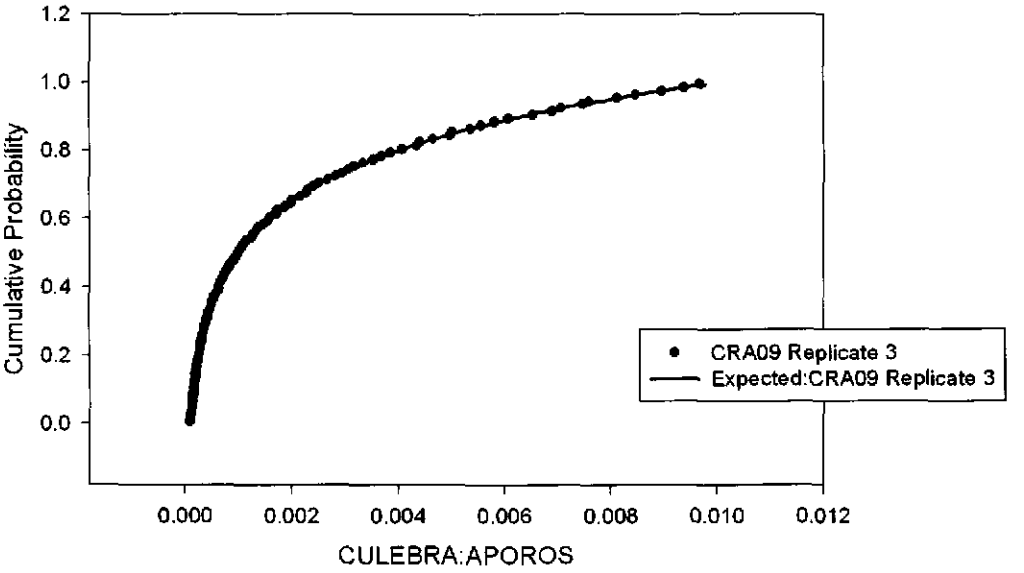


Figure 124. Observed and Expected CDFs for CULEBRA:HMBLKLT
Uniform Distribution

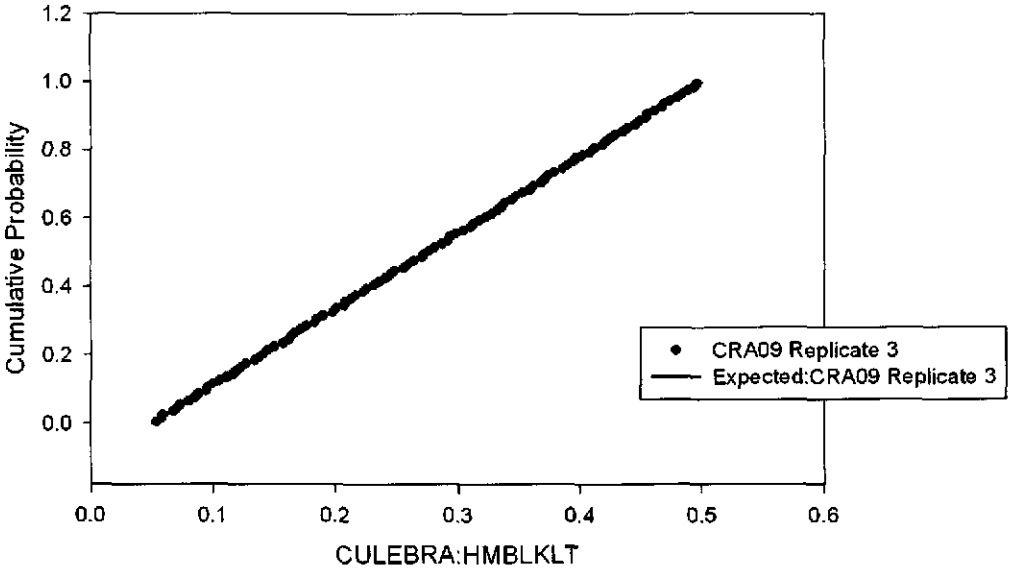


Figure 125. Observed and Expected CDFs for AM+3:MKD_AM Loguniform Distribution

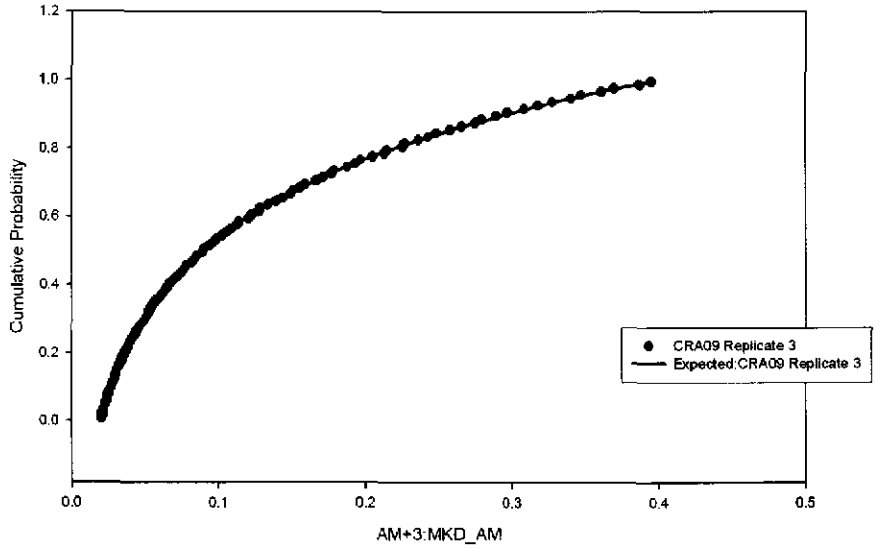


Figure 126. Observed and Expected CDFs for PU+3:MKD_PU Loguniform Distribution

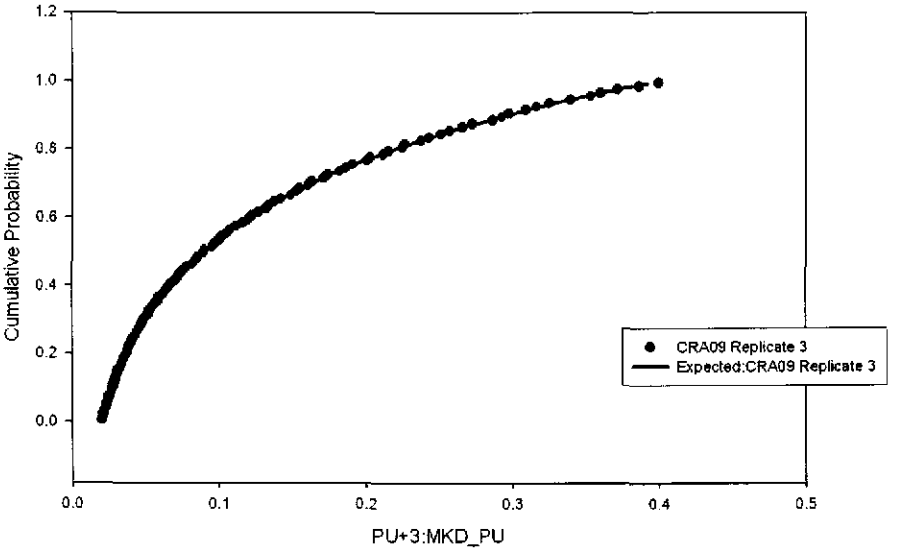


Figure 127. Observed and Expected CDFs for PU+4:MKD_PU
Loguniform Distribution

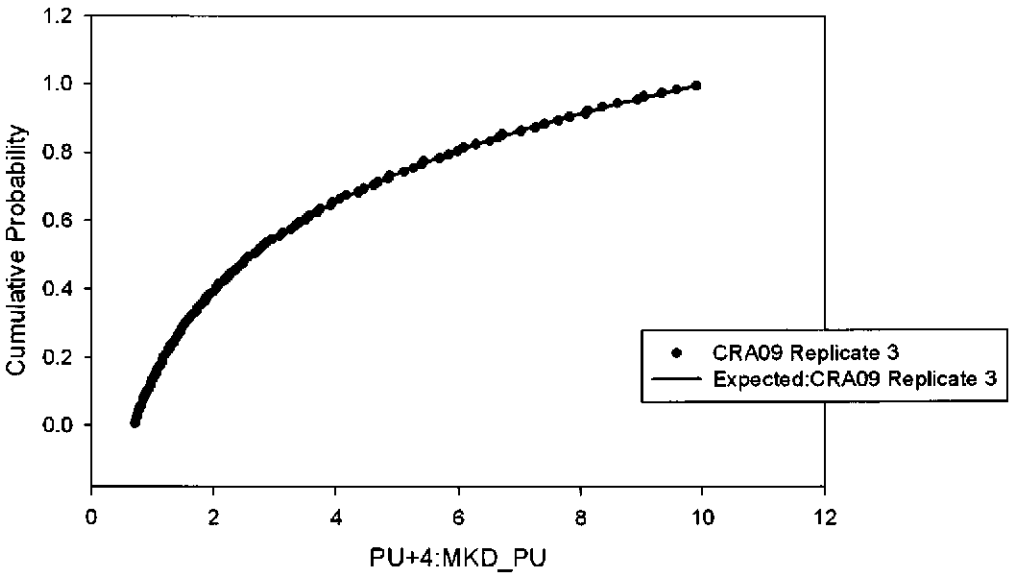


Figure 128. Observed and Expected CDFs for TH+4:MKD_TH
Loguniform Distribution

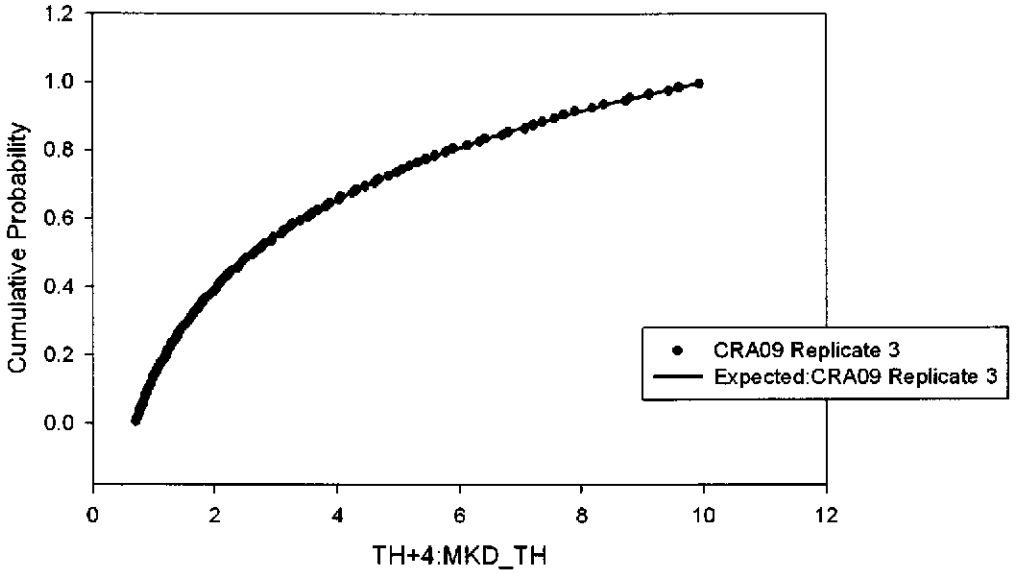


Figure 129. Observed and Expected CDFs for U+4:MKD_U
Loguniform Distribution

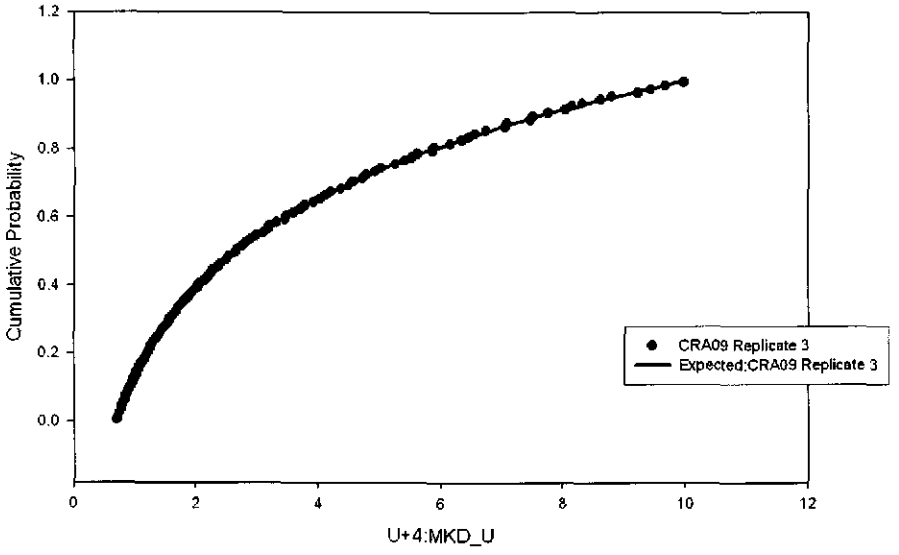


Figure 130. Observed and Expected CDFs for U+6:MKD_U
Loguniform Distribution

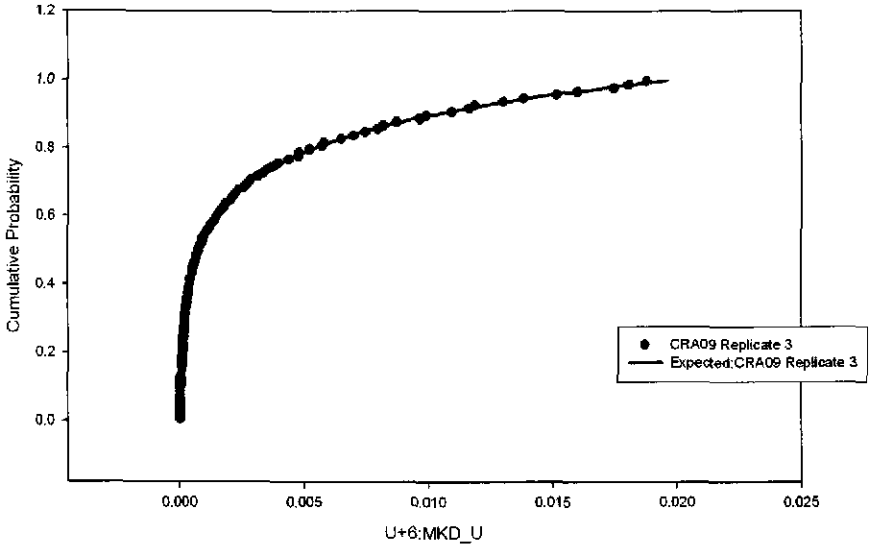


Figure 131. Observed and Expected CDFs for CULEBRA:DPOROS
User Continuous Distribution

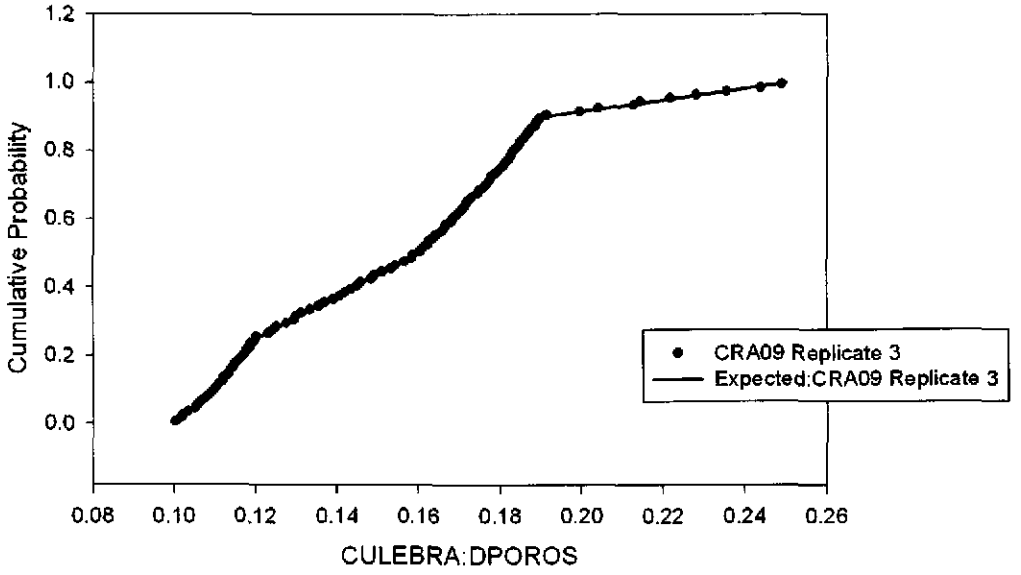


Figure 132. Observed and Expected CDFs for CONC_PCS:PORE_DIS
User Continuous Distribution

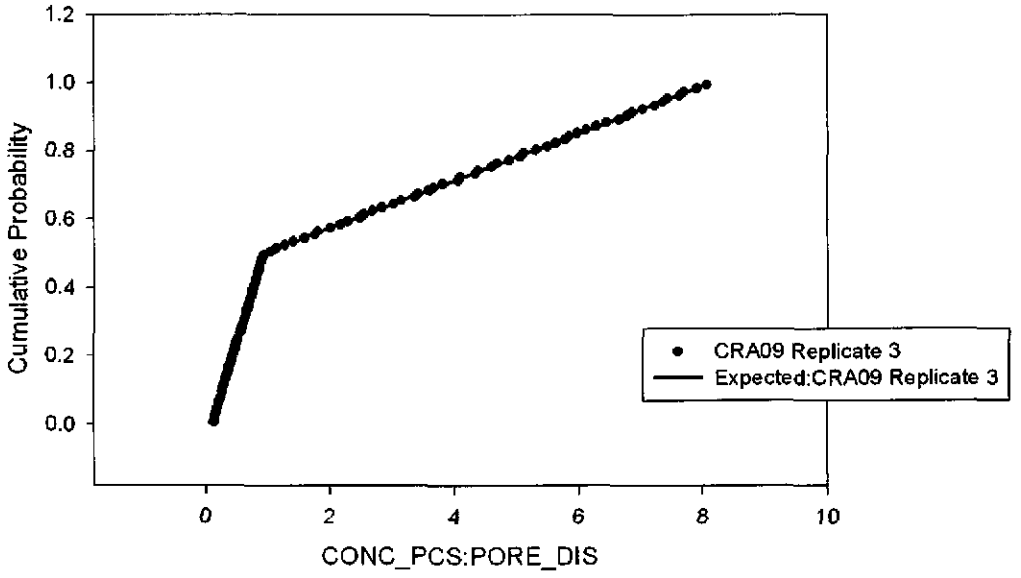


Figure 133. Observed and Expected CDFs for CONC_PCS:SAT_RBRN
User Continuous Distribution

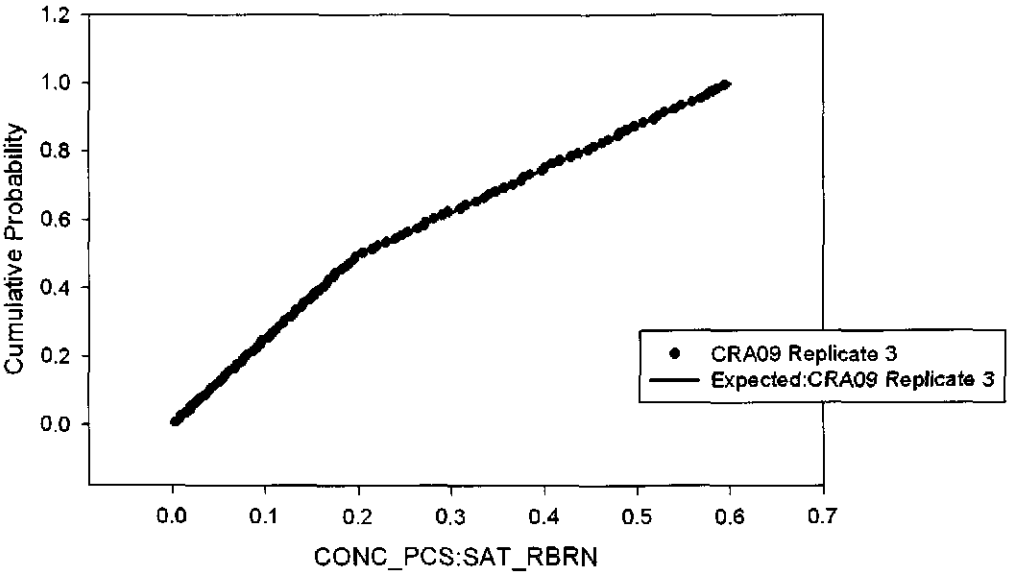


Figure 134. Observed and Expected CDFs for CONC_PCS:SAT_RGAS
Uniform Distribution

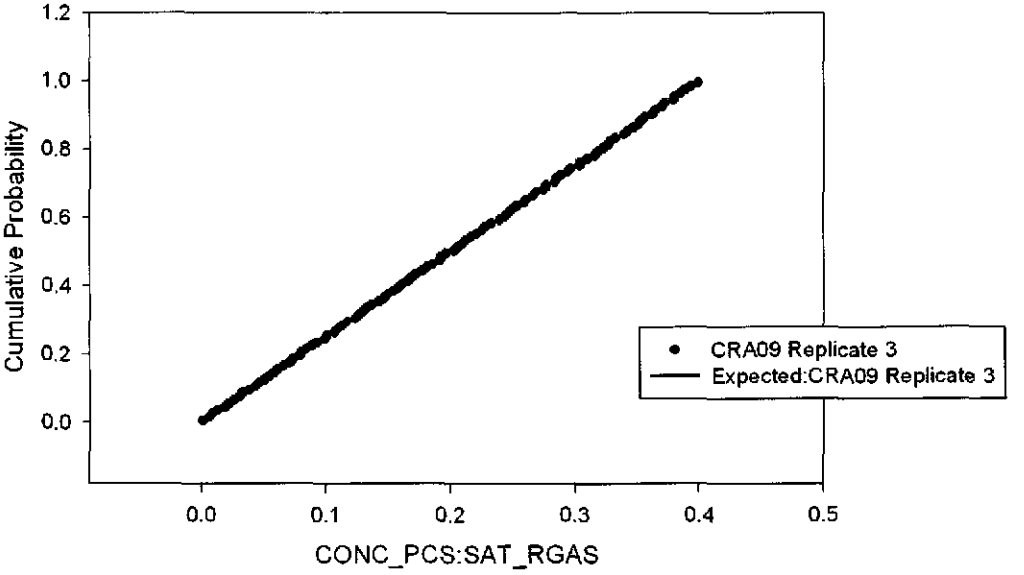


Figure 135. Observed and Expected CDFs for CONC_PCS:PRMX_LOG
Triangular Distribution

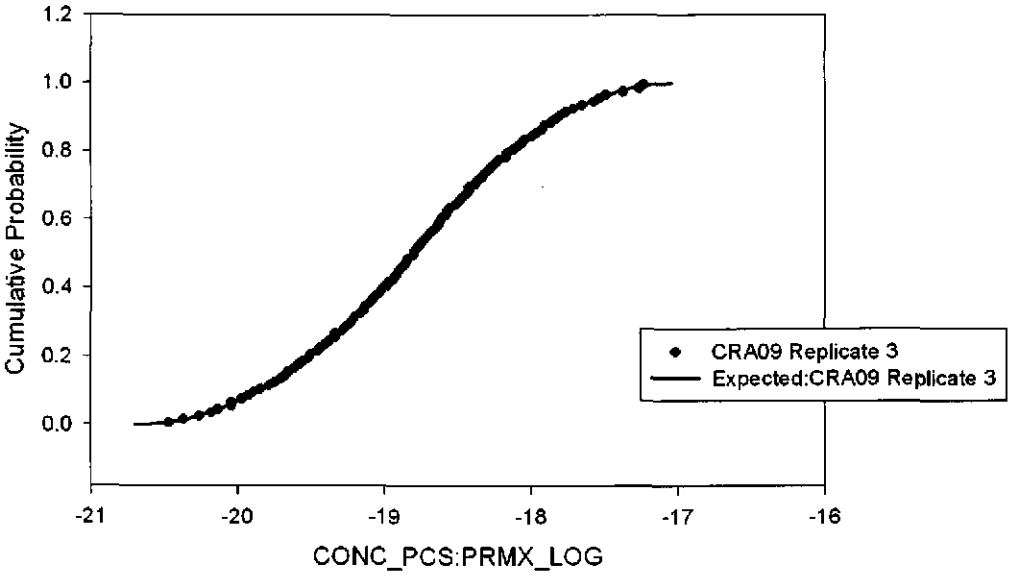


Figure 136. Observed and Expected CDFs for GLOBAL:TRANSIDX
Uniform Distribution

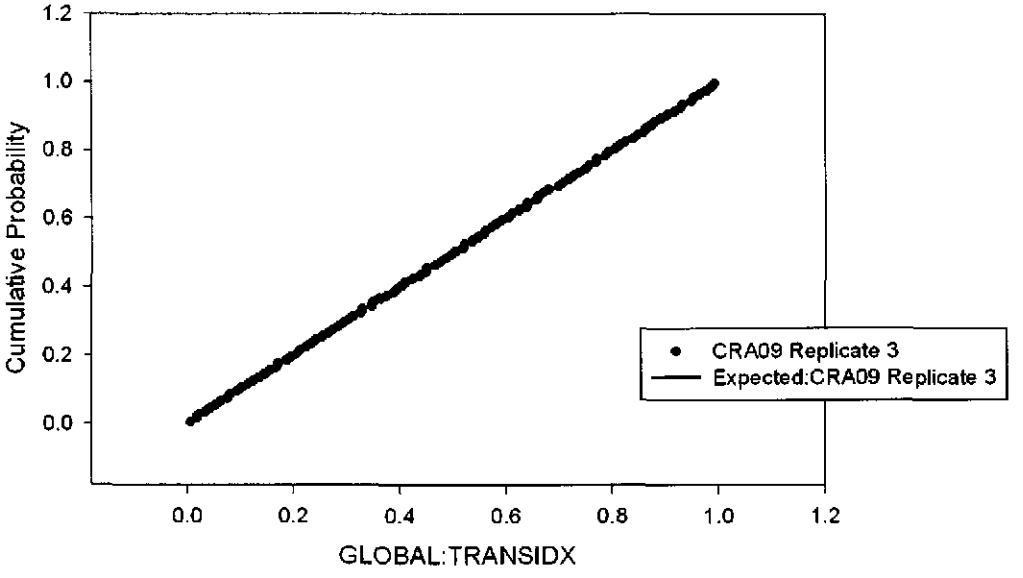


Figure 137. Observed and Expected CDFs for CULEBRA:MINP_FAC
Uniform Distribution

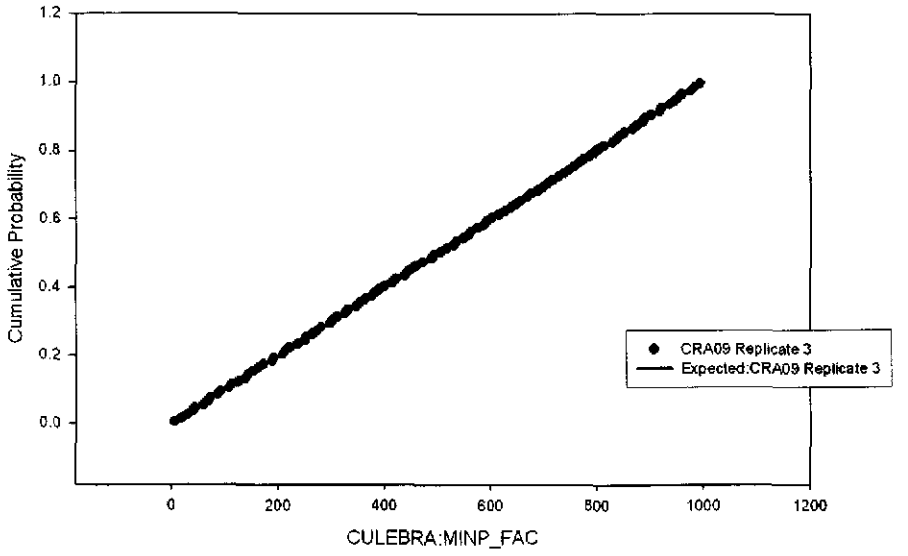


Figure 138. Observed and Expected CDFs for BOREHOLE:DOMEGA
User Continuous Distribution

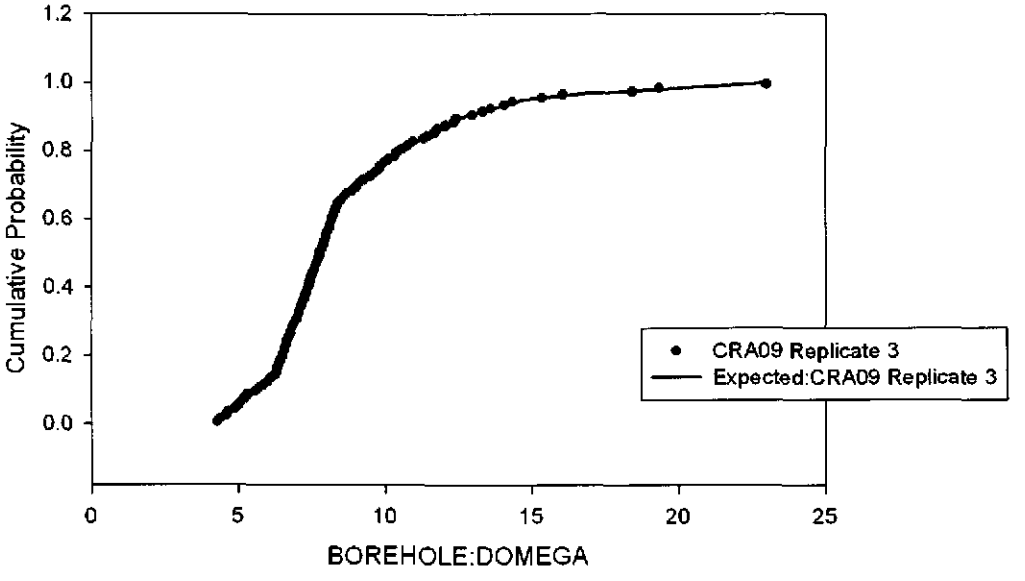


Figure 139. Observed and Expected CDFs for DRZ_PCS:PRMX_LOG
Triangular Distribution

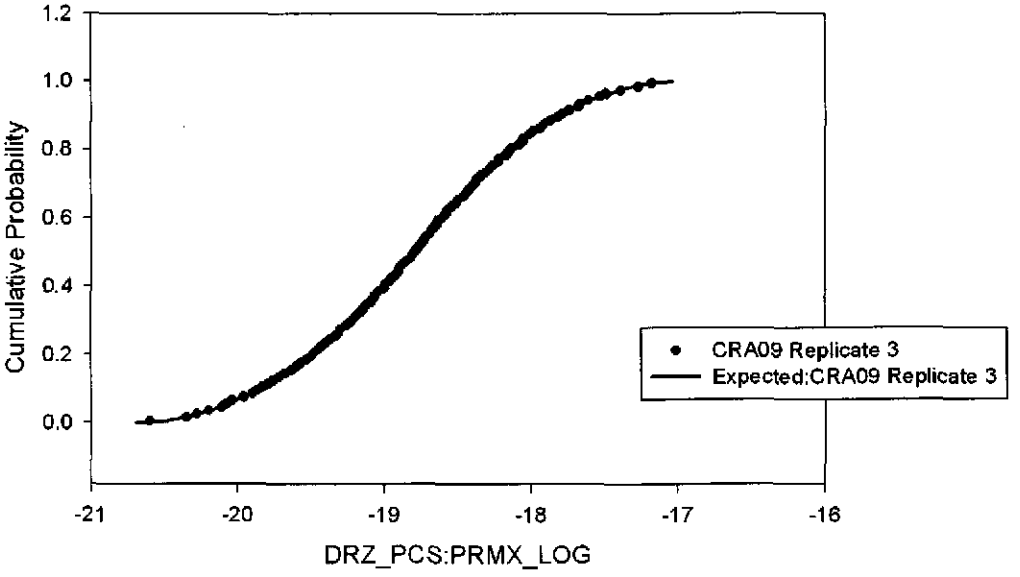


Figure 140. Observed and Expected CDFs for DRZ_1:PRMX_LOG
Uniform Distribution

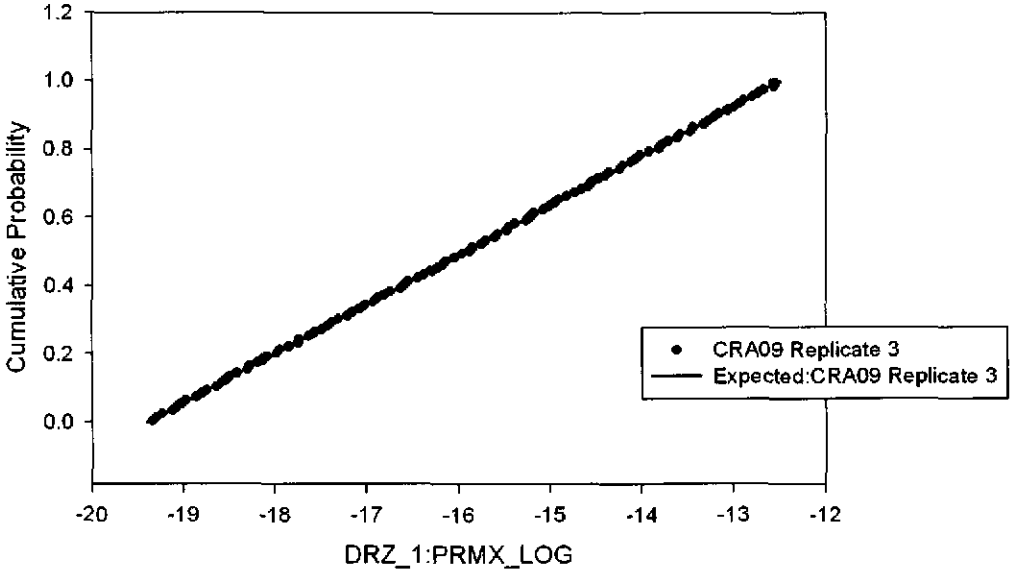


Figure 141. Observed and Expected CDFs for S_HALITE:COMP_RCK
Uniform Distribution

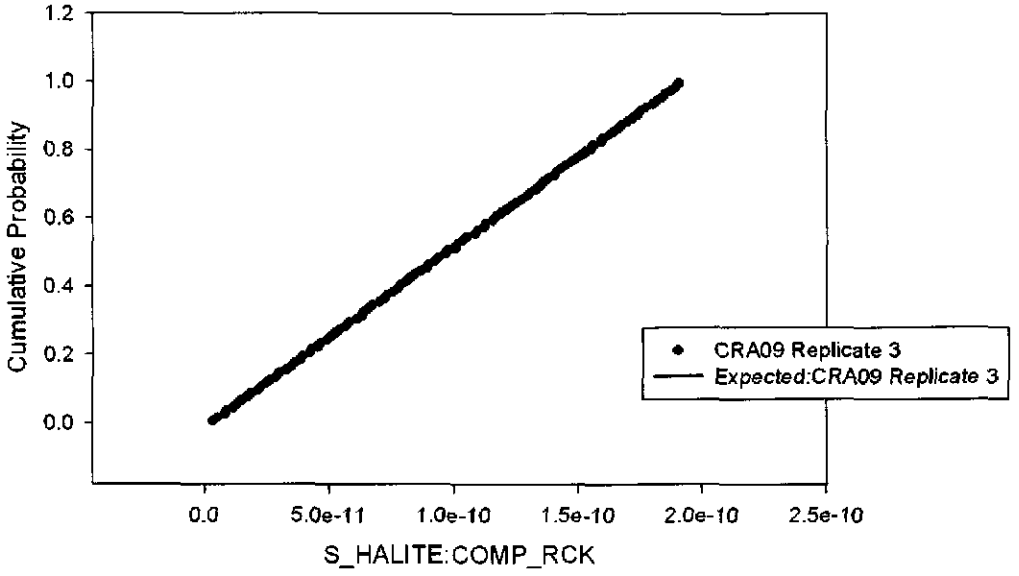


Figure 142. Observed and Expected CDFs for S_HALITE:POROSITY
User Continuous Distribution

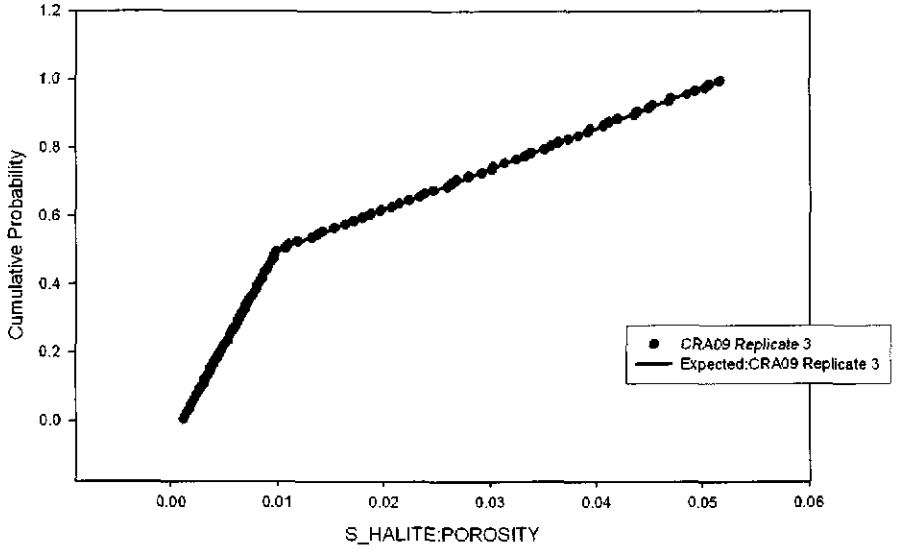


Figure 143. Observed and Expected CDFs for S_HALITE:PRMX_LOG
Uniform Distribution

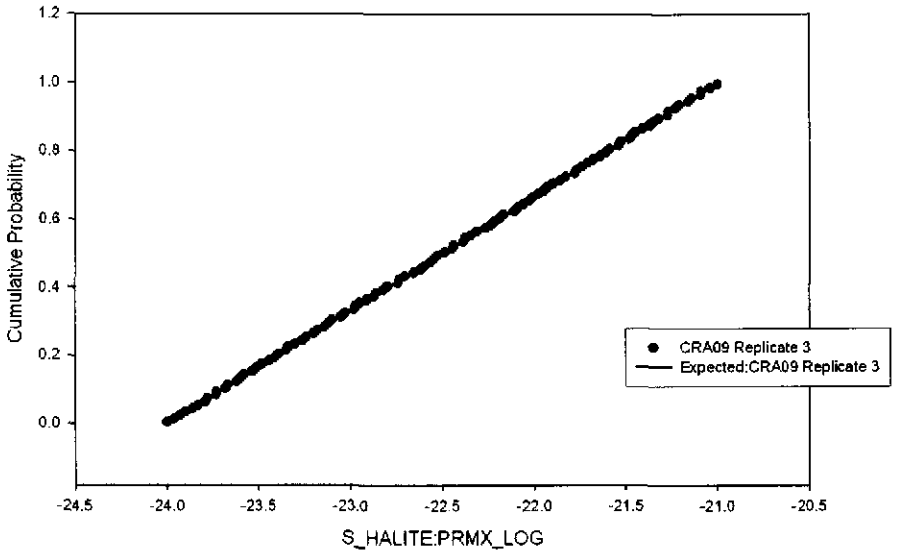


Figure 144. Observed and Expected CDFs for CONC_PLG:PRMX_LOG
Uniform Distribution

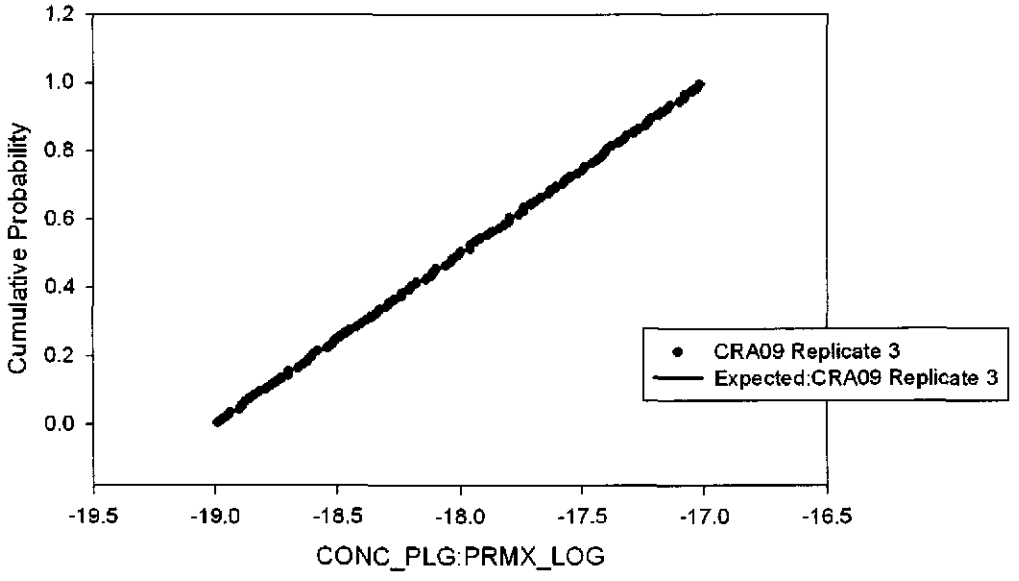


Figure 145. Observed and Expected CDFs for SPALLMOD:REPIPERM
Loguniform Distribution

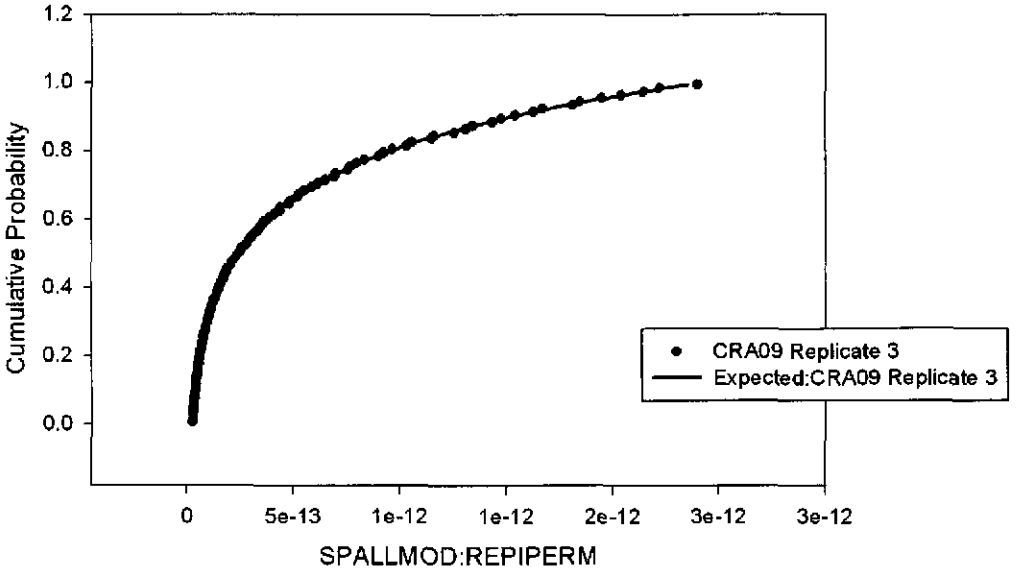


Figure 146. Observed and Expected CDFs for S_HALITE:PRESSURE
Uniform Distribution

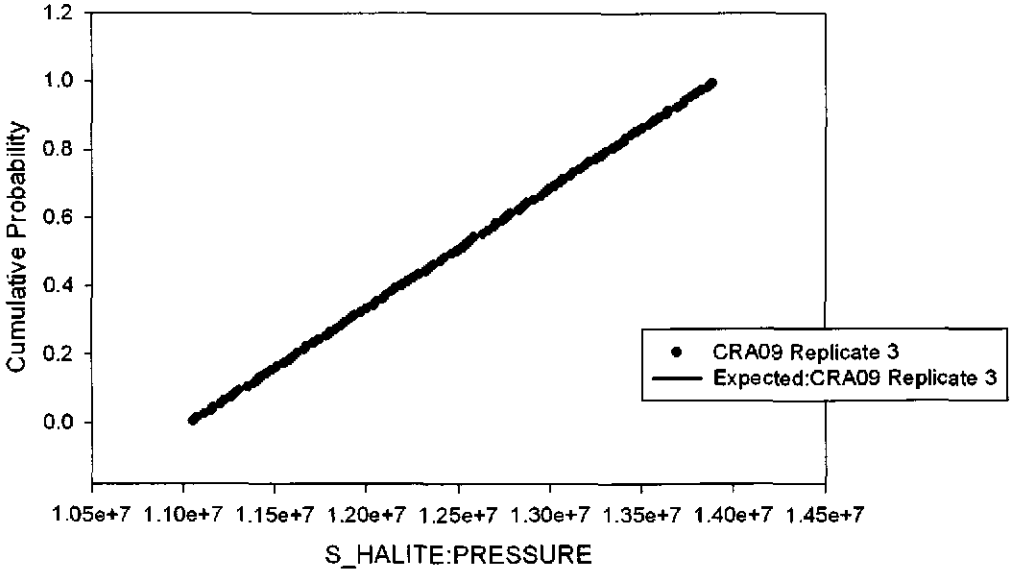


Figure 147. Observed and Expected CDFs for SHFTL_T1:PRMX_LOG
User Continuous Distribution

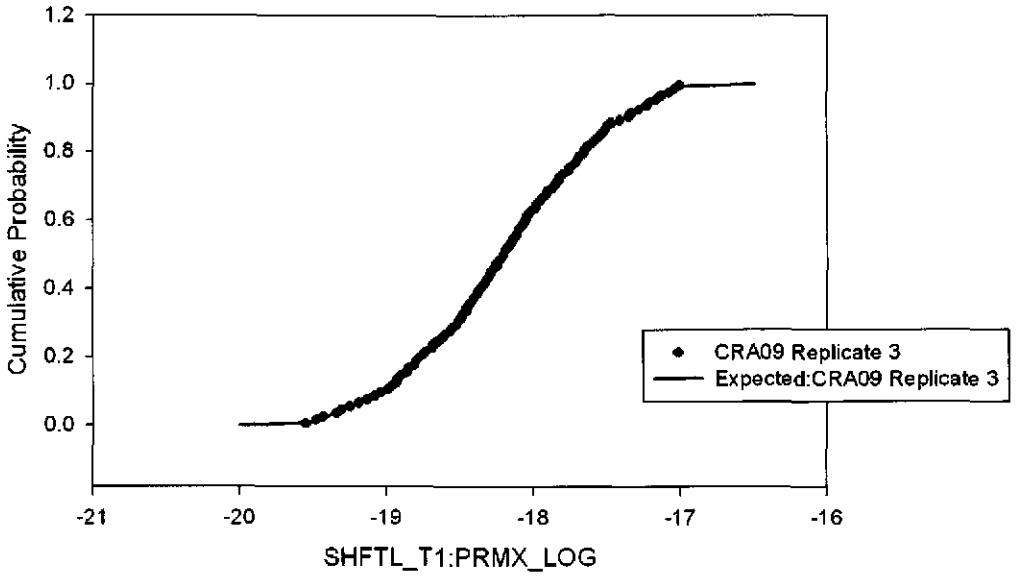


Figure 148. Observed and Expected CDFs for SHFTL_T2:PRMX_LOG
User Continuous Distribution

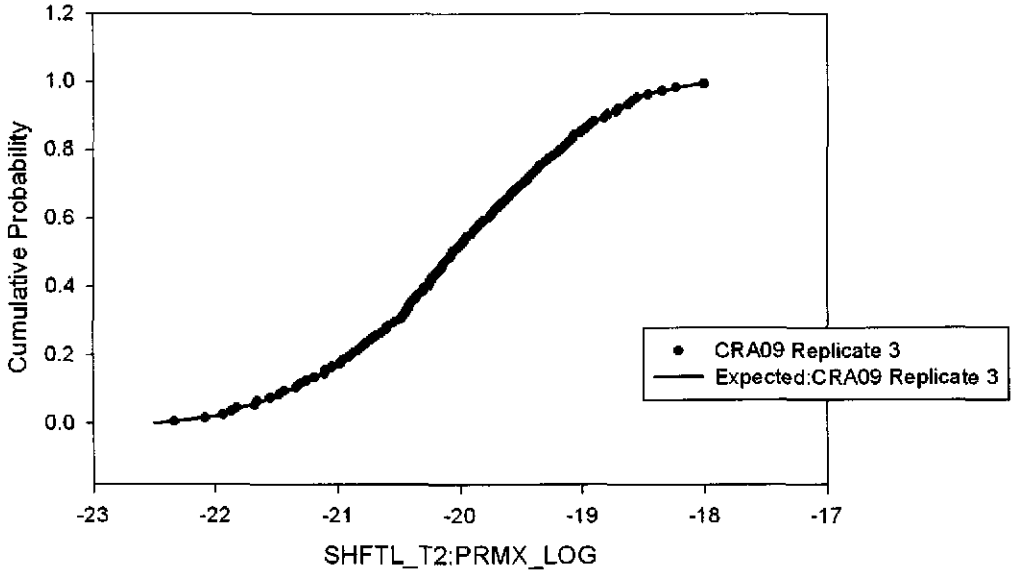


Figure 149. Observed and Expected CDFs for SHFTU:PRMX_LOG
User Continuous Distribution

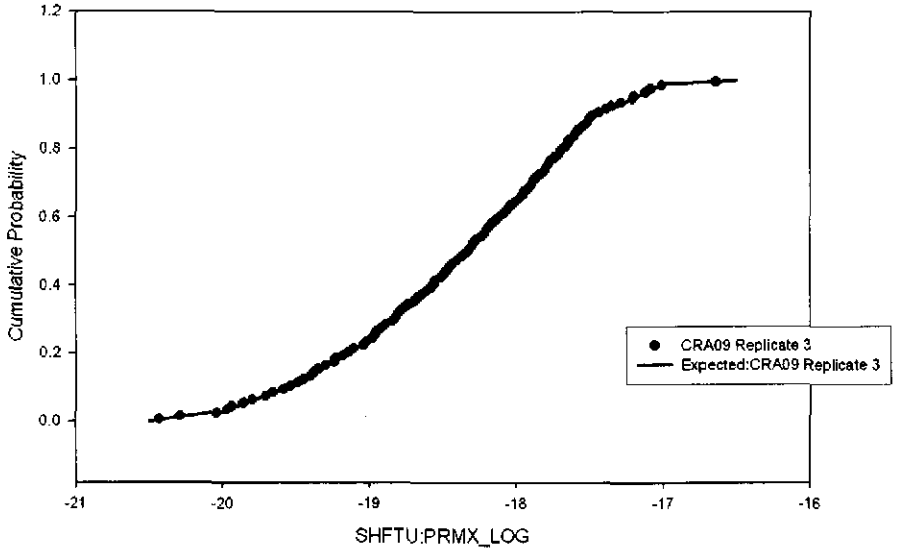


Figure 150. Observed and Expected CDFs for SHFTU:SAT_RBRN
User Continuous Distribution

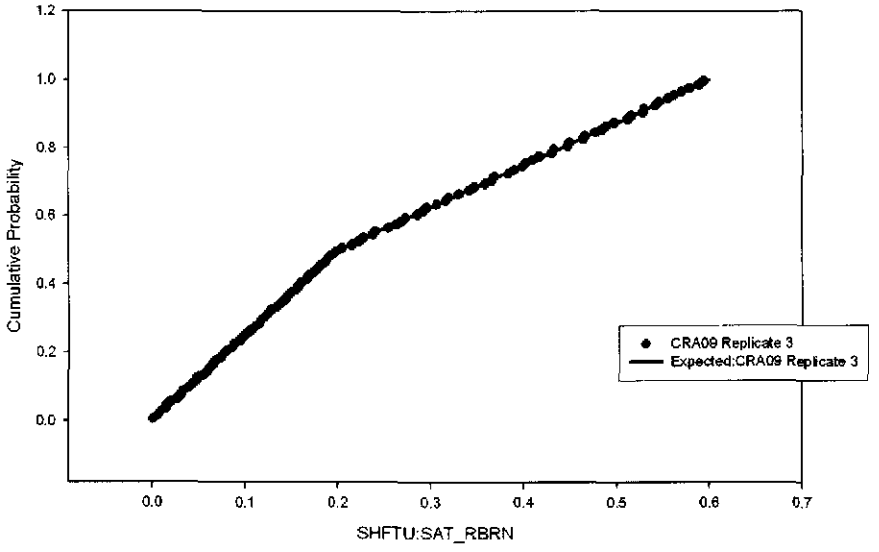


Figure 151. Observed and Expected CDFs for SHFTU:SAT_RGAS
Uniform Distribution

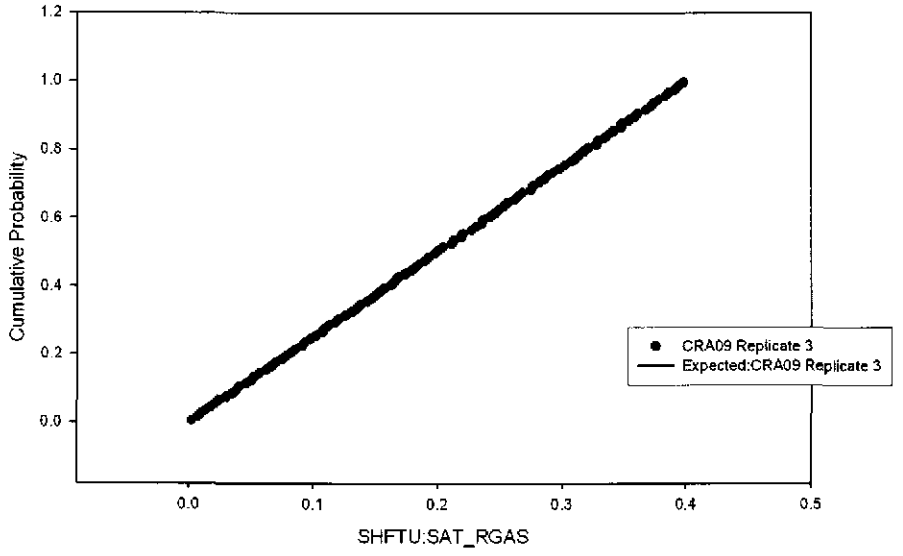


Figure 152. Observed and Expected CDFs for SPALLMOD:PARTDIAM
Loguniform Distribution

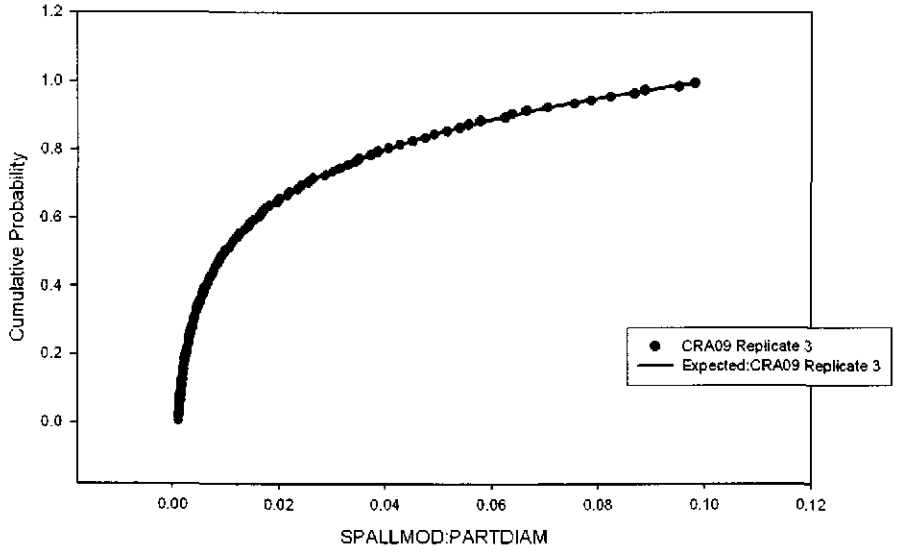


Figure 153. Observed and Expected CDFs for SPALLMOD:REPIPOR
Uniform Distribution

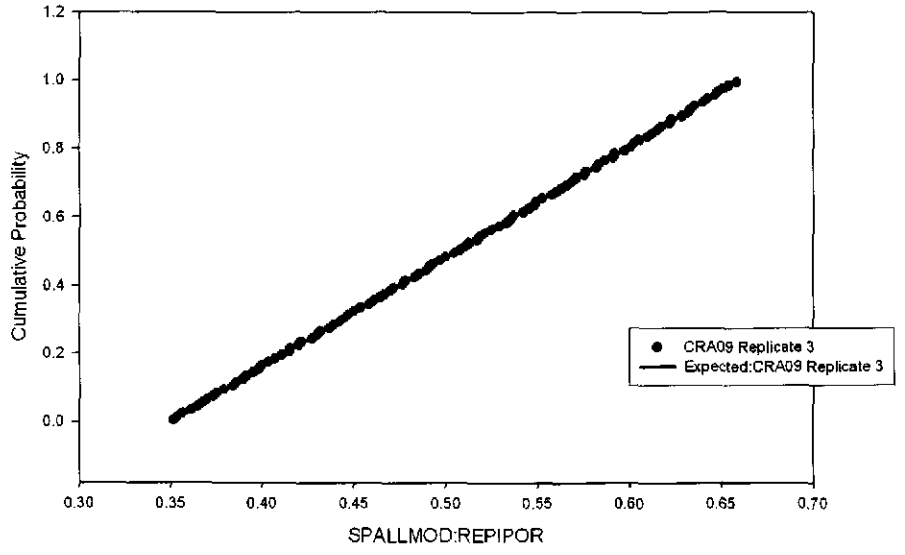


Figure 154. Observed and Expected CDFs for SPALLMOD:TENSLSTR
Uniform Distribution

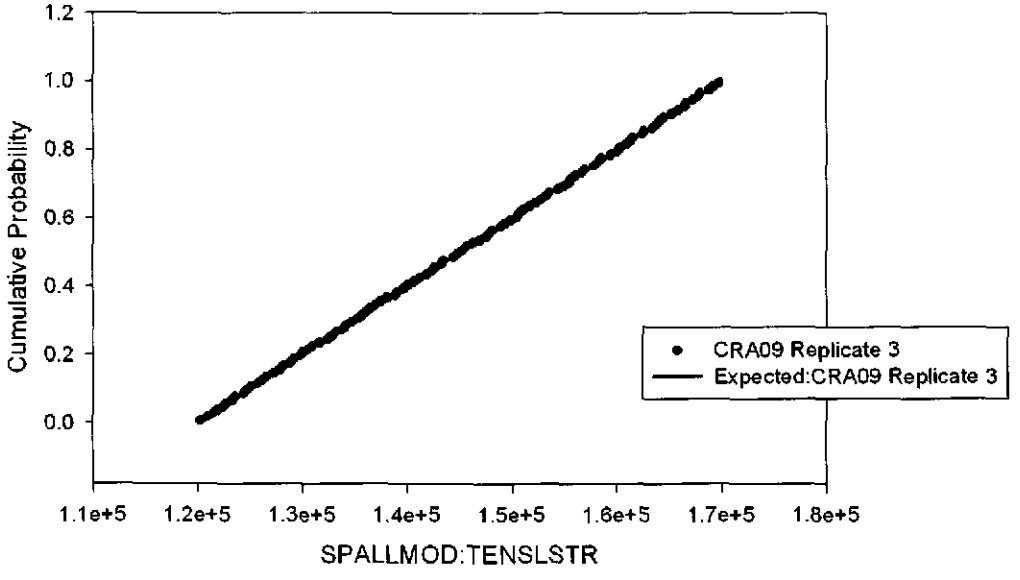


Figure 155. Observed and Expected CDFs for WAS_AREA:SAT_WICK
Uniform Distribution

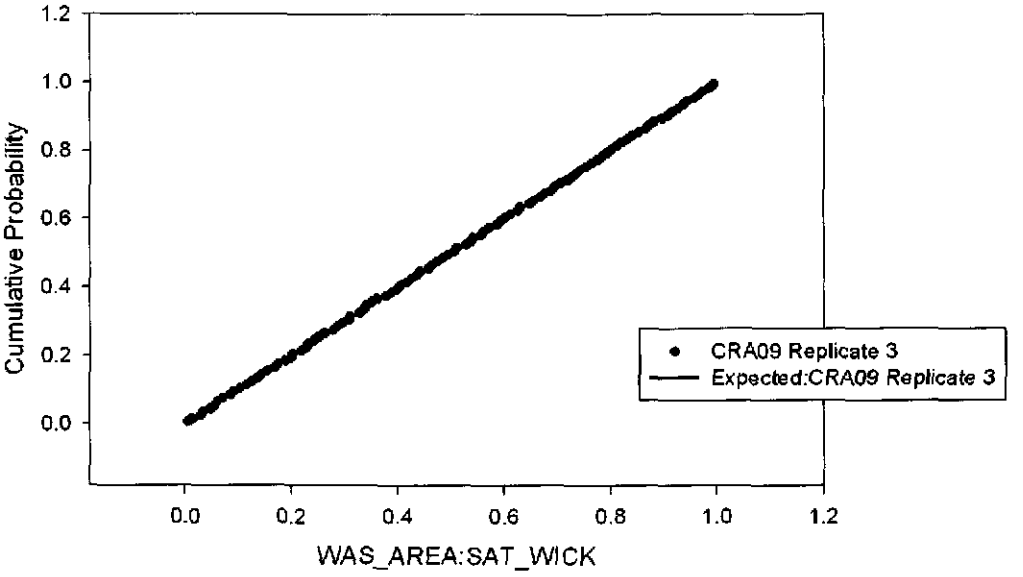


Figure 156. Observed and Expected CDFs for WAS_AREA:BIOGENFC
Uniform Distribution

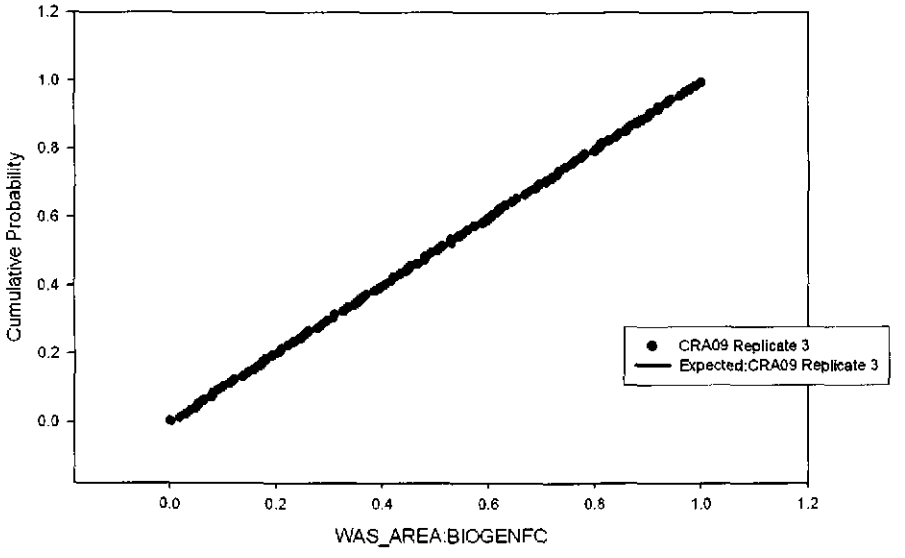


Figure 157. Observed and Expected CDFs for CELLULS:FBETA
Uniform Distribution

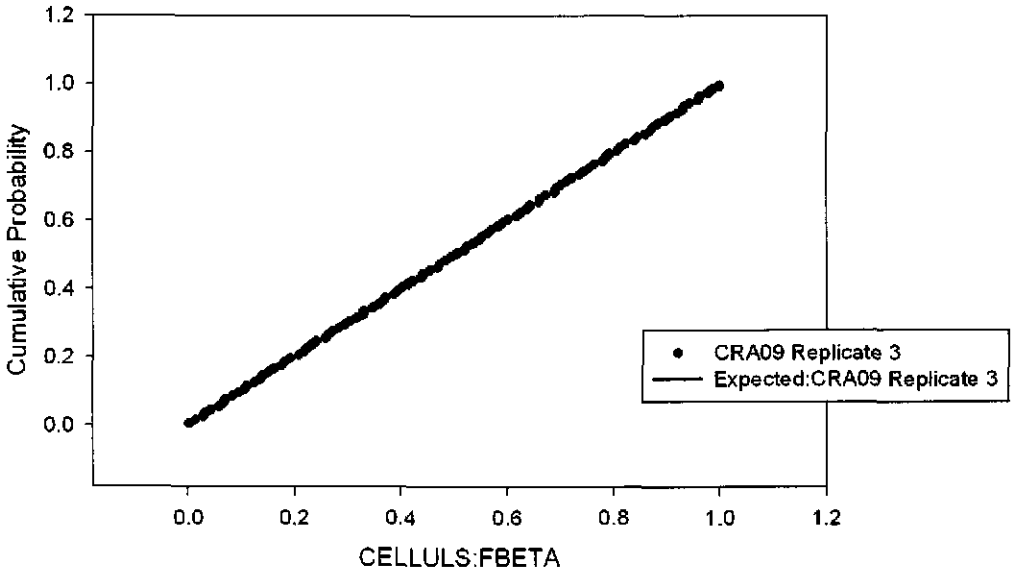


Figure 158. Observed and Expected CDFs for STEEL:CORRMCO2
Uniform Distribution

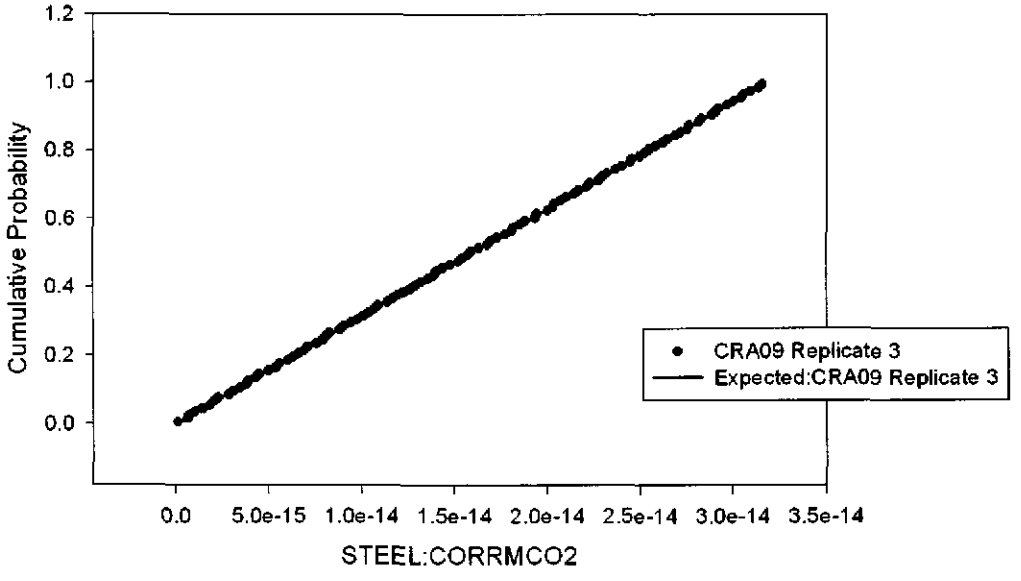


Figure 159. Observed and Expected CDFs for WAS_AREA:GRATMICH
Uniform Distribution

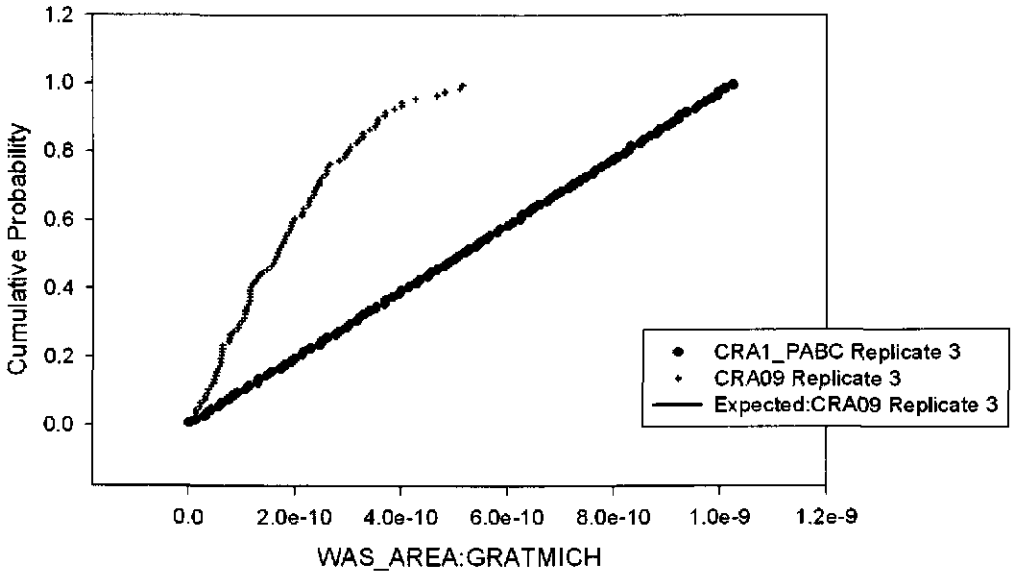


Figure 160. Observed and Expected CDFs for WAS_AREA:GRATMICI
Uniform Distribution

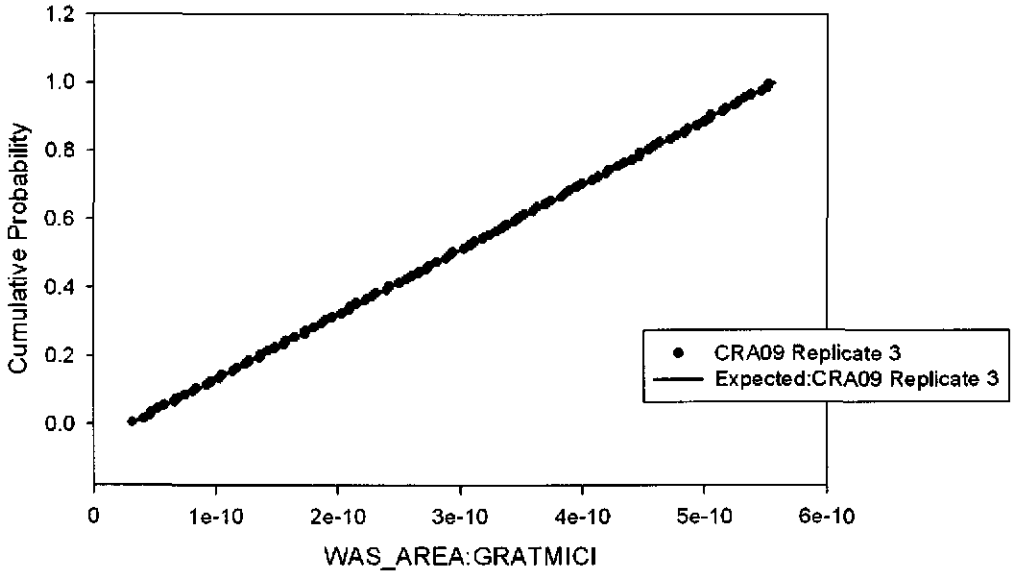


Figure 161. Observed and Expected CDFs for WAS_AREA:PROBDEG
User Discrete (Delta) Distribution

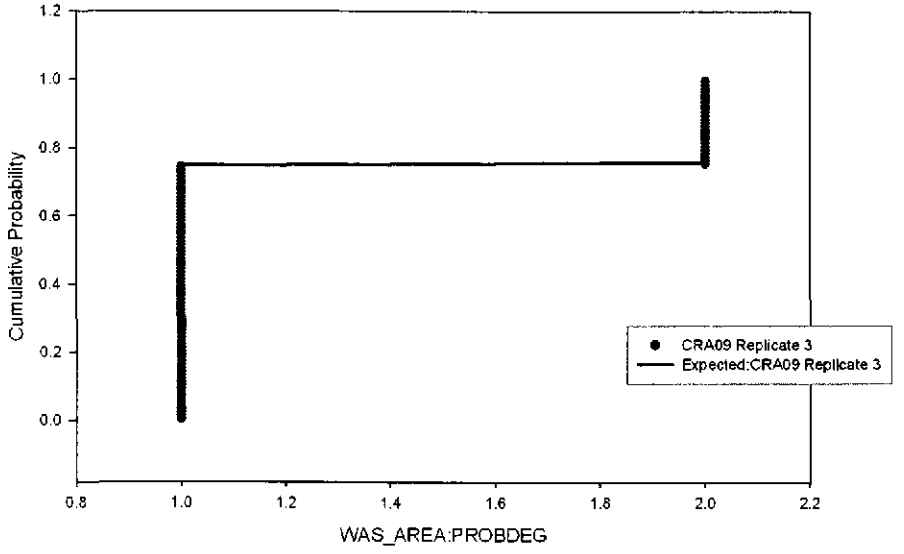


Figure 162. Observed and Expected CDFs for GLOBAL:OXSTAT
Uniform Distribution

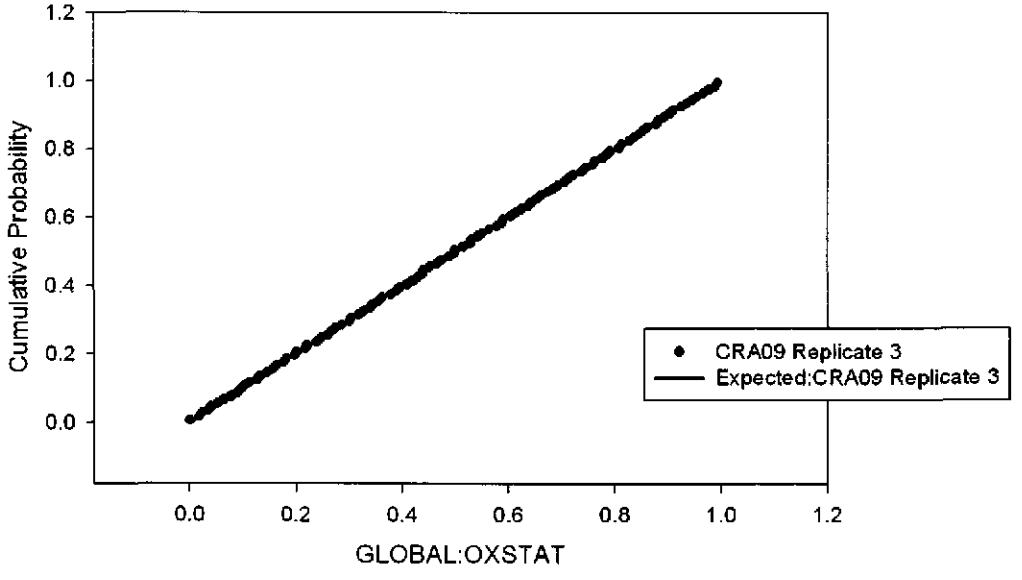


Figure 163. Observed and Expected CDFs for PHUMOX3:PHUMCIM User Continuous Distribution

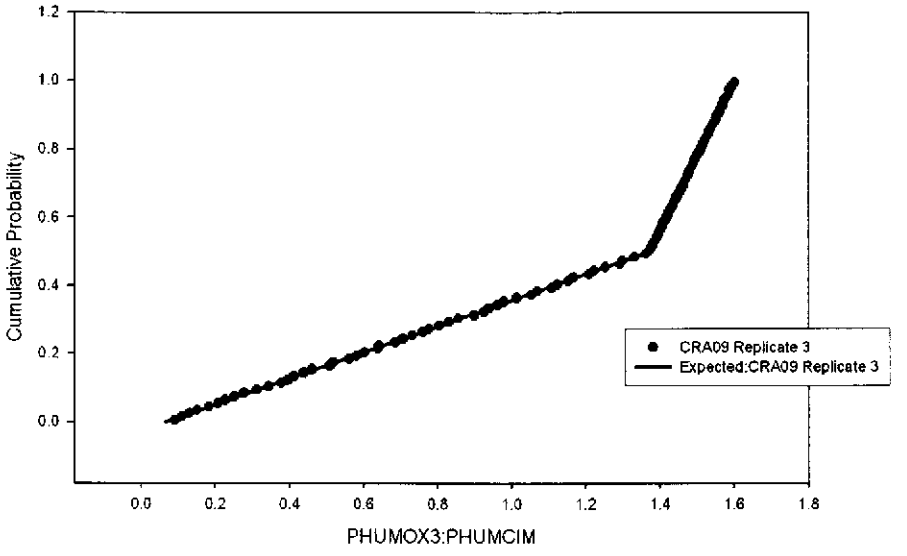


Figure 164. Observed and Expected CDFs for WAS_AREA:SAT_RBRN Uniform Distribution

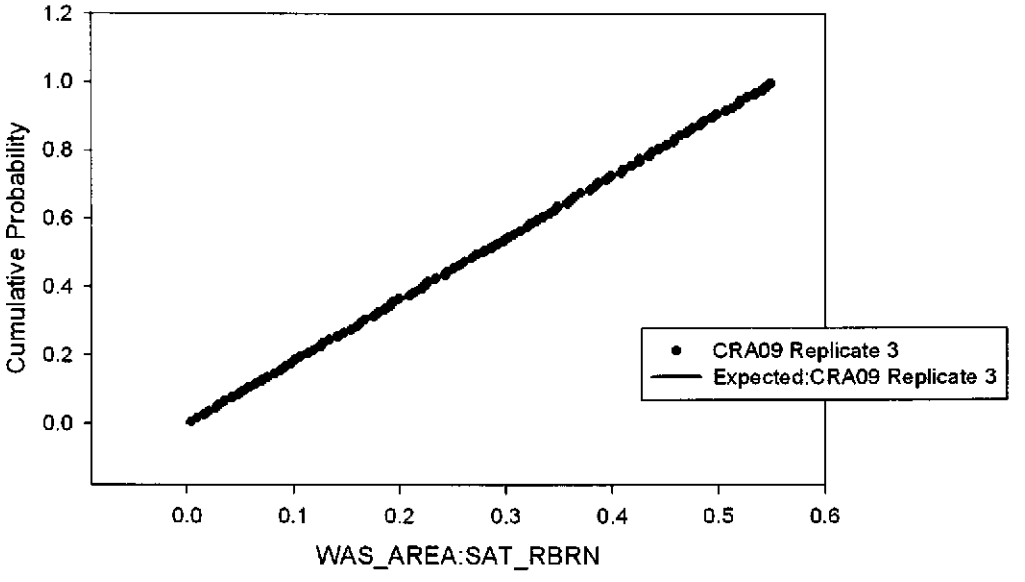


Figure 165. Observed and Expected CDFs for WAS_AREA:SAT_RGAS
Uniform Distribution

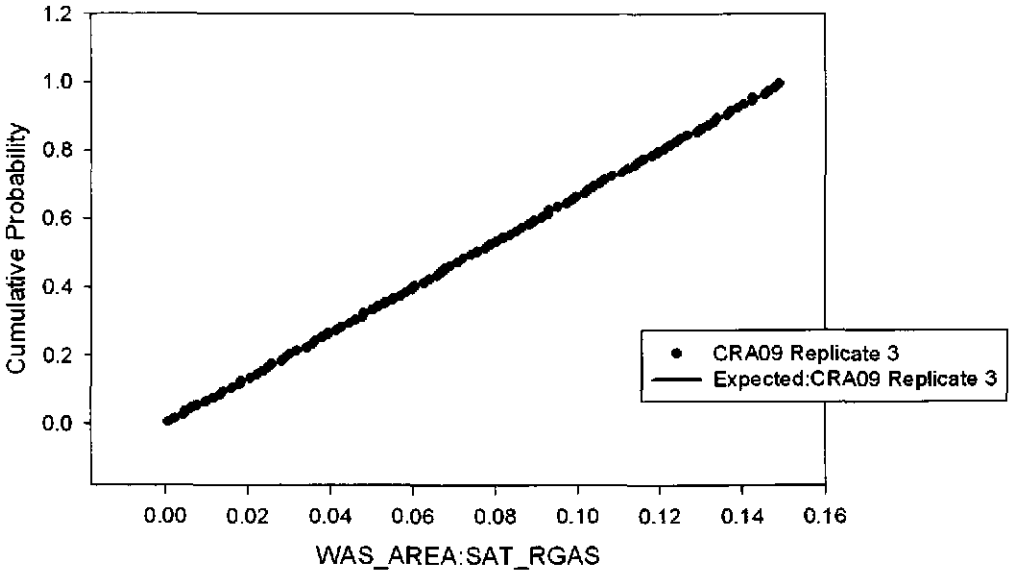


Figure 166. Observed and Expected CDFs for SOLMOD3:SOLVAR
User Continuous Distribution

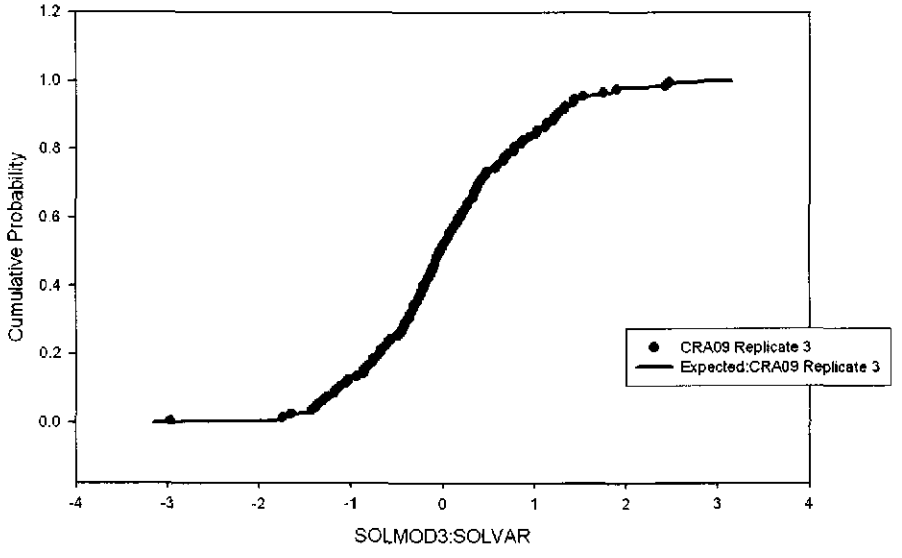


Figure 167. Observed and Expected CDFs for SOLMOD4:SOLVAR User Continuous Distribution

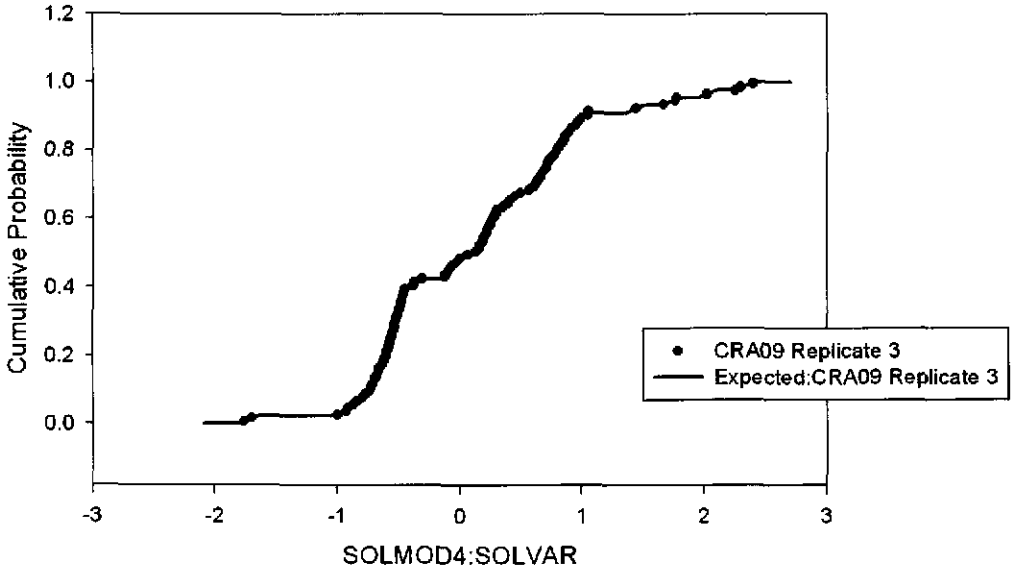


Figure 168. Observed and Expected CDFs for BOREHOLE:TAUFAIL Loguniform Distribution

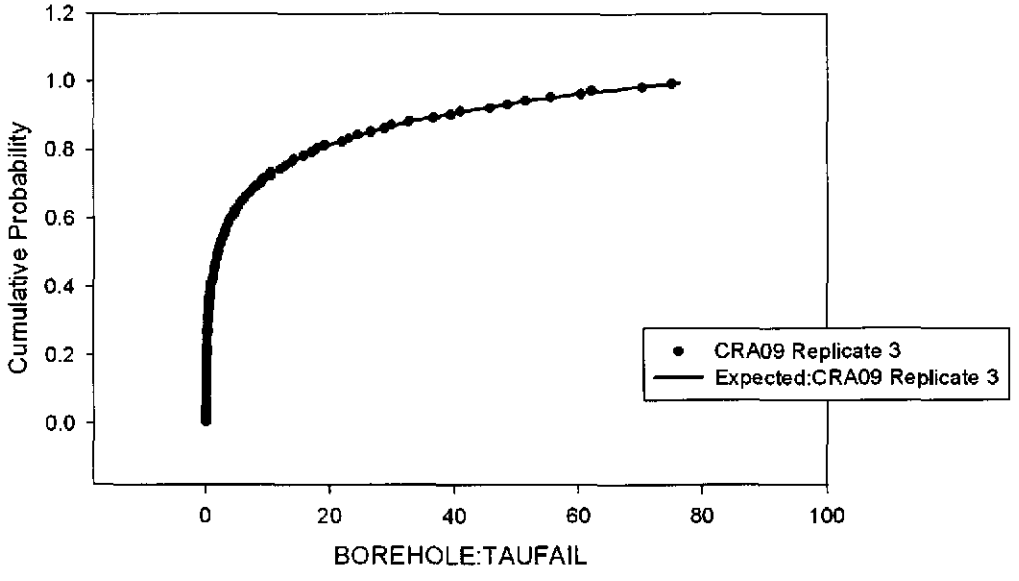
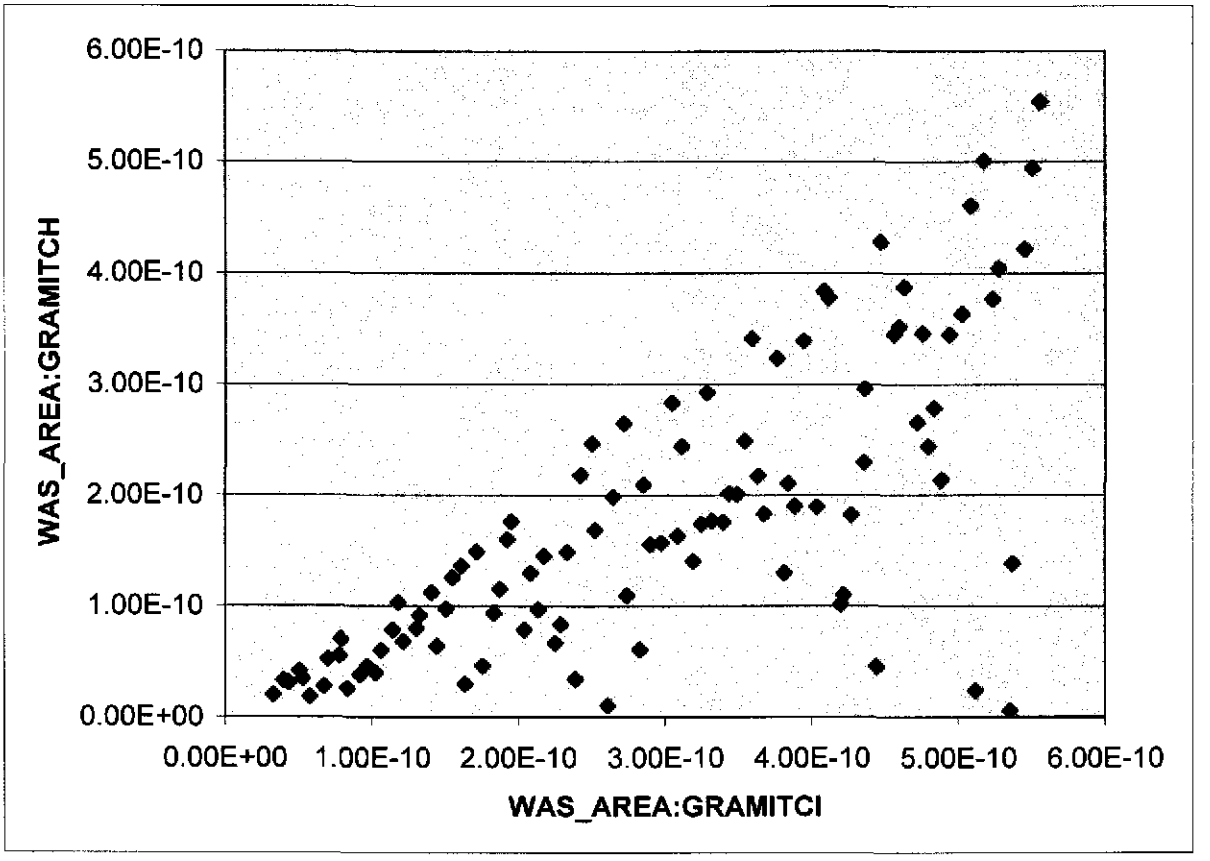


Figure 169. The conditional relationship introduced between WAS_AREA:GRAYMICI and WAS_AREA:GRATMICH also produces a correlation between the variables.



Appendix I. Input file to PRELHS for Replicate 1

```
! TITLE:          CRA09  PRELHS (LHS1) Input File
! ANALYSIS PLAN: AP-137
! ANALYST:        Thomas Kirchner
! CREATED:        December 2007
!
!  LHSCALC = CRA09 REALIZATION 1
!=======================================================================
!
!  DESCRIPTION:
!
!  WIPP 2009 Compliance Recertification Application PA
! aka (AP137)
!
!  This input file to PRELHS is used to generate, as an output file, an LHS
!  input file containing all distribution information and execution options
!  required to create a sample for Replicate R1 for the WIPP 2009 CRA
!
!  Changes from CRA1BC analyses:
!      1) a post processing step was added to induce a conditional
relationship
!      between WAS_AREA:GRAMICH and WAS_AREA:GRAMICI. This relationship
ensures
!      that WAS_AREA:GRAMICH never exceeds the value of WAS_AREA:GRAMICI. If
!      the value selected for WAS_AREA:GRAMICH does exceed WAS_AREA:GRAMICI
!      then a new value is computed for WAS_AREA:GRAMICH assuming that a) the
!      distribution for WAS_AREA:GRAMICH is uniform and b) that the maximum
!      value for the adjusted distribution of WAS_AREA:GRAMICH is the
!      sampled value for WAS_AREA:GRAMICI. A new WAS_AREA:GRAMICH is
generated
!      using the utility LHS_EDIT.EXE by computing the probability of
!      the value on the original range and getting the value associated
!      with that probability on the new range.

!========= No Comments Allowed between *ECHO and *ENDECHO ===============
!
*ECHOLHS
TITLE 2009 CRA PA Baseline Calculation, Replicate R1 Input File for the LHS
Code
NOBS            100
RANDOM SEED     582592385
CORRELATION MATRIX
    2
    53   54 -0.99
    61   62 -0.75
OUTPUT CORR HIST DATA
*ENDECHO
!
!== PROPERTIES TO BE RETRIEVED FROM WIPP PA CALCULATION DATABASE ==
!
*RETRIEVE
!1    CCDFGF
      MATERIALS,  GLOBAL
      PROPERTIES, PBRINE
!2
```

```
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!3
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!4    CUTTINGS_S
      MATERIALS,  BOREHOLE
      PROPERTIES, DOMEGA
!5    CUTTINGS_S
      MATERIALS,  BOREHOLE
      PROPERTIES, TAUFAIL
!6
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!7
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!8    DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, REPIPERM
!9    DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, TENSLSTR
!10   DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, PARTDIAM
!11   DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, REPIPOR
!12
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!13
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!14
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!15   PANEL
        MATERIALS,       SOLMOD3
        PROPERTIES,      SOLVAR
!16   PANEL
        MATERIALS,       SOLMOD4
        PROPERTIES,      SOLVAR
!17   PANEL
      MATERIALS,  PHUMOX3
      PROPERTIES, PHUMCIM
!18   PANEL/SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, OXSTAT
!19
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!20
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!21
```

```
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!22
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!23   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, MINP_FAC
!24   SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, TRANSIDX
!25   SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, CLIMTIDX
!26   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, HMBLKLT
!27   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, APOROS
!28   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, DPOROS
!29   SECOTP2D
      MATERIALS,  U+6
      PROPERTIES, MKD_U
!30   SECOTP2D
      MATERIALS,  U+4
      PROPERTIES, MKD_U
!31   SECOTP2D
      MATERIALS,  PU+3
      PROPERTIES, MKD_PU
!32   SECOTP2D
      MATERIALS,  PU+4
      PROPERTIES, MKD_PU
!33   SECOTP2D
      MATERIALS,  TH+4
      PROPERTIES, MKD_TH
!34   SECOTP2D
      MATERIALS,  AM+3
      PROPERTIES, MKD_AM
!35
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!36
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!37
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!38
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!39   BRAGFLO
      MATERIALS,  STEEL
      PROPERTIES, CORRMCO2
!40   BRAGFLO/PANEL
```

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      MATERIALS,  WAS_AREA
      PROPERTIES, PROBDEG
!41   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, GRATMICI
!42   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, GRATMICH
!43   BRAGFLO
      MATERIALS,  CELLULS
      PROPERTIES, FBETA
!44   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_RGAS
!45   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_RBRN
!46   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_WICK
!47   BRAGFLO
      MATERIALS,  DRZ_PCS
      PROPERTIES, PRMX_LOG
!48   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, PRMX_LOG
!49   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, SAT_RGAS
!50   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, SAT_RBRN
!51   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, PORE_DIS
!52   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, POROSITY
!53   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, PRMX_LOG
!54   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, COMP_RCK
!55   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, PRMX_LOG
!56   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, RELP_MOD
!57   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, SAT_RBRN
!58   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, PORE_DIS
!59   BRAGFLO
```

```
      MATERIALS,  S_HALITE
      PROPERTIES, PRESSURE
!60   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, PRESSURE
!61   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, PRMX_LOG
!62   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, COMP_RCK
!63   BRAGFLO
      MATERIALS,  BH_SAND
      PROPERTIES, PRMX_LOG
!64   BRAGFLO
      MATERIALS,  DRZ_1
      PROPERTIES, PRMX_LOG
!65   BRAGFLO
      MATERIALS,  CONC_PLG
      PROPERTIES, PRMX_LOG
!66   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, SAT_RBRN
!67   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, SAT_RGAS
!68   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, PRMX_LOG
!69   BRAGFLO
      MATERIALS,  SHFTL_T1
      PROPERTIES, PRMX_LOG
!70   BRAGFLO
      MATERIALS,  SHFTL_T2
      PROPERTIES, PRMX_LOG
!71   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, BIOGENFC
!72
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!73
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!74
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!75
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!
!=============================================================================
!
*END
```

Appendix II. Input file to PRELHS for Replicate 2

```
! TITLE:          CRA09  PRELHS (LHS1) Input File
! ANALYSIS PLAN: AP-137
! ANALYST:        Thomas Kirchner
! CREATED:        December 2007
!
!  LHSCALC = CRA09 REALIZATION 2
!=======================================================================
!
!  DESCRIPTION:
!
!  WIPP 2009 Compliance Recertification Application PA
! aka (AP137)
!
!  This input file to PRELHS is used to generate, as an output file, an LHS
!  input file containing all distribution information and execution options
!  required to create a sample for Replicate R2 for the WIPP 2009 CRA
!
!  Changes from CRA1BC analyses:
!      1) a post processing step was added to induce a conditional
relationship
!      between WAS_AREA:GRAMICH and WAS_AREA:GRAMICI. This relationship
ensures
!      that WAS_AREA:GRAMICH never exceeds the value of WAS_AREA:GRAMICI. If
!      the value selected for WAS_AREA:GRAMICH does exceed WAS_AREA:GRAMICI
!      then a new value is computed for WAS_AREA:GRAMICH assuming that a) the
!      distribution for WAS_AREA:GRAMICH is uniform and b) that the maximum
!      value for the adjusted distribution of WAS_AREA:GRAMICH is the
!      sampled value for WAS_AREA:GRAMICI. A new WAS_AREA:GRAMICH is
generated
!      using the utility LHS_EDIT.EXE by computing the probability of
!      the value on the original range and getting the value associated
!      with that probability on the new range.

!========= No Comments Allowed between *ECHO and *ENDECHO ================
!
*ECHOLHS
TITLE 2000 CRA PA Baseline Calculation, Replicate R2 Input File for the LHS
Code
NOBS            100
RANDOM SEED     168866235
CORRELATION MATRIX
    2
    53   54 -0.99
    61   62 -0.75
OUTPUT CORR HIST DATA
*ENDECHO
!
!== PROPERTIES TO BE RETRIEVED FROM WIPP PA CALCULATION DATABASE ==
!
*RETRIEVE
!1    CCDFGF
      MATERIALS,  GLOBAL
      PROPERTIES, PBRINE
!2
      MATERIALS,  REFCON
```

```
      PROPERTIES, LHSBLANK
!3
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!4    CUTTINGS_S
      MATERIALS,  BOREHOLE
      PROPERTIES, DOMEGA
!5    CUTTINGS_S
      MATERIALS,  BOREHOLE
      PROPERTIES, TAUFAIL
!6
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!7
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!8    DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, REPIPERM
!9    DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, TENSLSTR
!10   DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, PARTDIAM
!11   DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, REPIPOR
!12
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!13
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!14
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!15   PANEL
        MATERIALS,       SOLMOD3
        PROPERTIES,      SOLVAR
!16   PANEL
        MATERIALS,       SOLMOD4
        PROPERTIES,      SOLVAR
!17   PANEL
      MATERIALS,  PHUMOX3
      PROPERTIES, PHUMCIM
!18   PANEL/SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, OXSTAT
!19
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!20
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!21
      MATERIALS,  REFCON
```

```
      PROPERTIES, LHSBLANK
!22
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!23   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, MINP_FAC
!24   SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, TRANSIDX
!25   SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, CLIMTIDX
!26   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, HMBLKLT
!27   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, APOROS
!28   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, DPOROS
!29   SECOTP2D
      MATERIALS,  U+6
      PROPERTIES, MKD_U
!30   SECOTP2D
      MATERIALS,  U+4
      PROPERTIES, MKD_U
!31   SECOTP2D
      MATERIALS,  PU+3
      PROPERTIES, MKD_PU
!32   SECOTP2D
      MATERIALS,  PU+4
      PROPERTIES, MKD_PU
!33   SECOTP2D
      MATERIALS,  TH+4
      PROPERTIES, MKD_TH
!34   SECOTP2D
      MATERIALS,  AM+3
      PROPERTIES, MKD_AM
!35
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!36
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!37
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!38
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!39   BRAGFLO
      MATERIALS,  STEEL
      PROPERTIES, CORRMCO2
!40   BRAGFLO/PANEL
      MATERIALS,  WAS_AREA
```

```
      PROPERTIES, PROBDEG
!41   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, GRATMICI
!42   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, GRATMICH
!43   BRAGFLO
      MATERIALS,  CELLULS
      PROPERTIES, FBETA
!44   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_RGAS
!45   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_RBRN
!46   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_WICK
!47   BRAGFLO
      MATERIALS,  DRZ_PCS
      PROPERTIES, PRMX_LOG
!48   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, PRMX_LOG
!49   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, SAT_RGAS
!50   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, SAT_RBRN
!51   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, PORE_DIS
!52   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, POROSITY
!53   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, PRMX_LOG
!54   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, COMP_RCK
!55   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, PRMX_LOG
!56   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, RELP_MOD
!57   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, SAT_RBRN
!58   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, PORE_DIS
!59   BRAGFLO
      MATERIALS,  S_HALITE
```

```
      PROPERTIES, PRESSURE
!60   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, PRESSURE
!61   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, PRMX_LOG
!62   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, COMP_RCK
!63   BRAGFLO
      MATERIALS,  BH_SAND
      PROPERTIES, PRMX_LOG
!64   BRAGFLO
      MATERIALS,  DRZ_1
      PROPERTIES, PRMX_LOG
!65   BRAGFLO
      MATERIALS,  CONC_PLG
      PROPERTIES, PRMX_LOG
!66   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, SAT_RBRN
!67   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, SAT_RGAS
!68   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, PRMX_LOG
!69   BRAGFLO
      MATERIALS,  SHFTL_T1
      PROPERTIES, PRMX_LOG
!70   BRAGFLO
      MATERIALS,  SHFTL_T2
      PROPERTIES, PRMX_LOG
!71   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, BIOGENFC
!72
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!73
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!74
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!75
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!
!=============================================================================
!
*END
```

Appendix III. Input file to PRELHS for Replicate 3

```
! TITLE:          CRA09  PRELHS (LHS1) Input File
! ANALYSIS PLAN: AP-137
! ANALYST:        Thomas Kirchner
! CREATED:        December 2007
!
!  LHSCALC = CRA09 REALIZATION 3
!=======================================================================
!
!  DESCRIPTION:
!
!  WIPP 2009 Compliance Recertification Application PA
! aka (AP137)
!
!  This input file to PRELHS is used to generate, as an output file, an LHS
!  input file containing all distribution information and execution options
!  required to create a sample for Replicate R3 for the WIPP 2009 CRA
!
!  Changes from CRA1BC analyses:
!      1) a post processing step was added to induce a conditional
relationship
!      between WAS_AREA:GRAMICH and WAS_AREA:GRAMICI. This relationship
ensures
!      that WAS_AREA:GRAMICH never exceeds the value of WAS_AREA:GRAMICI. If
!      the value selected for WAS_AREA:GRAMICH does exceed WAS_AREA:GRAMICI
!      then a new value is computed for WAS_AREA:GRAMICH assuming that a) the
!      distribution for WAS_AREA:GRAMICH is uniform and b) that the maximum
!      value for the adjusted distribution of WAS_AREA:GRAMICH is the
!      sampled value for WAS_AREA:GRAMICI. A new WAS_AREA:GRAMICH is
generated
!      using the utility LHS_EDIT.EXE by computing the probability of
!      the value on the original range and getting the value associated
!      with that probability on the new range.

!========= No Comments Allowed between *ECHO and *ENDECHO ===============
!
*ECHOLHS
TITLE 2009 CRA PA Baseline Calculation, Replicate R3 Input File for the LHS
Code
NOBS            100
RANDOM SEED     292058223
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
*ENDECHO
!
!== PROPERTIES TO BE RETRIEVED FROM WIPP PA CALCULATION DATABASE ==
!
*RETRIEVE
!1    CCDFGF
      MATERIALS,  GLOBAL
      PROPERTIES, PBRINE
!2
```

```
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!3
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!4    CUTTINGS_S
      MATERIALS,  BOREHOLE
      PROPERTIES, DOMEGA
!5    CUTTINGS_S
      MATERIALS,  BOREHOLE
      PROPERTIES, TAUFAIL
!6
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!7
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!8    DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, REPIPERM
!9    DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, TENSLSTR
!10   DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, PARTDIAM
!11   DRSPALL
      MATERIALS,  SPALLMOD
      PROPERTIES, REPIPOR
!12
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!13
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!14
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!15   PANEL
        MATERIALS,       SOLMOD3
        PROPERTIES,      SOLVAR
!16   PANEL
        MATERIALS,       SOLMOD4
        PROPERTIES,      SOLVAR
!17   PANEL
      MATERIALS,  PHUMOX3
      PROPERTIES, PHUMCIM
!18   PANEL/SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, OXSTAT
!19
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!20
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!21
```

```
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!22
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!23   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, MINP_FAC
!24   SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, TRANSIDX
!25   SECOTP2D
      MATERIALS,  GLOBAL
      PROPERTIES, CLIMTIDX
!26   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, HMBLKLT
!27   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, APOROS
!28   SECOTP2D
      MATERIALS,  CULEBRA
      PROPERTIES, DPOROS
!29   SECOTP2D
      MATERIALS,  U+6
      PROPERTIES, MKD_U
!30   SECOTP2D
      MATERIALS,  U+4
      PROPERTIES, MKD_U
!31   SECOTP2D
      MATERIALS,  PU+3
      PROPERTIES, MKD_PU
!32   SECOTP2D
      MATERIALS,  PU+4
      PROPERTIES, MKD_PU
!33   SECOTP2D
      MATERIALS,  TH+4
      PROPERTIES, MKD_TH
!34   SECOTP2D
      MATERIALS,  AM+3
      PROPERTIES, MKD_AM
!35
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!36
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!37
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!38
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!39   BRAGFLO
      MATERIALS,  STEEL
      PROPERTIES, CORRMCO2
!40   BRAGFLO/PANEL
```

```
      MATERIALS,  WAS_AREA
      PROPERTIES, PROBDEG
!41   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, GRATMICI
!42   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, GRATMICH
!43   BRAGFLO
      MATERIALS,  CELLULS
      PROPERTIES, FBETA
!44   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_RGAS
!45   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_RBRN
!46   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, SAT_WICK
!47   BRAGFLO
      MATERIALS,  DRZ_PCS
      PROPERTIES, PRMX_LOG
!48   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, PRMX_LOG
!49   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, SAT_RGAS
!50   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, SAT_RBRN
!51   BRAGFLO
      MATERIALS,  CONC_PCS
      PROPERTIES, PORE_DIS
!52   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, POROSITY
!53   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, PRMX_LOG
!54   BRAGFLO
      MATERIALS,  S_HALITE
      PROPERTIES, COMP_RCK
!55   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, PRMX_LOG
!56   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, RELP_MOD
!57   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, SAT_RBRN
!58   BRAGFLO
      MATERIALS,  S_MB139
      PROPERTIES, PORE_DIS
!59   BRAGFLO
```

```
      MATERIALS,  S_HALITE
      PROPERTIES, PRESSURE
!60   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, PRESSURE
!61   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, PRMX_LOG
!62   BRAGFLO
      MATERIALS,  CASTILER
      PROPERTIES, COMP_RCK
!63   BRAGFLO
      MATERIALS,  BH_SAND
      PROPERTIES, PRMX_LOG
!64   BRAGFLO
      MATERIALS,  DRZ_1
      PROPERTIES, PRMX_LOG
!65   BRAGFLO
      MATERIALS,  CONC_PLG
      PROPERTIES, PRMX_LOG
!66   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, SAT_RBRN
!67   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, SAT_RGAS
!68   BRAGFLO
      MATERIALS,  SHFTU
      PROPERTIES, PRMX_LOG
!69   BRAGFLO
      MATERIALS,  SHFTL_T1
      PROPERTIES, PRMX_LOG
!70   BRAGFLO
      MATERIALS,  SHFTL_T2
      PROPERTIES, PRMX_LOG
!71   BRAGFLO
      MATERIALS,  WAS_AREA
      PROPERTIES, BIOGENFC
!72
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!73
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!74
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!75
      MATERIALS,  REFCON
      PROPERTIES, LHSBLANK
!
!=========================================================================
!
*END
```

Appendix IV. PRELHS Output (Transfer) File for Replicate 1

```
TITLE SDB: PARAMETER_PROD     Calc: CRA09        Ver: 1.00     12/07/07
14:02:51
TITLE 2009 CRA PA Baseline Calculation, Replicate R1 Input File for the LHS
Code
NOBS            100
RANDOM SEED     582592385
UNIFORM                 GLOBAL    PBRINE
    1.00000E-02    6.00000E-01
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)       BOREHOLE  DOMEGA
        10          SPECIFIED    CONTINUOUS
    4.20000E+00   0.15000
    6.30000E+00   0.50000
    8.40000E+00   0.15000
    1.05000E+01   0.10000
    1.26000E+01   0.05000
    1.47000E+01   0.02000
    1.68000E+01   0.01000
    1.88000E+01   0.01000
    2.09000E+01   0.01000
    2.30000E+01   0.00000
LOGUNIFORM              BOREHOLE  TAUFAIL
    5.00000E-02    7.70000E+01
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
LOGUNIFORM              SPALLMOD  REPIPERM
    2.40000E-14    2.40000E-12
UNIFORM                 SPALLMOD  TENSLSTR
    1.20000E+05    1.70000E+05
LOGUNIFORM              SPALLMOD  PARTDIAM
    1.00000E-03    1.00000E-01
UNIFORM                 SPALLMOD  REPIPOR
    3.50000E-01    6.60000E-01
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)       SOLMOD3   SOLVAR
        43          SPECIFIED    CONTINUOUS
   -3.15000E+00   0.00000
   -3.00000E+00   0.00412
   -2.85000E+00   0.00000
   -2.70000E+00   0.00000
   -2.55000E+00   0.00000
   -2.40000E+00   0.00000
   -2.25000E+00   0.00000
   -2.10000E+00   0.00000
   -1.95000E+00   0.00412
```

```
    -1.80000E+00   0.01646
    -1.65000E+00   0.00412
    -1.50000E+00   0.02469
    -1.35000E+00   0.03292
    -1.20000E+00   0.03292
    -1.05000E+00   0.02058
    -9.00000E-01   0.04527
    -7.50000E-01   0.04938
    -6.00000E-01   0.03292
    -4.50000E-01   0.07819
    -3.00000E-01   0.08230
    -1.50000E-01   0.09053
     0.00000E+00   0.06584
     1.50000E-01   0.06584
     3.00000E-01   0.07819
     4.50000E-01   0.02469
     6.00000E-01   0.04115
     7.50000E-01   0.03292
     9.00000E-01   0.02881
     1.05000E+00   0.02881
     1.20000E+00   0.04115
     1.35000E+00   0.02469
     1.50000E+00   0.00823
     1.65000E+00   0.00412
     1.80000E+00   0.01646
     1.95000E+00   0.00000
     2.10000E+00   0.00412
     2.25000E+00   0.00412
     2.40000E+00   0.00823
     2.55000E+00   0.00000
     2.70000E+00   0.00412
     2.85000E+00   0.00000
     3.00000E+00   0.00000
     3.15000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       SOLMOD4   SOLVAR
        33          SPECIFIED    CONTINUOUS
    -2.10000E+00   0.00000
    -1.95000E+00   0.00000
    -1.80000E+00   0.02222
    -1.65000E+00   0.00000
    -1.50000E+00   0.00000
    -1.35000E+00   0.00000
    -1.20000E+00   0.00000
    -1.05000E+00   0.02222
    -9.00000E-01   0.04444
    -7.50000E-01   0.11111
    -6.00000E-01   0.20000
    -4.50000E-01   0.02222
    -3.00000E-01   0.00000
    -1.50000E-01   0.06667
     0.00000E+00   0.02222
     1.50000E-01   0.11111
     3.00000E-01   0.04444
     4.50000E-01   0.02222
     6.00000E-01   0.08889
     7.50000E-01   0.08889
     9.00000E-01   0.04444
```

```
    1.05000E+00   0.00000
    1.20000E+00   0.00000
    1.35000E+00   0.02222
    1.50000E+00   0.00000
    1.65000E+00   0.02222
    1.80000E+00   0.00000
    1.95000E+00   0.02222
    2.10000E+00   0.00000
    2.25000E+00   0.02222
    2.40000E+00   0.00000
    2.55000E+00   0.00000
    2.70000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)        PHUMOX3    PHUMCIM
         3          SPECIFIED    CONTINUOUS
    6.50000E-02   0.50000
    1.37000E+00   0.50000
    1.60000E+00   0.00000
UNIFORM                 GLOBAL    OXSTAT
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 CULEBRA   MINP_FAC
    1.00000E+00    1.00000E+03
UNIFORM                 GLOBAL    TRANSIDX
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)        GLOBAL    CLIMTIDX
         4          SPECIFIED    CONTINUOUS
    1.00000E+00   0.75000
    1.25000E+00   0.00000
    1.50000E+00   0.25000
    2.25000E+00   0.00000
UNIFORM                 CULEBRA   HMBLKLT
    5.00000E-02    5.00000E-01
LOGUNIFORM              CULEBRA   APOROS
    1.00000E-04    1.00000E-02
USER DISTRIBUTION  (CUMULATIVE)        CULEBRA   DPOROS
         7          SPECIFIED    CONTINUOUS
    1.00000E-01   0.10000
    1.10000E-01   0.15000
    1.20000E-01   0.25000
    1.60000E-01   0.25000
    1.80000E-01   0.15000
    1.90000E-01   0.10000
    2.50000E-01   0.00000
LOGUNIFORM              U+6       MKD_U
    3.00000E-05    2.00000E-02
LOGUNIFORM              U+4       MKD_U
    7.00000E-01    1.00000E+01
LOGUNIFORM              PU+3      MKD_PU
    2.00000E-02    4.00000E-01
LOGUNIFORM              PU+4      MKD_PU
```

```
    7.00000E-01    1.00000E+01
LOGUNIFORM              TH+4       MKD_TH
    7.00000E-01    1.00000E+01
LOGUNIFORM              AM+3       MKD_AM
    2.00000E-02    4.00000E-01
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 STEEL      CORRMCO2
    0.00000E+00    3.17000E-14
USER DISTRIBUTION  (DELTA)            WAS_AREA  PROBDEG
         2          SPECIFIED     DISCRETE
    1.00000E+00   0.75000
    2.00000E+00   0.25000
UNIFORM                 WAS_AREA   GRATMICI
    3.08269E-11    5.56921E-10
UNIFORM                 WAS_AREA   GRATMICH
    0.00000E+00    1.02717E-09
UNIFORM                 CELLULS    FBETA
    0.00000E+00    1.00000E+00
UNIFORM                 WAS_AREA   SAT_RGAS
    0.00000E+00    1.50000E-01
UNIFORM                 WAS_AREA   SAT_RBRN
    0.00000E+00    5.52000E-01
UNIFORM                 WAS_AREA   SAT_WICK
    0.00000E+00    1.00000E+00
TRIANGULAR              DRZ_PCS    PRMX_LOG
   -2.06990E+01   -1.87496E+01   -1.70000E+01
TRIANGULAR              CONC_PCS   PRMX_LOG
   -2.06990E+01   -1.87496E+01   -1.70000E+01
UNIFORM                 CONC_PCS   SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       CONC_PCS  SAT_RBRN
         3          SPECIFIED     CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
USER DISTRIBUTION  (CUMULATIVE)       CONC_PCS  PORE_DIS
         3          SPECIFIED     CONTINUOUS
    1.10000E-01   0.50000
    9.40000E-01   0.50000
    8.10000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       S_HALITE  POROSITY
         3          SPECIFIED     CONTINUOUS
    1.00000E-03   0.50000
    1.00000E-02   0.50000
    5.19000E-02   0.00000
UNIFORM                 S_HALITE   PRMX_LOG
   -2.40000E+01   -2.10000E+01
UNIFORM                 S_HALITE   COMP_RCK
    2.94000E-12    1.92000E-10
STUDENT                 S_MB139    PRMX_LOG
```

```
         6
 -2.10000E+01 -1.92000E+01 -1.91000E+01 -1.88000E+01 -1.81000E+01 -
1.71000E+01
USER DISTRIBUTION  (DELTA)           S_MB139   RELP_MOD
         4          SPECIFIED    DISCRETE
    1.00000E+00   0.50000
    2.00000E+00   0.00000
    3.00000E+00   0.00000
    4.00000E+00   0.50000
STUDENT                 S_MB139   SAT_RBRN
         6
  7.78460E-03  6.88420E-02  6.98600E-02  7.26200E-02  1.08610E-01  1.74010E-
01
STUDENT                 S_MB139   PORE_DIS
         6
  4.90530E-01  5.57750E-01  6.52000E-01  6.55000E-01  6.64520E-01  8.41780E-
01
UNIFORM                 S_HALITE  PRESSURE
    1.10400E+07    1.38900E+07
TRIANGULAR              CASTILER  PRESSURE
    1.11000E+07    1.27000E+07    1.70000E+07
TRIANGULAR              CASTILER  PRMX_LOG
   -1.47000E+01   -1.18000E+01   -9.80000E+00
TRIANGULAR              CASTILER  COMP_RCK
    2.00000E-11    4.00000E-11    1.00000E-10
UNIFORM                 BH_SAND   PRMX_LOG
   -1.63000E+01   -1.10000E+01
UNIFORM                 DRZ_1     PRMX_LOG
   -1.94000E+01   -1.25000E+01
UNIFORM                 CONC_PLG  PRMX_LOG
   -1.90000E+01   -1.70000E+01
USER DISTRIBUTION  (CUMULATIVE)       SHFTU     SAT_RBRN
         3          SPECIFIED    CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
UNIFORM                 SHFTU     SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       SHFTU     PRMX_LOG
         9          SPECIFIED    CONTINUOUS
   -2.05000E+01   0.03000
   -2.00000E+01   0.08000
   -1.95000E+01   0.13000
   -1.90000E+01   0.19000
   -1.85000E+01   0.22000
   -1.80000E+01   0.24000
   -1.75000E+01   0.10000
   -1.70000E+01   0.01000
   -1.65000E+01   0.00000
USER DISTRIBUTION  (CUMULATIVE)       SHFTL_T1  PRMX_LOG
         8          SPECIFIED    CONTINUOUS
   -2.00000E+01   0.01000
   -1.95000E+01   0.09000
   -1.90000E+01   0.20700
   -1.85000E+01   0.33000
   -1.80000E+01   0.23600
   -1.75000E+01   0.12000
```

```
   -1.70000E+01   0.00700
   -1.65000E+01   0.00000
USER DISTRIBUTION  (CUMULATIVE)        SHFTL_T2  PRMX_LOG
        10          SPECIFIED     CONTINUOUS
   -2.25000E+01   0.02000
   -2.20000E+01   0.06000
   -2.15000E+01   0.09000
   -2.10000E+01   0.13500
   -2.05000E+01   0.22000
   -2.00000E+01   0.17500
   -1.95000E+01   0.16500
   -1.90000E+01   0.10000
   -1.85000E+01   0.03500
   -1.80000E+01   0.00000
UNIFORM                 WAS_AREA  BIOGENFC
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
TITLE SDB: PARAMETER_PROD     Calc: CRA09        Ver: 1.00     12/07/07
14:02:51
```

Appendix V. PRELHS Output (Transfer) File for Replicate 2

```
TITLE SDB: PARAMETER_PROD     Calc: CRA09        Ver: 1.00     12/07/07
14:03:23
TITLE 2009 CRA PA Baseline Calculation, Replicate R2 Input File for the LHS
Code
NOBS            100
RANDOM SEED     168866235
UNIFORM                  GLOBAL     PBRINE
    1.00000E-02    6.00000E-01
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)       BOREHOLE  DOMEGA
        10          SPECIFIED     CONTINUOUS
    4.20000E+00   0.15000
    6.30000E+00   0.50000
    8.40000E+00   0.15000
    1.05000E+01   0.10000
    1.26000E+01   0.05000
    1.47000E+01   0.02000
    1.68000E+01   0.01000
    1.88000E+01   0.01000
    2.09000E+01   0.01000
    2.30000E+01   0.00000
LOGUNIFORM               BOREHOLE   TAUFAIL
    5.00000E-02    7.70000E+01
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
LOGUNIFORM               SPALLMOD   REPIPERM
    2.40000E-14    2.40000E-12
UNIFORM                  SPALLMOD   TENSLSTR
    1.20000E+05    1.70000E+05
LOGUNIFORM               SPALLMOD   PARTDIAM
    1.00000E-03    1.00000E-01
UNIFORM                  SPALLMOD   REPIPOR
    3.50000E-01    6.60000E-01
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                  REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)       SOLMOD3   SOLVAR
        43          SPECIFIED     CONTINUOUS
   -3.15000E+00   0.00000
   -3.00000E+00   0.00412
   -2.85000E+00   0.00000
   -2.70000E+00   0.00000
   -2.55000E+00   0.00000
   -2.40000E+00   0.00000
   -2.25000E+00   0.00000
   -2.10000E+00   0.00000
```

```
   -1.95000E+00   0.00412
   -1.80000E+00   0.01646
   -1.65000E+00   0.00412
   -1.50000E+00   0.02469
   -1.35000E+00   0.03292
   -1.20000E+00   0.03292
   -1.05000E+00   0.02058
   -9.00000E-01   0.04527
   -7.50000E-01   0.04938
   -6.00000E-01   0.03292
   -4.50000E-01   0.07819
   -3.00000E-01   0.08230
   -1.50000E-01   0.09053
    0.00000E+00   0.06584
    1.50000E-01   0.06584
    3.00000E-01   0.07819
    4.50000E-01   0.02469
    6.00000E-01   0.04115
    7.50000E-01   0.03292
    9.00000E-01   0.02881
    1.05000E+00   0.02881
    1.20000E+00   0.04115
    1.35000E+00   0.02469
    1.50000E+00   0.00823
    1.65000E+00   0.00412
    1.80000E+00   0.01646
    1.95000E+00   0.00000
    2.10000E+00   0.00412
    2.25000E+00   0.00412
    2.40000E+00   0.00823
    2.55000E+00   0.00000
    2.70000E+00   0.00412
    2.85000E+00   0.00000
    3.00000E+00   0.00000
    3.15000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       SOLMOD4   SOLVAR
        33          SPECIFIED    CONTINUOUS
   -2.10000E+00   0.00000
   -1.95000E+00   0.00000
   -1.80000E+00   0.02222
   -1.65000E+00   0.00000
   -1.50000E+00   0.00000
   -1.35000E+00   0.00000
   -1.20000E+00   0.00000
   -1.05000E+00   0.02222
   -9.00000E-01   0.04444
   -7.50000E-01   0.11111
   -6.00000E-01   0.20000
   -4.50000E-01   0.02222
   -3.00000E-01   0.00000
   -1.50000E-01   0.06667
    0.00000E+00   0.02222
    1.50000E-01   0.11111
    3.00000E-01   0.04444
    4.50000E-01   0.02222
    6.00000E-01   0.08889
    7.50000E-01   0.08889
```

```
    9.00000E-01   0.04444
    1.05000E+00   0.00000
    1.20000E+00   0.00000
    1.35000E+00   0.02222
    1.50000E+00   0.00000
    1.65000E+00   0.02222
    1.80000E+00   0.00000
    1.95000E+00   0.02222
    2.10000E+00   0.00000
    2.25000E+00   0.02222
    2.40000E+00   0.00000
    2.55000E+00   0.00000
    2.70000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)        PHUMOX3    PHUMCIM
         3          SPECIFIED     CONTINUOUS
    6.50000E-02   0.50000
    1.37000E+00   0.50000
    1.60000E+00   0.00000
UNIFORM                 GLOBAL     OXSTAT
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 CULEBRA    MINP_FAC
    1.00000E+00    1.00000E+03
UNIFORM                 GLOBAL     TRANSIDX
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)        GLOBAL     CLIMTIDX
         4          SPECIFIED     CONTINUOUS
    1.00000E+00   0.75000
    1.25000E+00   0.00000
    1.50000E+00   0.25000
    2.25000E+00   0.00000
UNIFORM                 CULEBRA    HMBLKLT
    5.00000E-02    5.00000E-01
LOGUNIFORM              CULEBRA    APOROS
    1.00000E-04    1.00000E-02
USER DISTRIBUTION  (CUMULATIVE)        CULEBRA    DPOROS
         7          SPECIFIED     CONTINUOUS
    1.00000E-01   0.10000
    1.10000E-01   0.15000
    1.20000E-01   0.25000
    1.60000E-01   0.25000
    1.80000E-01   0.15000
    1.90000E-01   0.10000
    2.50000E-01   0.00000
LOGUNIFORM              U+6        MKD_U
    3.00000E-05    2.00000E-02
LOGUNIFORM              U+4        MKD_U
    7.00000E-01    1.00000E+01
LOGUNIFORM              PU+3       MKD_PU
    2.00000E-02    4.00000E-01
```

```
LOGUNIFORM                PU+4       MKD_PU
    7.00000E-01    1.00000E+01
LOGUNIFORM                TH+4       MKD_TH
    7.00000E-01    1.00000E+01
LOGUNIFORM                AM+3       MKD_AM
    2.00000E-02    4.00000E-01
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   STEEL      CORRMCO2
    0.00000E+00    3.17000E-14
USER DISTRIBUTION  (DELTA)            WAS_AREA  PROBDEG
         2          SPECIFIED     DISCRETE
    1.00000E+00   0.75000
    2.00000E+00   0.25000
UNIFORM                   WAS_AREA   GRATMICI
    3.08269E-11    5.56921E-10
UNIFORM                   WAS_AREA   GRATMICH
    0.00000E+00    1.02717E-09
UNIFORM                   CELLULS    FBETA
    0.00000E+00    1.00000E+00
UNIFORM                   WAS_AREA   SAT_RGAS
    0.00000E+00    1.50000E-01
UNIFORM                   WAS_AREA   SAT_RBRN
    0.00000E+00    5.52000E-01
UNIFORM                   WAS_AREA   SAT_WICK
    0.00000E+00    1.00000E+00
TRIANGULAR                DRZ_PCS    PRMX_LOG
   -2.06990E+01   -1.87496E+01   -1.70000E+01
TRIANGULAR                CONC_PCS   PRMX_LOG
   -2.06990E+01   -1.87496E+01   -1.70000E+01
UNIFORM                   CONC_PCS   SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       CONC_PCS  SAT_RBRN
         3          SPECIFIED     CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
USER DISTRIBUTION  (CUMULATIVE)       CONC_PCS  PORE_DIS
         3          SPECIFIED     CONTINUOUS
    1.10000E-01   0.50000
    9.40000E-01   0.50000
    8.10000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       S_HALITE  POROSITY
         3          SPECIFIED     CONTINUOUS
    1.00000E-03   0.50000
    1.00000E-02   0.50000
    5.19000E-02   0.00000
UNIFORM                   S_HALITE   PRMX_LOG
   -2.40000E+01   -2.10000E+01
UNIFORM                   S_HALITE   COMP_RCK
    2.94000E-12    1.92000E-10
```

```
STUDENT                 S_MB139   PRMX_LOG
         6
 -2.10000E+01 -1.92000E+01 -1.91000E+01 -1.88000E+01 -1.81000E+01 -
1.71000E+01
USER DISTRIBUTION  (DELTA)           S_MB139   RELP_MOD
         4          SPECIFIED    DISCRETE
    1.00000E+00   0.50000
    2.00000E+00   0.00000
    3.00000E+00   0.00000
    4.00000E+00   0.50000
STUDENT                 S_MB139   SAT_RBRN
         6
  7.78460E-03  6.88420E-02  6.98600E-02  7.26200E-02  1.08610E-01  1.74010E-
01
STUDENT                 S_MB139   PORE_DIS
         6
  4.90530E-01  5.57750E-01  6.52000E-01  6.55000E-01  6.64520E-01  8.41780E-
01
UNIFORM                 S_HALITE  PRESSURE
    1.10400E+07    1.38900E+07
TRIANGULAR              CASTILER  PRESSURE
    1.11000E+07    1.27000E+07    1.70000E+07
TRIANGULAR              CASTILER  PRMX_LOG
   -1.47000E+01   -1.18000E+01   -9.80000E+00
TRIANGULAR              CASTILER  COMP_RCK
    2.00000E-11    4.00000E-11    1.00000E-10
UNIFORM                 BH_SAND   PRMX_LOG
   -1.63000E+01   -1.10000E+01
UNIFORM                 DRZ_1     PRMX_LOG
   -1.94000E+01   -1.25000E+01
UNIFORM                 CONC_PLG  PRMX_LOG
   -1.90000E+01   -1.70000E+01
USER DISTRIBUTION  (CUMULATIVE)      SHFTU     SAT_RBRN
         3          SPECIFIED    CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
UNIFORM                 SHFTU     SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)      SHFTU     PRMX_LOG
         9          SPECIFIED    CONTINUOUS
   -2.05000E+01   0.03000
   -2.00000E+01   0.08000
   -1.95000E+01   0.13000
   -1.90000E+01   0.19000
   -1.85000E+01   0.22000
   -1.80000E+01   0.24000
   -1.75000E+01   0.10000
   -1.70000E+01   0.01000
   -1.65000E+01   0.00000
USER DISTRIBUTION  (CUMULATIVE)      SHFTL_T1  PRMX_LOG
         8          SPECIFIED    CONTINUOUS
   -2.00000E+01   0.01000
   -1.95000E+01   0.09000
   -1.90000E+01   0.20700
   -1.85000E+01   0.33000
   -1.80000E+01   0.23600
```

```
   -1.75000E+01   0.12000
   -1.70000E+01   0.00700
   -1.65000E+01   0.00000
USER DISTRIBUTION  (CUMULATIVE)        SHFTL_T2  PRMX_LOG
        10          SPECIFIED     CONTINUOUS
   -2.25000E+01   0.02000
   -2.20000E+01   0.06000
   -2.15000E+01   0.09000
   -2.10000E+01   0.13500
   -2.05000E+01   0.22000
   -2.00000E+01   0.17500
   -1.95000E+01   0.16500
   -1.90000E+01   0.10000
   -1.85000E+01   0.03500
   -1.80000E+01   0.00000
UNIFORM                 WAS_AREA  BIOGENFC
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
TITLE SDB: PARAMETER_PROD     Calc: CRA09        Ver: 1.00     12/07/07
14:03:23
```

Appendix VI. PRELHS Output (Transfer) File for Replicate 3

```
TITLE SDB: PARAMETER_PROD     Calc: CRA09        Ver: 1.00     12/07/07
14:04:01
TITLE 2009 CRA PA Baseline Calculation, Replicate R3 Input File for the LHS
Code
NOBS            100
RANDOM SEED     292058223
UNIFORM                  GLOBAL     PBRINE
     1.00000E-02     6.00000E-01
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
USER DISTRIBUTION   (CUMULATIVE)        BOREHOLE   DOMEGA
         10           SPECIFIED     CONTINUOUS
     4.20000E+00    0.15000
     6.30000E+00    0.50000
     8.40000E+00    0.15000
     1.05000E+01    0.10000
     1.26000E+01    0.05000
     1.47000E+01    0.02000
     1.68000E+01    0.01000
     1.88000E+01    0.01000
     2.09000E+01    0.01000
     2.30000E+01    0.00000
LOGUNIFORM               BOREHOLE   TAUFAIL
     5.00000E-02     7.70000E+01
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
LOGUNIFORM               SPALLMOD   REPIPERM
     2.40000E-14     2.40000E-12
UNIFORM                  SPALLMOD   TENSLSTR
     1.20000E+05     1.70000E+05
LOGUNIFORM               SPALLMOD   PARTDIAM
     1.00000E-03     1.00000E-01
UNIFORM                  SPALLMOD   REPIPOR
     3.50000E-01     6.60000E-01
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
UNIFORM                  REFCON     LHSBLANK
     0.00000E+00     1.00000E+00
USER DISTRIBUTION   (CUMULATIVE)        SOLMOD3    SOLVAR
         43           SPECIFIED     CONTINUOUS
    -3.15000E+00    0.00000
    -3.00000E+00    0.00412
    -2.85000E+00    0.00000
    -2.70000E+00    0.00000
    -2.55000E+00    0.00000
    -2.40000E+00    0.00000
    -2.25000E+00    0.00000
    -2.10000E+00    0.00000
```

```
   -1.95000E+00   0.00412
   -1.80000E+00   0.01646
   -1.65000E+00   0.00412
   -1.50000E+00   0.02469
   -1.35000E+00   0.03292
   -1.20000E+00   0.03292
   -1.05000E+00   0.02058
   -9.00000E-01   0.04527
   -7.50000E-01   0.04938
   -6.00000E-01   0.03292
   -4.50000E-01   0.07819
   -3.00000E-01   0.08230
   -1.50000E-01   0.09053
    0.00000E+00   0.06584
    1.50000E-01   0.06584
    3.00000E-01   0.07819
    4.50000E-01   0.02469
    6.00000E-01   0.04115
    7.50000E-01   0.03292
    9.00000E-01   0.02881
    1.05000E+00   0.02881
    1.20000E+00   0.04115
    1.35000E+00   0.02469
    1.50000E+00   0.00823
    1.65000E+00   0.00412
    1.80000E+00   0.01646
    1.95000E+00   0.00000
    2.10000E+00   0.00412
    2.25000E+00   0.00412
    2.40000E+00   0.00823
    2.55000E+00   0.00000
    2.70000E+00   0.00412
    2.85000E+00   0.00000
    3.00000E+00   0.00000
    3.15000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       SOLMOD4   SOLVAR
       33           SPECIFIED    CONTINUOUS
   -2.10000E+00   0.00000
   -1.95000E+00   0.00000
   -1.80000E+00   0.02222
   -1.65000E+00   0.00000
   -1.50000E+00   0.00000
   -1.35000E+00   0.00000
   -1.20000E+00   0.00000
   -1.05000E+00   0.02222
   -9.00000E-01   0.04444
   -7.50000E-01   0.11111
   -6.00000E-01   0.20000
   -4.50000E-01   0.02222
   -3.00000E-01   0.00000
   -1.50000E-01   0.06667
    0.00000E+00   0.02222
    1.50000E-01   0.11111
    3.00000E-01   0.04444
    4.50000E-01   0.02222
    6.00000E-01   0.08889
    7.50000E-01   0.08889
```

```
    9.00000E-01   0.04444
    1.05000E+00   0.00000
    1.20000E+00   0.00000
    1.35000E+00   0.02222
    1.50000E+00   0.00000
    1.65000E+00   0.02222
    1.80000E+00   0.00000
    1.95000E+00   0.02222
    2.10000E+00   0.00000
    2.25000E+00   0.02222
    2.40000E+00   0.00000
    2.55000E+00   0.00000
    2.70000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       PHUMOX3    PHUMCIM
         3          SPECIFIED    CONTINUOUS
    6.50000E-02   0.50000
    1.37000E+00   0.50000
    1.60000E+00   0.00000
UNIFORM                GLOBAL    OXSTAT
    0.00000E+00    1.00000E+00
UNIFORM                REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                CULEBRA   MINP_FAC
    1.00000E+00    1.00000E+03
UNIFORM                GLOBAL    TRANSIDX
    0.00000E+00    1.00000E+00
USER DISTRIBUTION  (CUMULATIVE)       GLOBAL    CLIMTIDX
         4          SPECIFIED    CONTINUOUS
    1.00000E+00   0.75000
    1.25000E+00   0.00000
    1.50000E+00   0.25000
    2.25000E+00   0.00000
UNIFORM                CULEBRA   HMBLKLT
    5.00000E-02    5.00000E-01
LOGUNIFORM             CULEBRA   APOROS
    1.00000E-04    1.00000E-02
USER DISTRIBUTION  (CUMULATIVE)       CULEBRA   DPOROS
         7          SPECIFIED    CONTINUOUS
    1.00000E-01   0.10000
    1.10000E-01   0.15000
    1.20000E-01   0.25000
    1.60000E-01   0.25000
    1.80000E-01   0.15000
    1.90000E-01   0.10000
    2.50000E-01   0.00000
LOGUNIFORM             U+6       MKD_U
    3.00000E-05    2.00000E-02
LOGUNIFORM             U+4       MKD_U
    7.00000E-01    1.00000E+01
LOGUNIFORM             PU+3      MKD_PU
    2.00000E-02    4.00000E-01
```

```
LOGUNIFORM                PU+4       MKD_PU
    7.00000E-01    1.00000E+01
LOGUNIFORM                TH+4       MKD_TH
    7.00000E-01    1.00000E+01
LOGUNIFORM                AM+3       MKD_AM
    2.00000E-02    4.00000E-01
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   REFCON     LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                   STEEL      CORRMCO2
    0.00000E+00    3.17000E-14
USER DISTRIBUTION  (DELTA)             WAS_AREA   PROBDEG
         2           SPECIFIED      DISCRETE
    1.00000E+00   0.75000
    2.00000E+00   0.25000
UNIFORM                   WAS_AREA   GRATMICI
    3.08269E-11    5.56921E-10
UNIFORM                   WAS_AREA   GRATMICH
    0.00000E+00    1.02717E-09
UNIFORM                   CELLULS    FBETA
    0.00000E+00    1.00000E+00
UNIFORM                   WAS_AREA   SAT_RGAS
    0.00000E+00    1.50000E-01
UNIFORM                   WAS_AREA   SAT_RBRN
    0.00000E+00    5.52000E-01
UNIFORM                   WAS_AREA   SAT_WICK
    0.00000E+00    1.00000E+00
TRIANGULAR                DRZ_PCS    PRMX_LOG
   -2.06990E+01   -1.87496E+01   -1.70000E+01
TRIANGULAR                CONC_PCS   PRMX_LOG
   -2.06990E+01   -1.87496E+01   -1.70000E+01
UNIFORM                   CONC_PCS   SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)        CONC_PCS   SAT_RBRN
         3           SPECIFIED      CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
USER DISTRIBUTION  (CUMULATIVE)        CONC_PCS   PORE_DIS
         3           SPECIFIED      CONTINUOUS
    1.10000E-01   0.50000
    9.40000E-01   0.50000
    8.10000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)        S_HALITE   POROSITY
         3           SPECIFIED      CONTINUOUS
    1.00000E-03   0.50000
    1.00000E-02   0.50000
    5.19000E-02   0.00000
UNIFORM                   S_HALITE   PRMX_LOG
   -2.40000E+01   -2.10000E+01
UNIFORM                   S_HALITE   COMP_RCK
    2.94000E-12    1.92000E-10
```

```
STUDENT                  S_MB139    PRMX_LOG
         6
 -2.10000E+01 -1.92000E+01 -1.91000E+01 -1.88000E+01 -1.81000E+01 -
1.71000E+01
USER DISTRIBUTION  (DELTA)            S_MB139    RELP_MOD
         4           SPECIFIED     DISCRETE
    1.00000E+00    0.50000
    2.00000E+00    0.00000
    3.00000E+00    0.00000
    4.00000E+00    0.50000
STUDENT                  S_MB139    SAT_RBRN
         6
  7.78460E-03  6.88420E-02  6.98600E-02  7.26200E-02  1.08610E-01  1.74010E-
01
STUDENT                  S_MB139    PORE_DIS
         6
  4.90530E-01  5.57750E-01  6.52000E-01  6.55000E-01  6.64520E-01  8.41780E-
01
UNIFORM                  S_HALITE   PRESSURE
    1.10400E+07    1.38900E+07
TRIANGULAR               CASTILER   PRESSURE
    1.11000E+07    1.27000E+07    1.70000E+07
TRIANGULAR               CASTILER   PRMX_LOG
   -1.47000E+01   -1.18000E+01   -9.80000E+00
TRIANGULAR               CASTILER   COMP_RCK
    2.00000E-11    4.00000E-11    1.00000E-10
UNIFORM                  BH_SAND    PRMX_LOG
   -1.63000E+01   -1.10000E+01
UNIFORM                  DRZ_1      PRMX_LOG
   -1.94000E+01   -1.25000E+01
UNIFORM                  CONC_PLG   PRMX_LOG
   -1.90000E+01   -1.70000E+01
USER DISTRIBUTION  (CUMULATIVE)       SHFTU      SAT_RBRN
         3           SPECIFIED     CONTINUOUS
    0.00000E+00    0.50000
    2.00000E-01    0.50000
    6.00000E-01    0.00000
UNIFORM                  SHFTU      SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       SHFTU      PRMX_LOG
         9           SPECIFIED     CONTINUOUS
   -2.05000E+01    0.03000
   -2.00000E+01    0.08000
   -1.95000E+01    0.13000
   -1.90000E+01    0.19000
   -1.85000E+01    0.22000
   -1.80000E+01    0.24000
   -1.75000E+01    0.10000
   -1.70000E+01    0.01000
   -1.65000E+01    0.00000
USER DISTRIBUTION  (CUMULATIVE)       SHFTL_T1   PRMX_LOG
         8           SPECIFIED     CONTINUOUS
   -2.00000E+01    0.01000
   -1.95000E+01    0.09000
   -1.90000E+01    0.20700
   -1.85000E+01    0.33000
   -1.80000E+01    0.23600
```

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   -1.75000E+01   0.12000
   -1.70000E+01   0.00700
   -1.65000E+01   0.00000
USER DISTRIBUTION  (CUMULATIVE)        SHFTL_T2  PRMX_LOG
        10          SPECIFIED    CONTINUOUS
   -2.25000E+01   0.02000
   -2.20000E+01   0.06000
   -2.15000E+01   0.09000
   -2.10000E+01   0.13500
   -2.05000E+01   0.22000
   -2.00000E+01   0.17500
   -1.95000E+01   0.16500
   -1.90000E+01   0.10000
   -1.85000E+01   0.03500
   -1.80000E+01   0.00000
UNIFORM                 WAS_AREA  BIOGENFC
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
UNIFORM                 REFCON    LHSBLANK
    0.00000E+00    1.00000E+00
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
TITLE SDB: PARAMETER_PROD     Calc: CRA09        Ver: 1.00     12/07/07
14:04:01
```

Appendix VII. Parameter Ranges for AP137 (conditional)

Parameter CRA09

Material Property	*Parameter*	*Replicate*	*Minimum*	*Maximum*	*Mean*
AM+3					
MKD_AM	*CMKDAM3*				
		1	2.01E-02	3.98E-01	1.2677E-01
		2	2.05E-02	3.92E-01	1.2697E-01
		3	2.06E-02	3.95E-01	1.2672E-01
BH_SAND					
PRMX_LOG	*BHPERM*				
		1	-1.63E+01	-1.10E+01	-1.3648E+01
		2	-1.63E+01	-1.10E+01	-1.3649E+01
		3	-1.63E+01	-1.10E+01	-1.3648E+01
BOREHOLE					
DOMEGA	*DOMEGA*				
		1	4.34E+00	2.16E+01	8.6253E+00
		2	4.27E+00	2.27E+01	8.6183E+00
		3	4.27E+00	2.30E+01	8.6407E+00
TAUFAIL	*WTAUFAIL*				
		1	5.00E-02	7.67E+01	1.0500E+01
		2	5.10E-02	7.22E+01	1.0427E+01
		3	5.12E-02	7.50E+01	1.0521E+01
CASTILER					
COMP_RCK	*BPCOMP*				
		1	2.07E-11	9.36E-11	5.3286E-11
		2	2.28E-11	9.48E-11	5.3349E-11
		3	2.14E-11	9.49E-11	5.3273E-11
PRESSURE	*BPINTPRS*				
		1	1.12E+07	1.65E+07	1.3595E+07
		2	1.14E+07	1.67E+07	1.3606E+07
		3	1.14E+07	1.69E+07	1.3602E+07

Material Property	Parameter Replicate	Minimum	Maximum	Mean
PRMX_LOG	*BPPRM*			
	1	-1.45E+01	-9.94E+00	-1.2099E+01
	2	-1.45E+01	-1.01E+01	-1.2101E+01
	3	-1.44E+01	-9.89E+00	-1.2096E+01
CELLULS				
FBETA	*WFBETCEL*			
	1	1.03E-03	1.00E+00	5.0032E-01
	2	9.13E-03	9.92E-01	4.9969E-01
	3	1.65E-03	9.98E-01	4.9969E-01
CONC_PCS				
PORE_DIS	*CONBCEXP*			
	1	1.20E-01	8.06E+00	2.5202E+00
	2	1.10E-01	8.02E+00	2.5170E+00
	3	1.26E-01	8.06E+00	2.5231E+00
SAT_RBRN	*CONBRSAT*			
	1	1.96E-03	5.95E-01	2.5009E-01
	2	6.93E-04	5.95E-01	2.4978E-01
	3	2.91E-03	5.94E-01	2.5013E-01
SAT_RGAS	*CONGSSAT*			
	1	9.61E-04	3.98E-01	2.0010E-01
	2	2.78E-03	3.99E-01	2.0019E-01
	3	5.95E-04	3.99E-01	1.9982E-01
PRMX_LOG	*CONPRM*			
	1	-2.05E+01	-1.72E+01	-1.8817E+01
	2	-2.07E+01	-1.72E+01	-1.8819E+01
	3	-2.05E+01	-1.72E+01	-1.8816E+01
CONC_PLG				
PRMX_LOG	*PLGPRM*			
	1	-1.90E+01	-1.70E+01	-1.8001E+01
	2	-1.90E+01	-1.70E+01	-1.8000E+01
	3	-1.90E+01	-1.70E+01	-1.7999E+01

Material / *Property*	*Parameter* / *Replicate*	*Minimum*	*Maximum*	*Mean*
CULEBRA				
APOROS	*CFRACPOR*			
	1	1.01E-04	9.82E-03	2.1380E-03
	2	1.02E-04	9.58E-03	2.1522E-03
	3	1.01E-04	9.70E-03	2.1448E-03
HMBLKLT	*CFRACSP*			
	1	5.26E-02	4.99E-01	2.7524E-01
	2	5.39E-02	4.96E-01	2.7502E-01
	3	5.41E-02	4.96E-01	2.7484E-01
DPOROS	*CMTRXPOR*			
	1	1.00E-01	2.46E-01	1.5495E-01
	2	1.00E-01	2.48E-01	1.5499E-01
	3	1.00E-01	2.49E-01	1.5498E-01
MINP_FAC	*CTRANSFM*			
	1	1.02E+00	9.95E+02	5.0069E+02
	2	5.56E+00	9.96E+02	5.0051E+02
	3	4.34E+00	9.92E+02	5.0036E+02
DRZ_1				
PRMX_LOG	*DRZPRM*			
	1	-1.94E+01	-1.25E+01	-1.5949E+01
	2	-1.94E+01	-1.26E+01	-1.5951E+01
	3	-1.93E+01	-1.26E+01	-1.5948E+01
DRZ_PCS				
PRMX_LOG	*DRZPCPRM*			
	1	-2.05E+01	-1.72E+01	-1.8815E+01
	2	-2.06E+01	-1.72E+01	-1.8819E+01
	3	-2.06E+01	-1.72E+01	-1.8816E+01
GLOBAL				
PBRINE	*BPPROB*			
	1	1.53E-02	5.98E-01	3.0496E-01
	2	1.36E-02	5.97E-01	3.0508E-01

Material / *Property*	*Parameter* / *Replicate*	*Minimum*	*Maximum*	*Mean*
	3	1.41E-02	5.95E-01	3.0522E-01
CLIMTIDX	*CCLIMSF*			
	1	1.00E+00	2.23E+00	1.3121E+00
	2	1.00E+00	2.25E+00	1.3128E+00
	3	1.00E+00	2.24E+00	1.3121E+00
TRANSIDX	*CTRAN*			
	1	7.95E-03	9.98E-01	4.9977E-01
	2	6.83E-03	9.92E-01	4.9963E-01
	3	6.61E-03	9.92E-01	5.0027E-01
OXSTAT	*WOXSTAT*			
	1	4.38E-03	9.95E-01	5.0010E-01
	2	7.89E-03	9.92E-01	5.0070E-01
	3	8.11E-04	9.94E-01	5.0016E-01
PHUMOX3				
PHUMCIM	*WPHUMOX3*			
	1	8.48E-02	1.60E+00	1.1019E+00
	2	7.88E-02	1.60E+00	1.1012E+00
	3	9.04E-02	1.60E+00	1.1012E+00
PU+3				
MKD_PU	*CMKDPU3*			
	1	2.00E-02	3.97E-01	1.2690E-01
	2	2.02E-02	3.97E-01	1.2688E-01
	3	2.01E-02	4.00E-01	1.2681E-01
PU+4				
MKD_PU	*CMKDPU4*			
	1	7.07E-01	9.92E+00	3.4975E+00
	2	7.08E-01	9.88E+00	3.4994E+00
	3	7.14E-01	9.90E+00	3.4992E+00
S_HALITE				
COMP_RCK	*HALCROCK*			
	1	3.77E-12	1.92E-10	9.7462E-11

Material Property	Parameter Replicate	Minimum	Maximum	Mean
	2	3.20E-12	1.90E-10	9.7516E-11
	3	3.46E-12	1.91E-10	9.7436E-11
POROSITY	*HALPOR*			
	1	1.13E-03	5.12E-02	1.8230E-02
	2	1.05E-03	5.12E-02	1.8224E-02
	3	1.11E-03	5.16E-02	1.8243E-02
PRMX_LOG	*HALPRM*			
	1	-2.40E+01	-2.10E+01	-2.2499E+01
	2	-2.40E+01	-2.10E+01	-2.2500E+01
	3	-2.40E+01	-2.10E+01	-2.2502E+01
PRESSURE	*SALPRES*			
	1	1.11E+07	1.39E+07	1.2465E+07
	2	1.11E+07	1.39E+07	1.2464E+07
	3	1.11E+07	1.39E+07	1.2466E+07
S_MB139				
PORE_DIS	*ANHBCEXP*			
	1	4.99E-01	8.02E-01	6.4383E-01
	2	5.00E-01	7.99E-01	6.4367E-01
	3	5.03E-01	7.95E-01	6.4362E-01
RELP_MOD	*ANHBCVGP*			
	1	1.00E+00	4.00E+00	2.5000E+00
	2	1.00E+00	4.00E+00	2.5000E+00
	3	1.00E+00	4.00E+00	2.5000E+00
PRMX_LOG	*ANHPRM*			
	1	-2.04E+01	-1.71E+01	-1.8880E+01
	2	-2.07E+01	-1.72E+01	-1.8883E+01
	3	-2.04E+01	-1.73E+01	-1.8884E+01
SAT_RBRN	*ANRBRSAT*			
	1	1.50E-02	1.57E-01	8.3627E-02
	2	2.13E-02	1.57E-01	8.3789E-02
	3	2.14E-02	1.46E-01	8.3763E-02

Material Property	Parameter / Replicate	Minimum	Maximum	Mean
SHFTL_T1				
PRMX_LOG	*SHLPRM2*			
	1	-2.00E+01	-1.69E+01	-1.8214E+01
	2	-1.99E+01	-1.70E+01	-1.8214E+01
	3	-1.96E+01	-1.70E+01	-1.8210E+01
SHFTL_T2				
PRMX_LOG	*SHLPRM3*			
	1	-2.24E+01	-1.80E+01	-2.0063E+01
	2	-2.23E+01	-1.81E+01	-2.0064E+01
	3	-2.23E+01	-1.80E+01	-2.0065E+01
SHFTU				
PRMX_LOG	*SHUPRM*			
	1	-2.05E+01	-1.69E+01	-1.8422E+01
	2	-2.04E+01	-1.68E+01	-1.8420E+01
	3	-2.04E+01	-1.66E+01	-1.8421E+01
SAT_RBRN	*SHURBRN*			
	1	1.79E-03	6.00E-01	2.5011E-01
	2	2.76E-03	5.97E-01	2.5008E-01
	3	9.67E-04	5.93E-01	2.5007E-01
SAT_RGAS	*SHURGAS*			
	1	9.09E-04	3.98E-01	2.0013E-01
	2	2.05E-03	3.98E-01	1.9999E-01
	3	2.70E-03	3.98E-01	1.9997E-01
SOLMOD3				
SOLVAR	*WSOLVAR3*			
	1	-2.87E+00	2.53E+00	2.7719E-02
	2	-1.80E+00	2.76E+00	4.2462E-02
	3	-2.97E+00	2.47E+00	2.5774E-02

Material / *Property*	*Parameter* / *Replicate*	*Minimum*	*Maximum*	*Mean*
SOLMOD4				
SOLVAR	*WSOLVAR4*			
	1	-1.75E+00	2.36E+00	1.0508E-01
	2	-1.76E+00	2.35E+00	1.1144E-01
	3	-1.76E+00	2.40E+00	1.0696E-01
SPALLMOD				
REPIPERM	*REPIPERM*			
	1	2.42E-14	2.32E-12	5.1466E-13
	2	2.49E-14	2.37E-12	5.1489E-13
	3	2.45E-14	2.40E-12	5.1606E-13
PARTDIAM	*SPLPTDIA*			
	1	1.01E-03	9.65E-02	2.1478E-02
	2	1.00E-03	9.76E-02	2.1560E-02
	3	1.04E-03	9.82E-02	2.1569E-02
REPIPOR	*SPLRPOR*			
	1	3.51E-01	6.58E-01	5.0482E-01
	2	3.51E-01	6.58E-01	5.0501E-01
	3	3.52E-01	6.58E-01	5.0508E-01
TENSLSTR	*TENSLSTR*			
	1	1.21E+05	1.70E+05	1.4499E+05
	2	1.20E+05	1.70E+05	1.4497E+05
	3	1.20E+05	1.70E+05	1.4501E+05
STEEL				
CORRMCO2	*WGRCOR*			
	1	2.16E-16	3.16E-14	1.5849E-14
	2	2.37E-16	3.14E-14	1.5860E-14
	3	5.60E-17	3.15E-14	1.5855E-14
TH+4				
MKD_TH	*CMKDTH4*			
	1	7.08E-01	9.92E+00	3.4977E+00
	2	7.09E-01	9.94E+00	3.4980E+00
	3	7.09E-01	9.93E+00	3.4969E+00

Material Property	Parameter Replicate	Minimum	Maximum	Mean
U+4				
MKD_U	*CMKDU4*			
	1	7.16E-01	9.84E+00	3.4951E+00
	2	7.08E-01	9.93E+00	3.4967E+00
	3	7.03E-01	9.97E+00	3.4994E+00
U+6				
MKD_U	*CMKDU6*			
	1	3.14E-05	1.97E-02	3.0715E-03
	2	3.11E-05	1.99E-02	3.0796E-03
	3	3.07E-05	1.88E-02	3.0749E-03
WAS_AREA				
SAT_WICK	*WASTWICK*			
	1	3.06E-03	9.92E-01	5.0024E-01
	2	2.32E-03	9.99E-01	5.0047E-01
	3	4.40E-03	9.93E-01	4.9988E-01
BIOGENFC	*WBIOGENF*			
	1	2.82E-03	9.97E-01	5.0055E-01
	2	1.81E-03	9.97E-01	5.0033E-01
	3	2.65E-04	9.99E-01	5.0033E-01
GRATMICH	*WGRMICH*			
	1	5.57E-12	5.54E-10	1.7965E-10
	2	2.65E-12	5.31E-10	1.7812E-10
	3	6.73E-13	5.16E-10	1.8351E-10
GRATMICI	*WGRMICI*			
	1	3.26E-11	5.55E-10	2.9402E-10
	2	3.40E-11	5.53E-10	2.9363E-10
	3	3.15E-11	5.52E-10	2.9375E-10
PROBDEG	*WMICDFLG*			
	1	1.00E+00	2.00E+00	1.2500E+00
	2	1.00E+00	2.00E+00	1.2500E+00
	3	1.00E+00	2.00E+00	1.2500E+00

Material Property	*Parameter*	*Replicate*	*Minimum*	*Maximum*	*Mean*
SAT_RBRN	*WRBRNSAT*				
		1	2.71E-03	5.51E-01	2.7620E-01
		2	6.63E-04	5.47E-01	2.7587E-01
		3	3.97E-03	5.48E-01	2.7631E-01
SAT_RGAS	*WRGSSAT*				
		1	7.72E-04	1.48E-01	7.4990E-02
		2	6.34E-04	1.50E-01	7.4972E-02
		3	7.07E-04	1.49E-01	7.5076E-02

Appendix VIII. LHS_EDIT

1.1. Description and Requirements

LHS_EDIT was created to impose conditional relationships between pairs of variables for the case where 1) one variable was restricted to having values less than or equal to the other "controlling" variable and 2) the restricted, or conditioned, variable has a uniform distribution. LHS_EDIT is designed to read the LHS output (transfer) file and:

1) Extract the upper and lower bounds for the uniform distribution of the variable to be restricted,
2) Extract the sampled values for each pair of variables,
3) Compare the value of the variable to be restricted to the value of the controlling variable,
4) Rescale the restricted value if it exceeds the value of the controlling variable, and
5) Write a new transfer file containing the modified data.

The restricted value is rescaled by assuming that the distribution of the restricted value is a uniform distribution with an upper bound that is the minimum of the upper bound assigned to the parameter in the parameter data base and the sampled value of the controlling variable. The conditioned value of the restricted variable is computed using:

$$v_i' = \frac{v_i - U_{V,lower}}{U_{V,upper} - U_{V,lower}} \times \left(Min(x_i, U_{V,upper}) - U_{V,lower} \right) + U_{V,lower} \qquad (2)$$

where v_i' is the conditioned value of the restricted variable, v_i is the sampled value of the restricted variable, x_i is the sampled value of the controlling variable, and $U_{V,lower}$ and $U_{V,upper}$ are the bounds of the uniform distribution assigned to the restricted variable. This method preserves the probability associated with the value of the restricted variable but will affect the rank-order correlations with the other variables.

The format of the numbers in the listing of the distribution parameters in the LHS transfer file is limited to four digits after the decimal point, whereas the database can store more significant digits. The variable WAS_AREA:GRATMICH that was modified by LHS_EDIT has 1 more digit stored in the database than can be represented by the LHS format, thus introducing a small error in the rescaling calculation. However, the error is insignificant because the rounding occurs in the fourth digit after the decimal point, i.e. the fifth significant digit.

1.2. Platform and Source Code Description

The LHS_EDIT source code was written in FORTRAN 90 and executed on OpenVMS Version 7.3-1 operating system.

1.3. Usage

Files

LHS_EDIT requires as input the LHS output (transfer) file and a control file listing the pairs of variables to be related. The control file contains a record for each pair of variables and the variables are identified by a number corresponding to the numeric sequence of the variables in the PRELHS input file. The format for the record is (I2,1x,I2). The output files for LHS_EDIT

are a new transfer file having the conditioned data and a file called CHECK.TXT. CHECK.TXT lists the values of the controlling, restricted and conditioned variables in a comma-delimited format. CHECK.TXT is meant to be used to easily check whether LHS_EDIT is functioning properly.

Execution

File names are passed to LHS_EDIT using VMS logical variables. These variables are assigned values using the define command. The logical variables are LHS_CONTROL, LHS2_TRN, and LHS_EDIT_OUT for the control, LHS transfer file and the new transfer file, respectively. For example:

```
$  define LHS_CONTROL lhs_control_R1.inp
$  define LHS2_TRN lhs2_AP132_R1.trn
$  define LHS_EDIT_OUT lhs2_AP132_R1_CON.trn
$  run LHS_EDIT
```

For the CRA-2009 PA LHS_EDIT was executed using the EVAL_LHS.COM script and the file names were passed to EVAL_LHS.COM through its input file (EVAL_LHS_AP132_R*n*.INP, where *n* is 1, 2 or 3 for the three replicates). The script and input files are stored in the SCMS library PACMS2:[CMS_CRA09.CRA09_EVAL]

1.4. Testing of LHS_EDIT

Test Procedure

The test of the performance of LHS_EDIT was conducted by examining the data for Replicate 1 in the LHS transfer file and the LHS_EDIT output file produced for AP137. This case was run using the WIPP PA run control system and is documented in Long (2007).The data were extracted from these files by 1) cutting the data from the files, 2) pasting the data into Notebook and saving the data as a text file, 3) importing the data from the text files into Excel, and 4) selecting the values for WAS_AREA:GRAMICHI and WAS_AREA:GRAMICH from the LHS transfer file sheets and WAS_AREA:GRAMICH from the LHS_EDIT transfer file sheet and pasting them into a new into Excel sheet (Table 3). The maximum and minimum for the uniform distribution of WAS_AREA:GRAMICH were also transcribed from the LHS transfer file to the spreadsheet. A "Test Value" was computed using the Excel formula "=IF(C3>B3,(C3-G1)/(I1-G1)*(B3-G1)+G1,C3)", where G1 is the minimum and I1 is the maximum for the distribution of WAS_AREA:GRAMICH. This formula is equivalent to Eq. 2. The spreadsheet is stored in the library LIBCRA09_LHS as LHS2_CRA09_R1_validation.xls.

Table 3. Spreadsheet results showing independently computed values (Test Value) for WAS_AREA: GRATMICH.

Vector	WAS_AREA: GRATMICI	WAS_AREA: GRATMICH	WAS_AREA: GRATMICH (conditioned)	Test Value
1	2.39E-10	3.39E-11	3.39E-11	
2	7.82E-11	7.24E-10	5.51E-11	5.51E-11
3	3.29E-10	2.92E-10	2.92E-10	
4	7.93E-11	9.08E-10	7.01E-11	7.01E-11

5	5.28E-10	7.87E-10	4.04E-10	4.04E-10
6	4.09E-10	9.65E-10	3.84E-10	3.84E-10
7	5.09E-10	4.60E-10	4.60E-10	
8	3.04E-10	9.55E-10	2.83E-10	2.83E-10
9	5.45E-10	7.94E-10	4.21E-10	4.21E-10
10	3.32E-10	1.76E-10	1.76E-10	
11	5.35E-10	5.57E-12	5.57E-12	
12	1.22E-10	5.75E-10	6.80E-11	6.80E-11
13	3.19E-10	4.50E-10	1.40E-10	1.40E-10
14	1.31E-10	6.29E-10	7.99E-11	7.99E-11
15	1.83E-10	5.24E-10	9.35E-11	9.35E-11
16	1.72E-10	8.89E-10	1.49E-10	1.49E-10
17	2.61E-10	1.03E-11	1.03E-11	
18	3.26E-11	6.24E-10	1.98E-11	1.98E-11
19	1.92E-10	8.52E-10	1.60E-10	1.60E-10
20	2.85E-10	7.52E-10	2.09E-10	2.09E-10
21	4.89E-10	2.13E-10	2.13E-10	
22	2.25E-10	3.04E-10	6.66E-11	6.66E-11
23	2.08E-10	6.38E-10	1.29E-10	1.29E-10
24	3.95E-11	8.54E-10	3.28E-11	3.28E-11
25	4.44E-10	4.51E-11	4.51E-11	
26	1.14E-10	7.01E-10	7.80E-11	7.80E-11
27	2.33E-10	6.52E-10	1.48E-10	1.48E-10
28	4.36E-10	6.95E-10	2.95E-10	2.95E-10
29	4.32E-11	7.34E-10	3.09E-11	3.09E-11
30	3.81E-10	1.29E-10	1.29E-10	
31	9.19E-11	4.25E-10	3.80E-11	3.80E-11
32	2.65E-10	1.98E-10	1.98E-10	
33	4.72E-10	2.65E-10	2.65E-10	
34	4.04E-10	4.81E-10	1.89E-10	1.89E-10
35	2.50E-10	1.01E-09	2.46E-10	2.46E-10
36	1.51E-10	6.63E-10	9.72E-11	9.72E-11
37	4.60E-10	3.51E-10	3.51E-10	
38	3.89E-10	5.00E-10	1.89E-10	1.89E-10
39	3.59E-10	9.74E-10	3.41E-10	3.41E-10
40	3.54E-10	2.49E-10	2.49E-10	
41	4.20E-10	1.01E-10	1.01E-10	
42	1.61E-10	8.64E-10	1.36E-10	1.36E-10
43	4.47E-10	9.82E-10	4.27E-10	4.27E-10
44	5.18E-10	9.93E-10	5.00E-10	5.00E-10
45	8.36E-11	3.11E-10	2.53E-11	2.53E-11
46	2.52E-10	6.83E-10	1.68E-10	1.68E-10
47	1.03E-10	3.94E-10	3.94E-11	3.94E-11
48	2.29E-10	3.72E-10	8.28E-11	8.28E-11
49	3.25E-10	1.74E-10	1.74E-10	
50	5.03E-10	3.63E-10	3.63E-10	

51	2.72E-10	9.99E-10	2.64E-10	2.64E-10
52	5.37E-10	1.38E-10	1.38E-10	
53	3.49E-10	5.88E-10	2.00E-10	2.00E-10
54	2.90E-10	5.49E-10	1.55E-10	1.55E-10
55	4.84E-10	2.78E-10	2.78E-10	
56	5.06E-11	8.39E-10	4.13E-11	4.13E-11
57	4.56E-10	7.75E-10	3.44E-10	3.44E-10
58	3.09E-10	5.42E-10	1.63E-10	1.63E-10
59	4.22E-10	1.10E-10	1.10E-10	
60	5.23E-10	7.40E-10	3.77E-10	3.77E-10
61	1.07E-10	5.76E-10	5.98E-11	5.98E-11
62	3.63E-10	6.13E-10	2.17E-10	2.17E-10
63	1.41E-10	8.14E-10	1.12E-10	1.12E-10
64	6.74E-11	4.16E-10	2.73E-11	2.73E-11
65	5.12E-10	2.36E-11	2.36E-11	
66	9.68E-11	4.84E-10	4.56E-11	4.56E-11
67	1.95E-10	9.25E-10	1.76E-10	1.76E-10
68	2.83E-10	6.04E-11	6.04E-11	
69	3.95E-10	8.82E-10	3.39E-10	3.39E-10
70	1.64E-10	1.86E-10	2.97E-11	2.97E-11
71	5.50E-10	9.22E-10	4.94E-10	4.94E-10
72	2.42E-10	2.18E-10	2.18E-10	
73	4.76E-10	3.46E-10	3.46E-10	
74	3.44E-10	6.01E-10	2.01E-10	2.01E-10
75	2.97E-10	1.56E-10	1.56E-10	
76	5.56E-10	1.02E-09	5.54E-10	5.54E-10
77	1.76E-10	2.67E-10	4.57E-11	4.57E-11
78	1.44E-10	6.38E-11	6.38E-11	
79	1.33E-10	9.12E-11	9.12E-11	
80	7.02E-11	7.61E-10	5.20E-11	5.20E-11
81	3.68E-10	5.10E-10	1.83E-10	1.83E-10
82	1.18E-10	8.95E-10	1.03E-10	1.03E-10
83	2.04E-10	7.85E-11	7.85E-11	
84	5.26E-11	6.73E-10	3.45E-11	3.45E-11
85	4.79E-10	2.43E-10	2.43E-10	
86	5.76E-11	3.29E-10	1.84E-11	1.84E-11
87	4.94E-10	7.16E-10	3.45E-10	3.45E-10
88	2.74E-10	4.09E-10	1.09E-10	1.09E-10
89	4.27E-10	4.37E-10	1.82E-10	1.82E-10
90	1.87E-10	1.15E-10	1.15E-10	
91	3.11E-10	8.04E-10	2.44E-10	2.44E-10
92	1.55E-10	8.29E-10	1.25E-10	1.25E-10
93	4.35E-10	2.29E-10	2.29E-10	
94	4.63E-10	3.87E-10	3.87E-10	
95	3.84E-10	5.62E-10	2.10E-10	2.10E-10
96	3.76E-10	3.23E-10	3.23E-10	

97	3.40E-10	5.29E-10	1.75E-10	1.75E-10
98	4.12E-10	9.42E-10	3.78E-10	3.77E-10
99	2.17E-10	1.45E-10	1.45E-10	
100	2.13E-10	4.65E-10	9.65E-11	9.65E-11

Acceptance Criteria

The acceptance criteria for the test is that an independent calculation of the conditioned value for WAS_AREA:GRAMICH match with the reported precision the value computed by LHS_EDIT.

Evaluation
The Test Values matched the values computed by LHS_EDIT in every case where WAS_AREA:GRAMICH exceeded WAS_AREA:GRAMICI.

Source Code

The source code for LHS_EDIT Version 1.0 can be found in the file LHS_EDIT.FOR in the SCMS library PACMS2:[CMS_AP132.AP132_LHS] (LIBAP132_LHS) in the LHS_EDIT_V1.0 class. The executable LHS_EDIT.EXE is found in the same library and class. The source code is reproduced below.

```
      Program LHSedit
!.....Purpose: Edit a LHS output file by restricting the value in column col2
to
!               to never exceed the value in col1
!     Author: Tom Kirchner
!     Version: 1.0

!.....Edit a LHS output file by restricting the value in column col2 to
!     never exceed the value in col1
      Character*160 line
      Double precision a,b    !Endpoints of the first (rightmost)
distribution
      Double precision c,d    !Endpoints of the second (leftmost)
distribution
      Integer col1, col2      !The primary and conditional variables
      Double precision current(100,75)
      Character*160 spacer(4,7)
      Common/NewData/current,spacer

!.....Load the data into value()
      Call ReadFloats(current,spacer)

!.....Open the "control" file
      OPEN(2,file='LHS_CONTROL')
      Open(3,FILE="check.txt")
    5 Read(2,'(i2,1x,i2)',END=50) col1, col2
!.........Read the distribution definition section
```

```
          Call ReadDistInfo(col1, a, b, col2, c, d)
          write(*,*) "Column 1: ", col1," Range: ",a,b
          write(*,*) "Column 2: ", col2," Range: ",c,d
          write(*,'(a,i2,2a,i2)') " Data in column ",col2," to be ",
     &             "conditioned on column ",col1

!.........Now mofify the file
          Call MakeConditional(col1,col2,a,b,c,d)
       GoTo 5
   50  Close(2)
       Close(3)

!.....Now write the new file
       Call WriteFile

       Stop
  100  Format(a160)
  110  Format(a160)
       End

       Subroutine ReadFloats(fpvalue,spacer)
!.....Read the sampled values into the fpvalue array, preserving the
!      headers between "pages" in the spacer array
       Double precision fpvalue(100,75)
       Character*160 spacer(4,7)
       Character*160 line
       Integer LineNum

       Open(1,FILE='LHS2_TRN',ERR=75)
       Do While (.not.eof(1))
           Read(1,210) line
         If (line(1:14).eq." RUN NO.  X(1)") then
               Do k=1,7
                   Do i=1,100
                     Read(1,200) LineNum,(fpvalue(i,(k-1)*10+j),j=1,10)
                 End Do
                 Do i=1,4
                     Read(1,210) spacer(i,k)
                 End Do
                End Do

               Do i=1,100
                 Read(1,200) LineNum,(fpvalue(i,70+j),j=1,5)
               End Do
               Close(1)
               Return
            End If
       End Do
       Close (1)
       Return
    75 Write(*,*) "Error opening file"
   200 Format(3x,i3,10(1x,f10.3))
   210 Format(a160)
       End

       Subroutine MakeConditional(col1,col2,a,b,c,d)
!.....Modify values in column col2
```

```
!     by 1) reading values from columns col1 and col2 of LHS2_TRN
!        2) rescaling the value in col2 so that it is alway greater than
!           that in col1
!     A new file is written which leaves all the data in LHS2_TRN above and
!     below the sampled values unchanged.
      Integer col1, col2
      Character*160 line
      Double precision current(100,75)
      Character*160 spacer(4,7)
      Common/NewData/current,spacer
      Double precision Rescale, v, a, b, c, d, upper

!..... Now replace the data
        Write(3,*) "Column 1, Column 2, Conditioned Column 2"
      Do i=1,100
          v=Rescale(i,current,col1,col2, a,b,c,d)
          Write(3,*) current(i,col1),",",current(i,col2),',',v
          current(i,col2)=v
      End Do
      Return
      End

      Subroutine WriteFile
!.......Write out the file with the modify values
!     A new file is written which leaves all the data in LHS2_TRN above and
!     below the sampled values unchanged.
      character*160 line
      Double precision current(100,75)
      character*160 spacer(4,7)
      Common/NewData/current,spacer
      Character*3 fmt

      fmt="0  "

      Open(1,FILE='LHS2_TRN')
      Open(2,FILE='LHS_EDIT_OUT',recl=160)
        Write(2,'(a)') "1"
      Do While (.not.eof(1))
          Read(1,410) line
          If (line(1:14).eq." RUN NO.  X(1)") then
              Write(2,'(a)') trim(line)
!           and write the new values out
            Do k=1,7
                Do i=1,100
                    Write(2,400)fmt,i,(current(i,(k-1)*10+j),
     &                          j=1,10)
                End Do
                Do i=1,4
                      Write(2,'(a)') trim(spacer(i,k))
                End Do
            End Do
            Do i=1,100
                Write(2,400) fmt,i,(current(i,70+j),j=1,5)
            End Do

          Else
              Write(2,'(a)') trim(line)
```

```
          End If
        End Do
        Return
  400   Format(a3,i3,10(1x,1pE10.3))
  410   Format(a160)
        End

        Double Precision Function Rescale(i,current,col1, col2, a, b, c, d)
!.....Adjust col2 so that it never exceeds col1
!       The distribution of col2 ranges from [c-d]
!       The distribution of col1 ranges from [a-b]
        Double precision current(100,75), a, b, c, d, upper
        Integer i, col1, col2
        Double precision v

        v=current(i,col2)
        If (current(i,col2).GT.current(i,col1)) then
            upper=current(i,col1)
            v=(current(i,col2)-c)/(d-c)*(upper-c)+c
        End If

        Rescale = v

        Return
        End

        Subroutine ReadDistInfo(col1, a, b, col2, c, d)
!.....Read the distribution information and save the range limits
!       for the uniform distribution for the col1 variable
        Integer col2, col1
        Integer VarNum
        Double Precision a, b, c, d
        Character*160 line
!       Open the file
        Open(1,FILE='LHS2_TRN')
!       Skip the first page of the header
        Do While (line(1:26).ne."    VARIABLE  DISTRIBUTION")
            Read(1,800) line
        End Do
!.....Now process the definitions
        Do While (line(1:1).ne."1")          !marks the end of the data
          Read(1,800) line
          If (line(11:21).eq."    UNIFORM") Then
!               Get the variable number
                Read(line,'(7x,i2)') VarNum
              If (VarNum.eq.col2) Then
!               Get the minimum and maximum
                    Read(line,'(33x,e10.4)') c
                    Read(line,'(49x,e10.4)') d
              Else if (VarNum.eq.col1) Then
!               Get the minimum and maximum
                    Read(line,'(33x,e10.4)') a
                    Read(line,'(49x,e10.4)') b
              End if
          End If
        End Do
        Close (1)
```

```
    return
800 Format(a160)
    End
```