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Generation of the LHS Samples for the AP-161 (PCS-2012) Revision 0 PA Calculations

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WIPP:1.4.1.2:PA:QA-L:557313

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120913.5

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I. Introduction

The Waste Isolation Pilot Plant (WIPP), located in southeastern New Mexico, has been developed by the U.S. Department of Energy (DOE) for the geologic (deep underground) disposal of transuranic (TRU) waste. Containment of TRU waste at the WIPP is regulated by the U.S. Environmental Protection Agency (EPA) according to the regulations set forth in Title 40 of the Code of Federal Regulations (CFR), Part 191. The DOE demonstrates compliance with the containment requirements according to the Certification Criteria in Title 40 CFR Part 194 by means of performance assessment (PA) calculations performed by Sandia National Laboratories (SNL). WIPP PA calculations estimate the probability and consequence of potential radionuclide releases from the repository to the accessible environment for a regulatory period of 10,000 years after facility closure. The models used in PA are maintained and updated with new information as part of an ongoing process. Improved information regarding important WIPP features, events, and processes typically results in refinements and modifications to PA models and the parameters used in them. Planned changes to the repository and/or the components therein also result in updates to WIPP PA models. WIPP PA models are used to support the repository recertification process that occurs at five-year intervals following the receipt of the first waste shipment at the site in 1999.

Waste panel closures comprise a repository feature that has been represented in WIPP PA since the original Compliance Certification Application (CCA) of 1996. Panel closures are included in WIPP PA models principally because they are a part of the disposal system, not because they play a substantive role in inhibiting the release of radionuclides to the outside environment. The DOE stated in the CCA (DOE 1996) that *"The panel closure system was not designed or intended to support long-term repository performance."* The 1998 rulemaking that certified WIPP to receive transuranic waste placed conditions on the panel closure design to be implemented in the repository. The mandated design consists of a concrete block wall, an open drift section, and a concrete monolith, and was termed the "Option D" panel closure. Following the selection of the Option D design in 1998, the engineering of the panel closure has been re-assessed, and a revised design has been established that is simpler, cheaper, and easier to construct. The revised panel closure design, termed the Run-of-Mine Panel Closure System (ROMPCS), is comprised of 100 feet of ROM salt with barriers at each end. The ROM salt is generated from ongoing mining operations at the WIPP and may be compacted and/or moistened as it is emplaced in a panel entry. The barriers consist of ventilation bulkheads, similar to those currently used in the panels as room closures.

The DOE has submitted a planned change request (PCR) to the EPA requesting that EPA modify Condition 1 of the Final Certification Rulemaking for 40 CFR Part 194 (EPA, 1998) for the WIPP. The PCR submitted to EPA requests that Condition 1 be changed, and that the ROMPCS design be approved for use in all panels (DOE, 2011). In support of this rulemaking change, a performance assessment has been completed that incorporates the ROMPCS design into the current PA baseline established by the 2009 Performance Assessment Baseline Calculation

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(PABC-2009) (Clayton et al., 2010). The name given to this new panel closure PA is PCS-2012, and the plan for its execution is detailed in AP-161 (Camphouse 2012).

The program LHS is used to sample the distributions of parameters having epistemic uncertainty using a Latin Hypercube sampling design. PRELHS is run prior to LHS and is used to obtain from the WIPP Parameter Database the data describing the distributions and to create an input file to LHS based on that data. PRELHS Version 2.40 was used in this analysis, which is a deviation from the analysis plan (Camphouse 2012). The analysis plan specified the wrong version number for PRELHS. 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, other conditional relationships were specified by the code analysts for three parameters. These conditional relationships restricted the value for one parameter to be less than the sampled value of another parameter. 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 2.40, LHS Version 2.42 and LHS_EDIT to provide three sets of sampled data for use in the 2012 PCS-2012 PA (Camphouse 2012). These three sets represent three replicates of one hundred samples for each of 75 variables. Sixty of these variables are associated with model parameters. However, there are also 15 "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 analysis plan (AP) for the analysis (AP161).
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.

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II. 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 Camphouse et al. (2012). The script and its input files are stored in LIBAP161_EVAL (PACMS2:[CMS_AP161.AP161_EVAL]).

III. PRELHS Input Files

The three input files for PRELHS are listed in appendices I to III. These files are named LHS1_AP161_R1.INP, LHS1_AP161_R2.INP and LHS1_AP161_R3.INP, respectively for replicates 1 to 3.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 random seeds used were those used in the PABC09, as specified in AP-161. This sampling design eliminates from comparisons of the results to the PABC09 results the impact of sampling of the distributions of the parameters having epistemic uncertainty. The corresponding output (transfer) files from PRELHS for the three replicates are listed in appendices IV to VI. These files are named LHS1_AP161_R1.TRN, LHS1_AP161_R2.TRN and LHS1_AP161_R3.TRN, respectively for replicates 1 to 3. 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.

IV. 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 (Appendix VII). No values were found to exceed the specified ranges of the distributions although a few were found to cover less than 90% of the specified range, e.g. 77.4 % of the range was covered by the samples for S_MB139:PRMX_LOG (*material:property*) in replicate 3 (Fig. 156). These low coverage values are undoubtedly due to the shape of the distribution; the tails of the CDF curves are nearly horizontal, so that the width of 1 % and 99 % quantiles sampled by LHS are relatively wide. The width of the intervals (covering 1 % of the probability) is set by the number of LHS samples in the replicate (100).

The LHS output file lists the correlation coefficients between the sampled variables. The sampled data for those variables for which a correlation matrix was entered showed correlations that were close to those specified (Table 1). 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 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 57). 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.

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To evaluate the frequency with which high correlation coefficients would be expected in such variables, a test was conducted (Kirchner 2009). In the test, 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.

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Replicate	Between		Expected Correlation	Observed Correlation	Significance[2]
1	CASTILER:COMP_RCK	CASTILER:PRMX_LOG	-0.75	-0.7281	**
	S_HALITE:COMP_RCK	S_HALITE:PRMX_LOG	-0.99	-0.9869	**
2	CASTILER:COMP_RCK	CASTILER:PRMX_LOG	-0.75	-0.7242	**
	CASTILER:PRESSURE[1]	WAS_AREA:PROBDEG	0.00	-0.234	*
	S_HALITE:COMP_RCK	S_HALITE:PRMX_LOG	-0.99	-0.9907	**
3	CASTILER:COMP_RCK	CASTILER:PRMX_LOG	-0.75	-0.7252	**
	S_HALITE:COMP_RCK	S_HALITE:PRMX_LOG	-0.99	-0.9834	**

1 This correlation is spurious.

2 * = Significant at $p<0.05$, ** = Significant at $p<0.01$

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 $i/100-0.005$ to the ith ordered value, i.e. the midpoint of the interval containing the value based on order statistics (Figures 1 through 180). With the exception of the variables modified using LHS_EDIT (Figures 26, 27 and 55 for replicate 1, Figures 86, 87 and 115 for replicate 2 and Figures 146,147 and 175 for replicate 3), 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.

V. Imposing Additional Limits on Some Variables

LHS_EDIT was used to enforce a conditional relationship between three pairs of variables. The relationships were WAS_AREA:GRATMICH ≤ WAS_AREA:GRATMICI (Clayton 2008, Nemer and Stein 2005) and PCS_T3: POROSITY ≤ PCS_T2: POROSITY ≤

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PCS_T1:POROSITY (Camphouse 2012). The relationships were enforced by modifying values in the LHS transfer file, thus making the conditioned values available for use in the sensitivity analysis. For each pair of variables LHS_EDIT rescales the sampled value of the parameter to the left of the $\leq$ symbol to the new "controlled" value using the equation

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

Where v_i' is the conditioned value of left hand variable, v_i is the sampled value of that variable, x_i is the sampled value of the right hand variable, and $U_{V,lower}$ and $U_{V,upper}$ are the bounds of the distribution assigned to the left hand variable. This method preserves the probability associated with the value of the left hand variable. The CDFs for the original sampled values and the conditioned values are shown in Figures 27, 28 and 56 for replicate 1, Figures 88, 89 and 117 for replicate 2 and Figures 149,150 and 178 for replicate 3. This conditional relationship results in a positive correlation between the pairs of variables. For example, the correlation between WAS_AREA:GRATMICH and WAS_AREA:GRATMICI was computed for Replicate 1 using Excel and found to be 0.74 (Figure 181). The nature of these correlations is fundamentally different than that which LHS could induce between the variables. LHS achieves correlations between variables by reordering the sampled data whereas LHS_EDIT changes the range of the left hand sampled variable. If instead of limiting the value of the left hand variable an equivalent correlation had been specified between the variables in the input file to LHS then LHS would have generated values for the left hand variable that could have exceeded the corresponding value for the right hand variable.

VI. 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 PABC09 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:GRATMICH and WAS_AREA:GRATMICI, PCS_T3: POROSITY and PCS_T2: POROSITY, and PCS_T2: POROSITY and PCS_T1:POROSITY.

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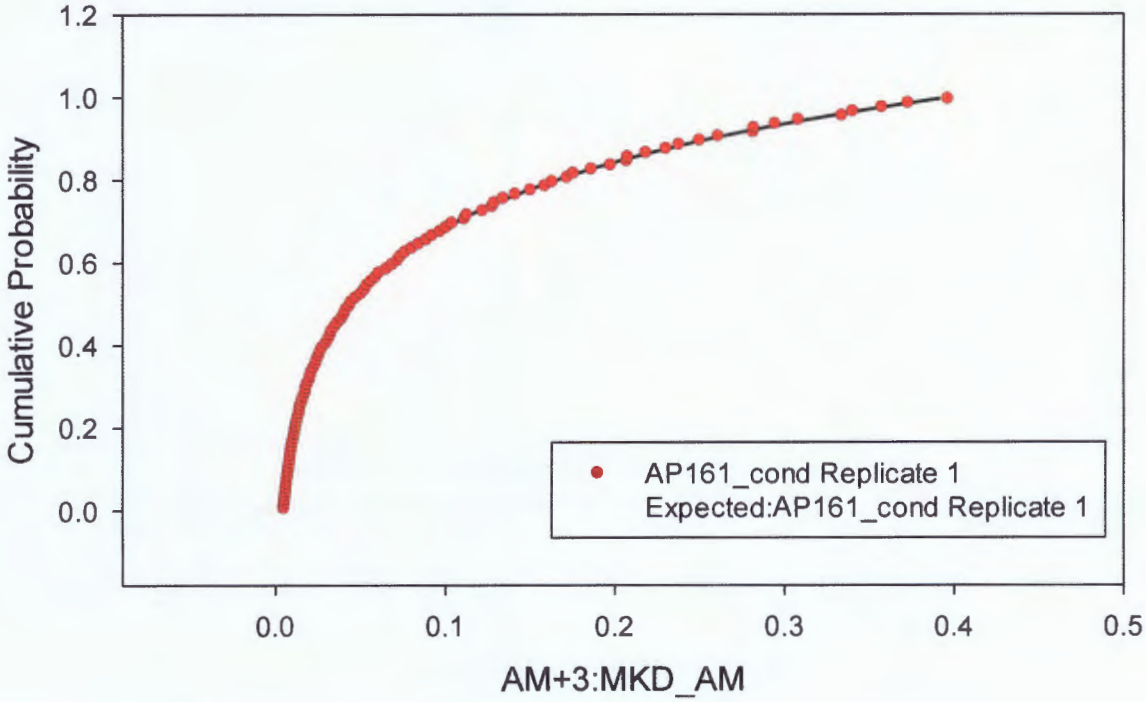

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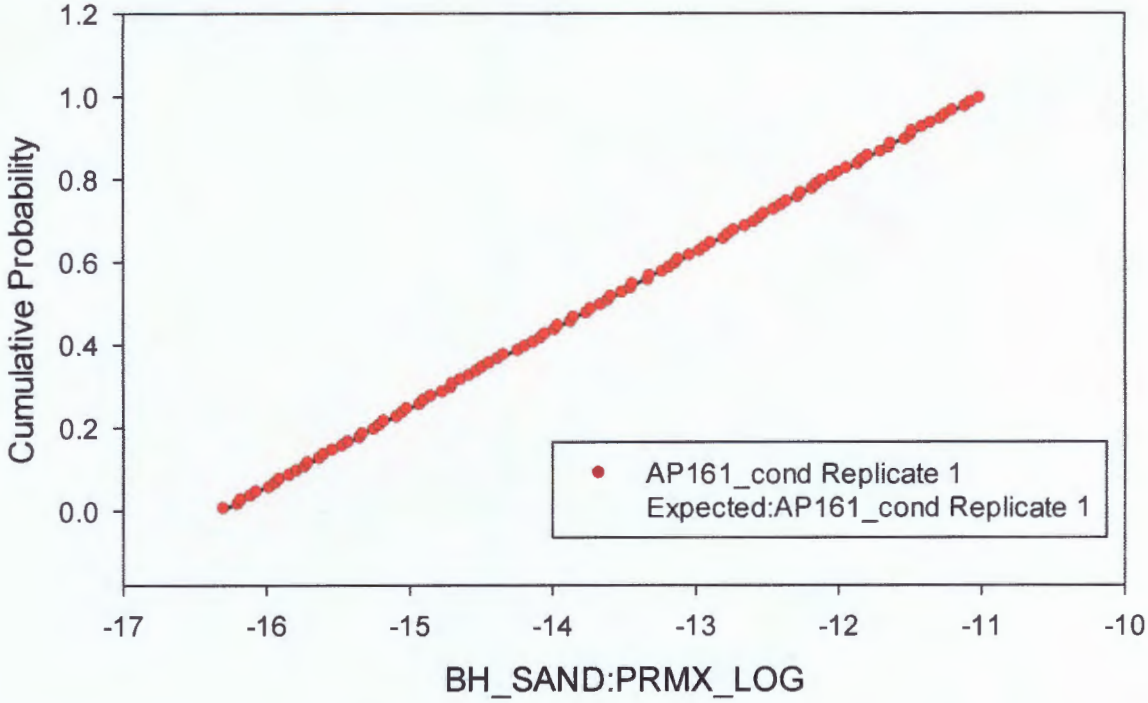

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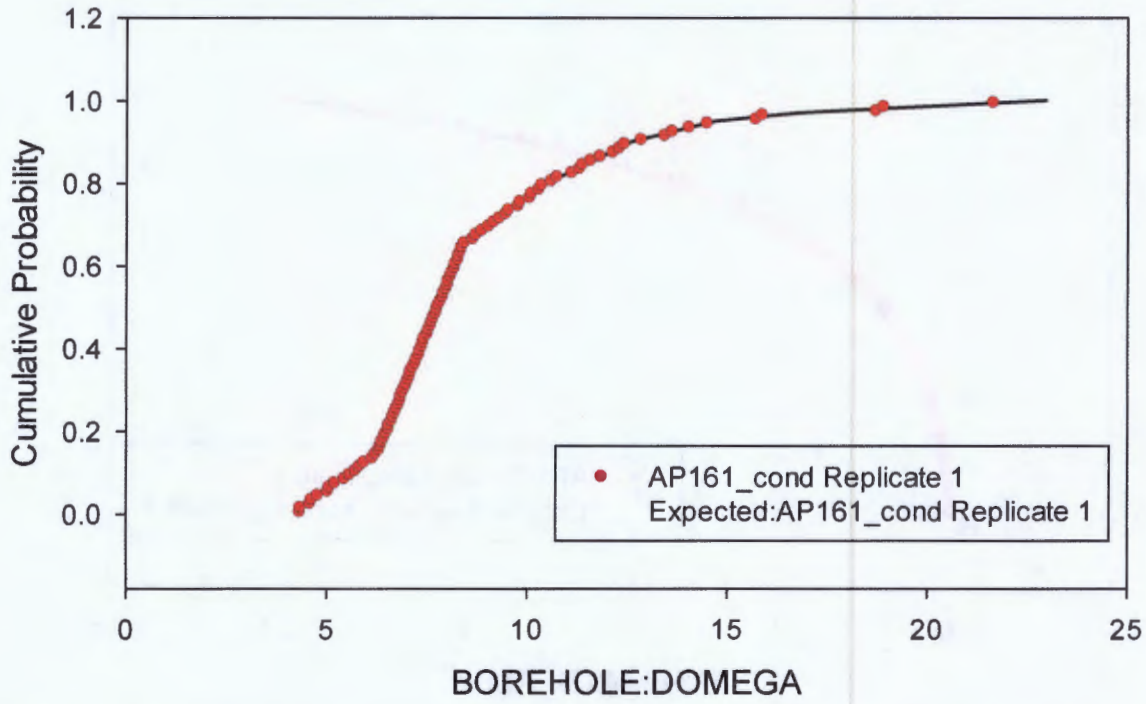

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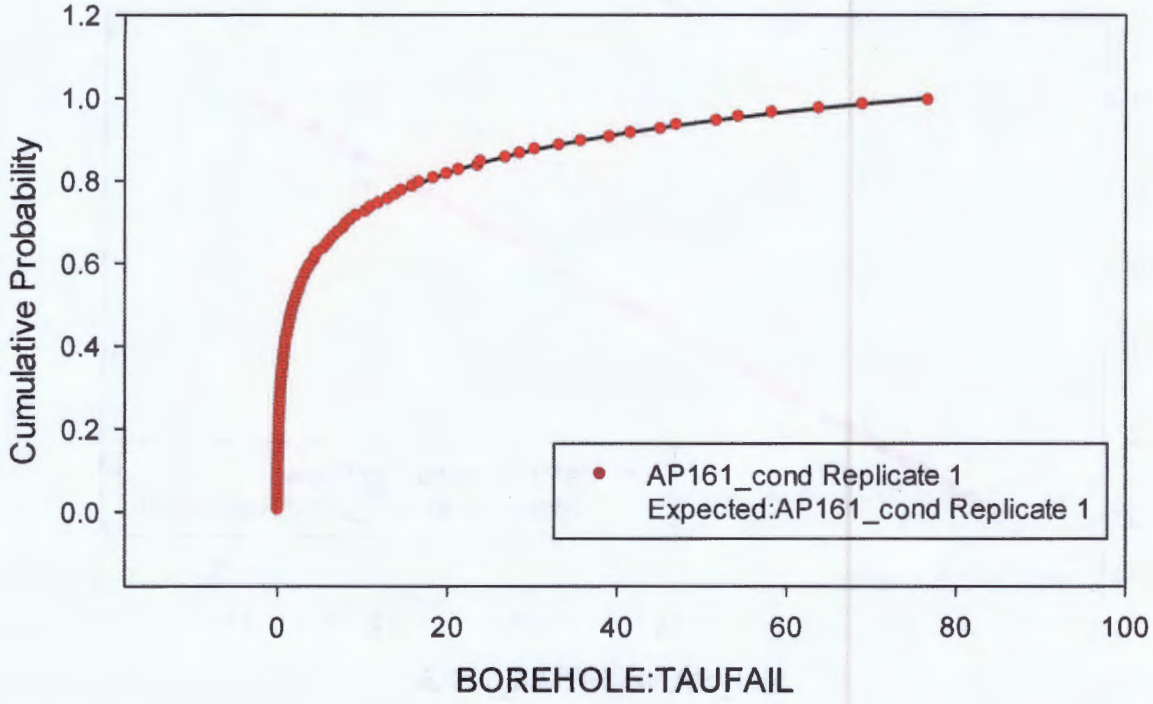

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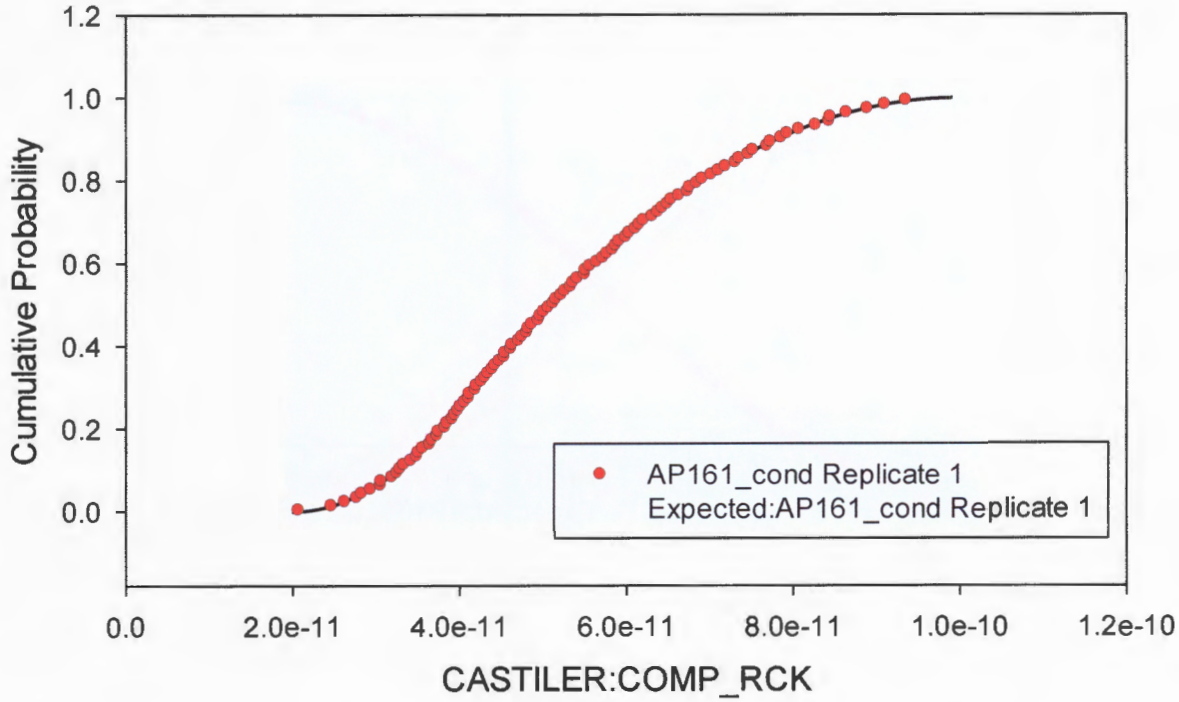

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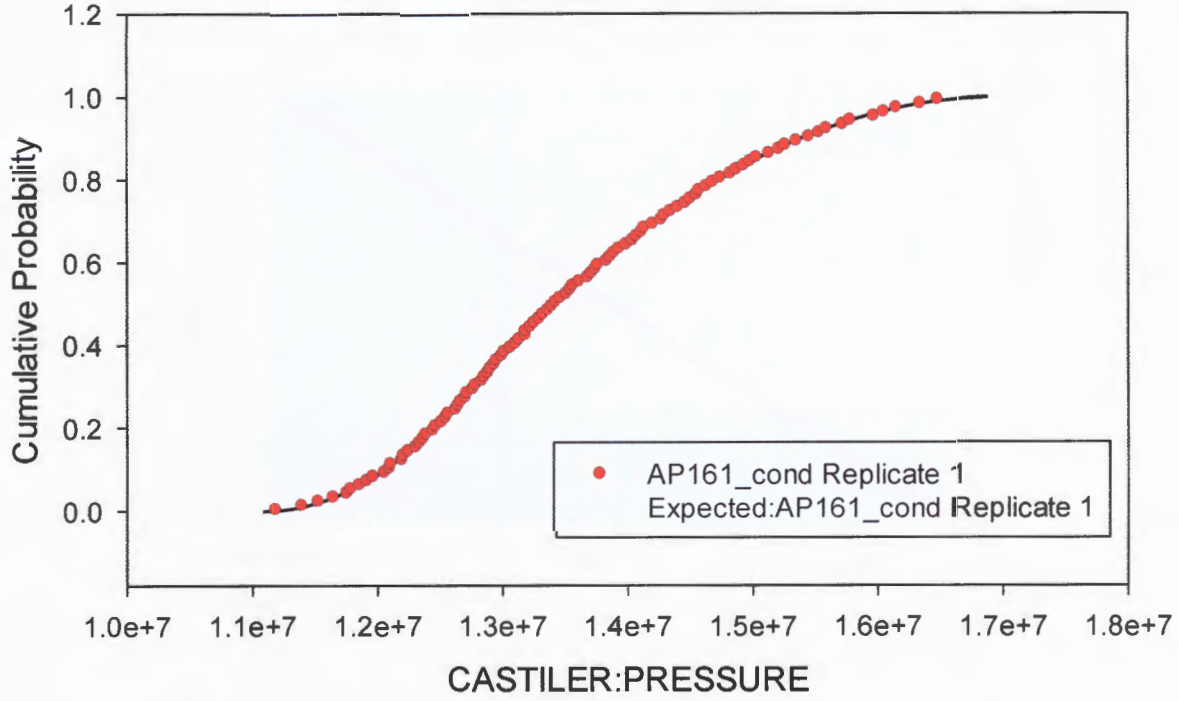

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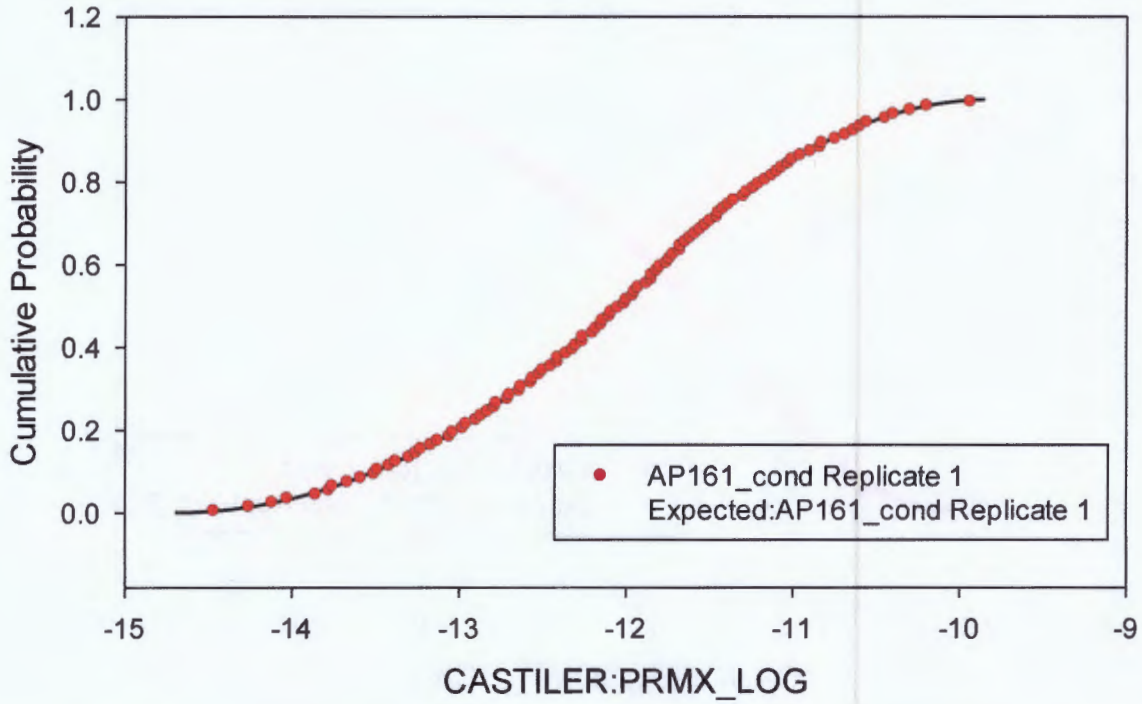

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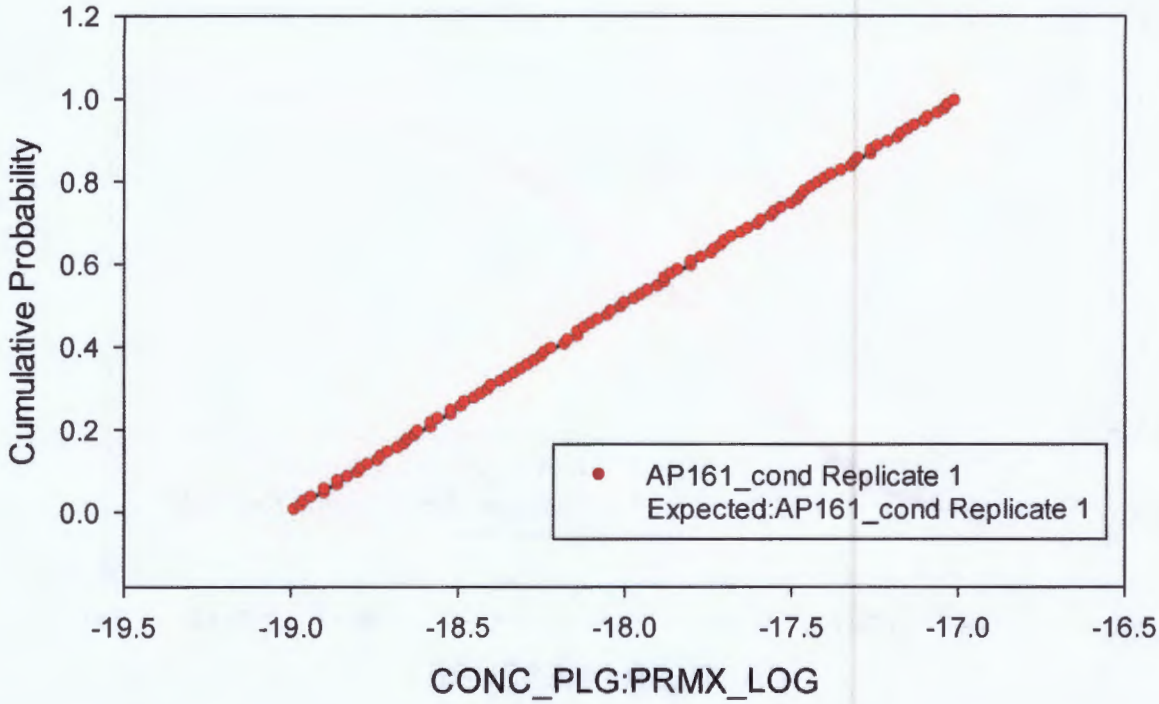

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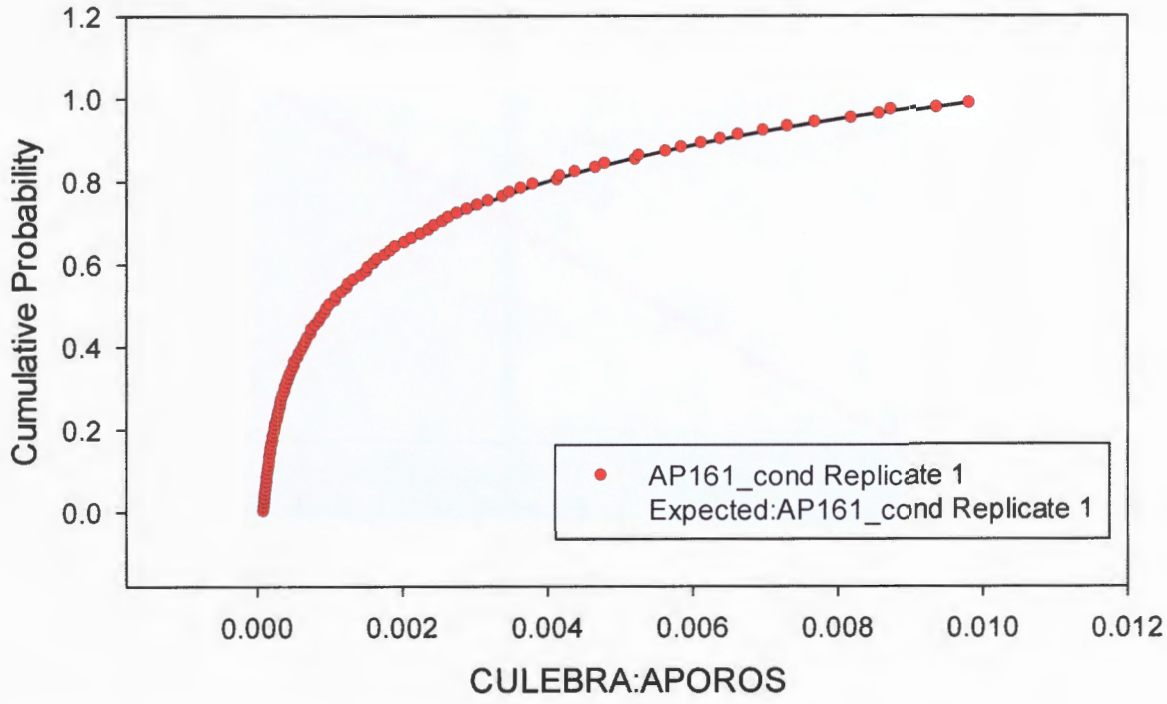

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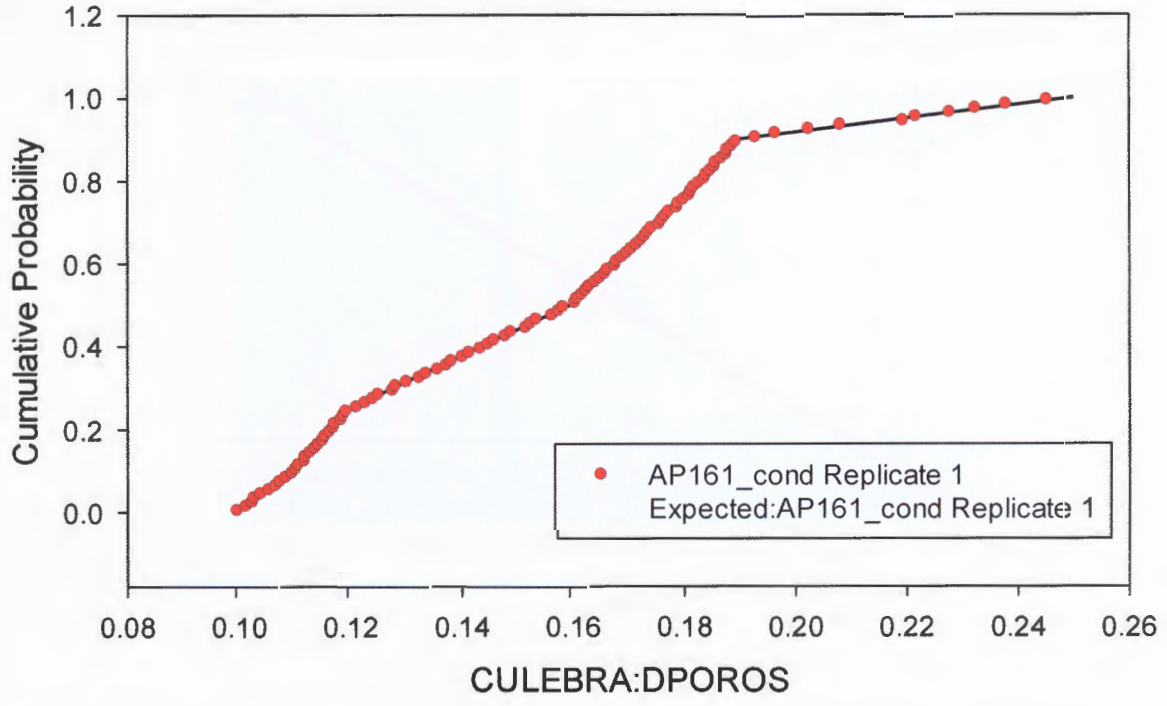

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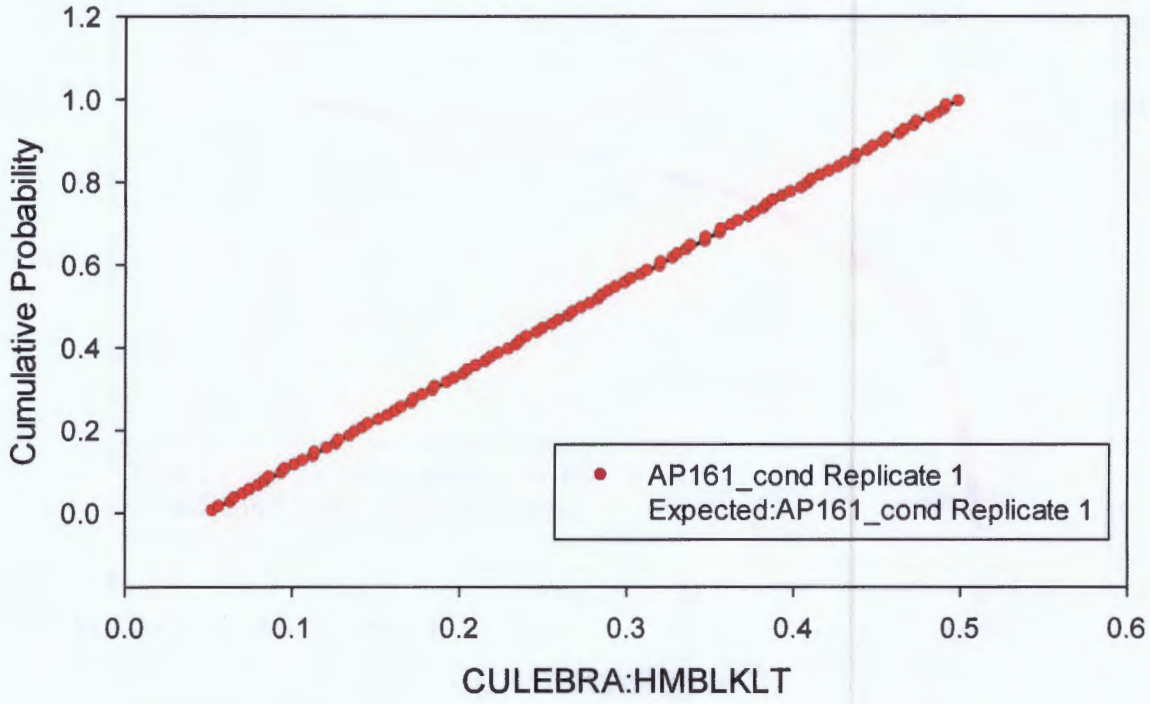

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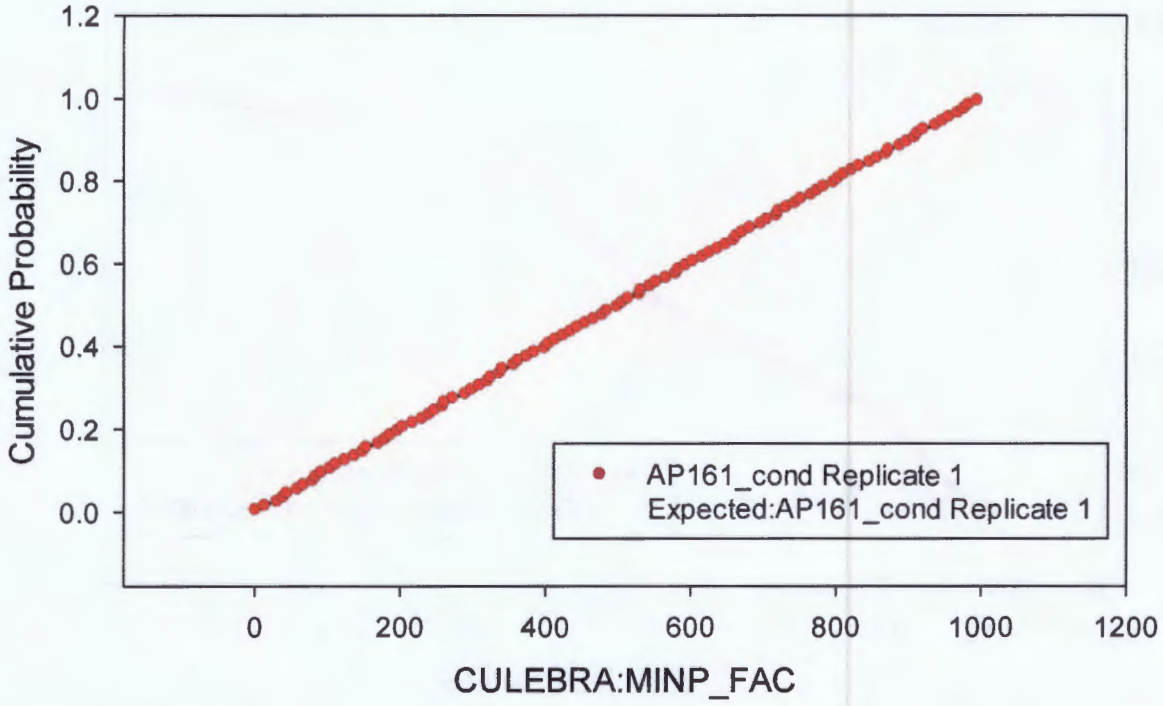

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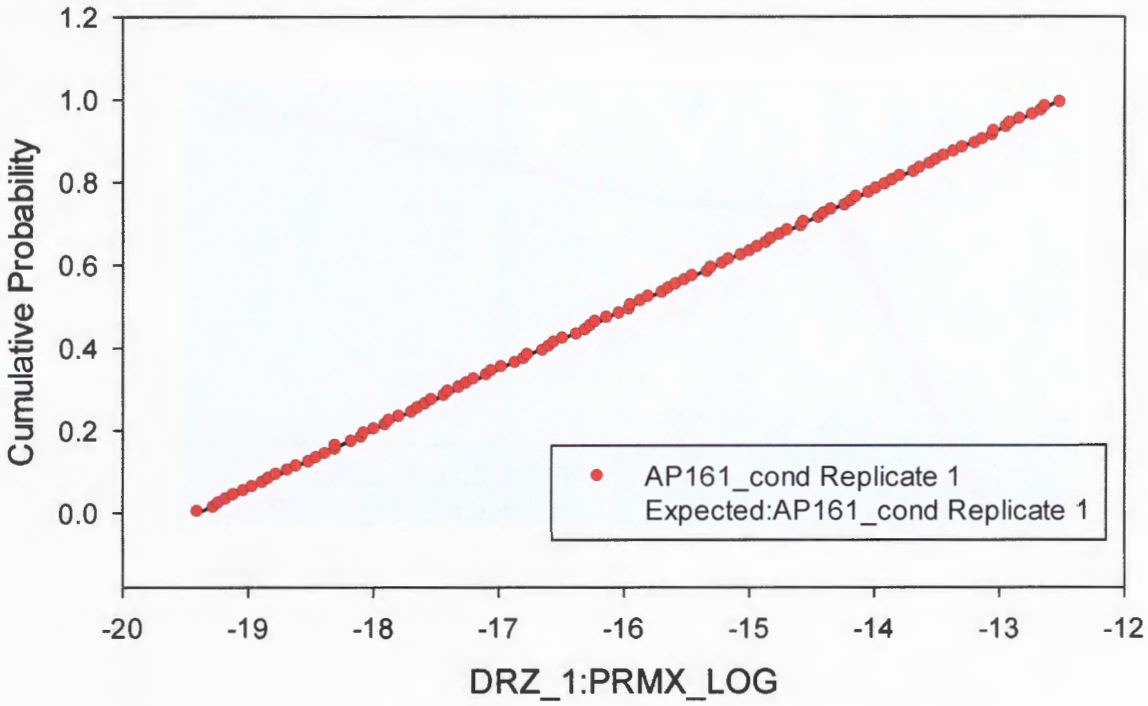

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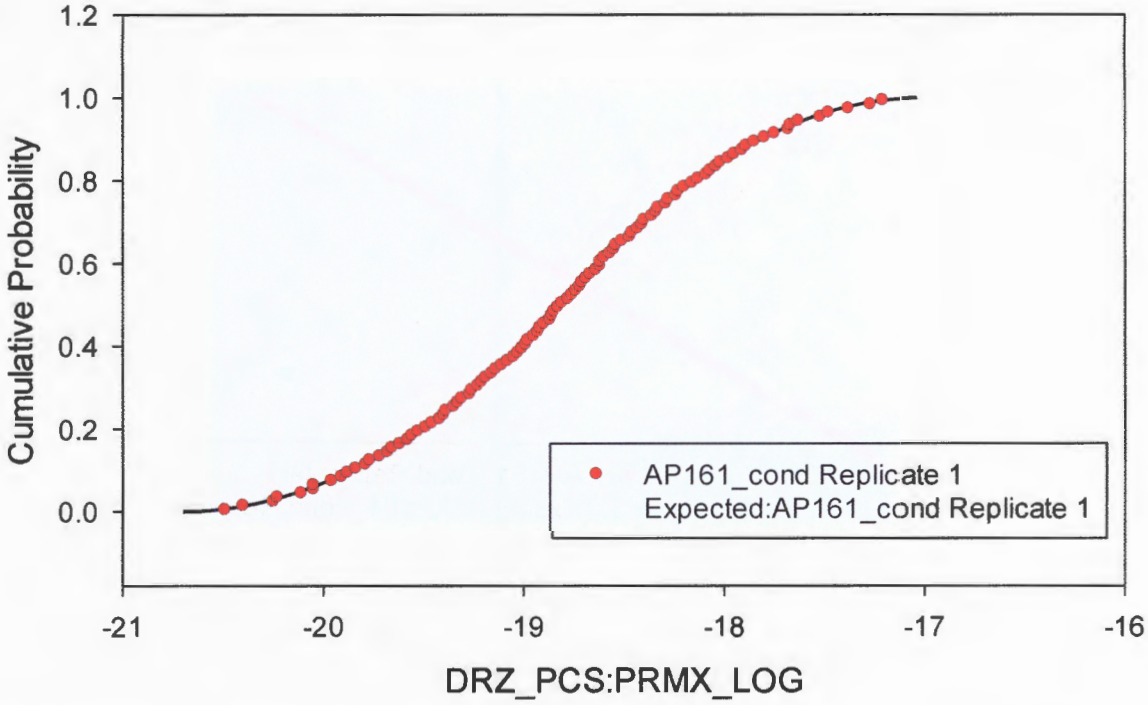

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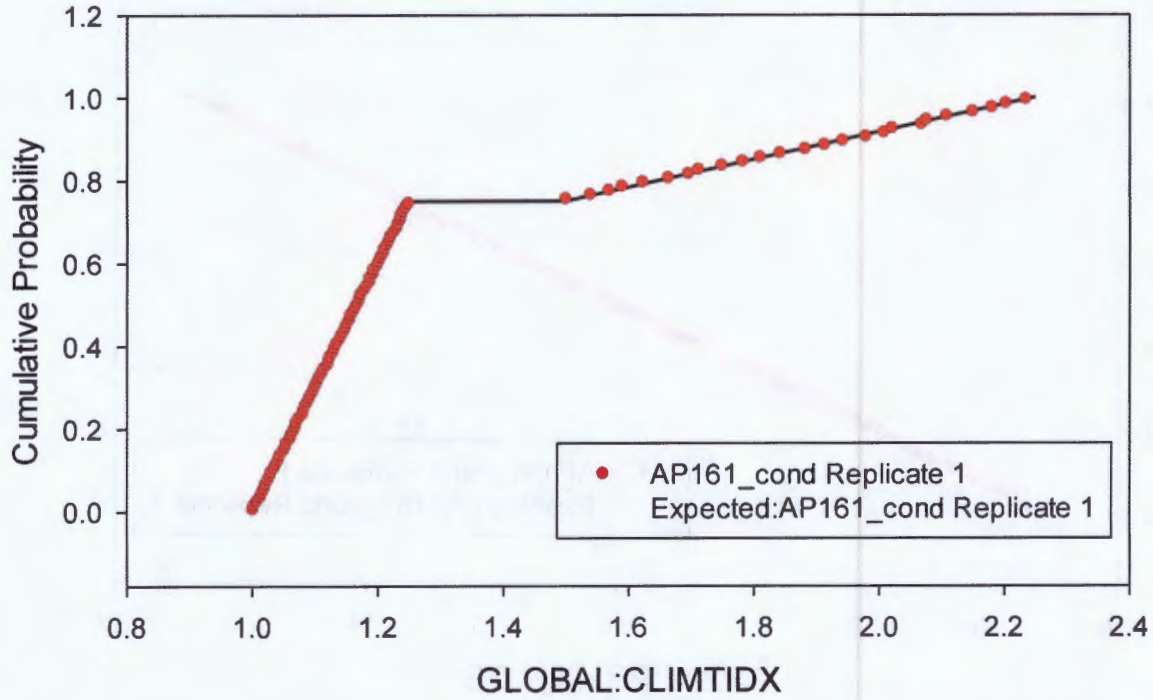

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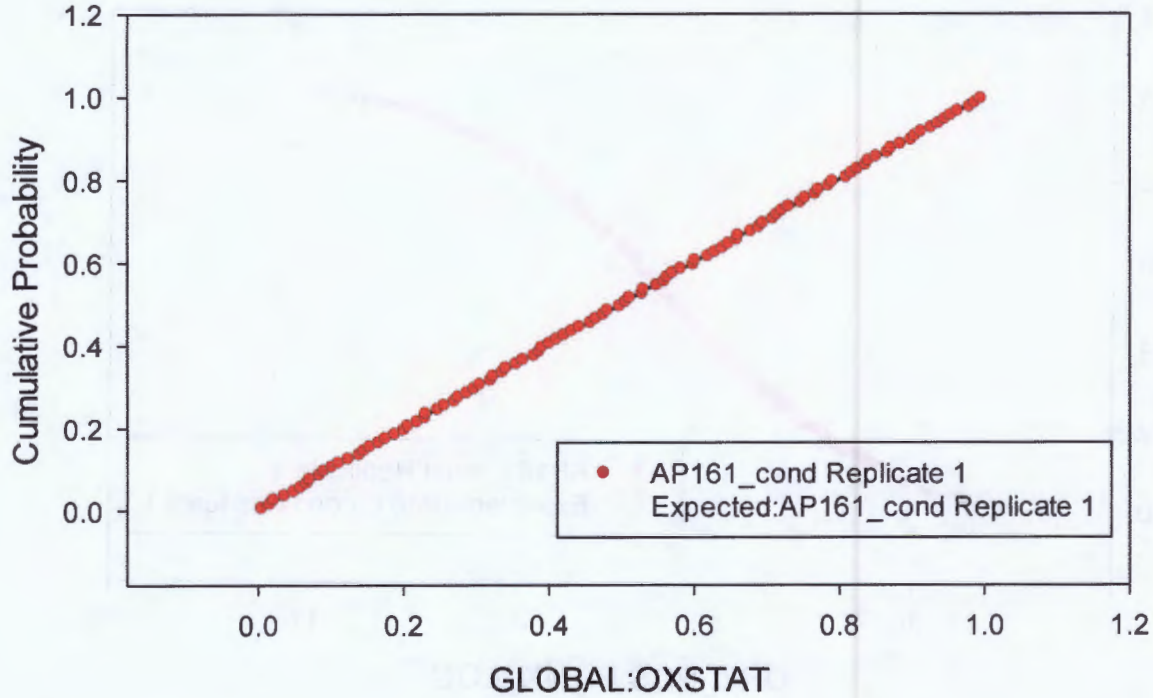

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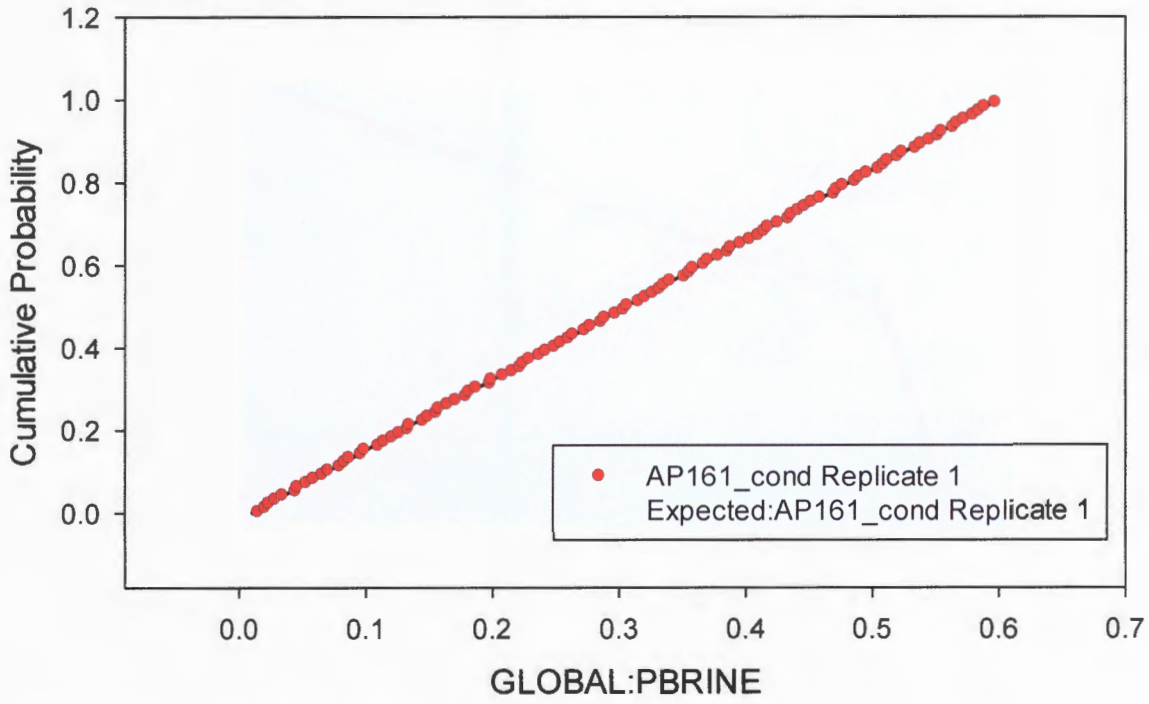

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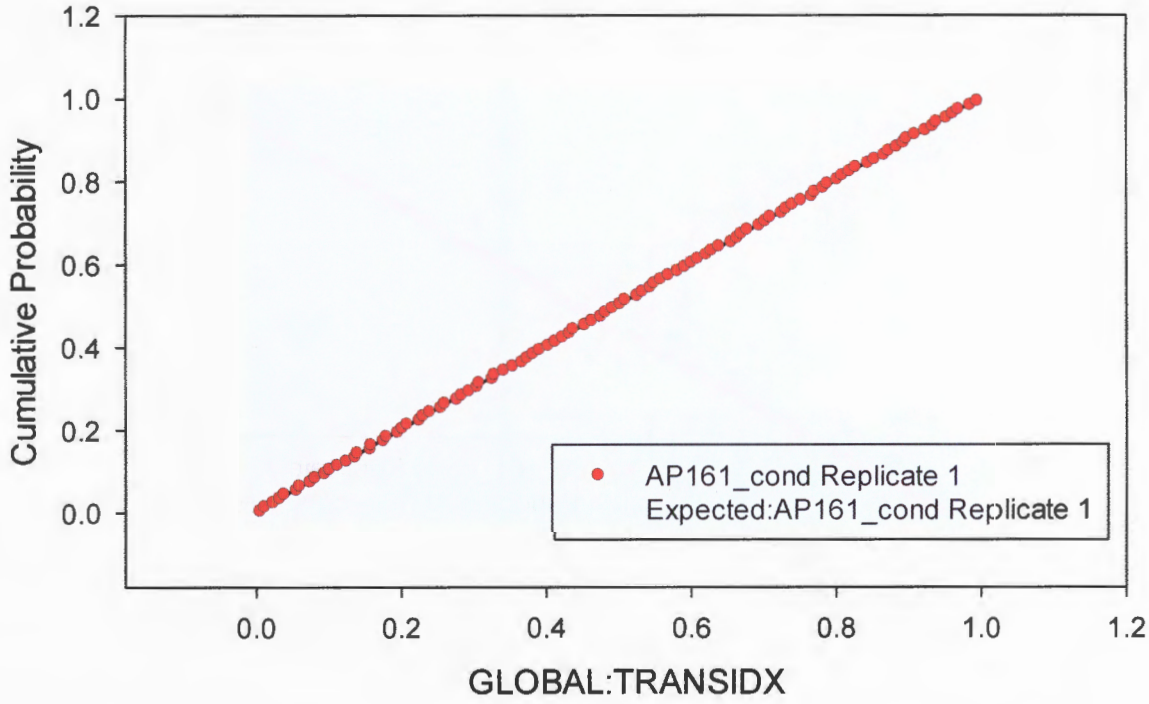

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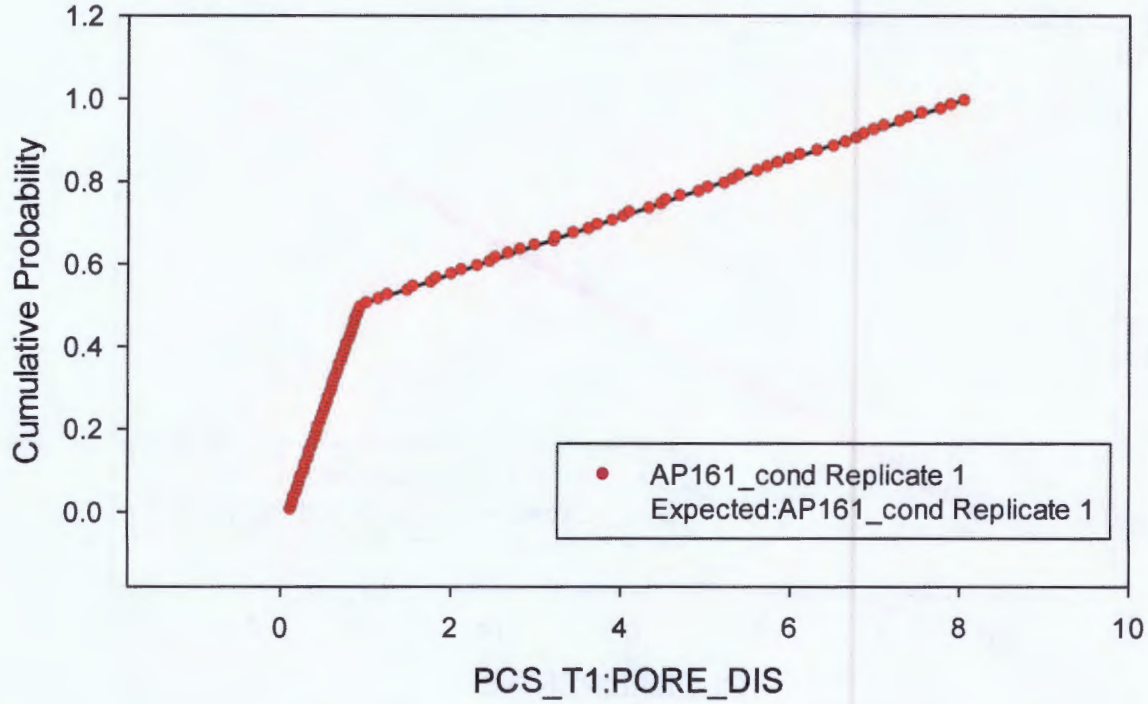

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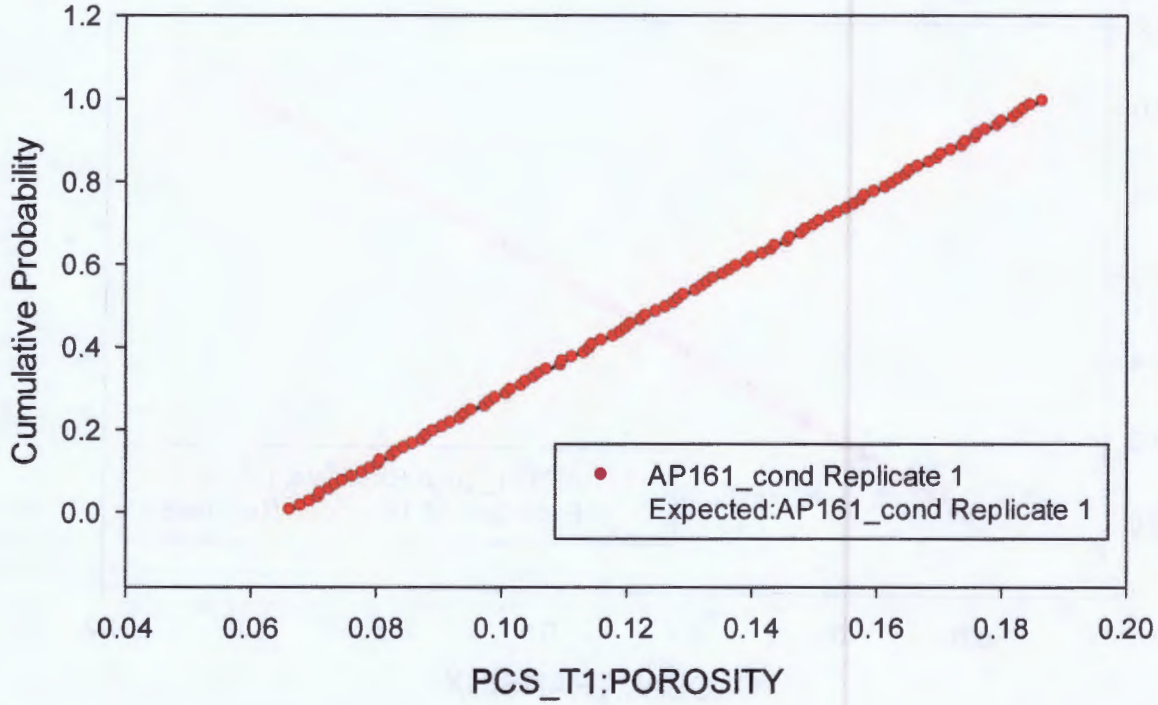

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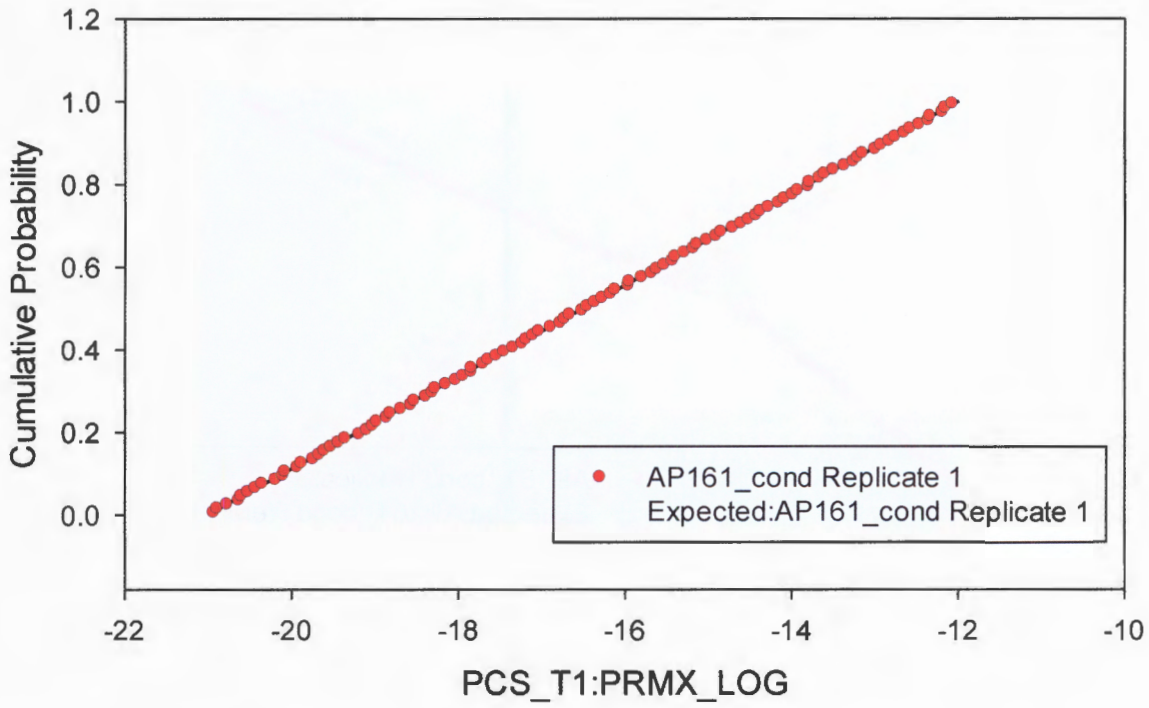

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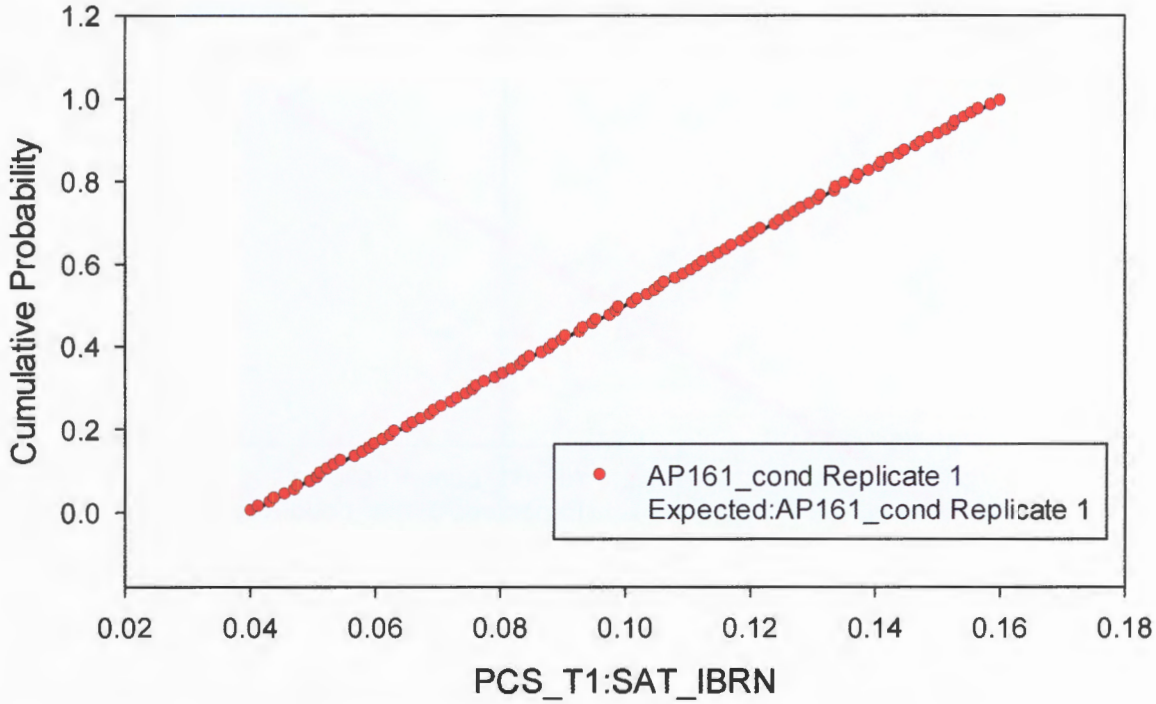

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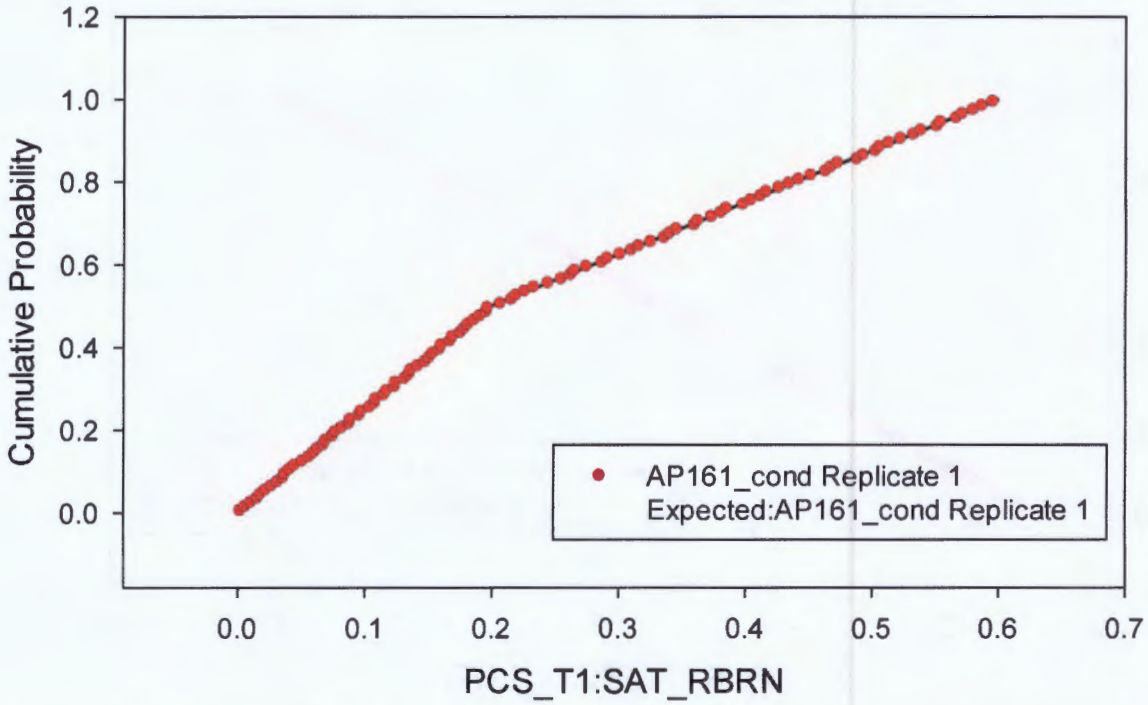

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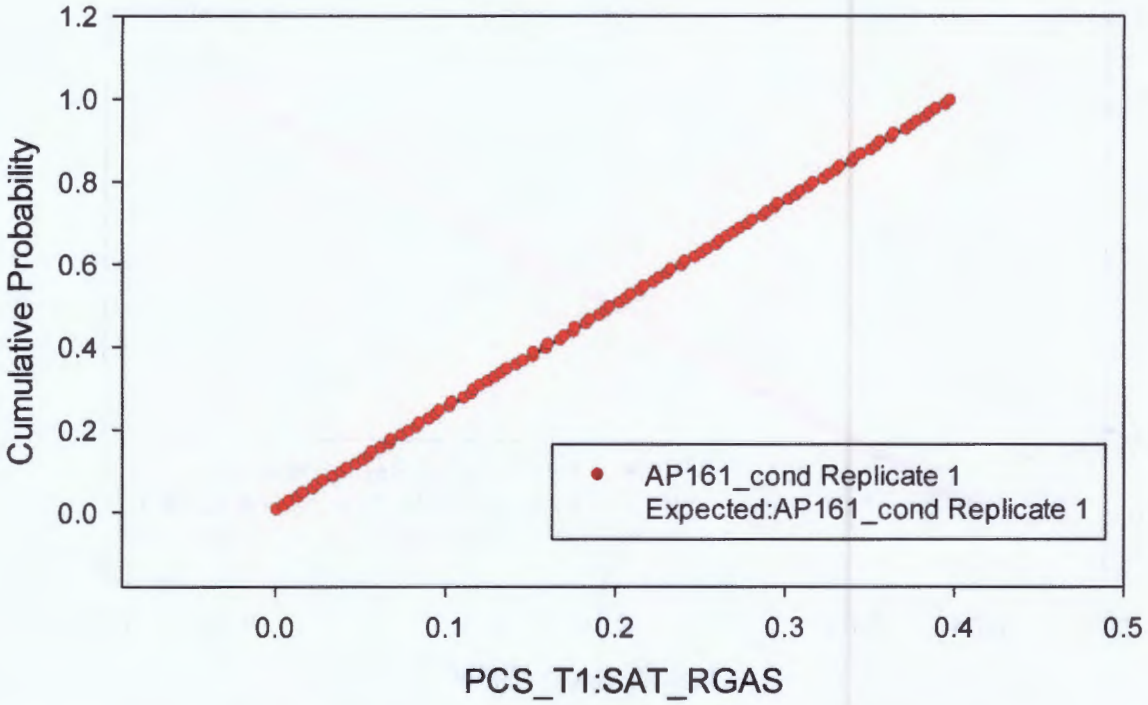

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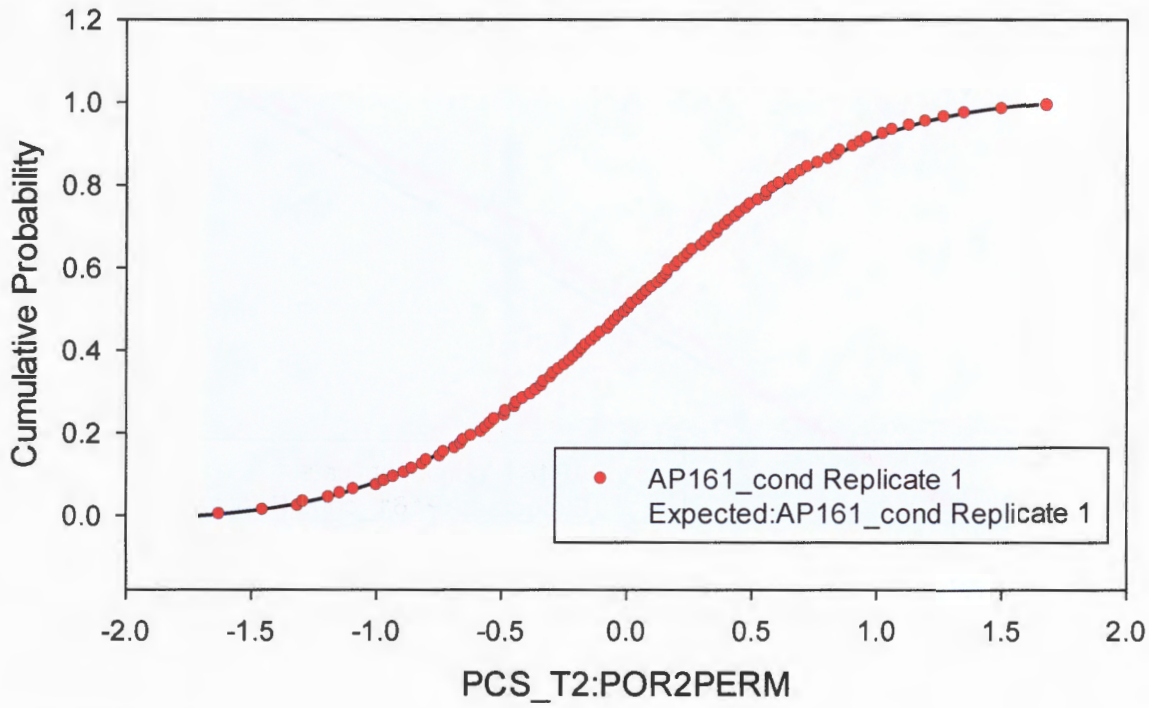

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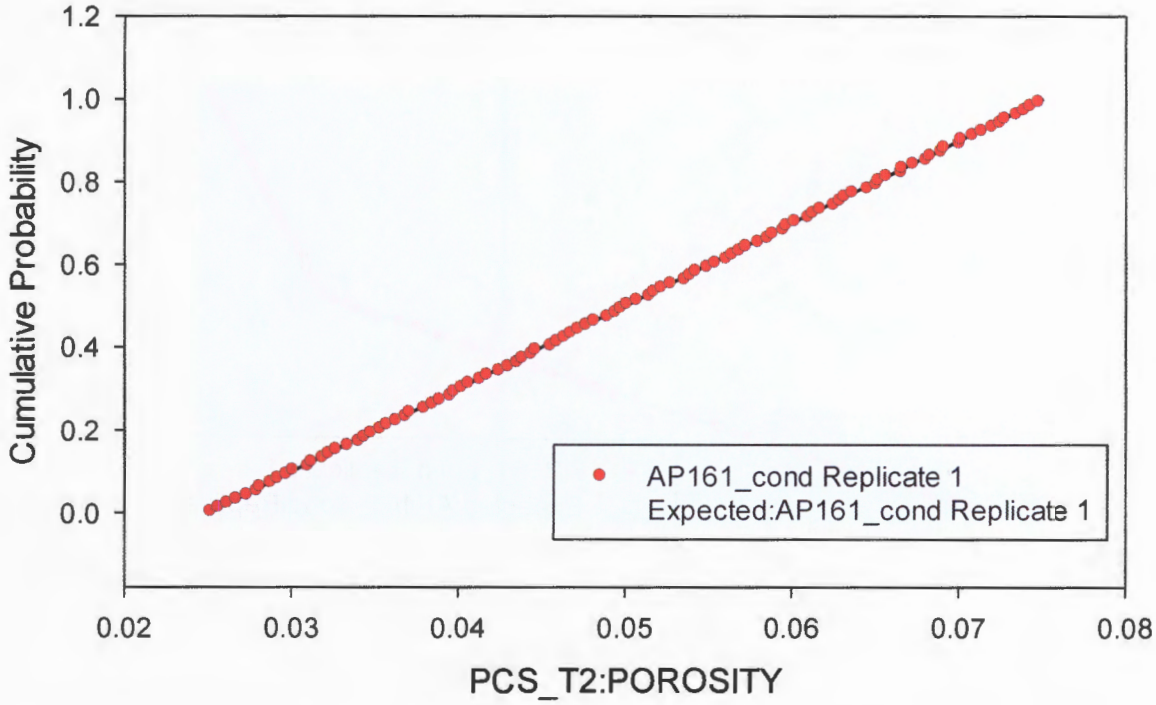

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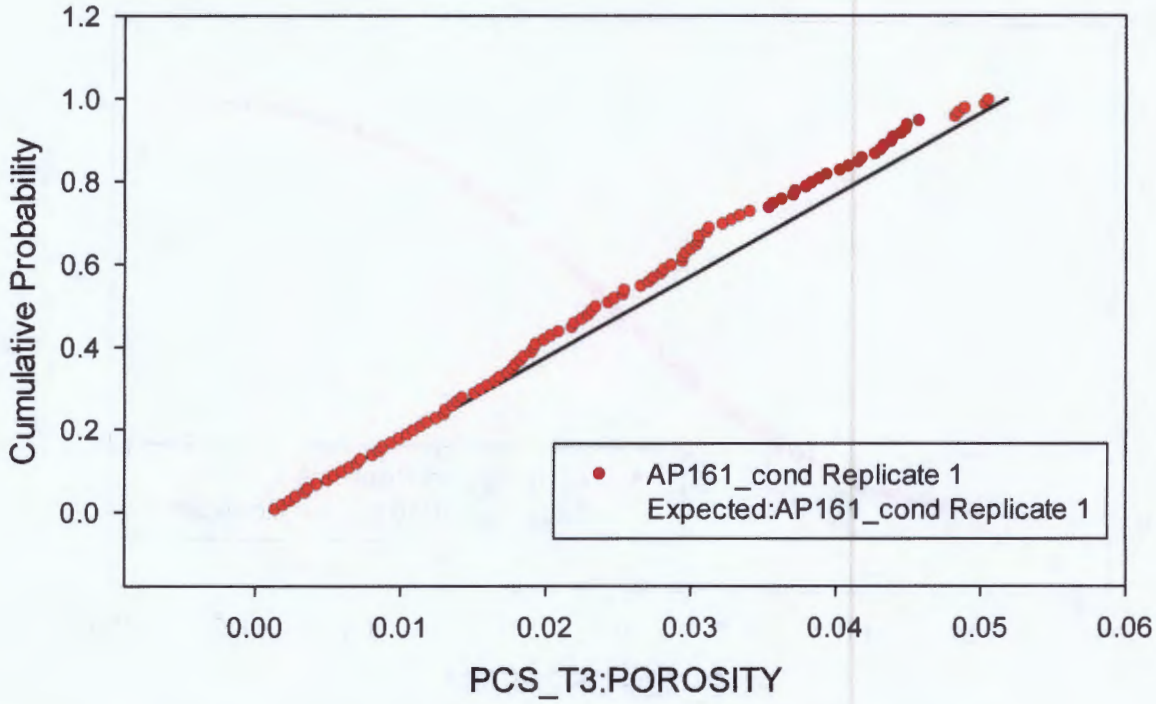

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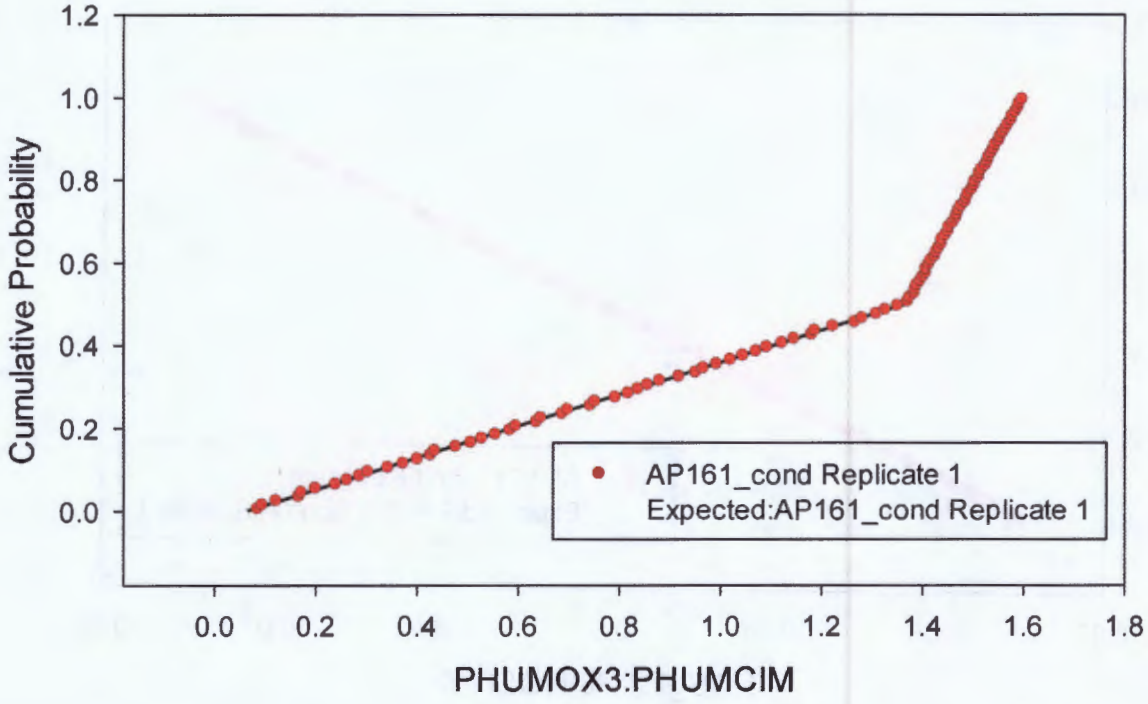

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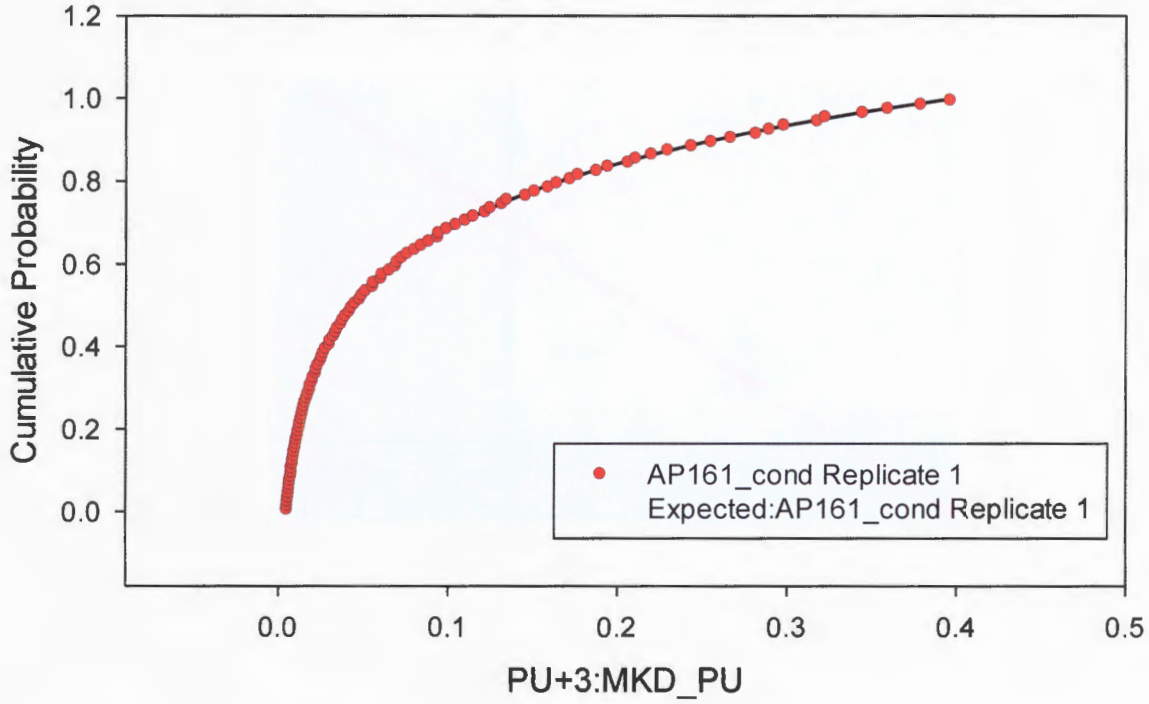

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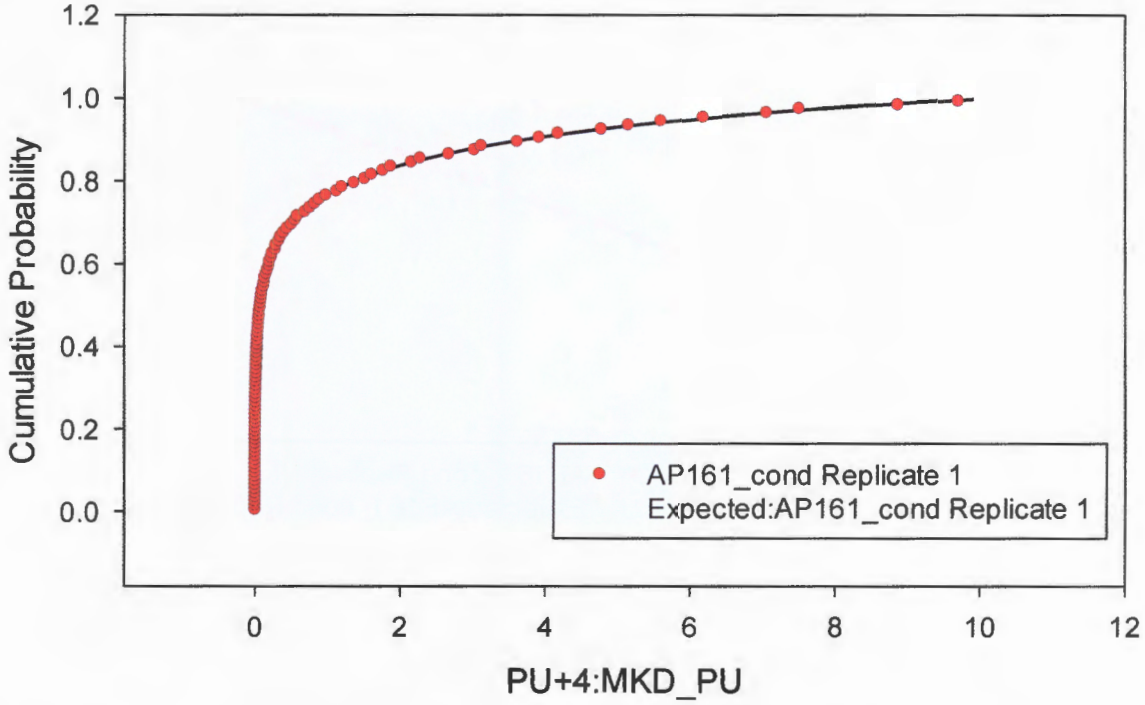

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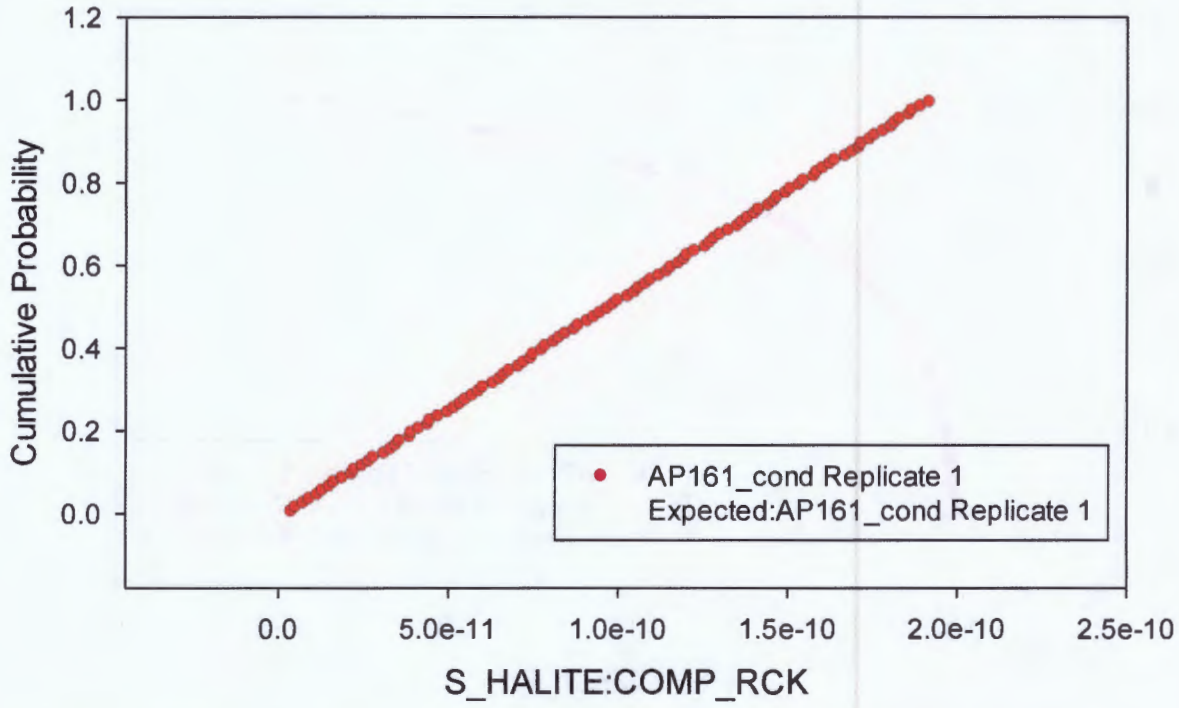

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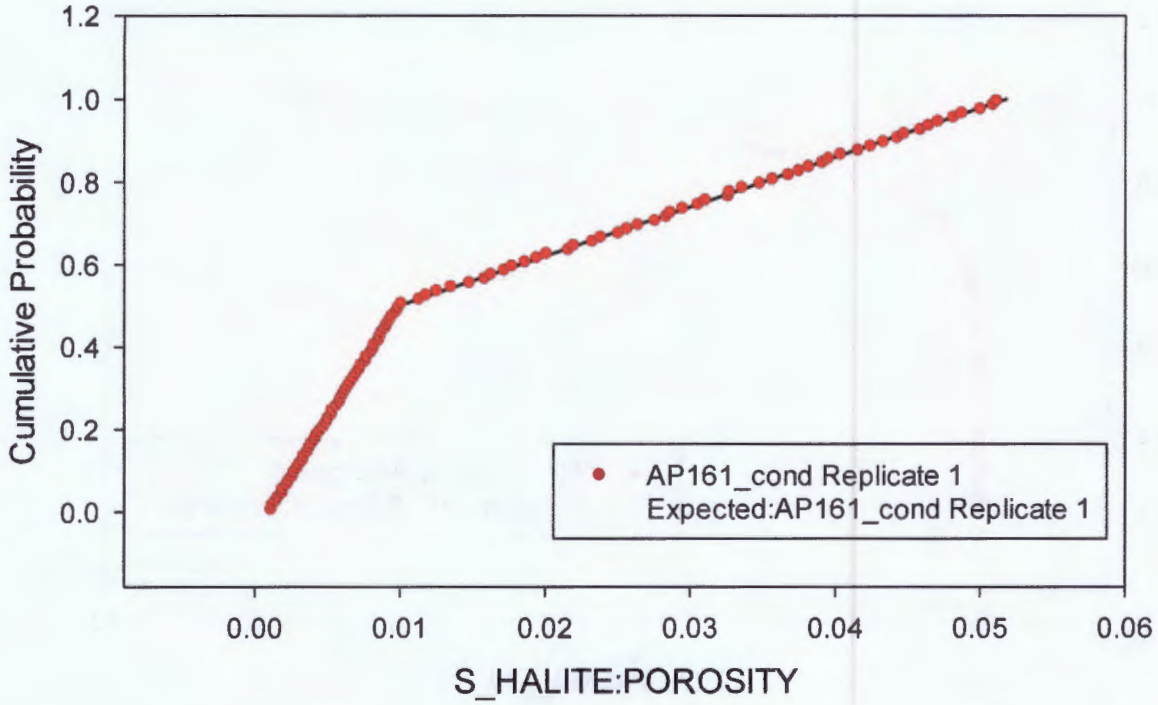

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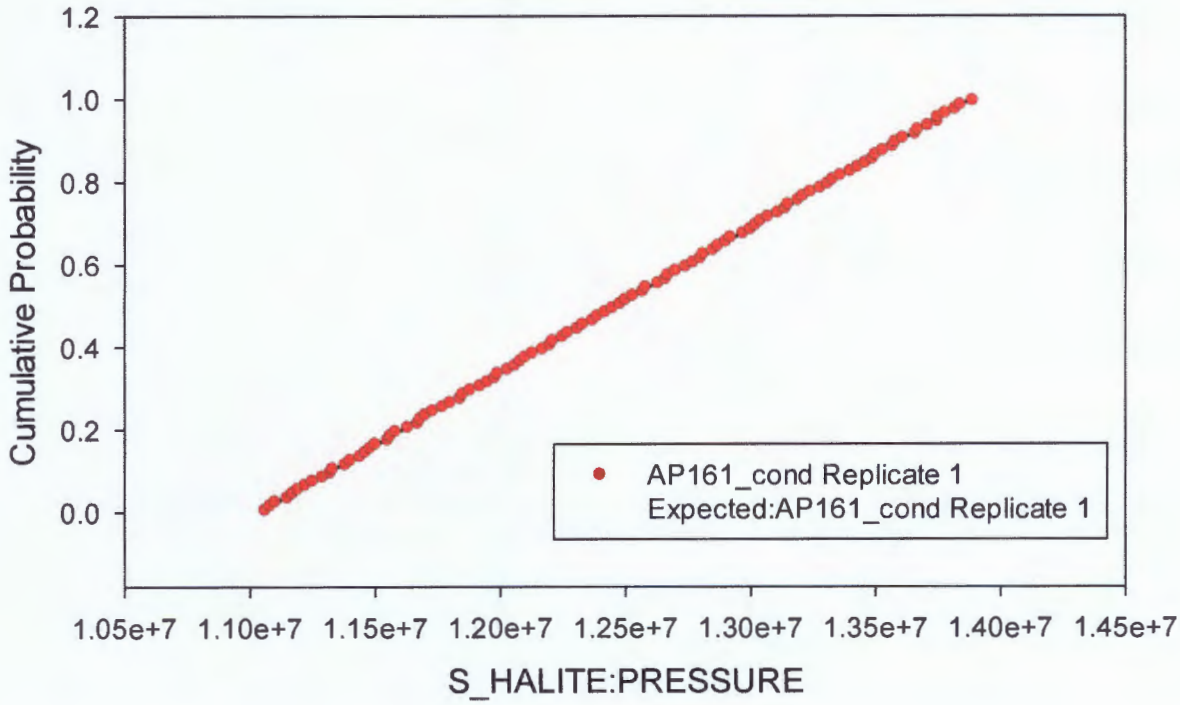

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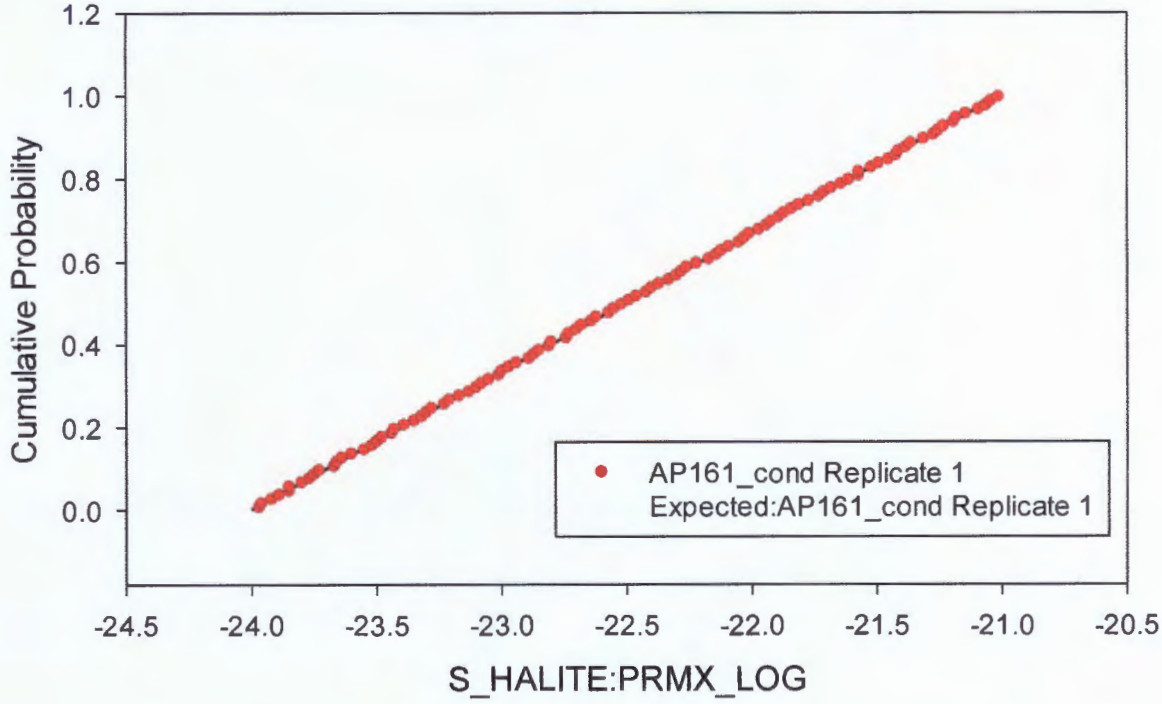

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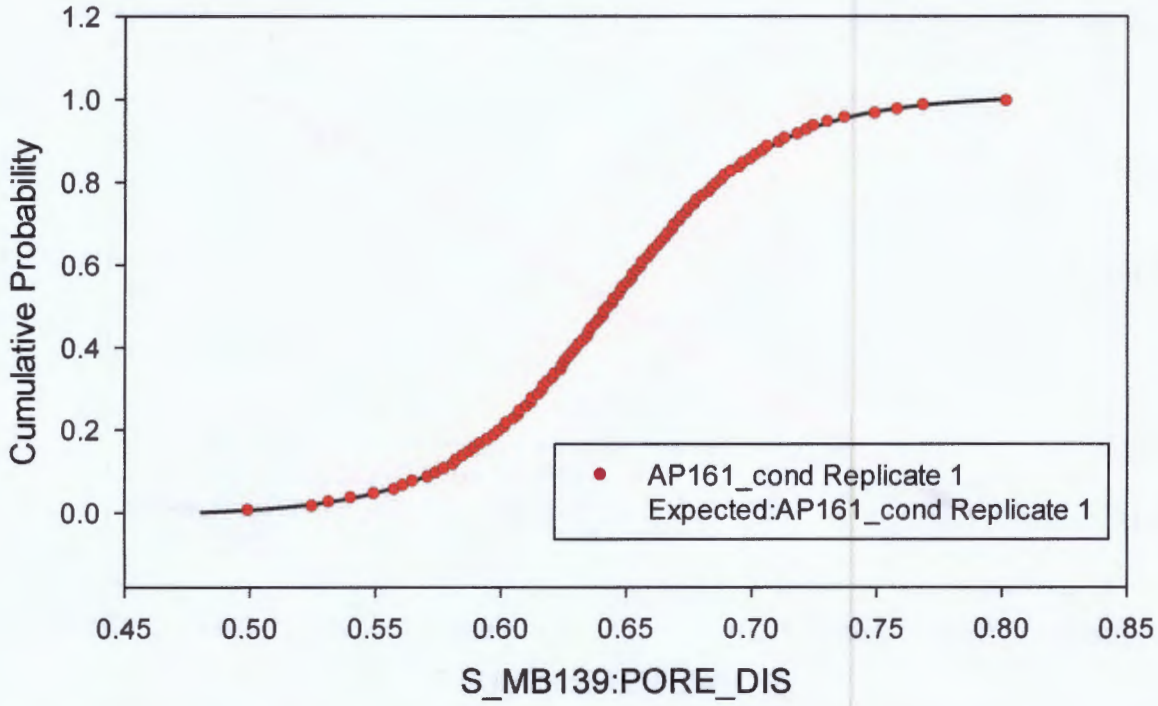

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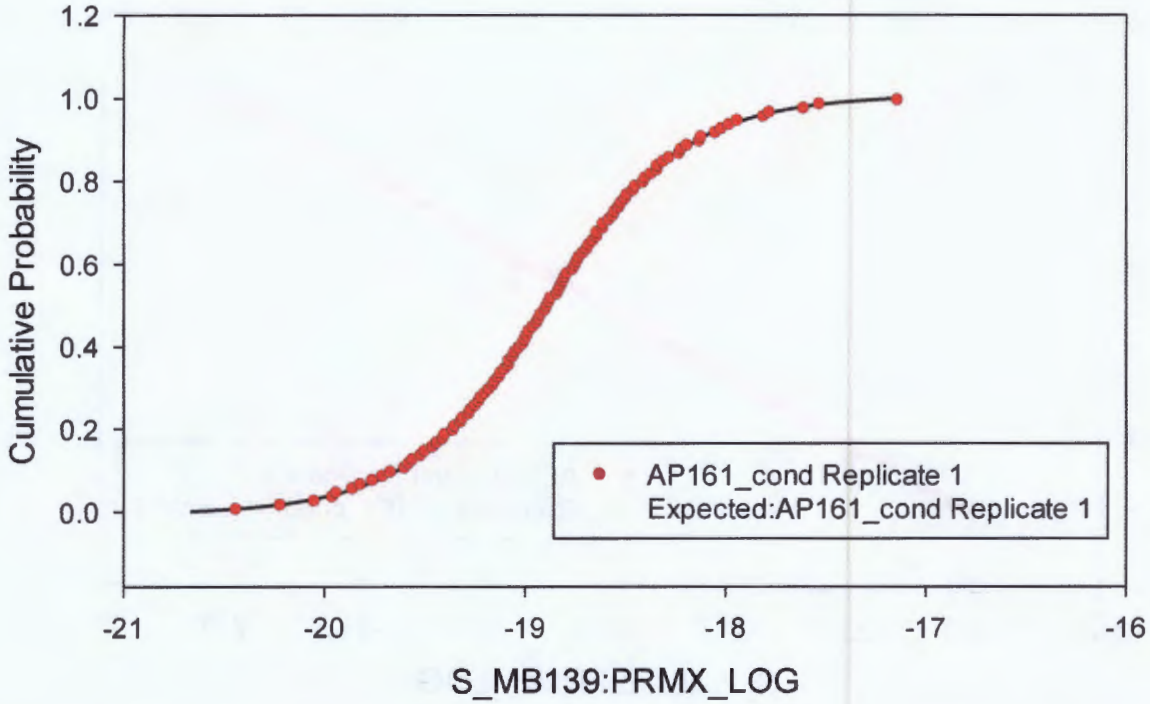

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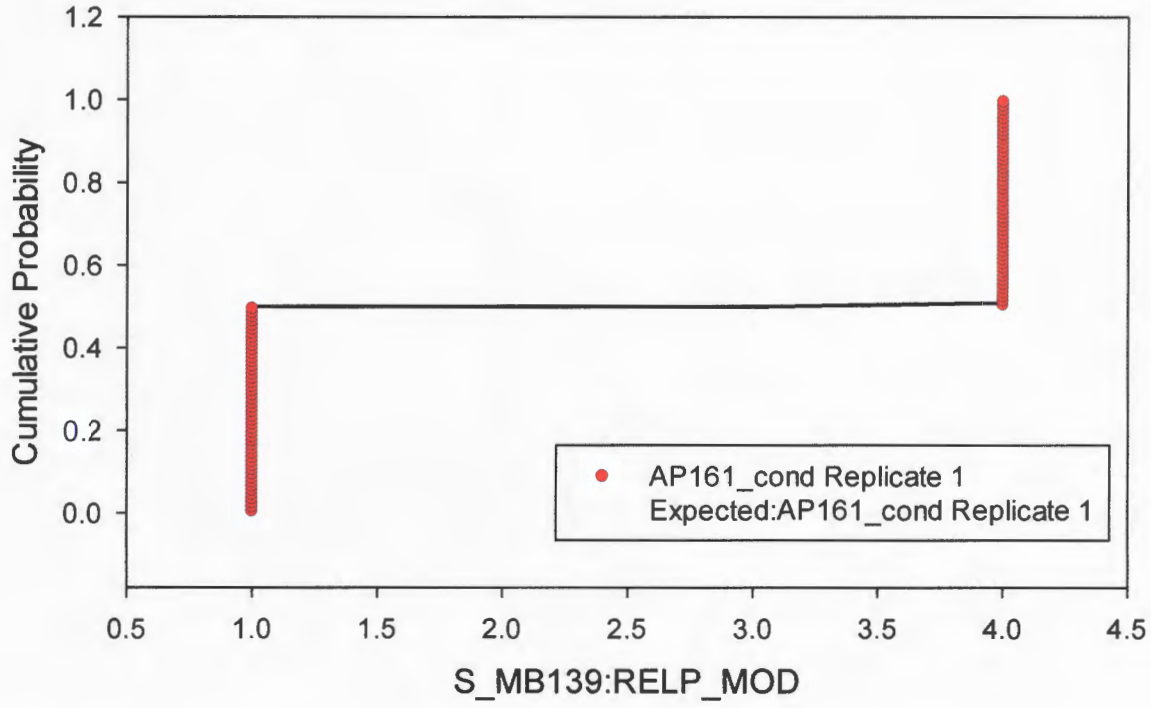

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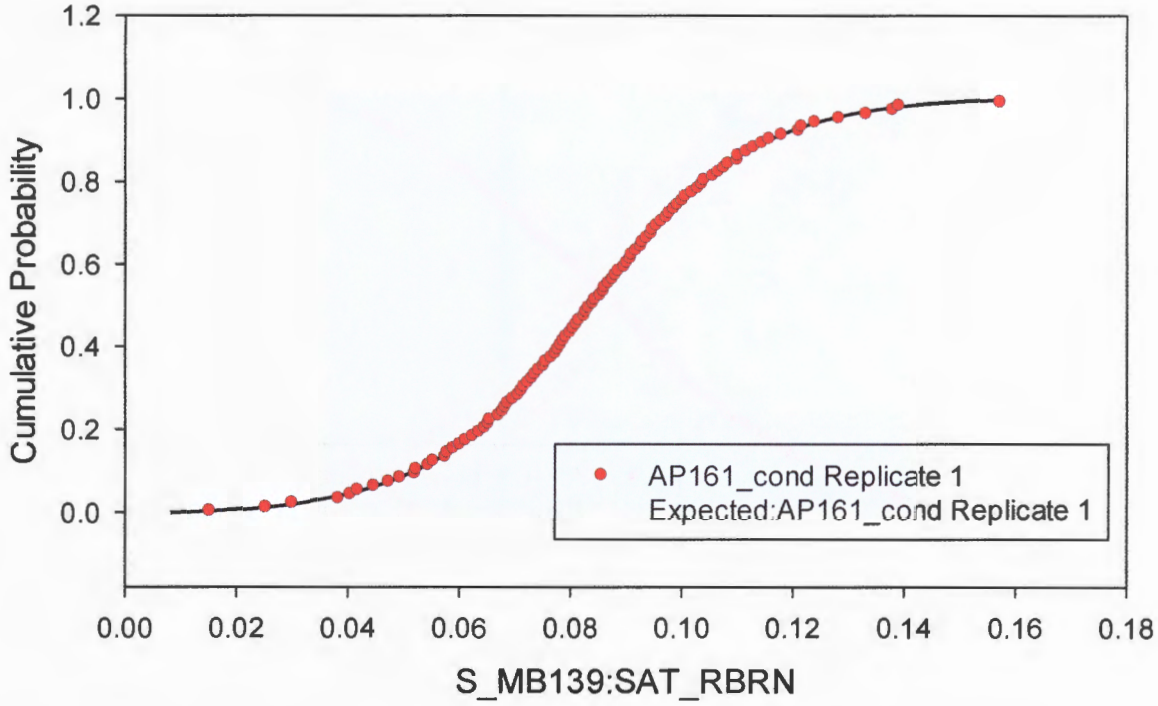

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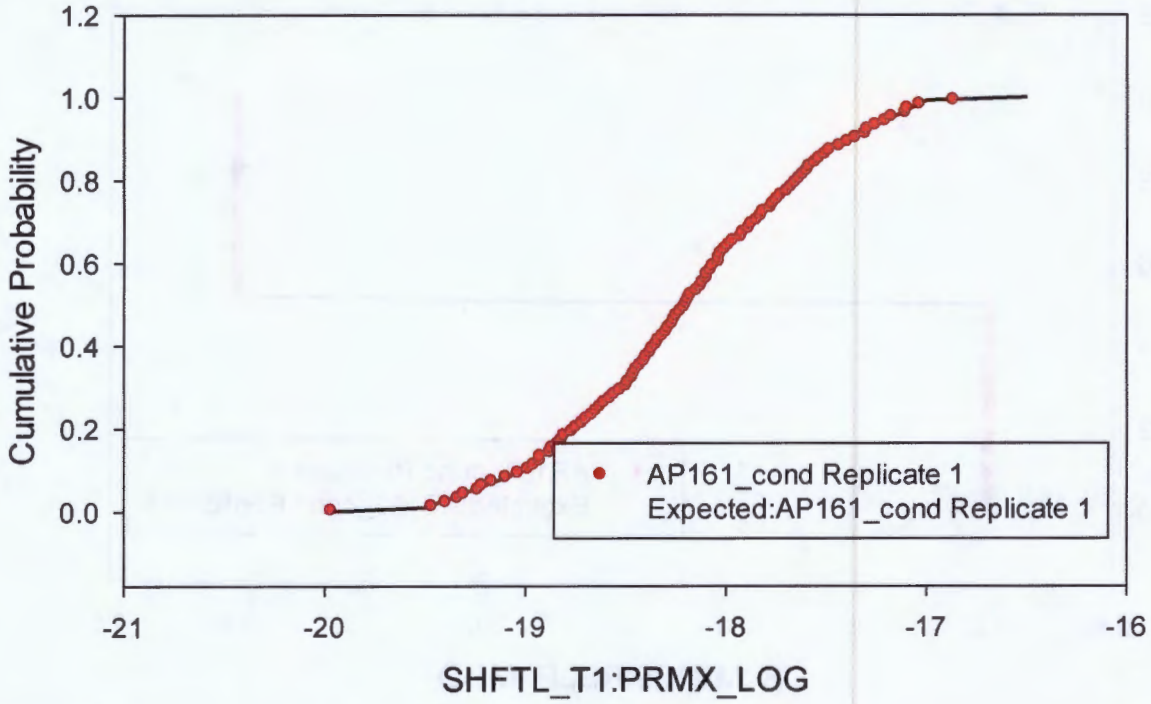

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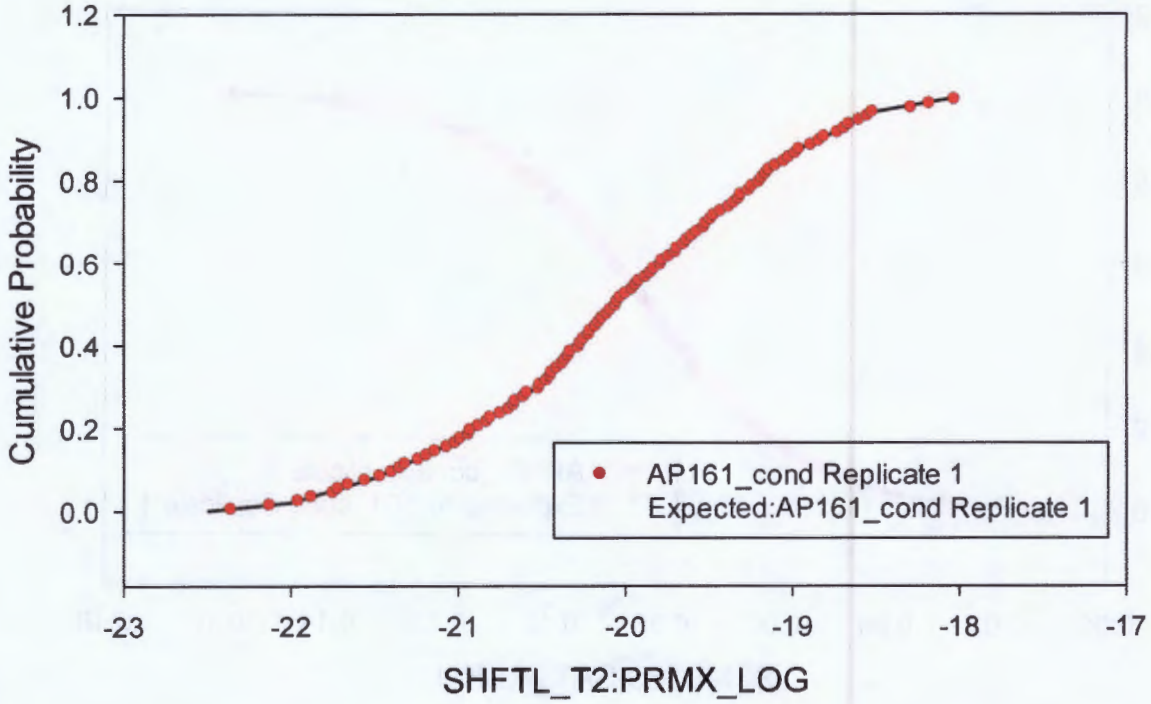

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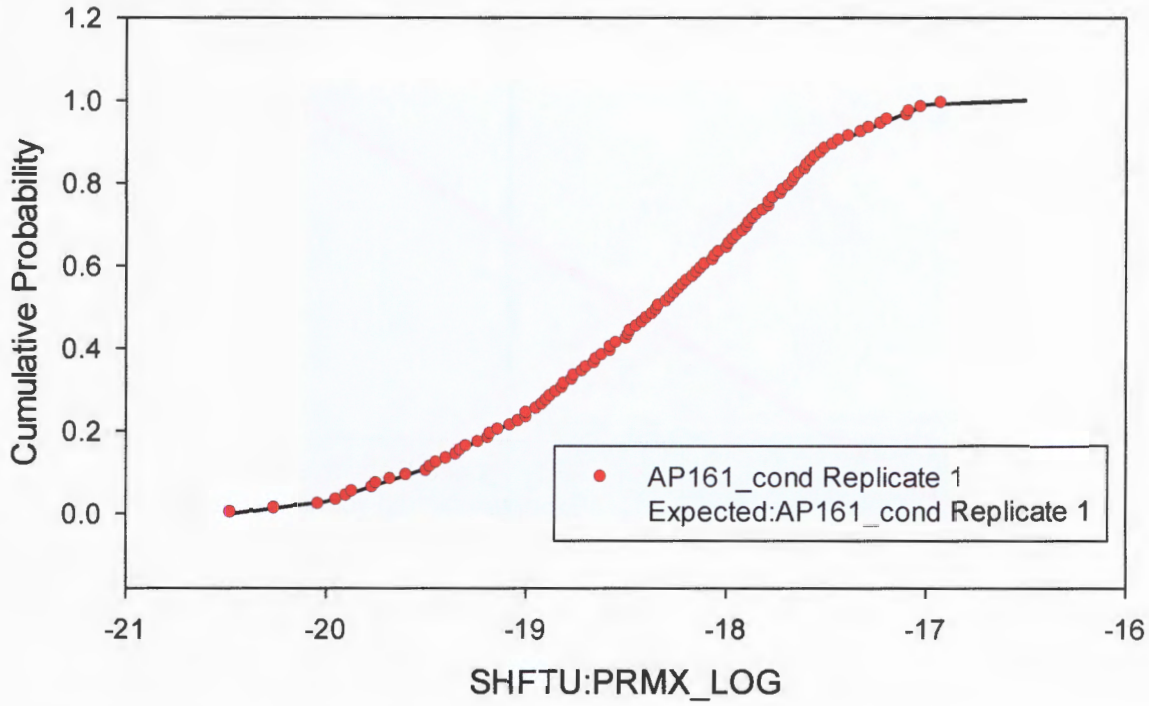

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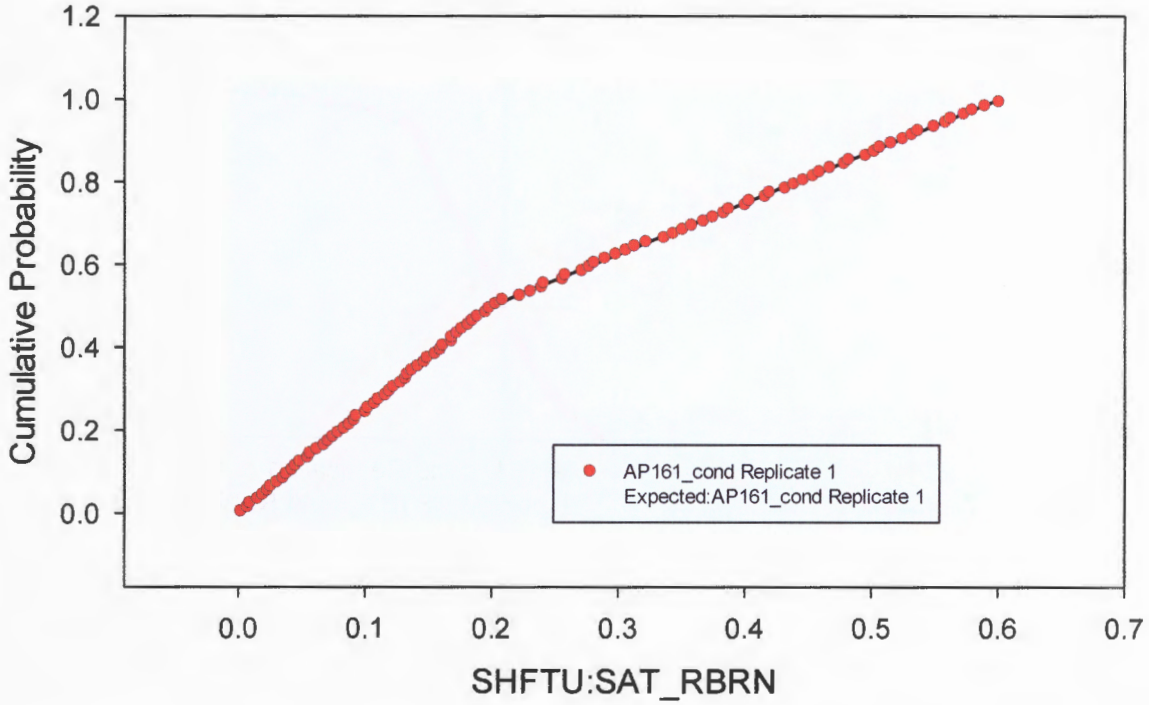

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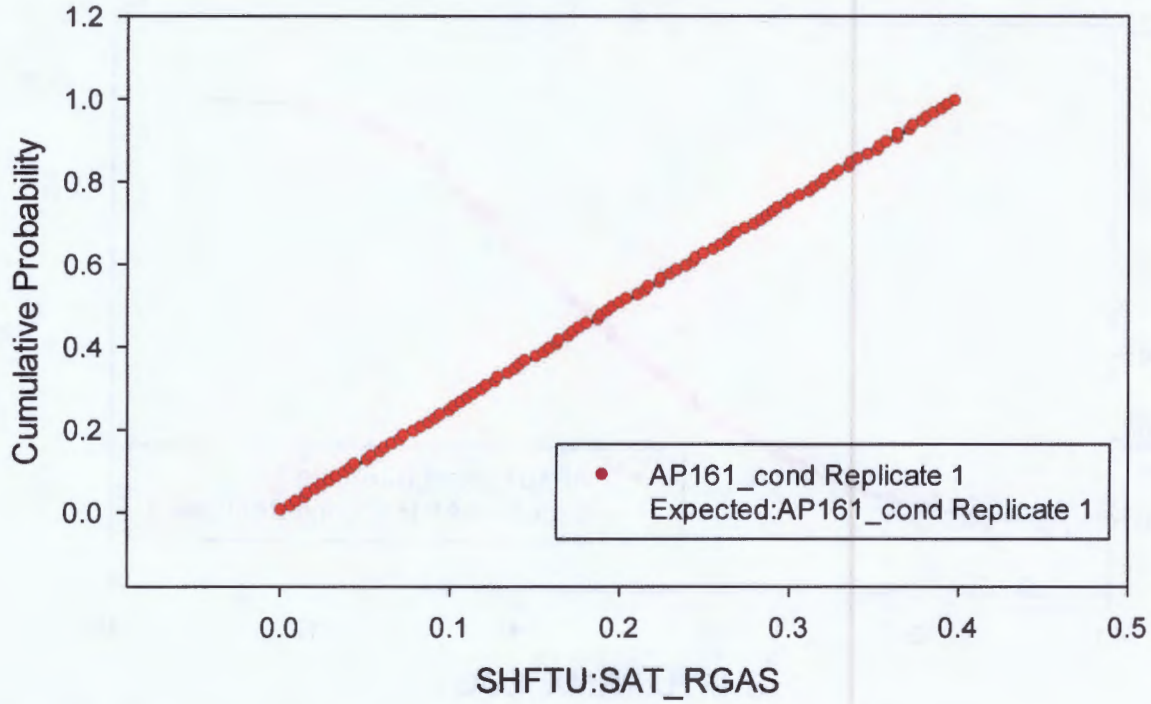

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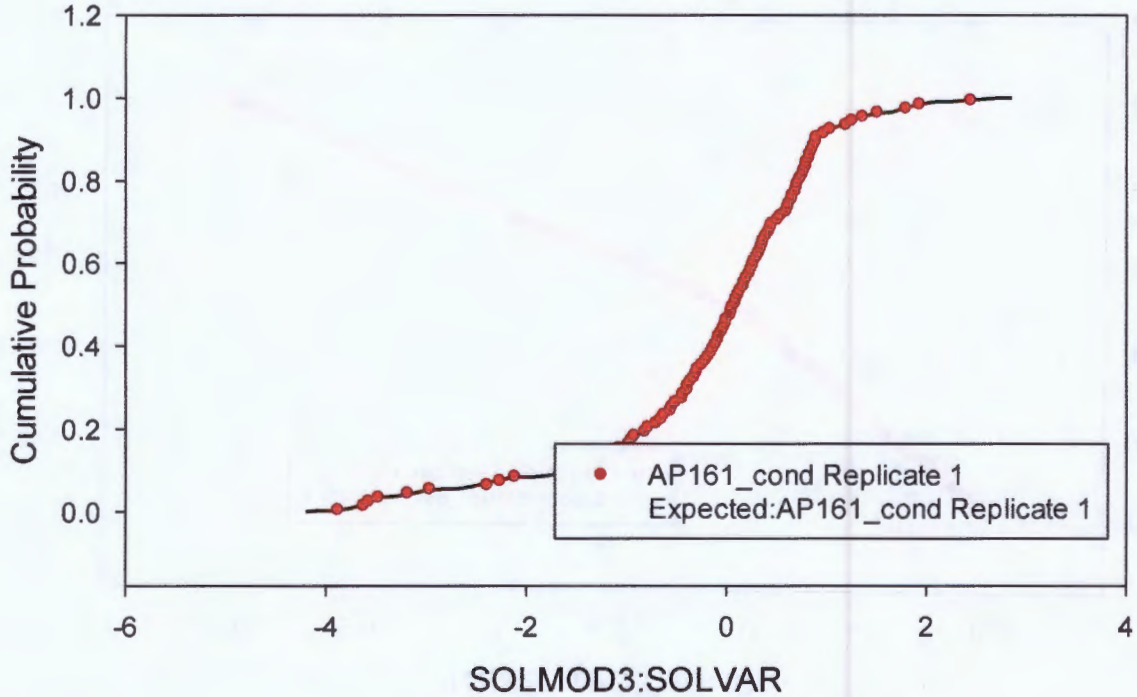

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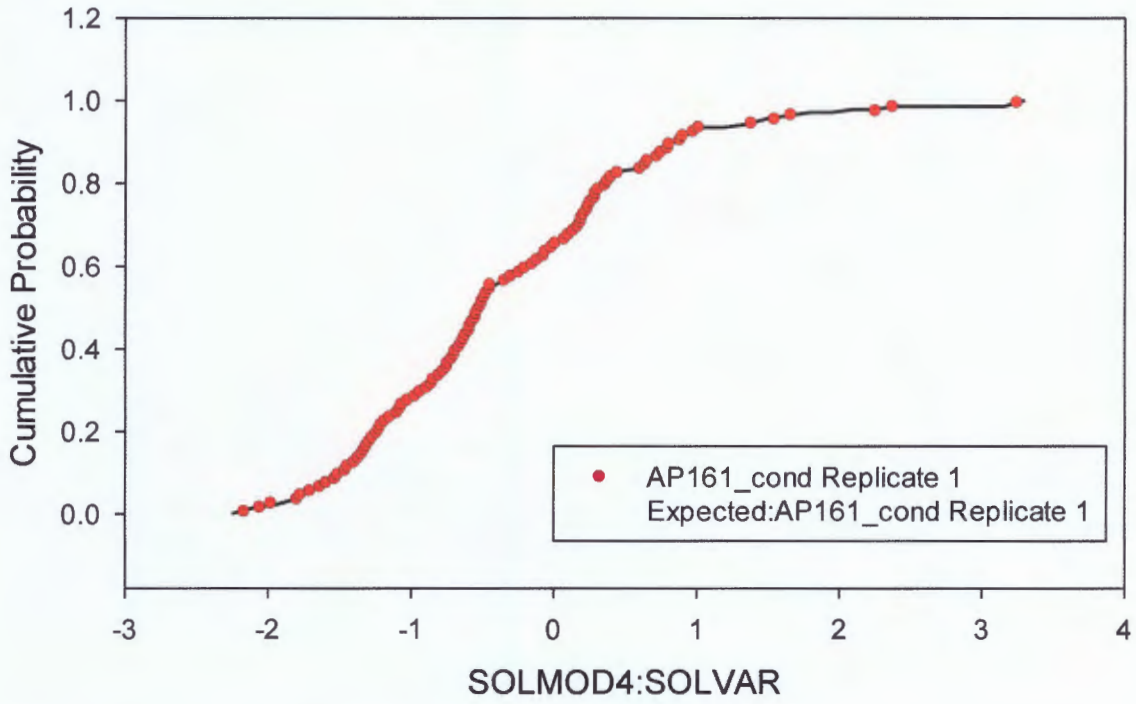

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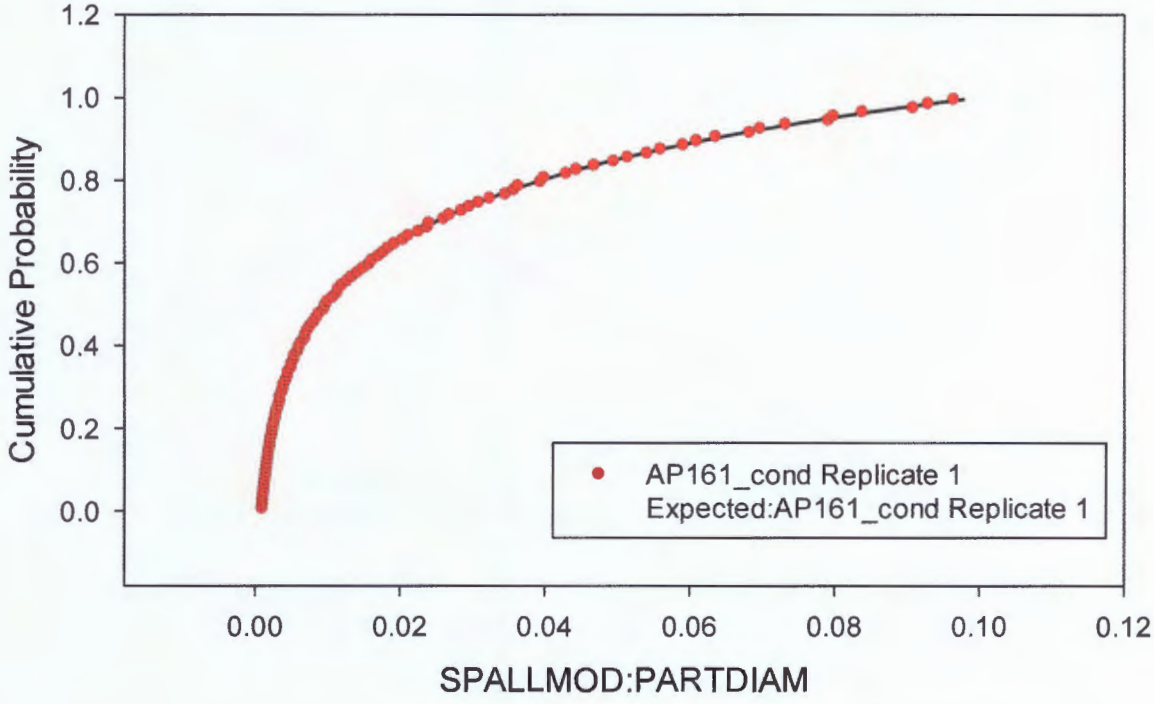

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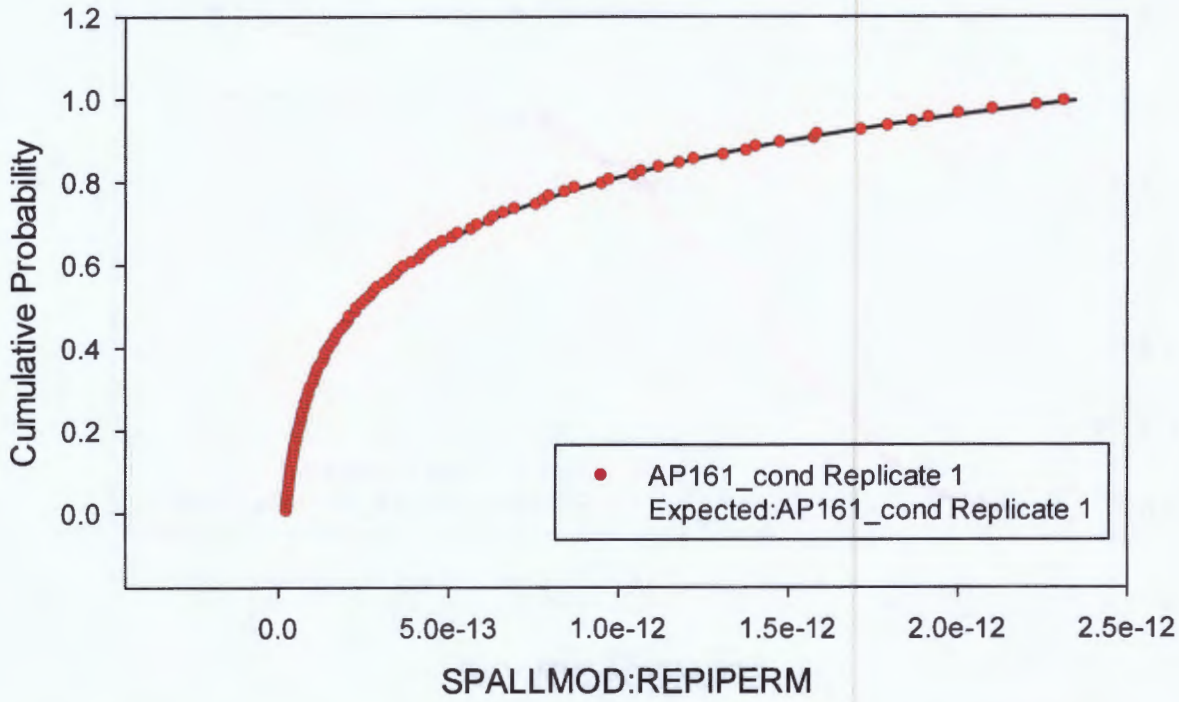

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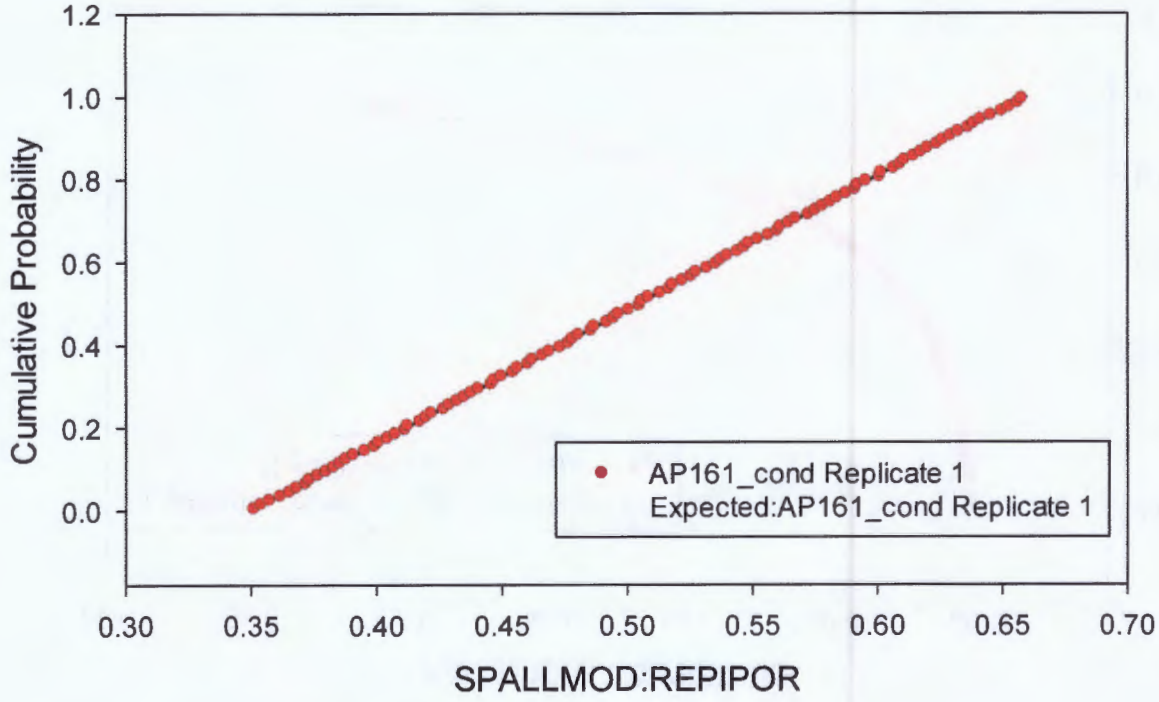

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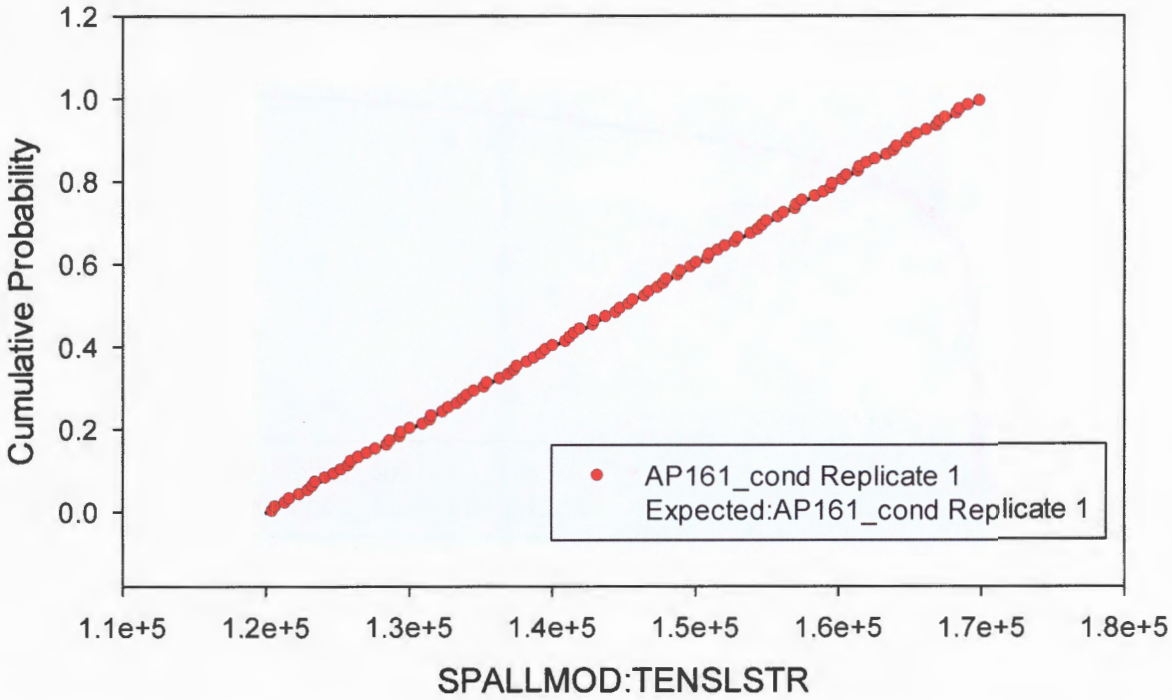

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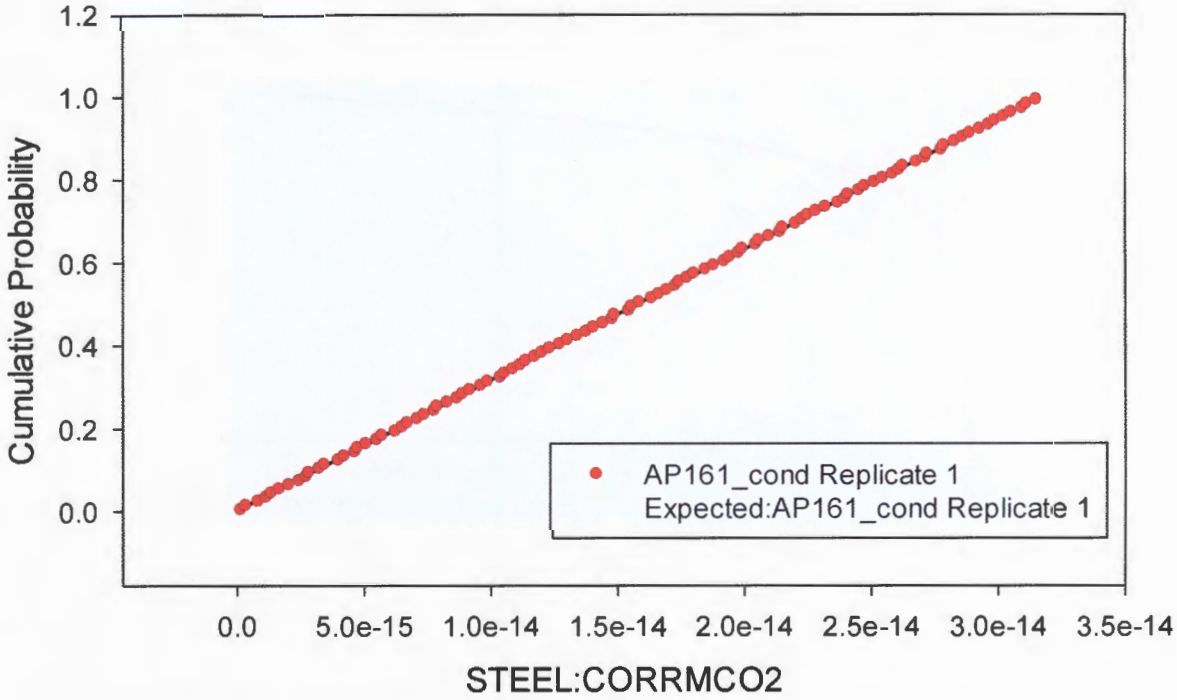

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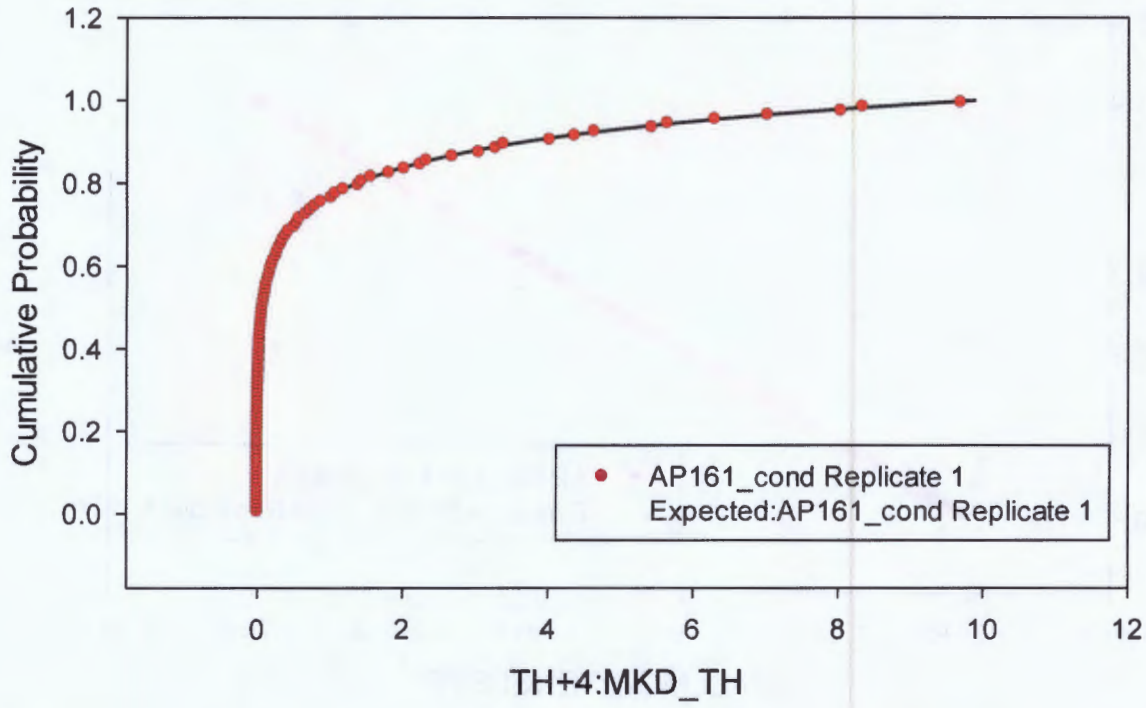

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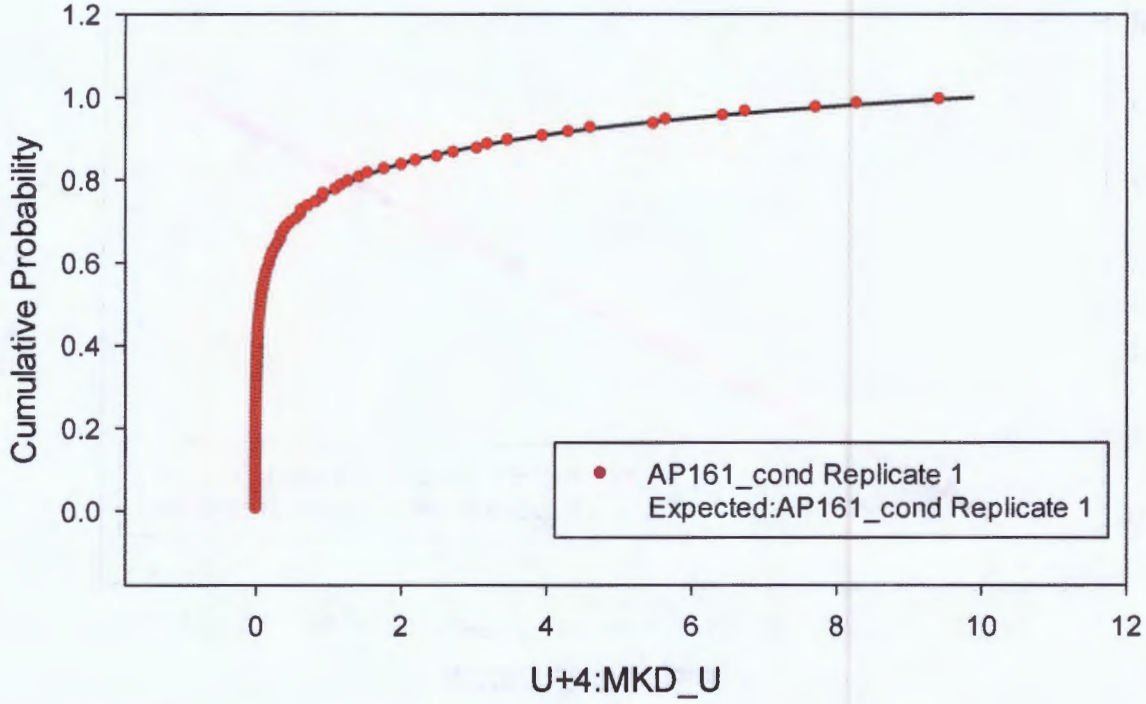

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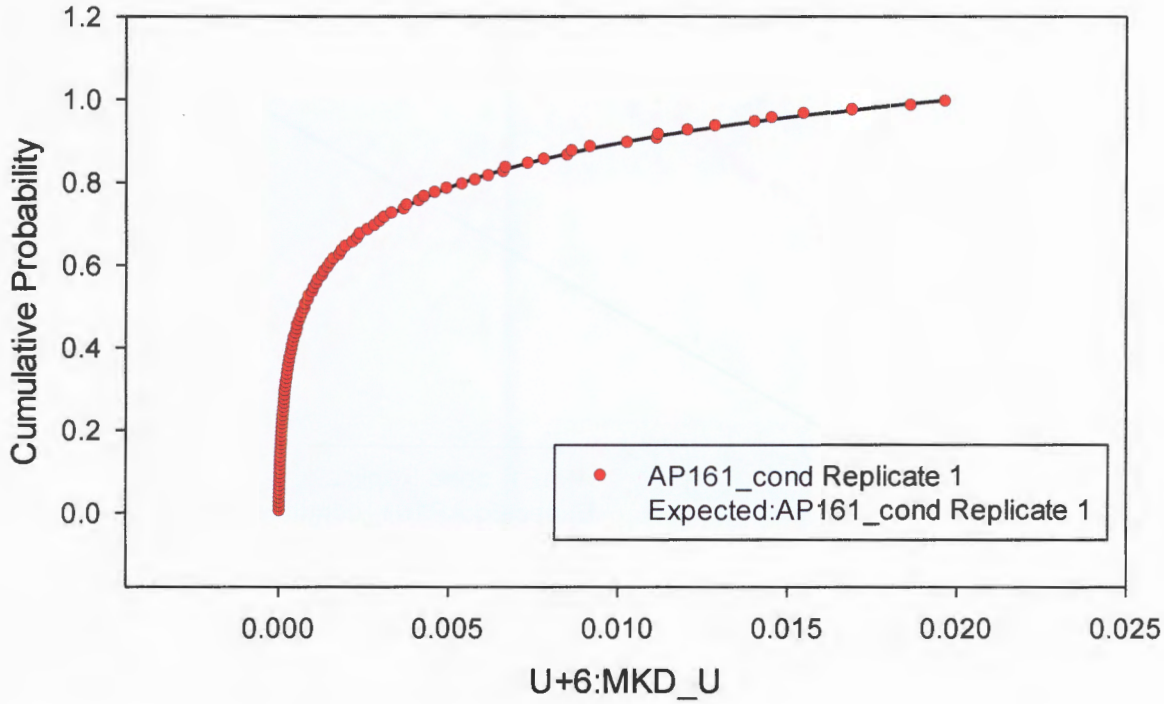

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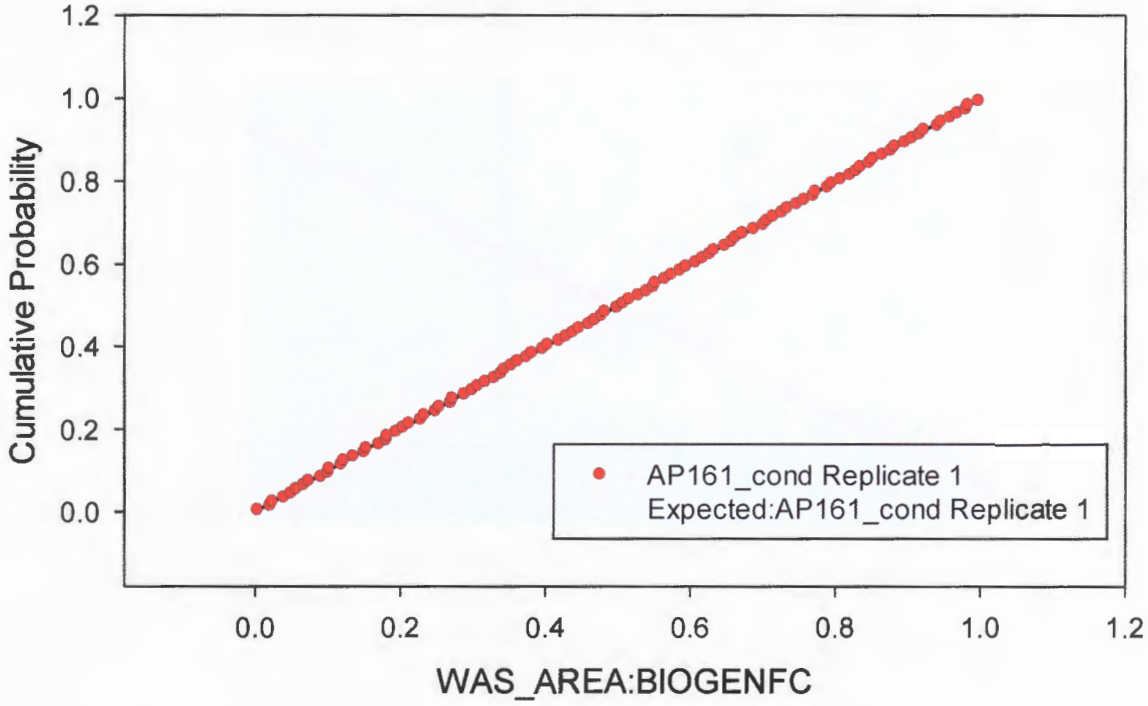

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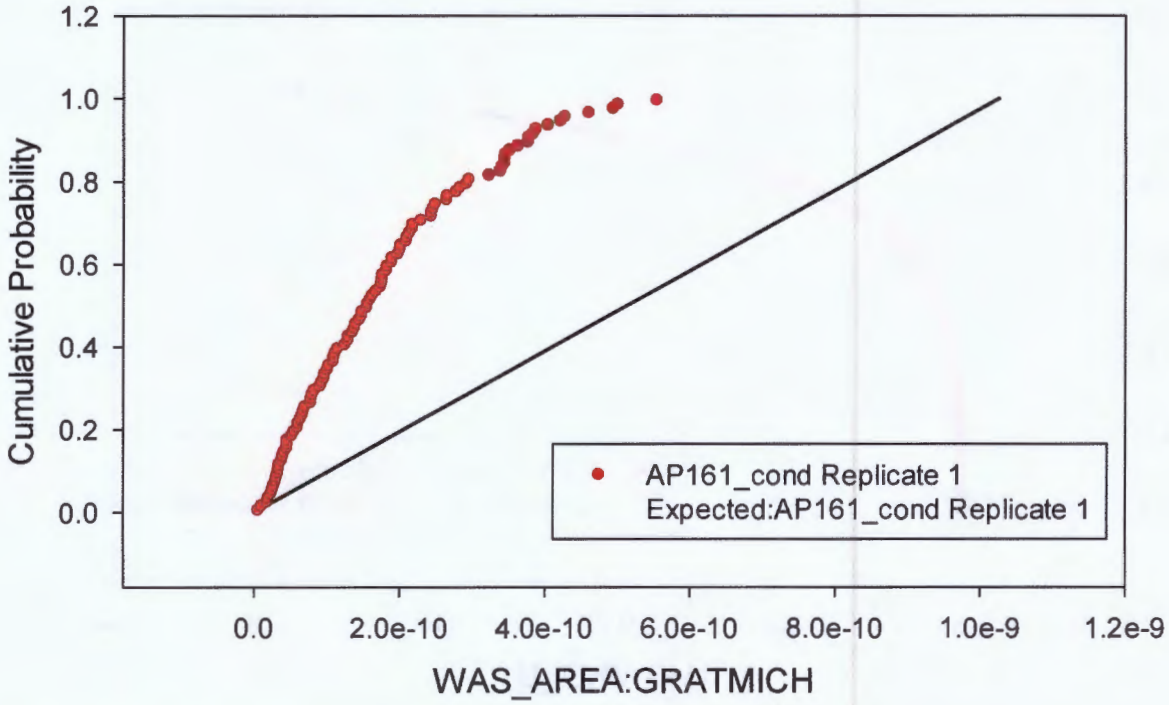

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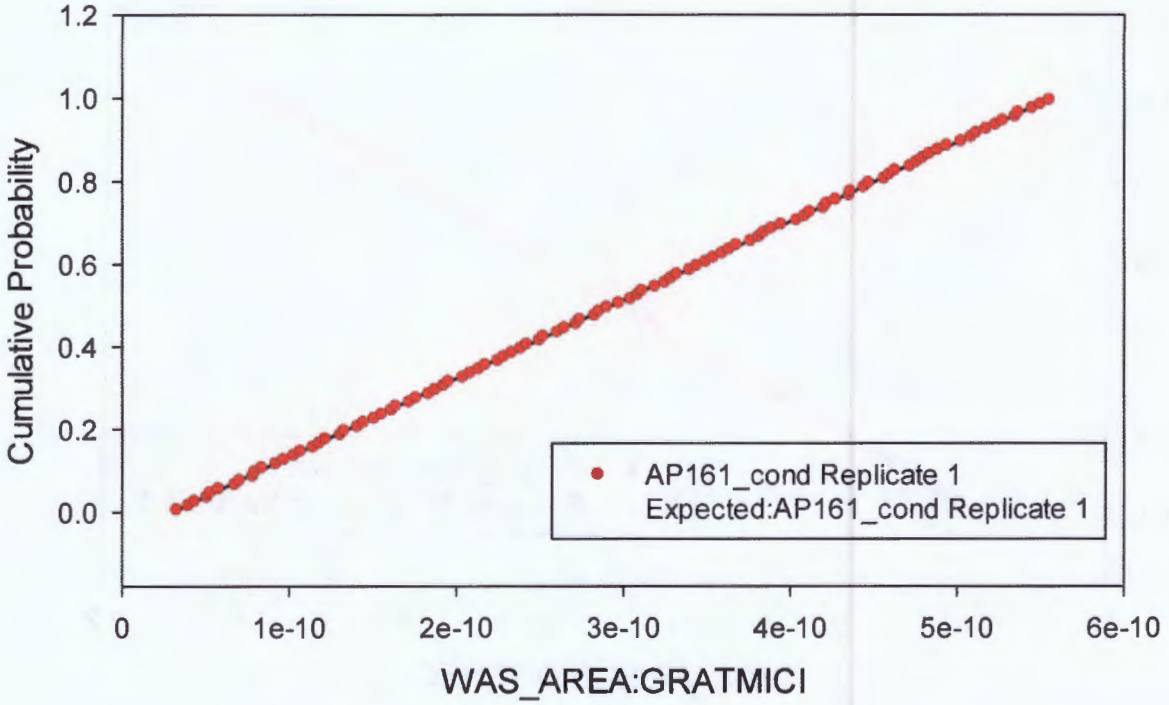

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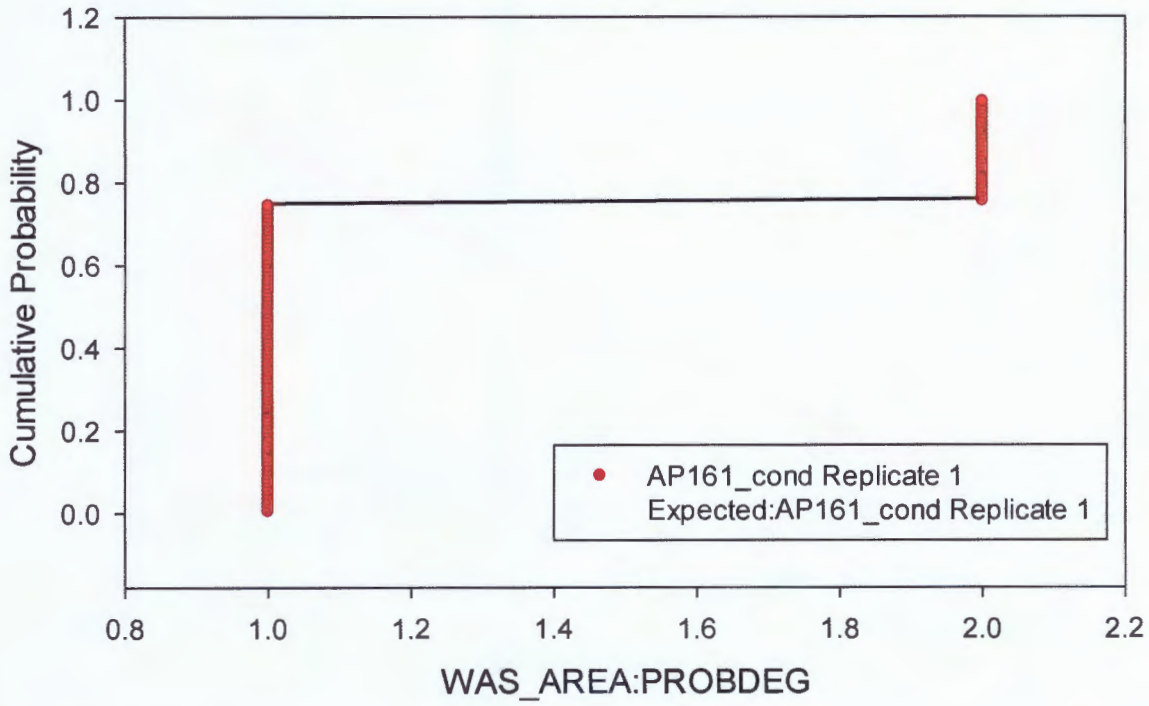

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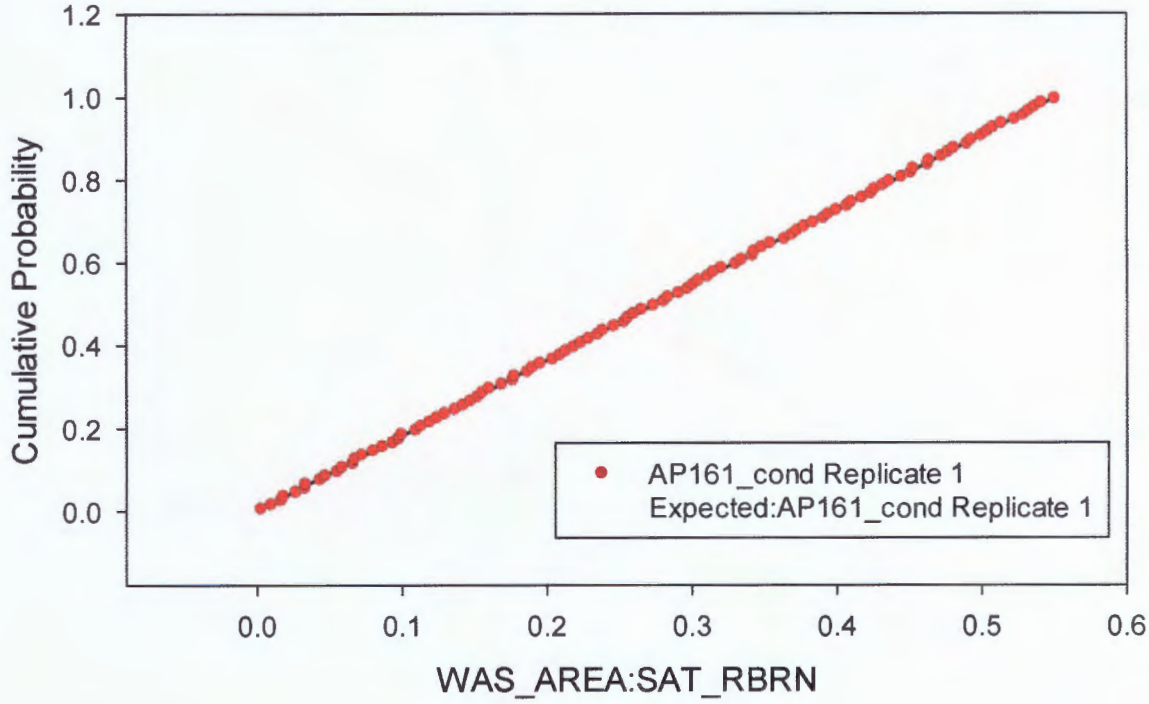

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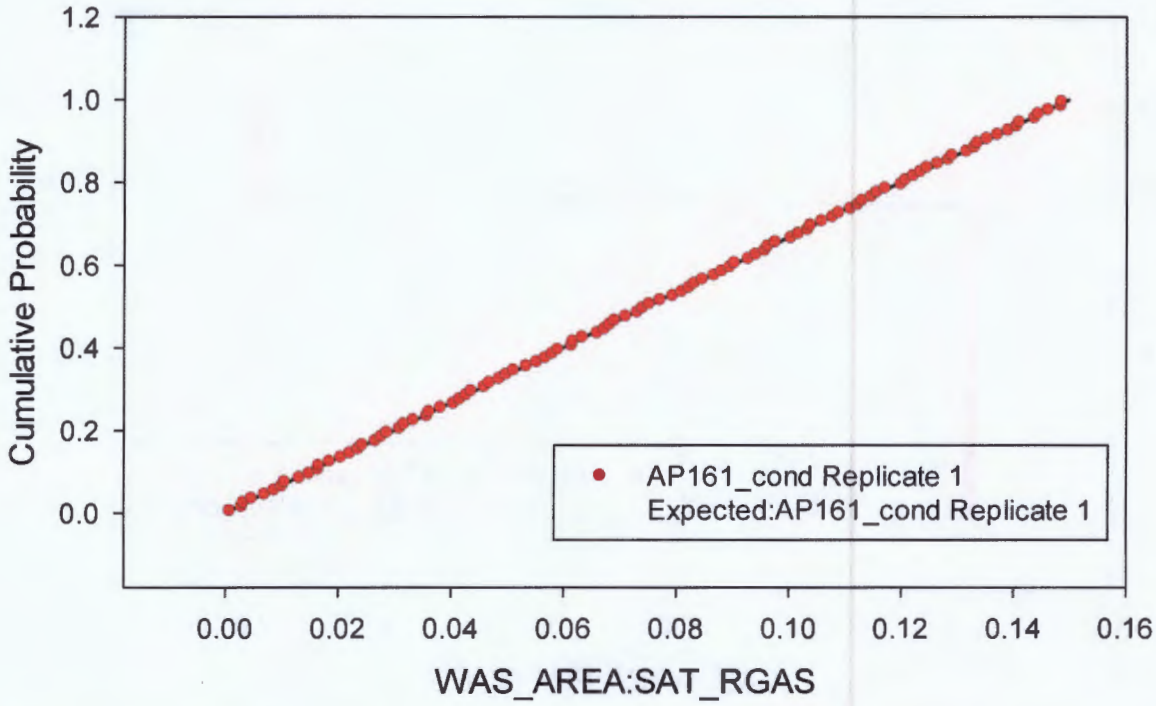

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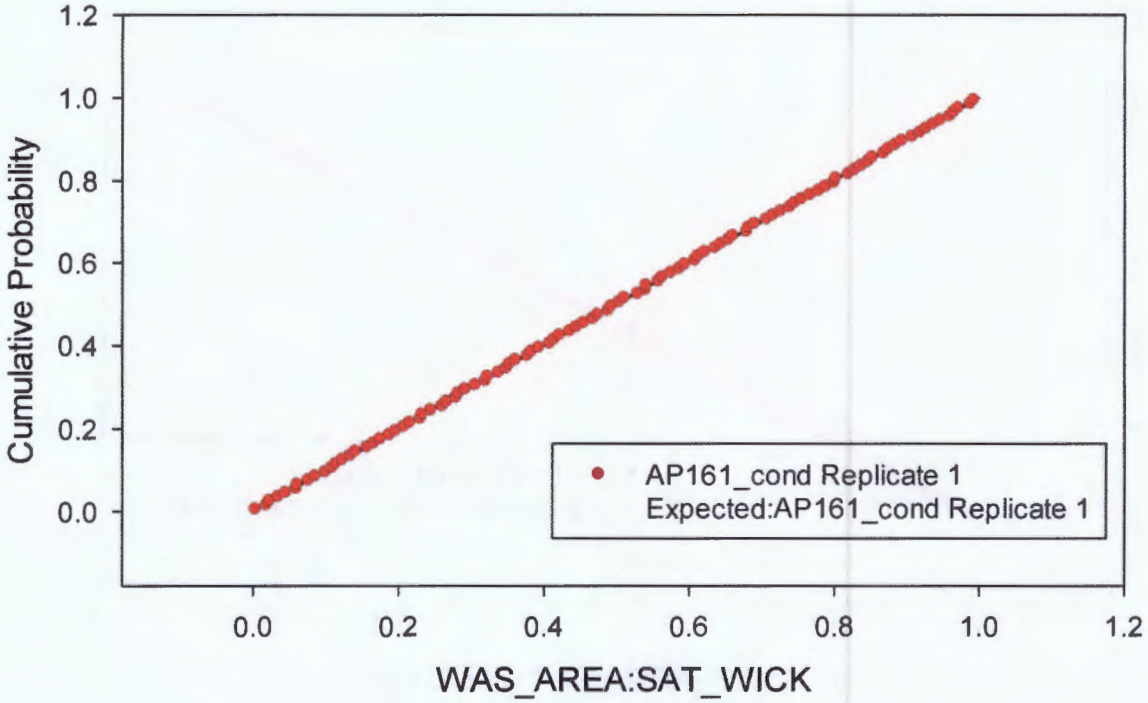

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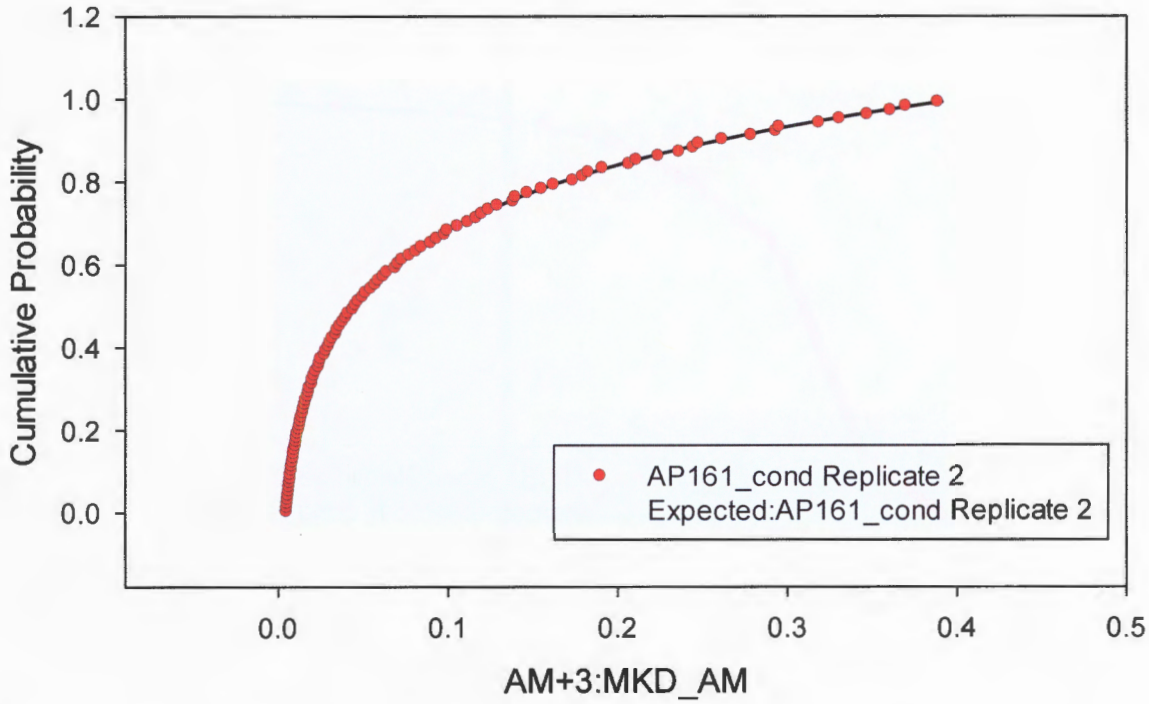

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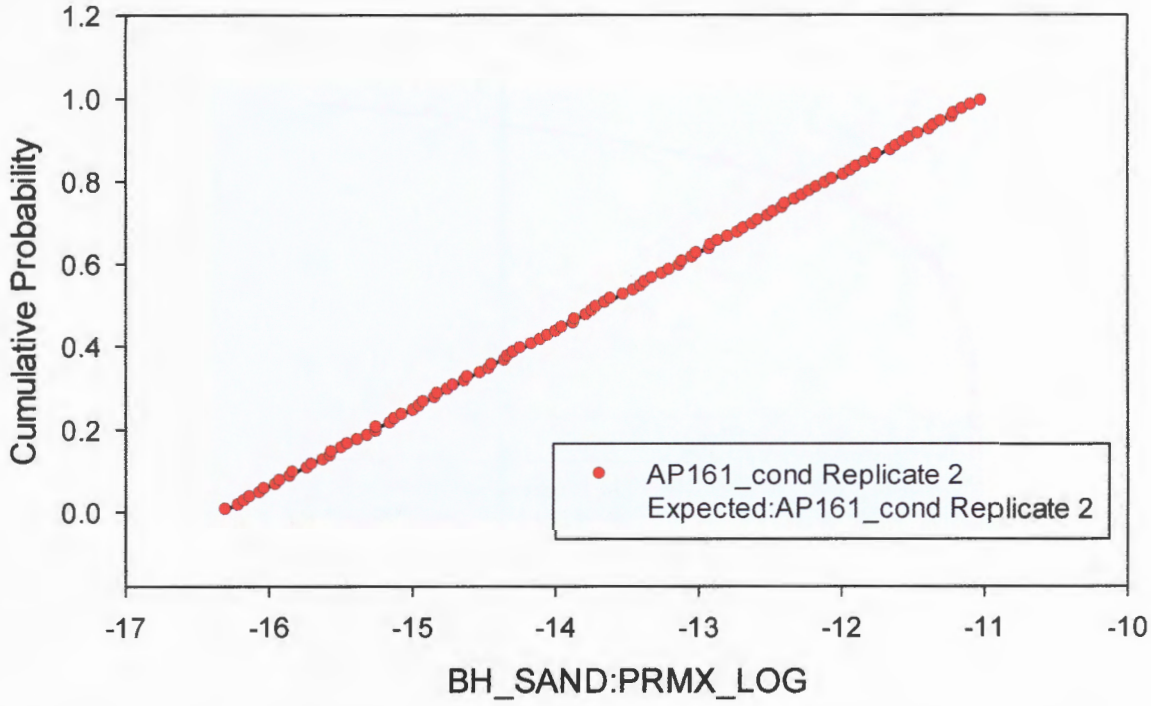

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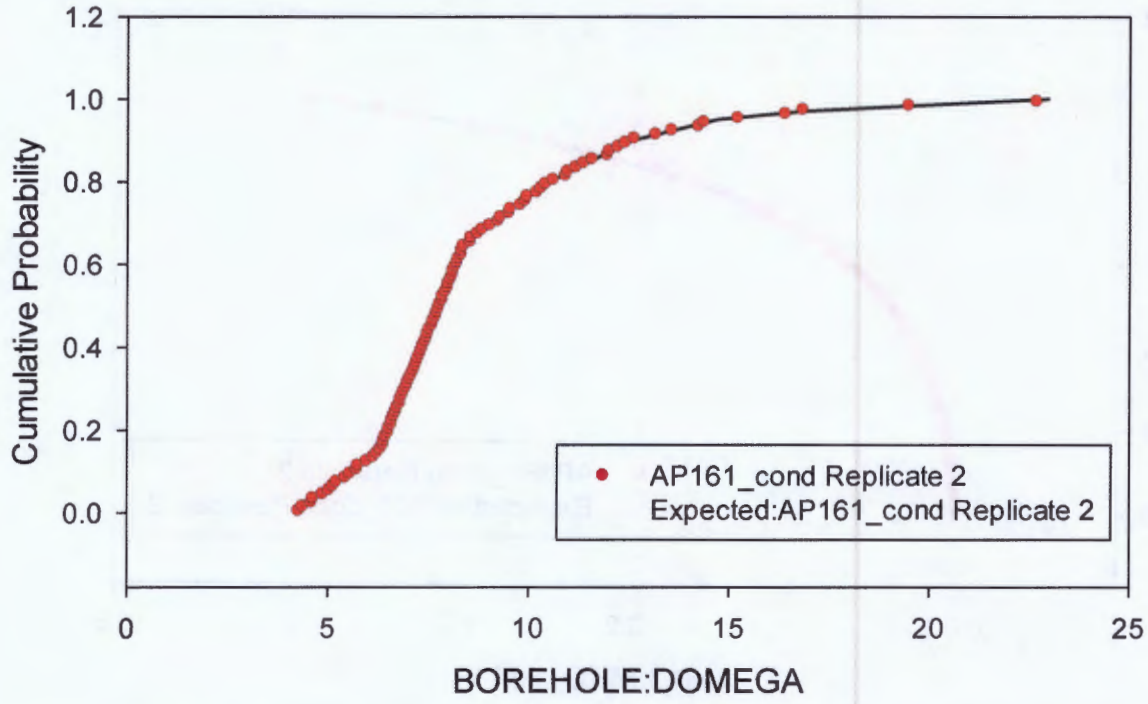

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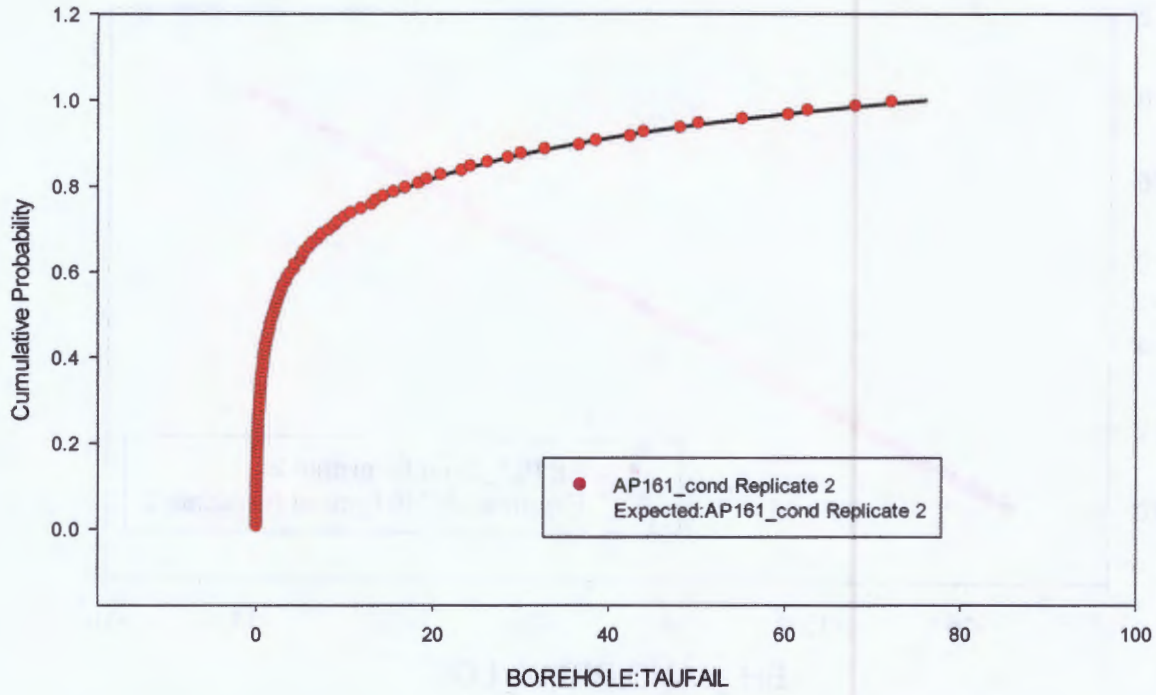

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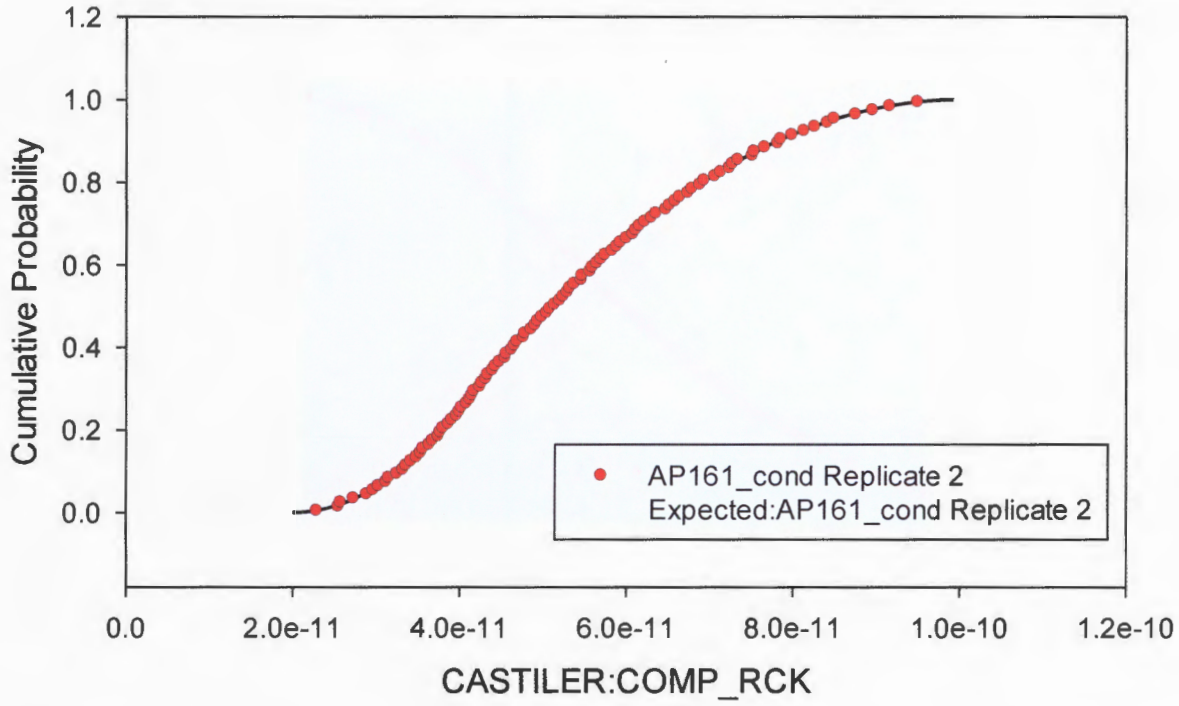

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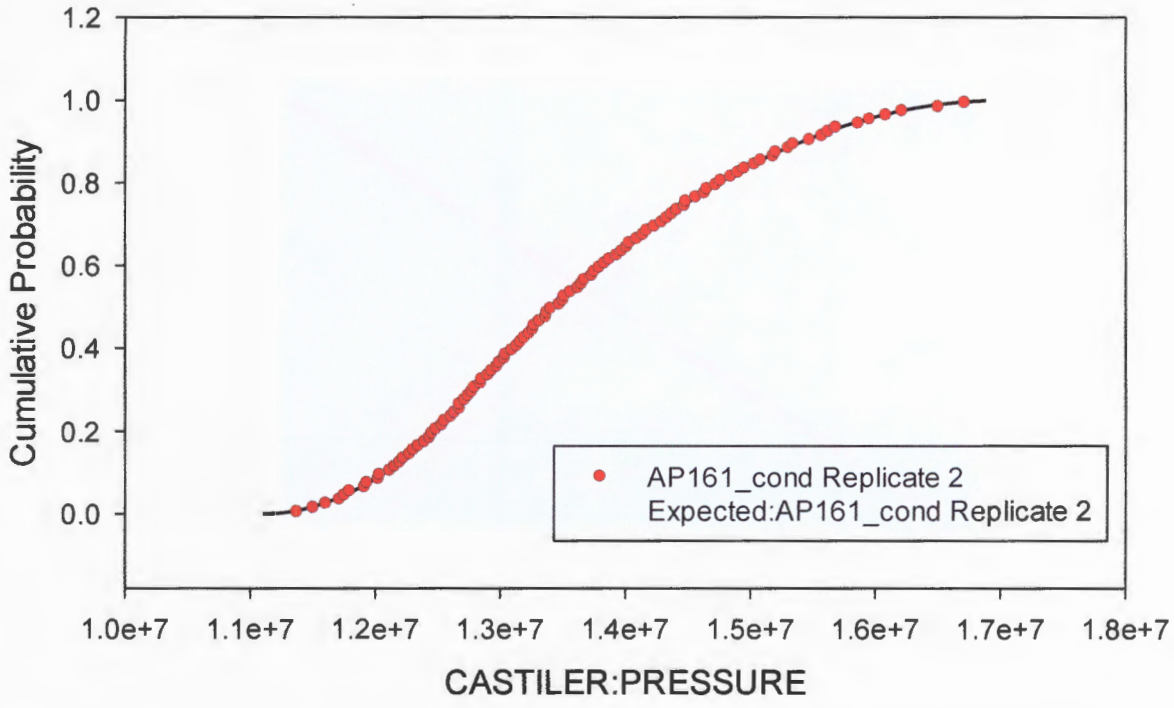

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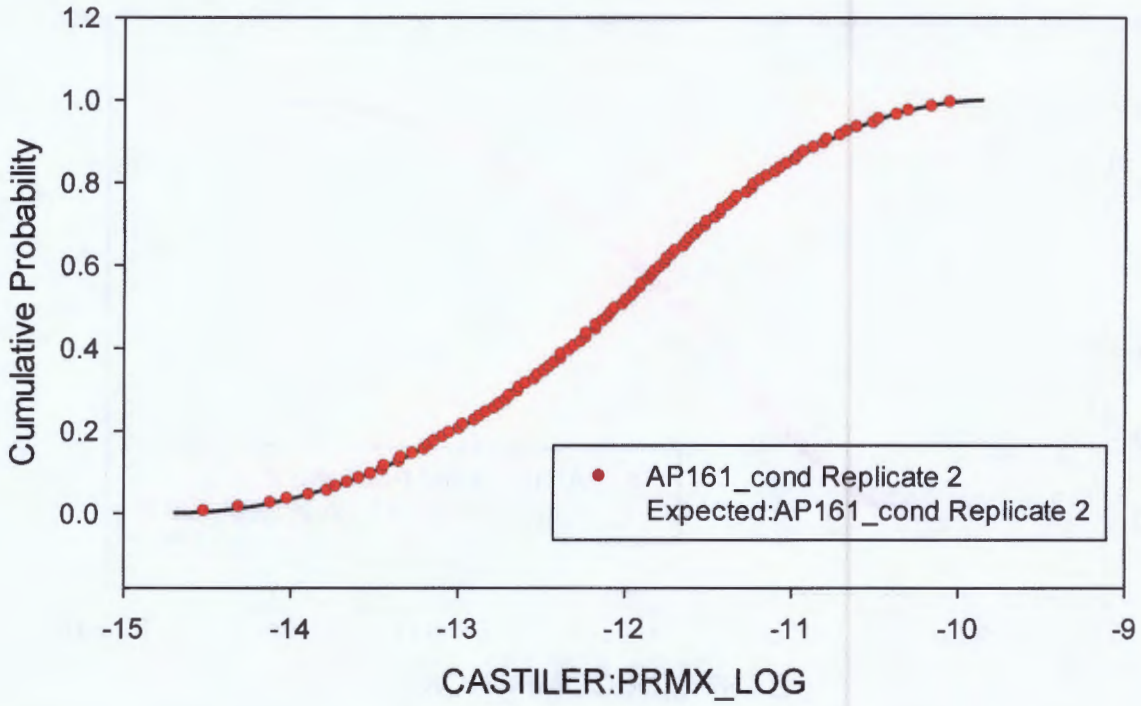

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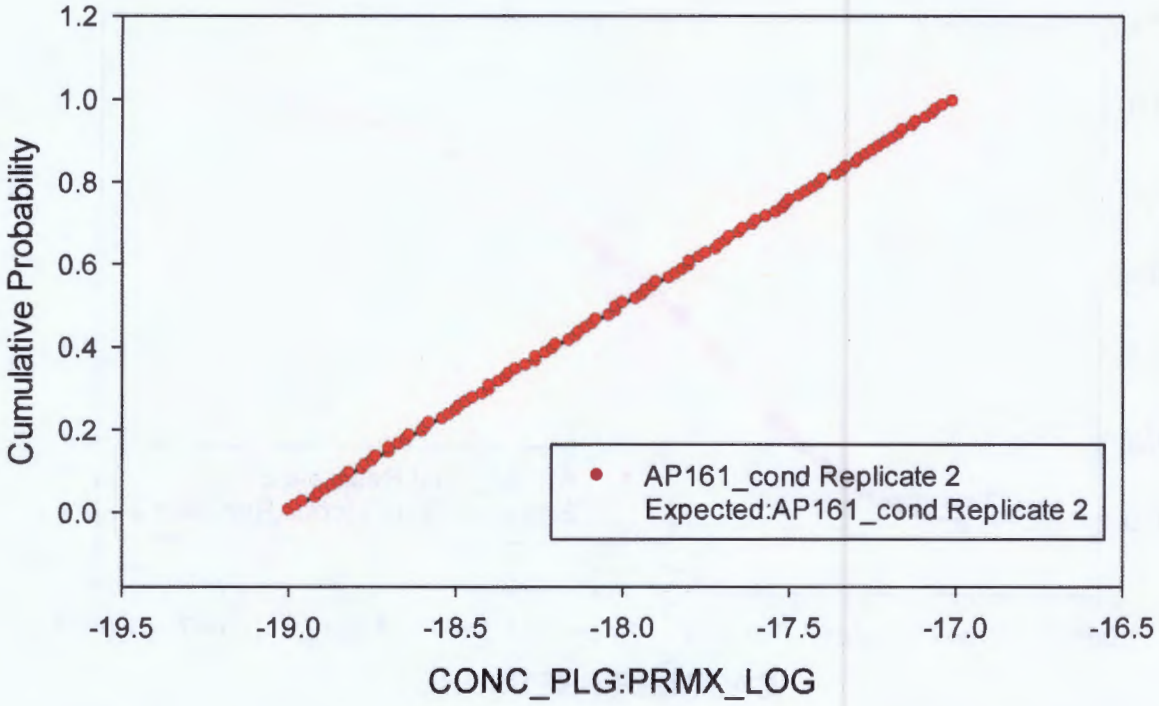

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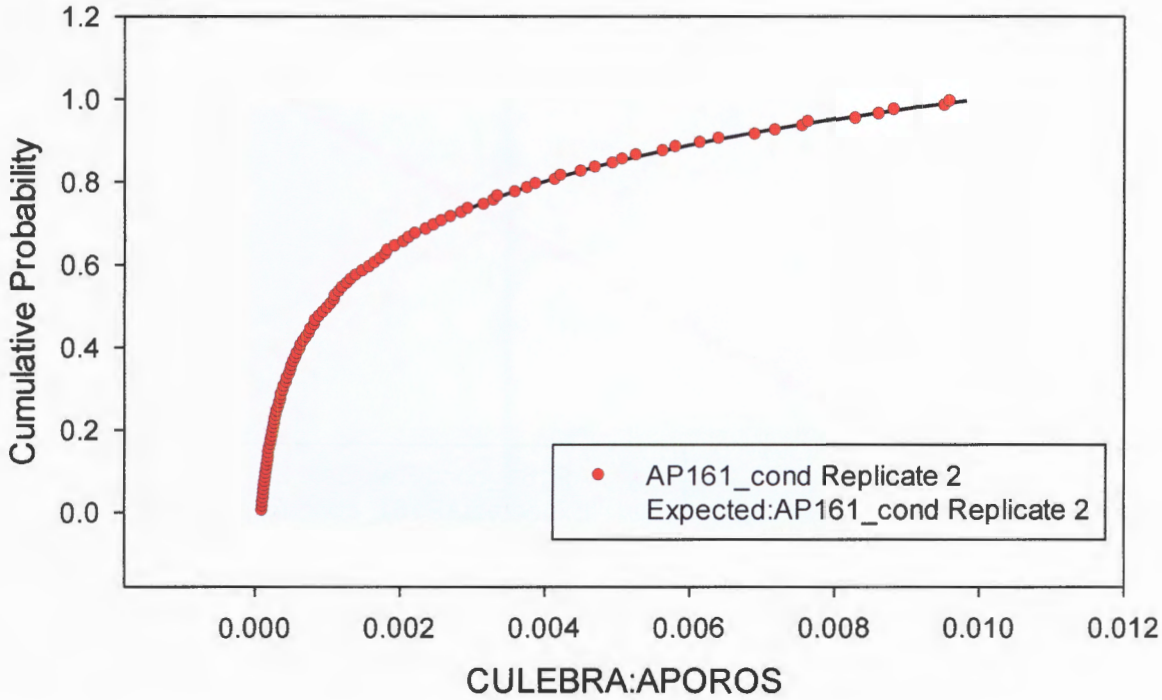

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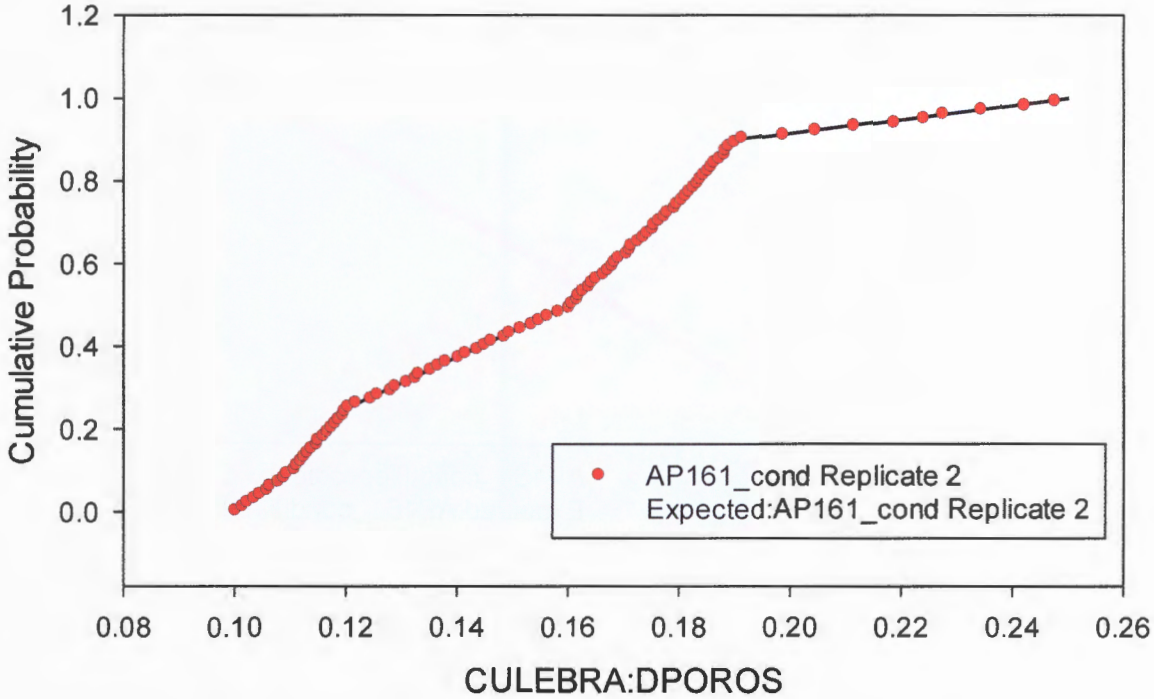

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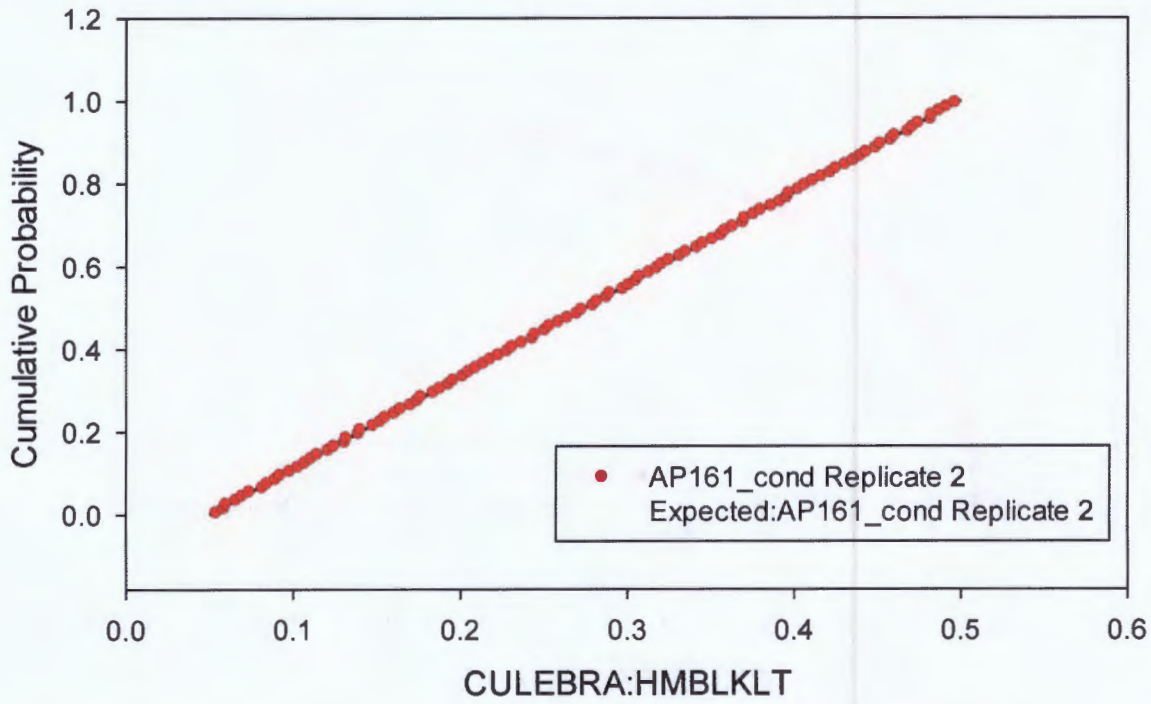

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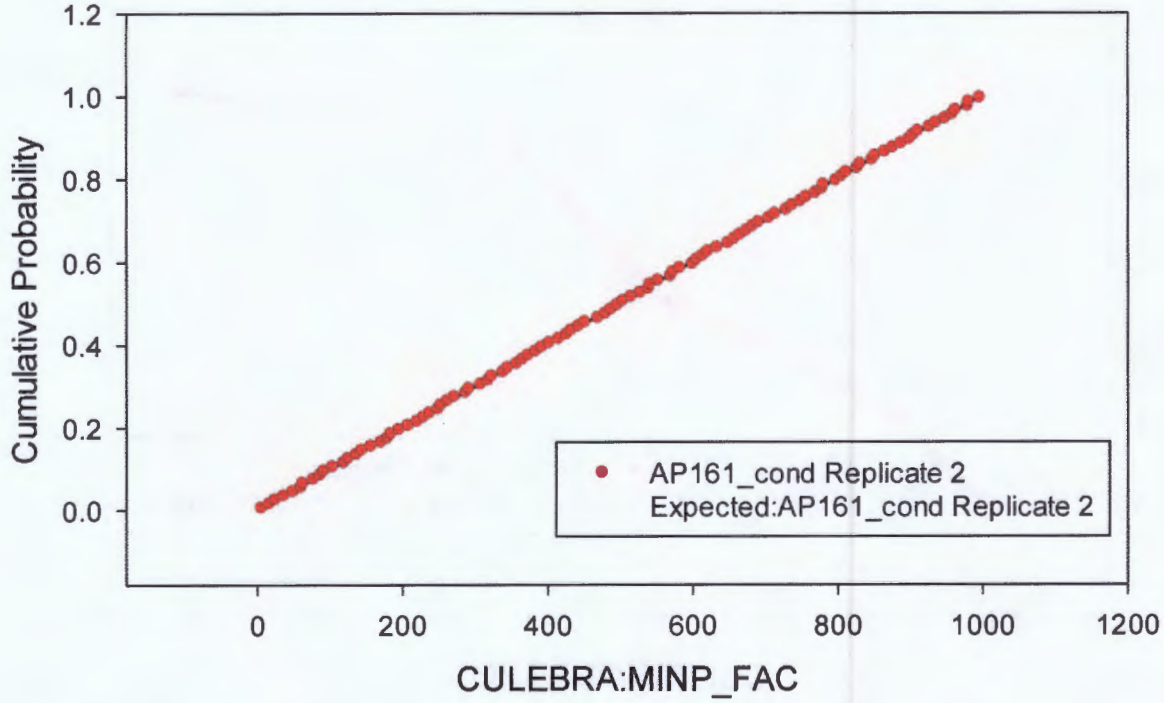

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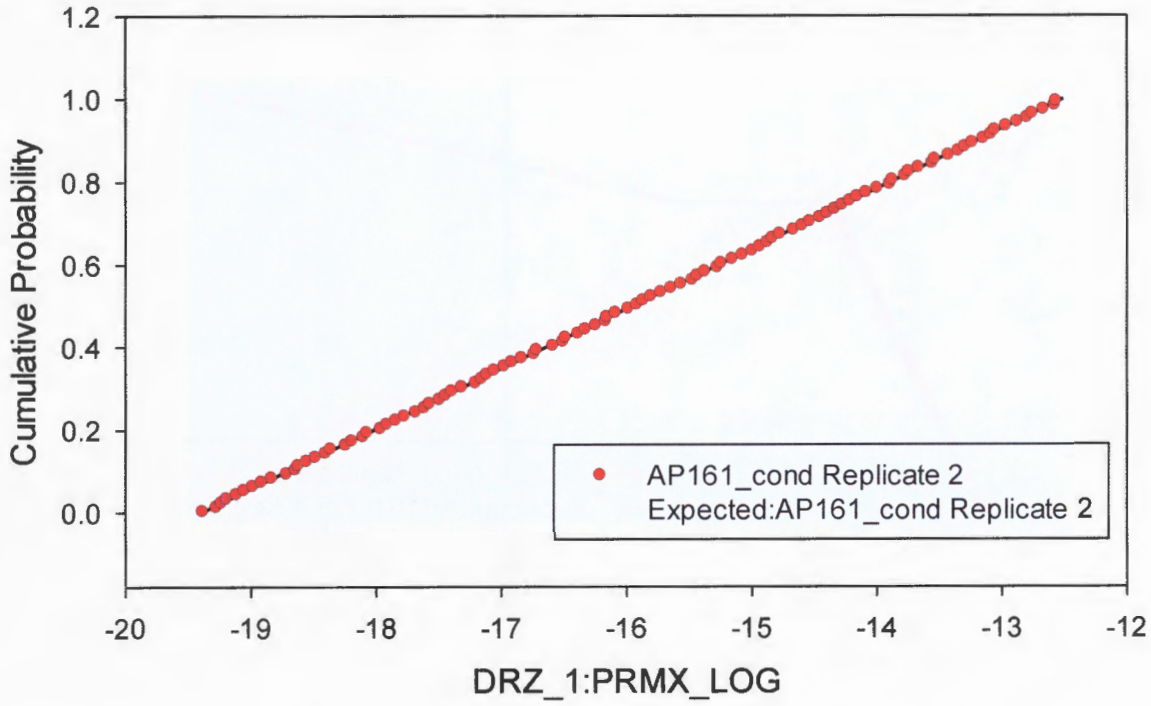

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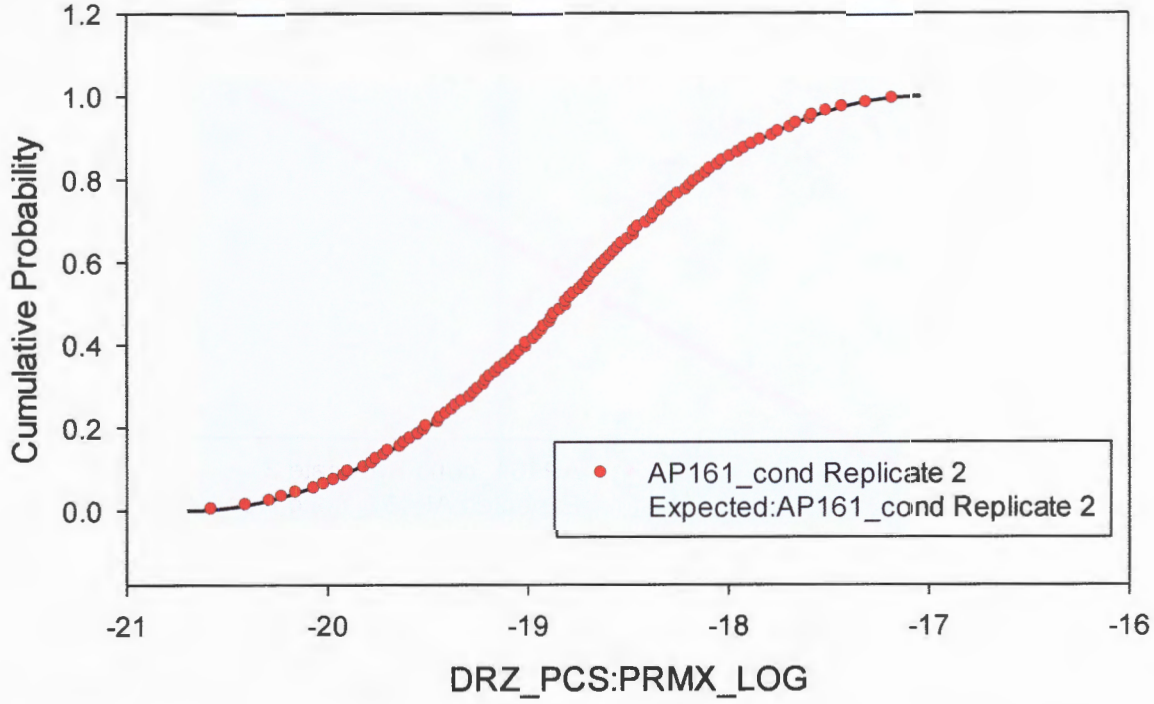

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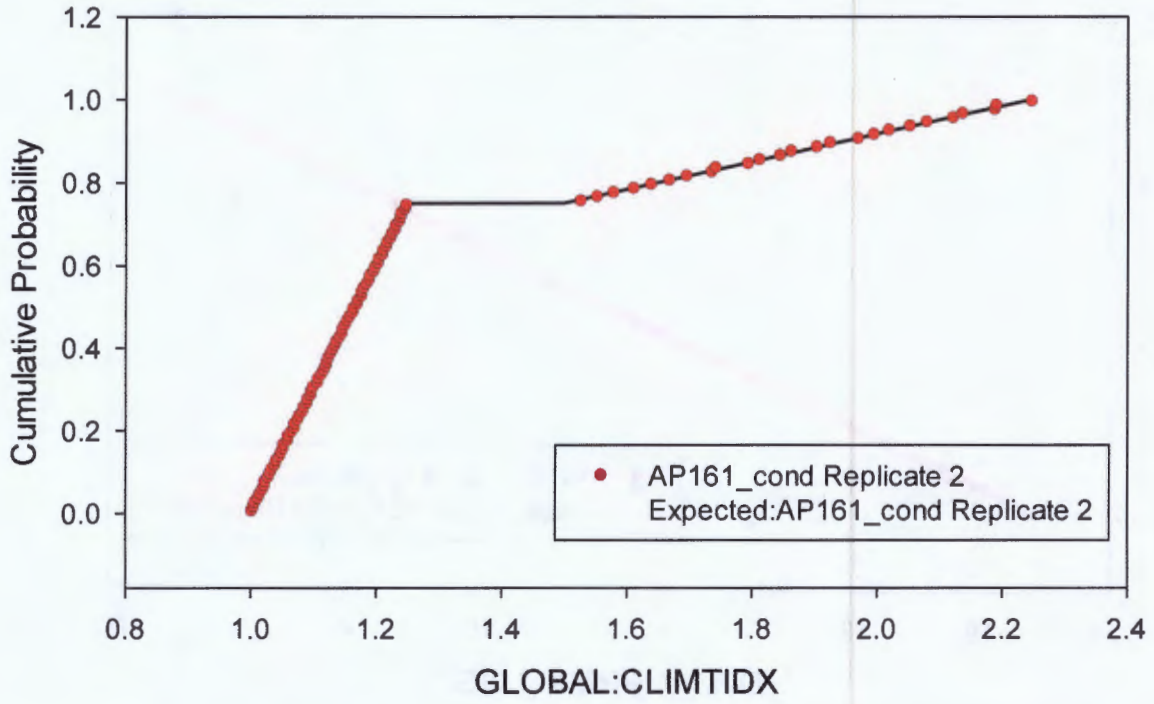

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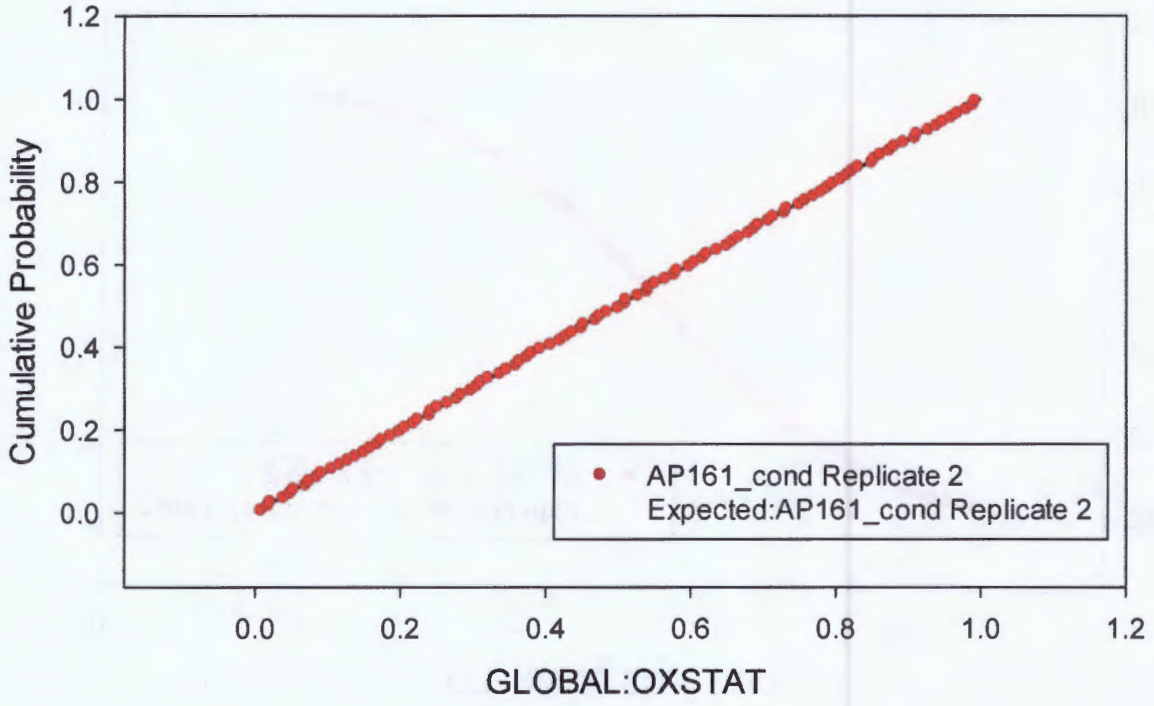

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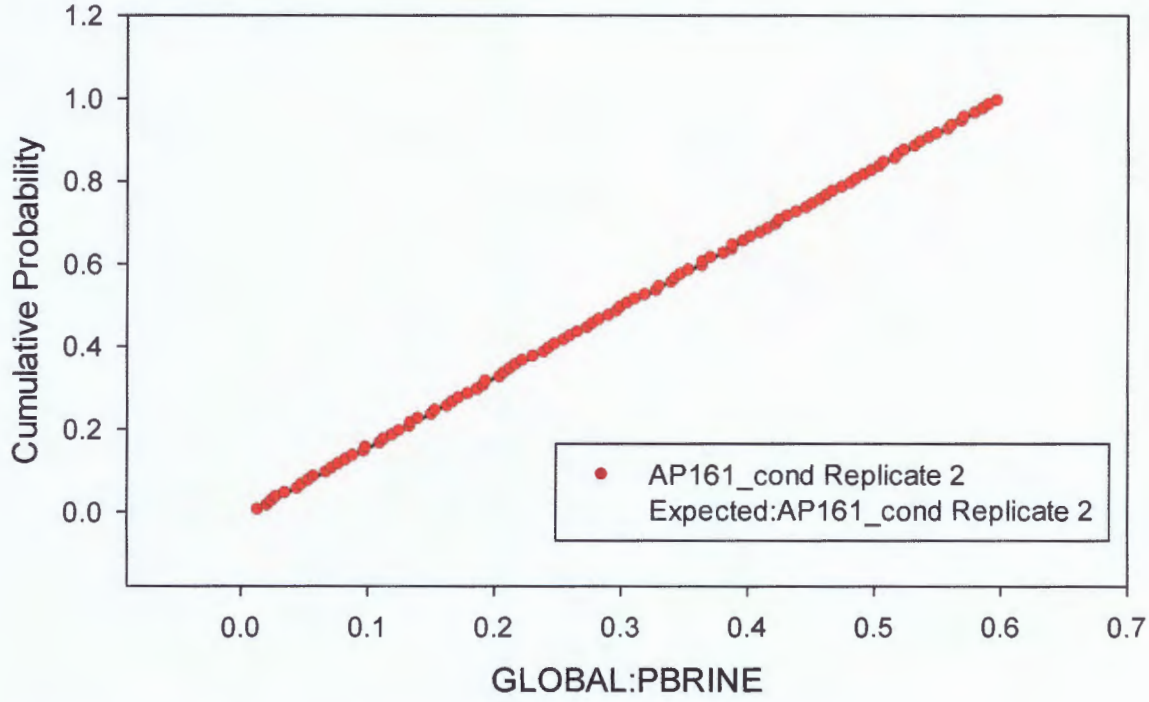

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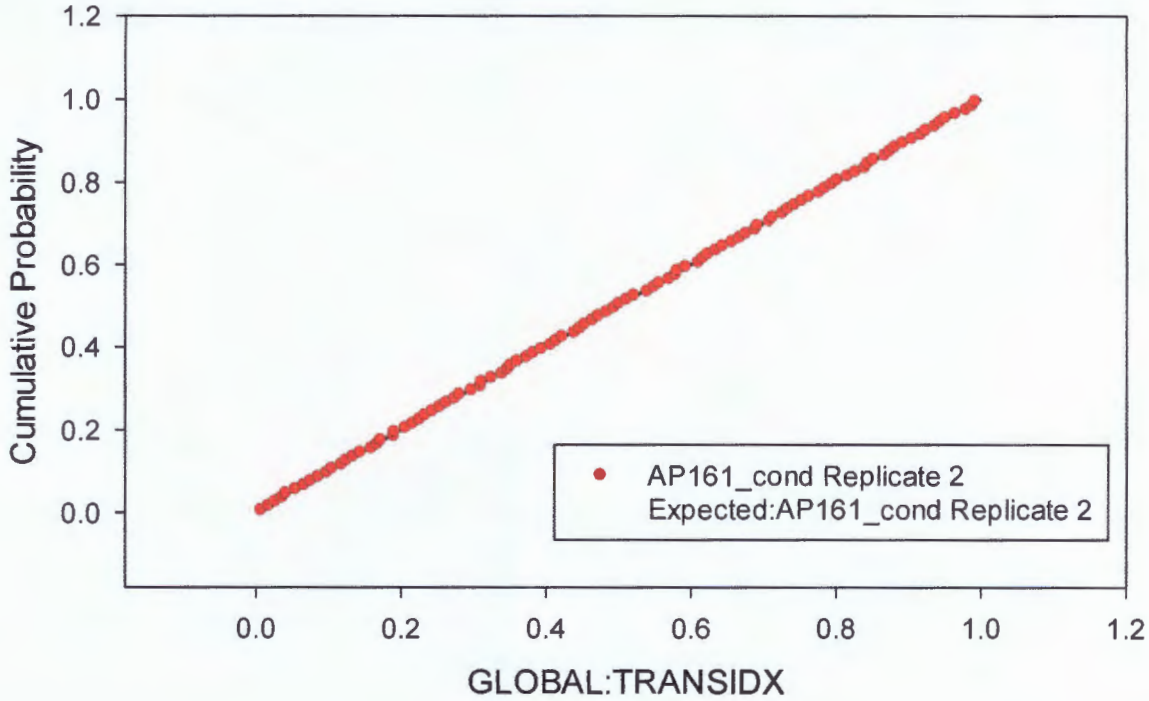

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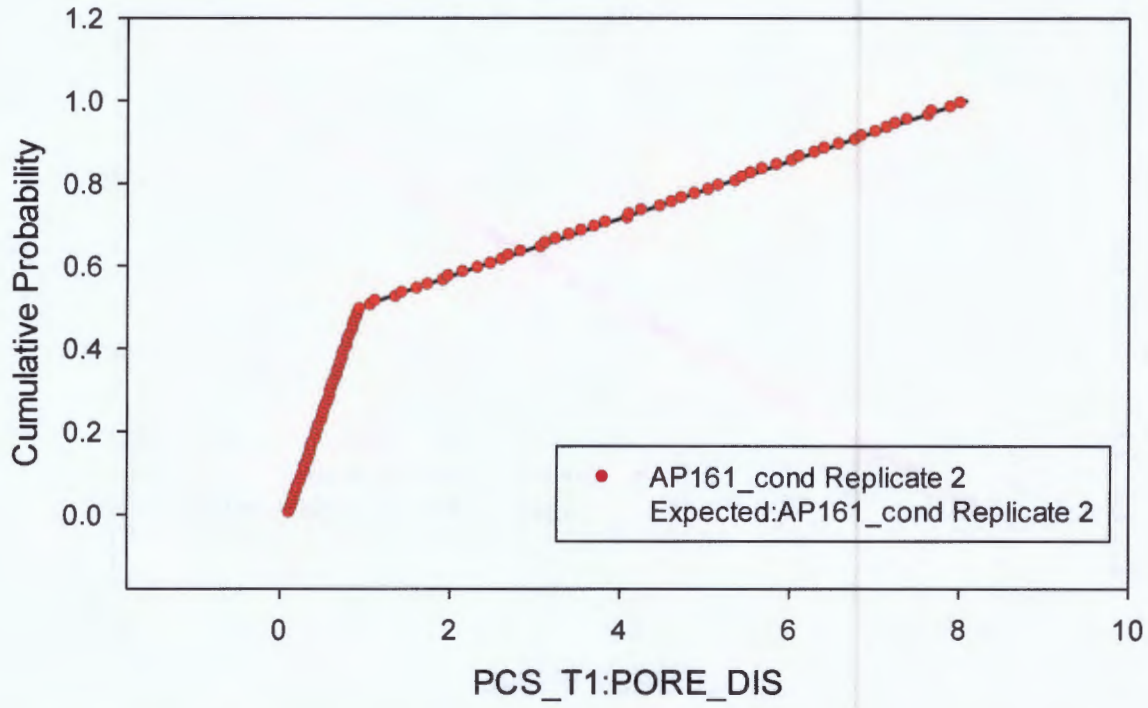

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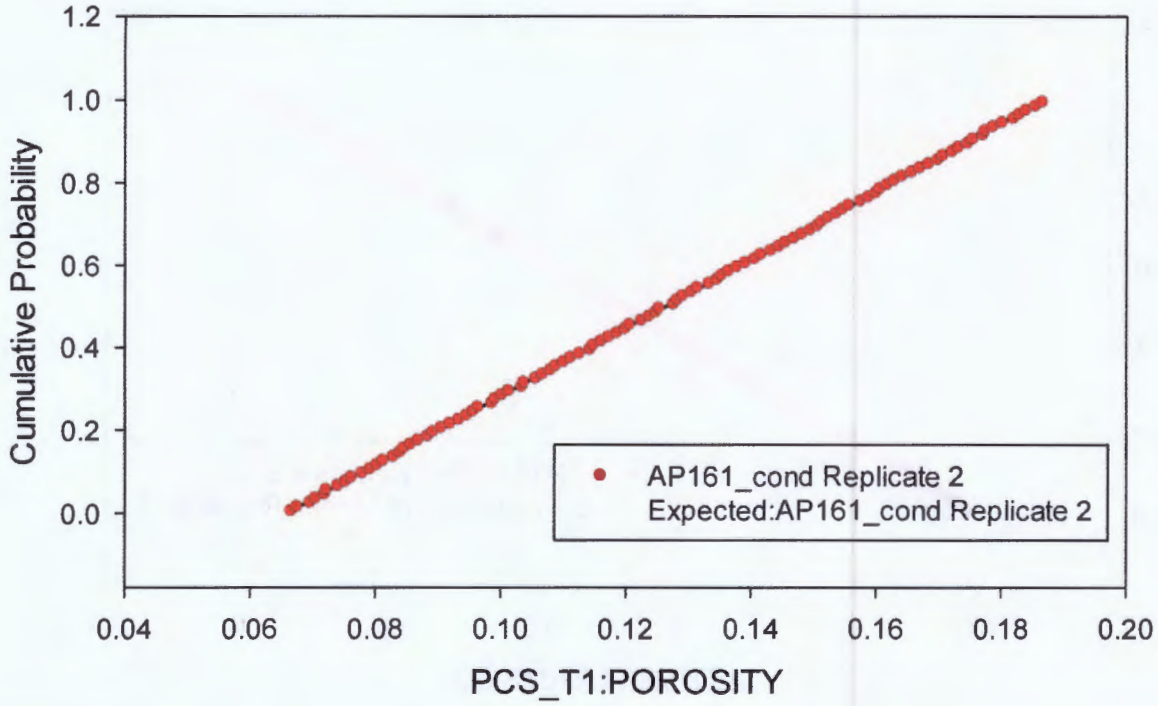

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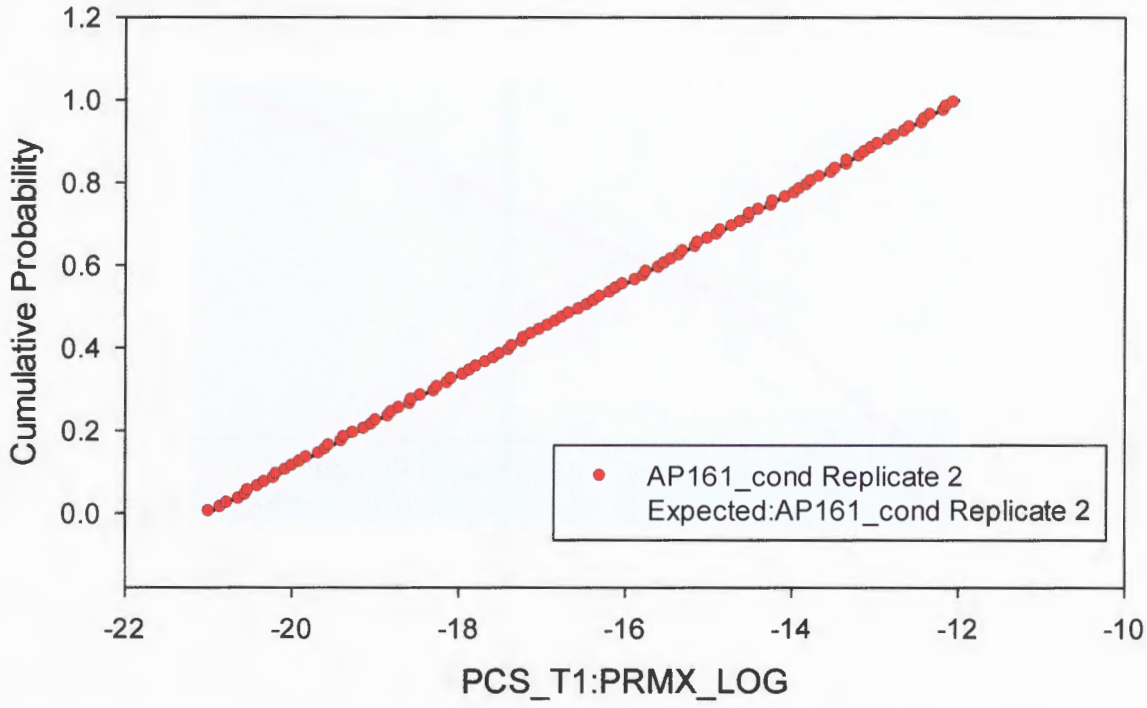

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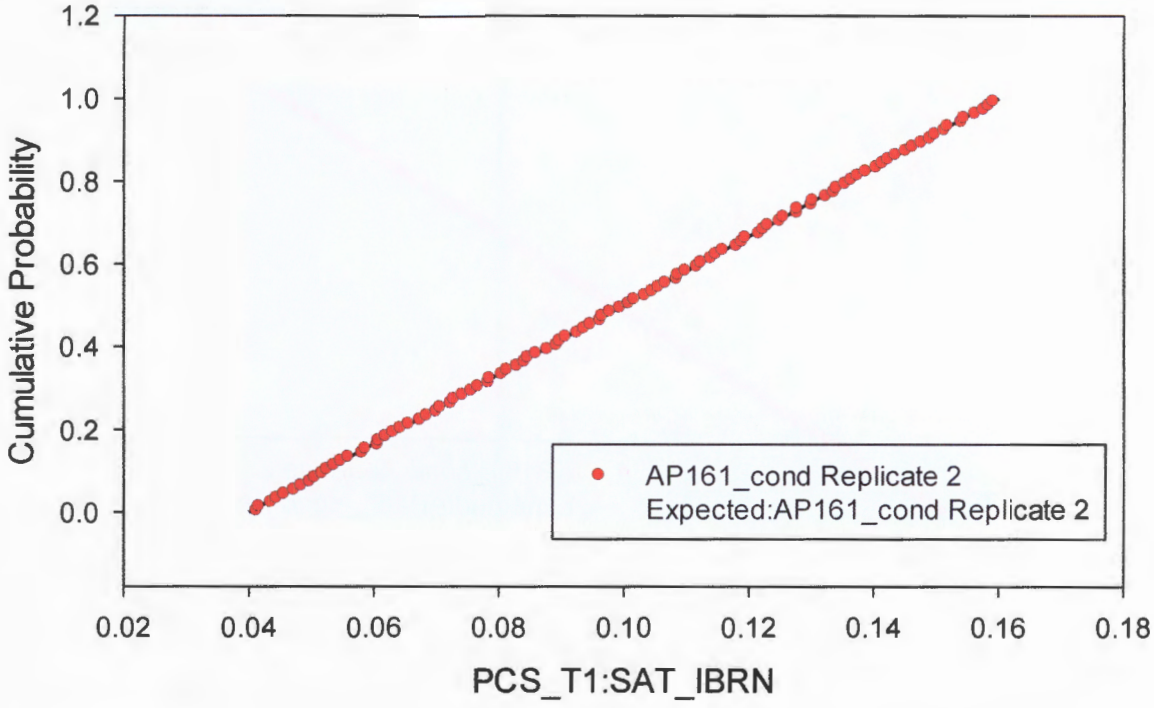

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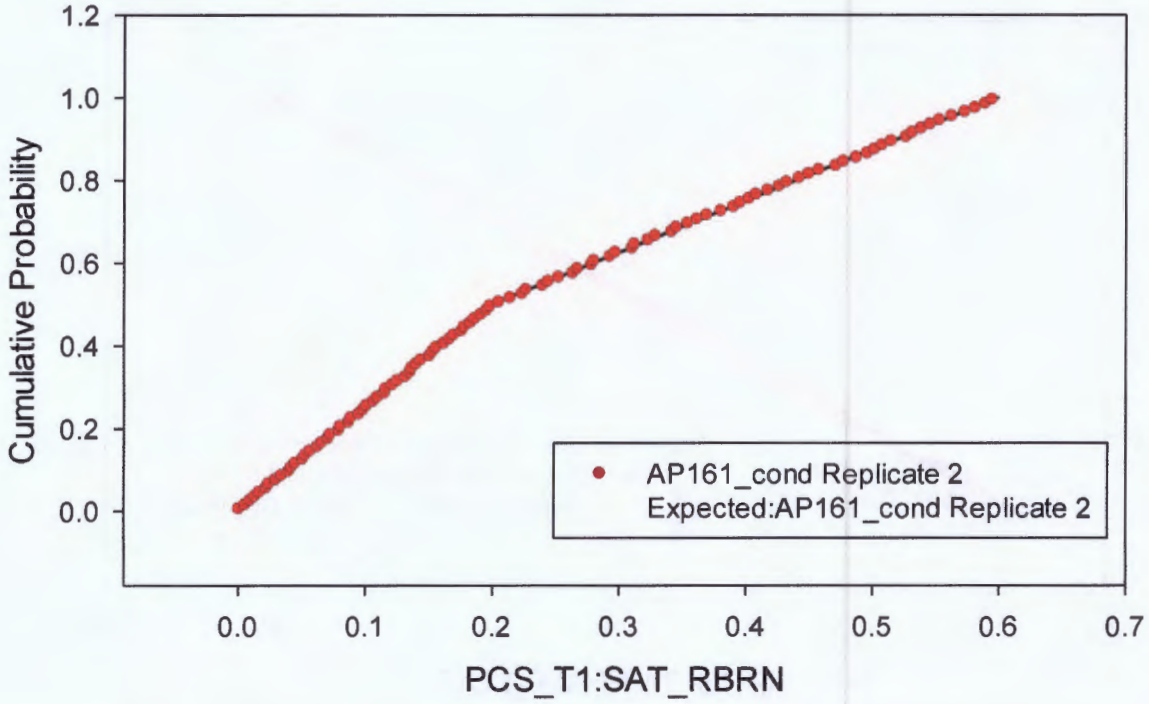

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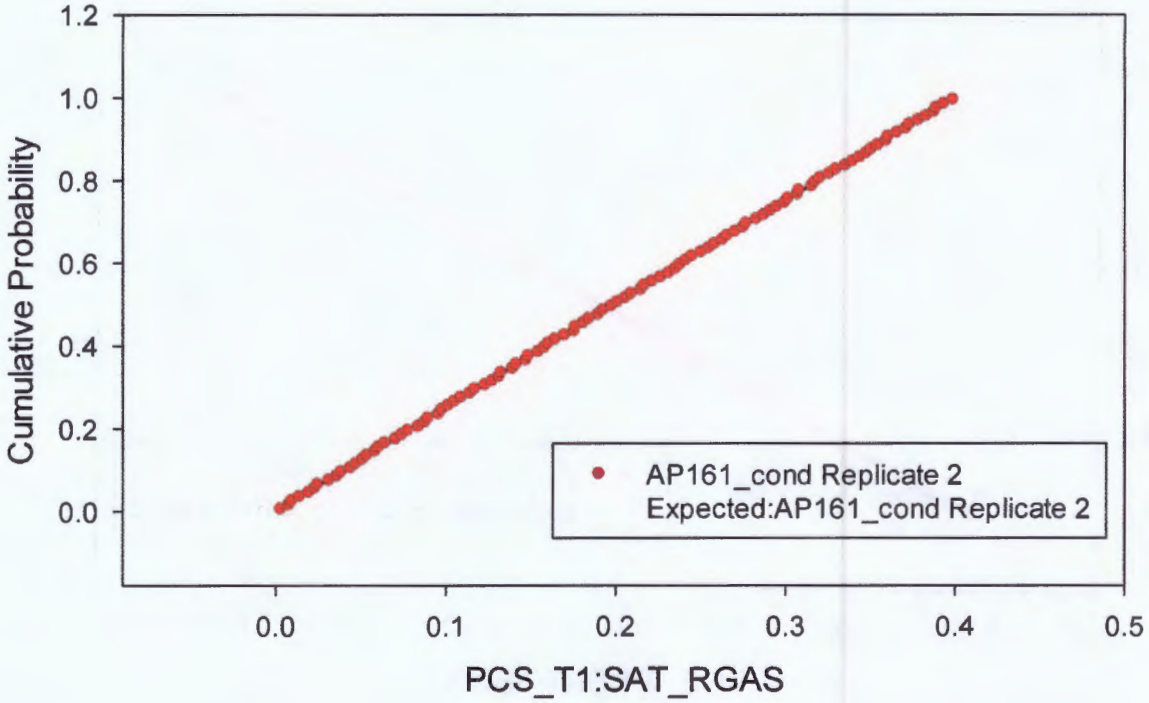

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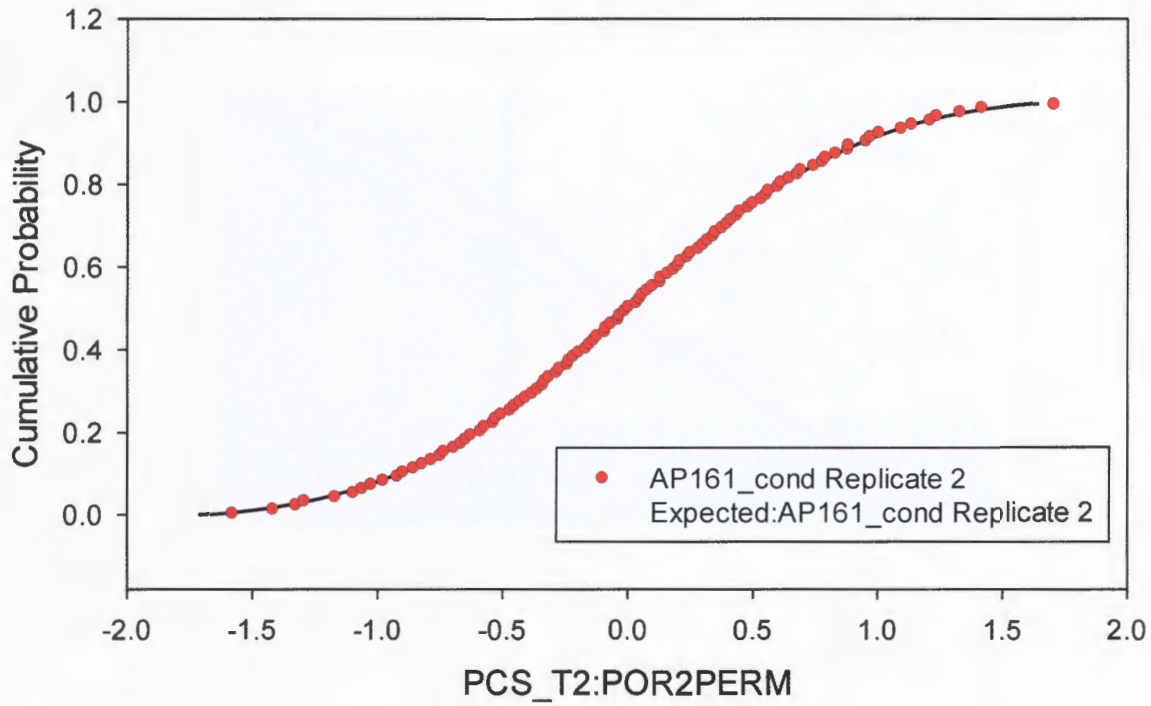

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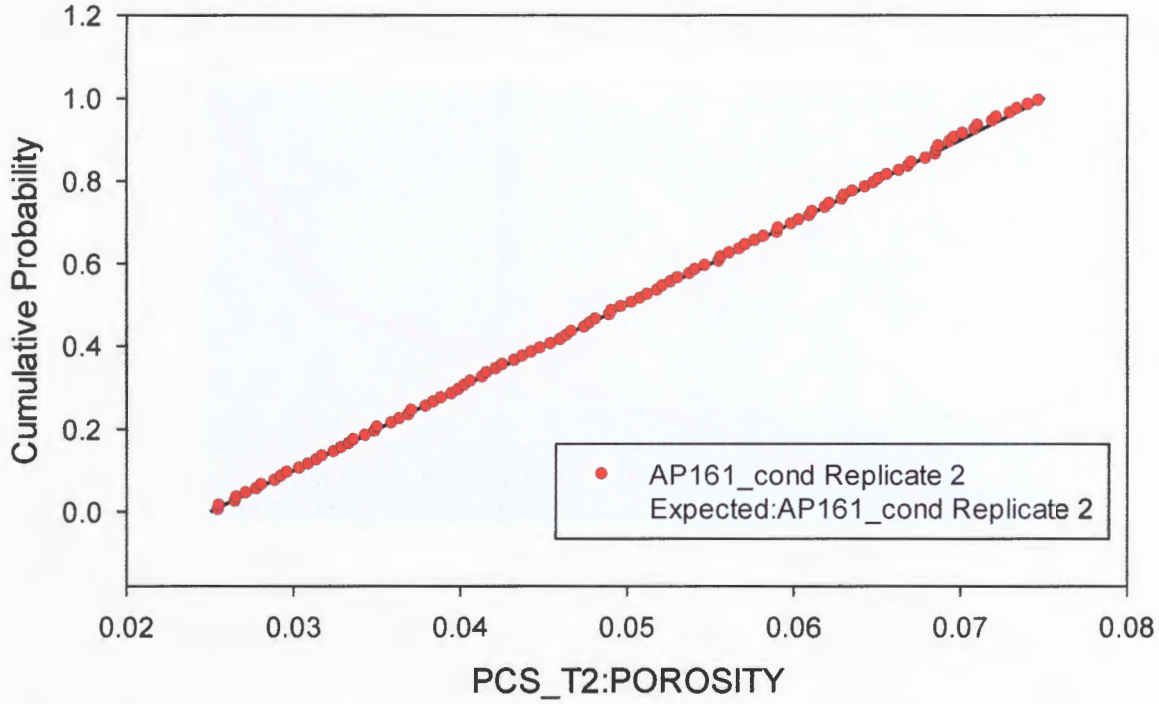

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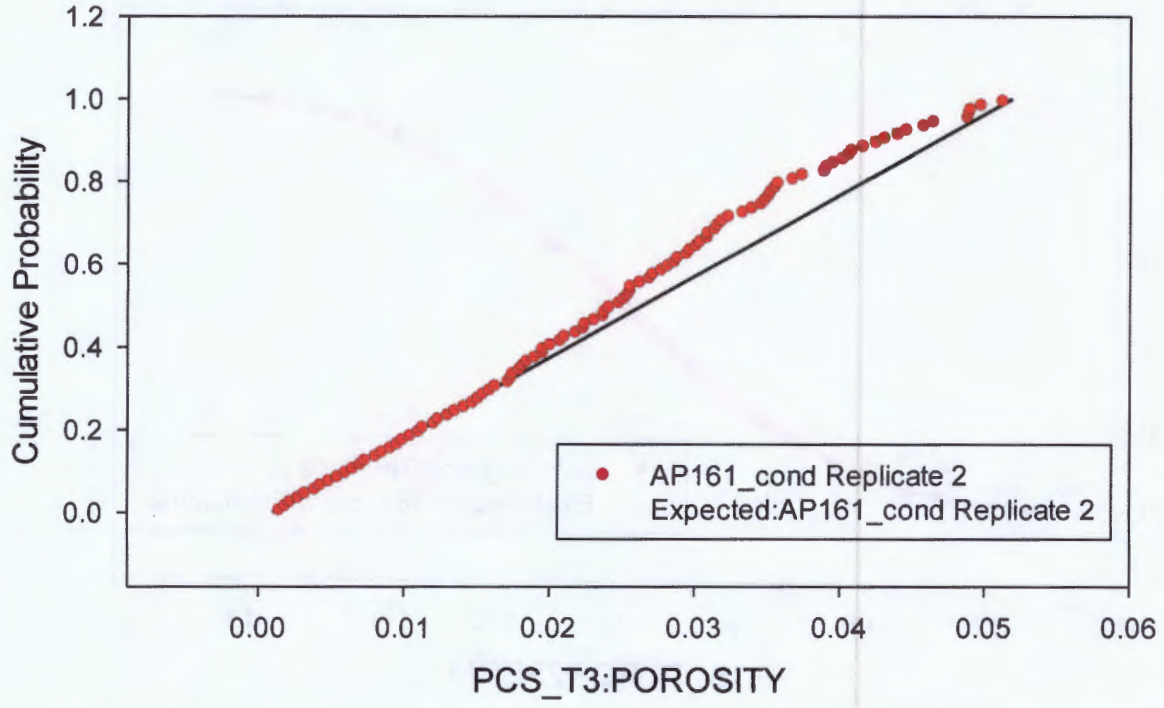

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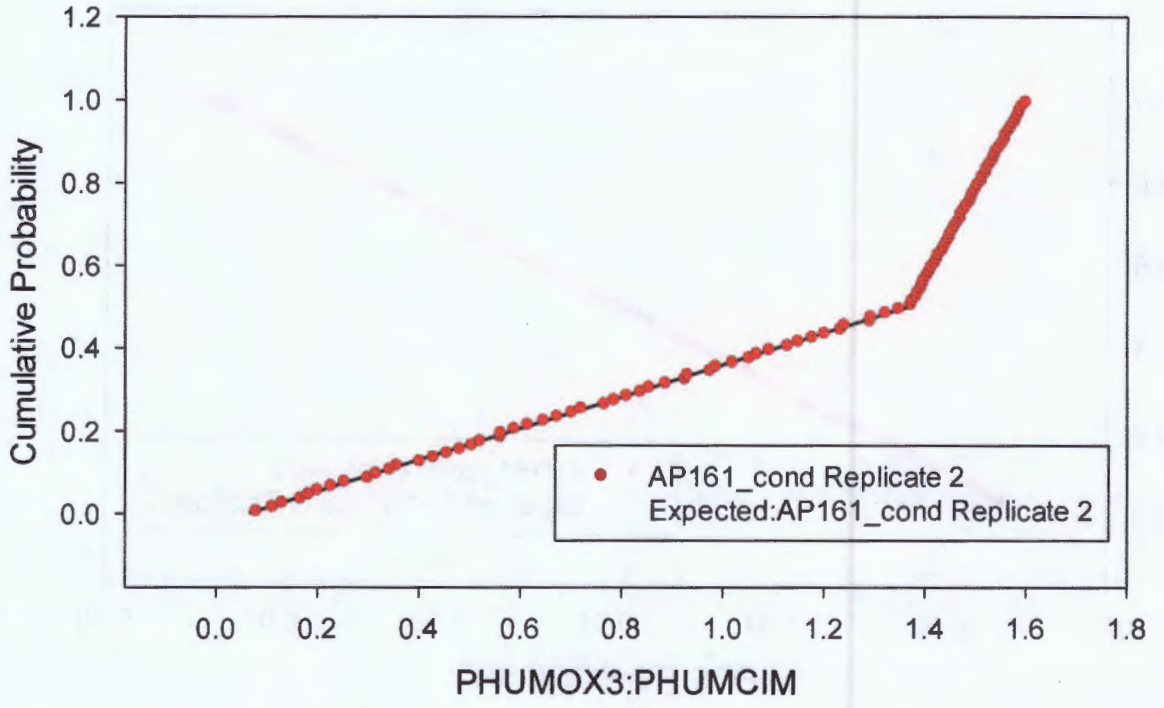

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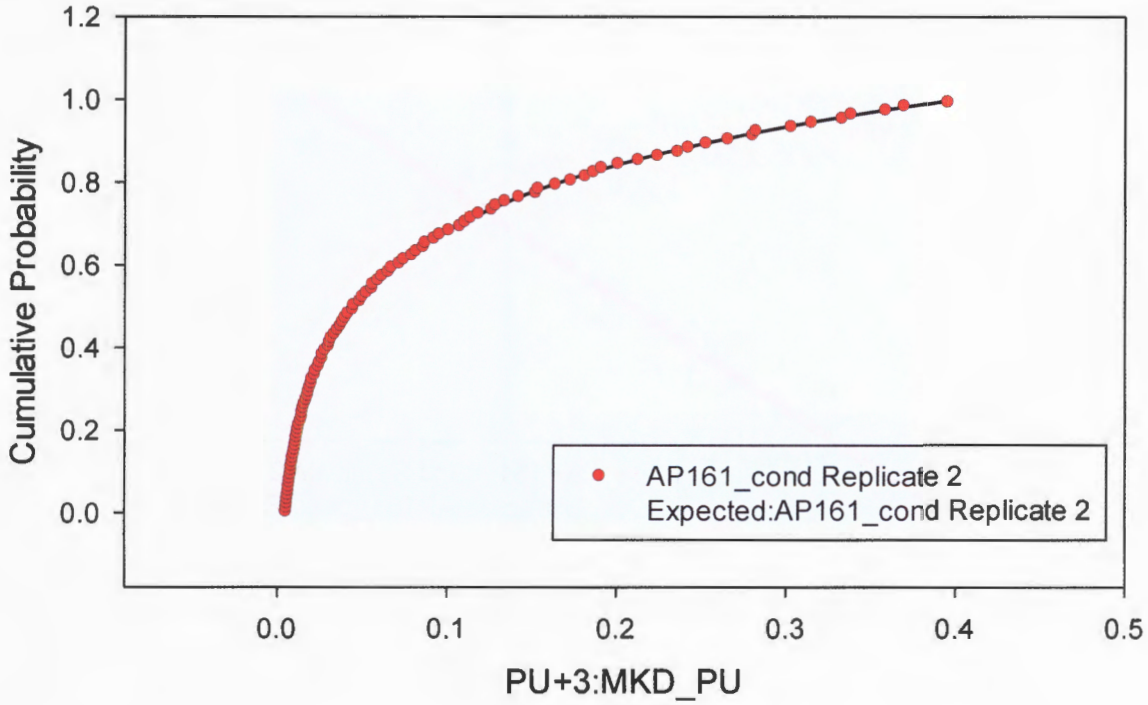

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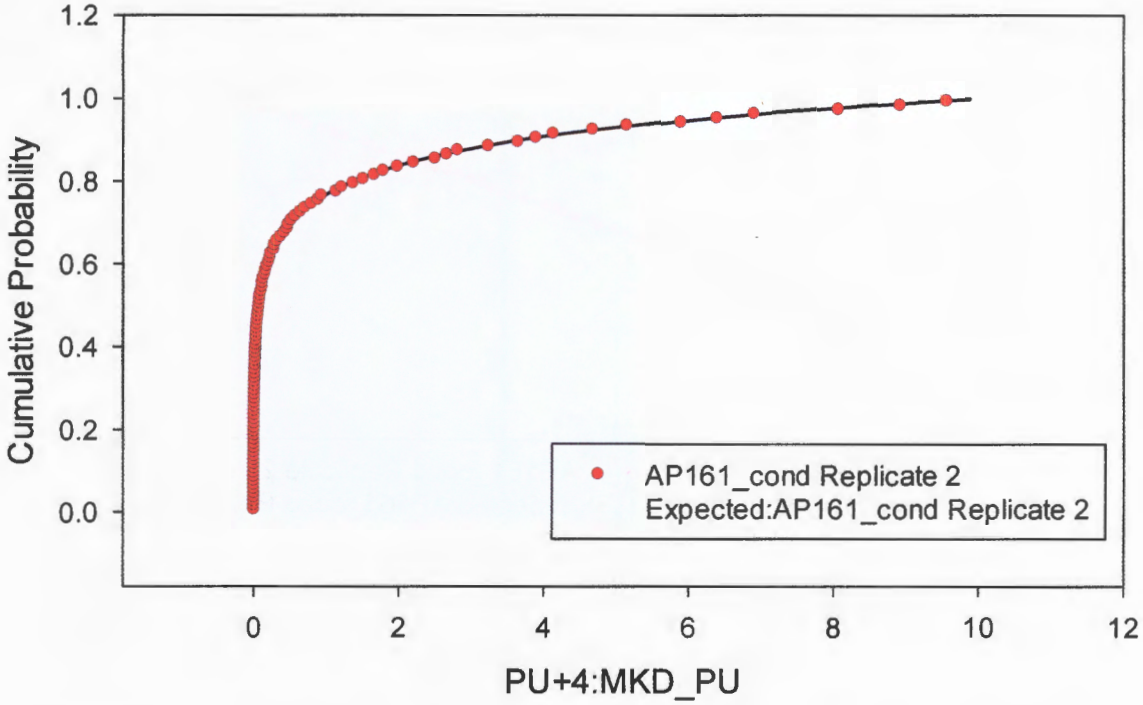

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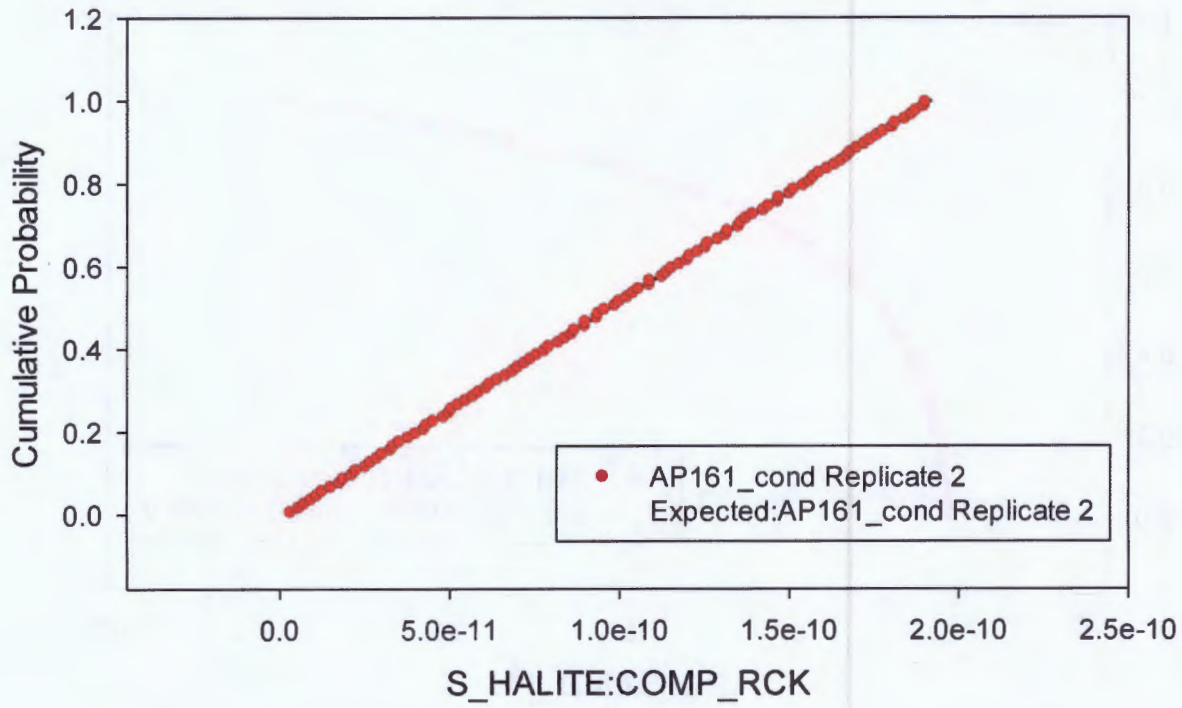

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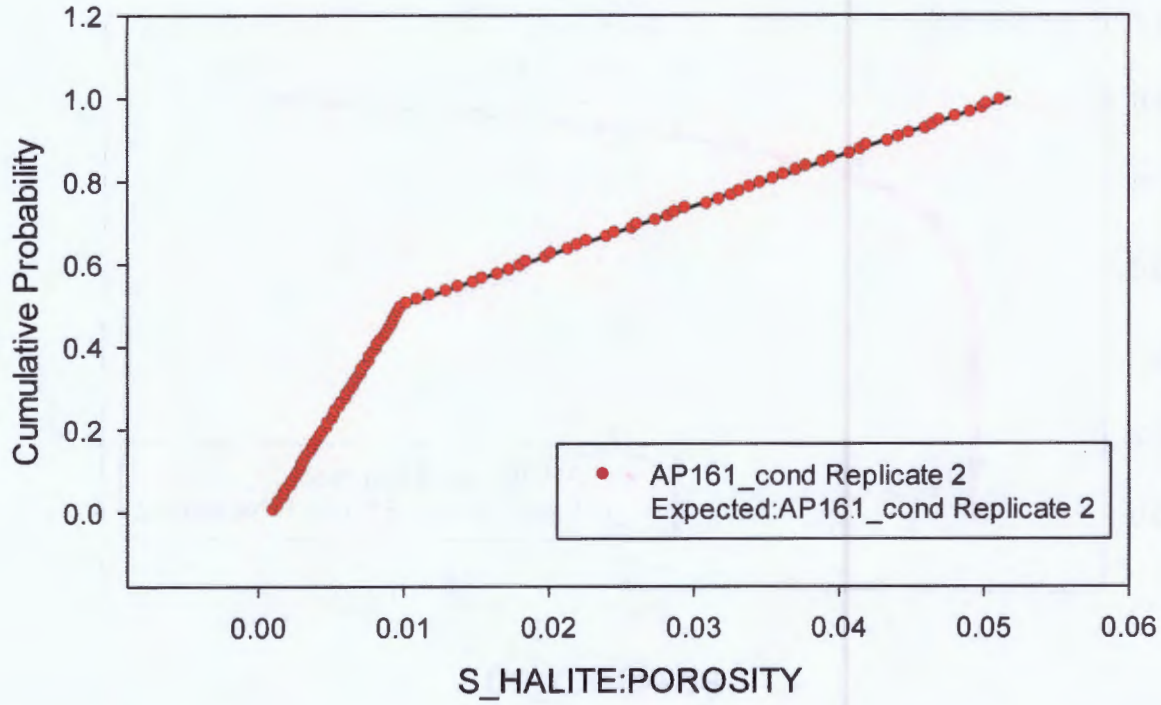

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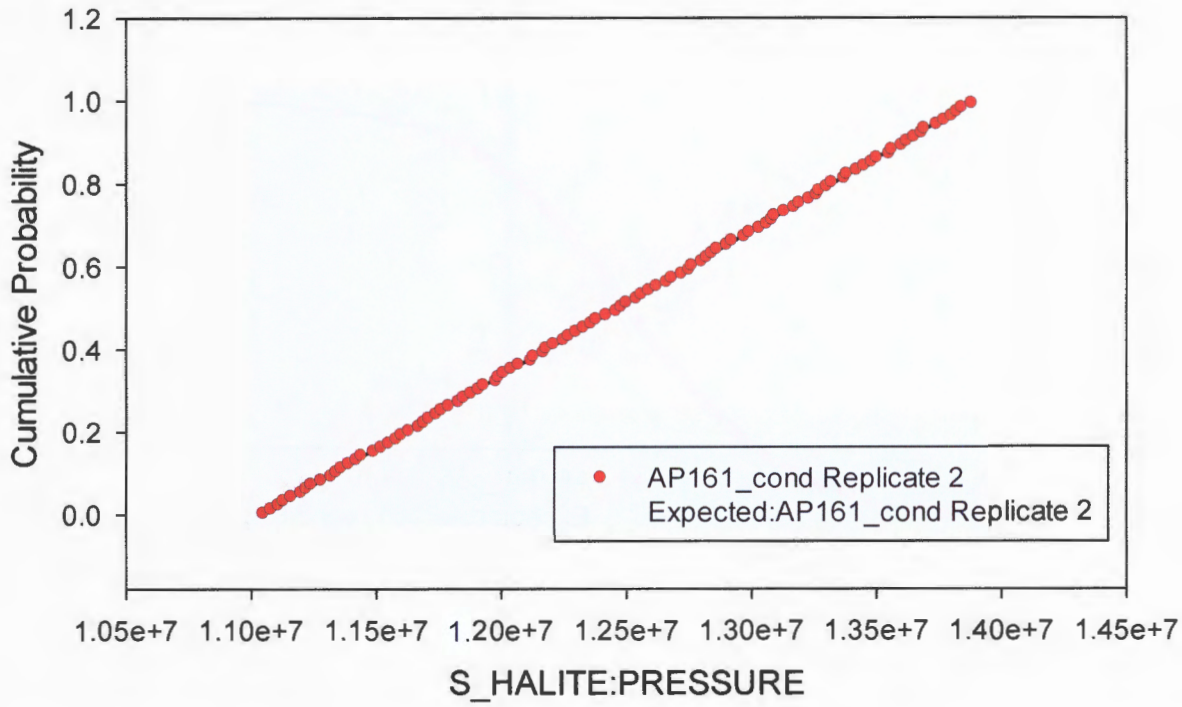

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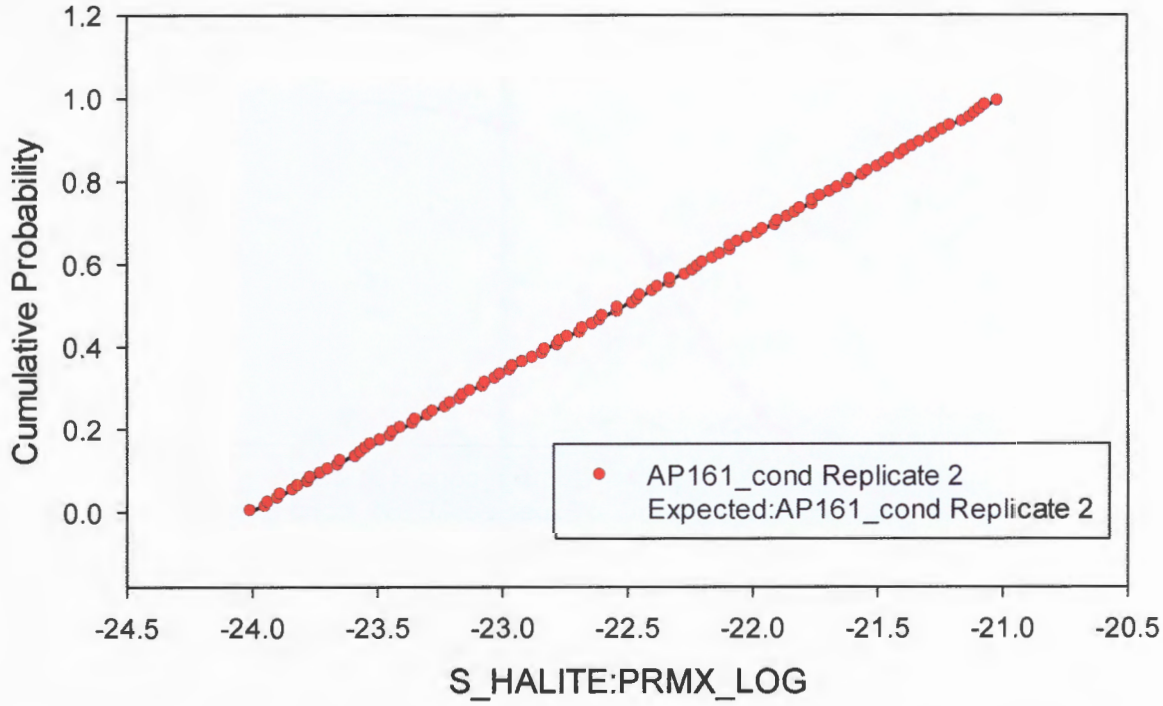

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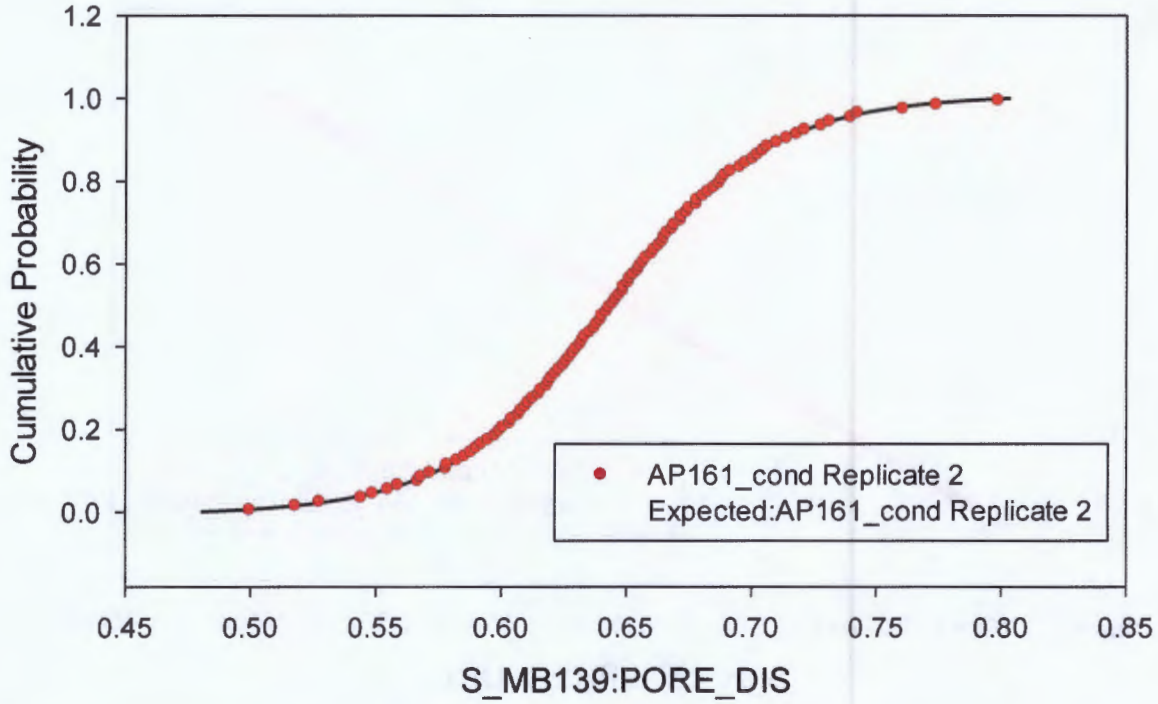

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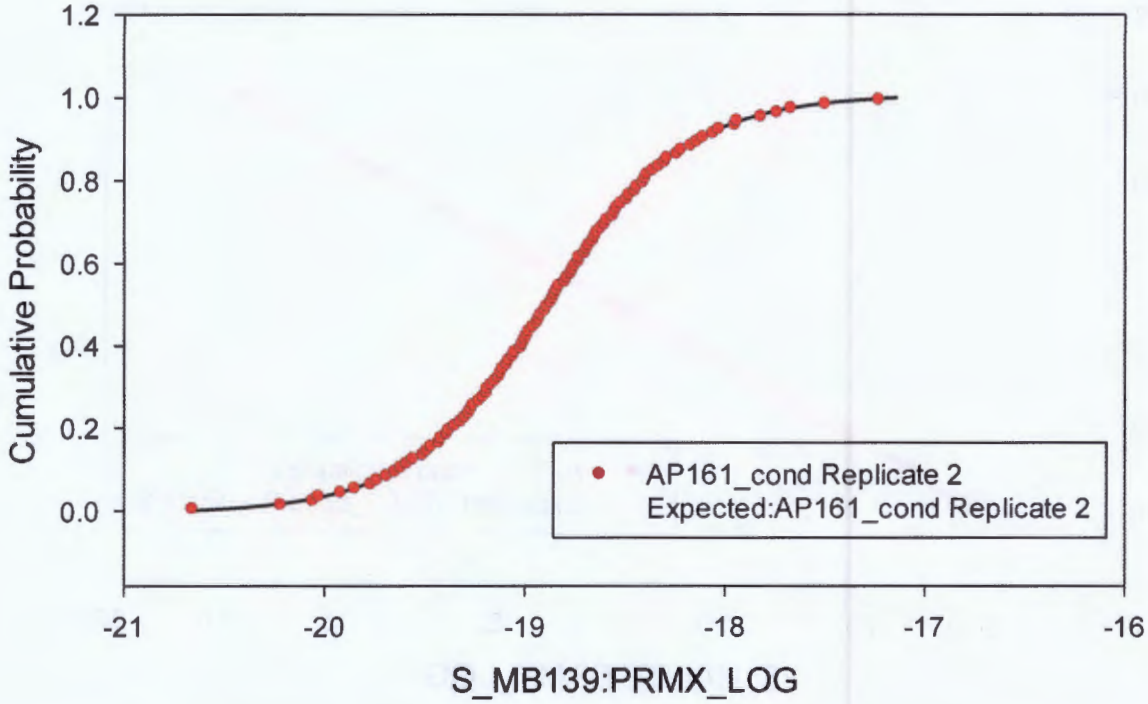

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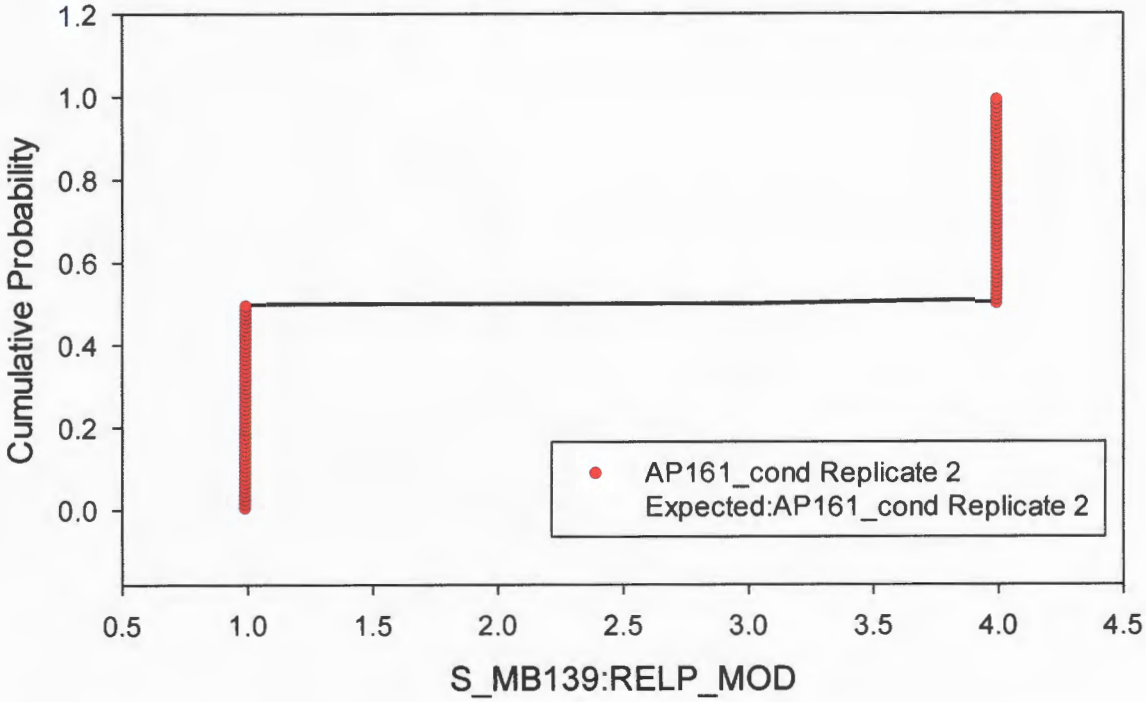

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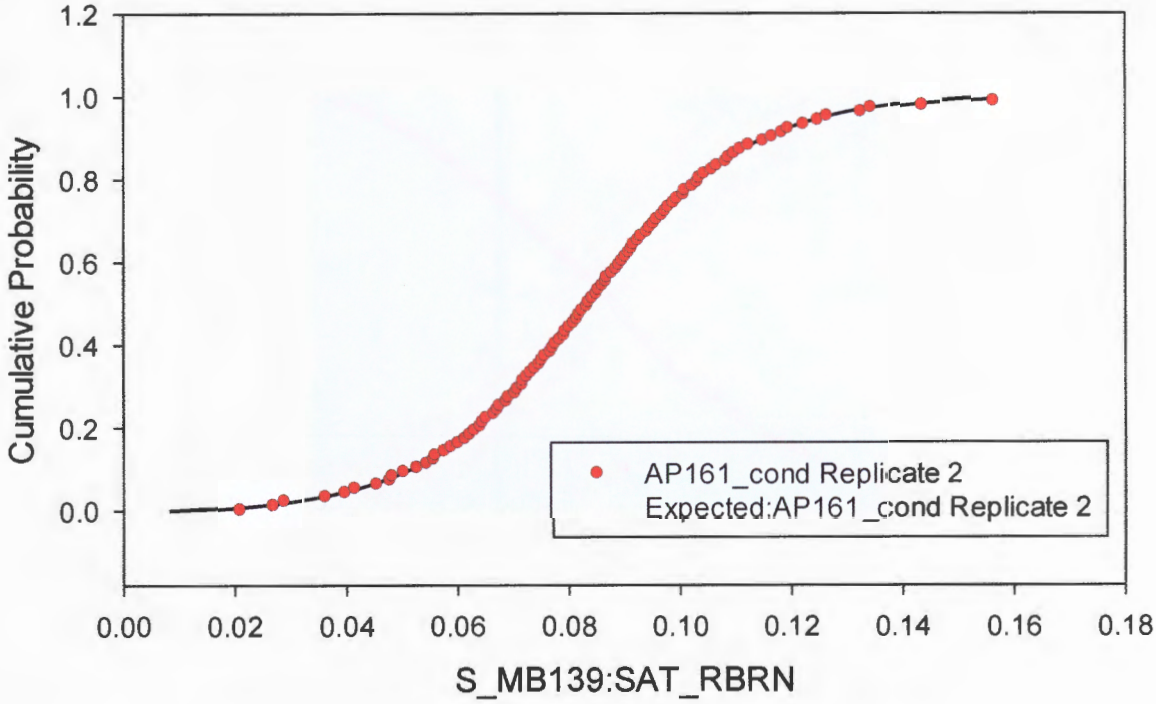

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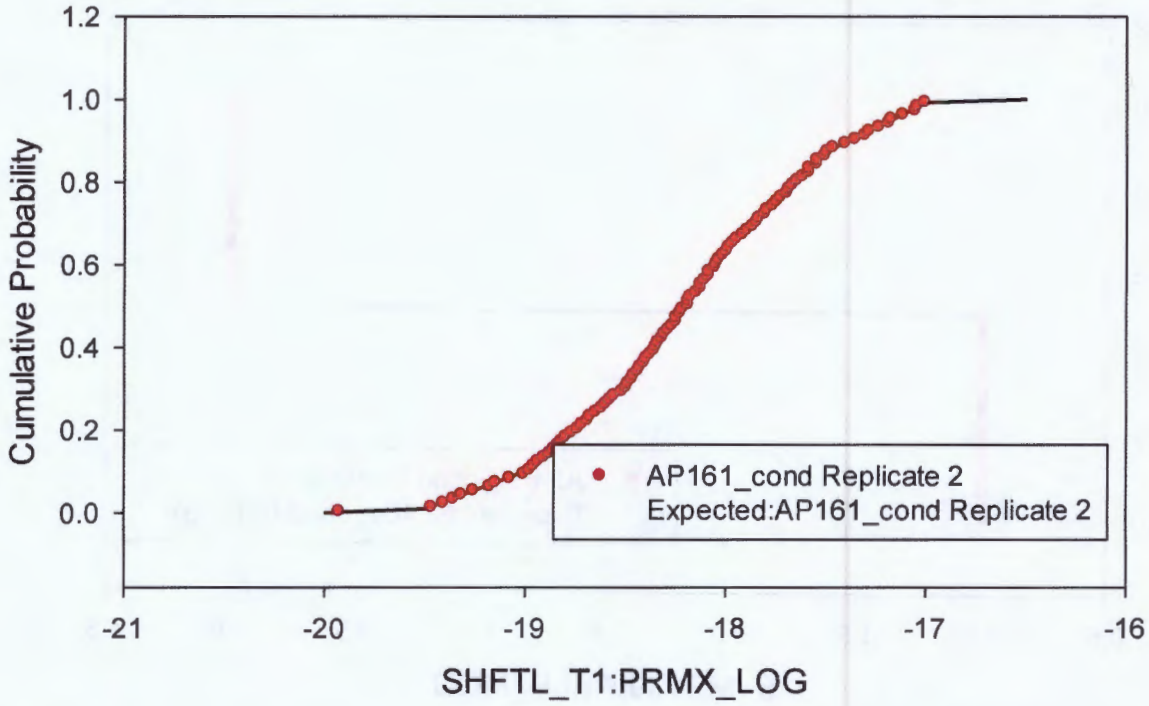

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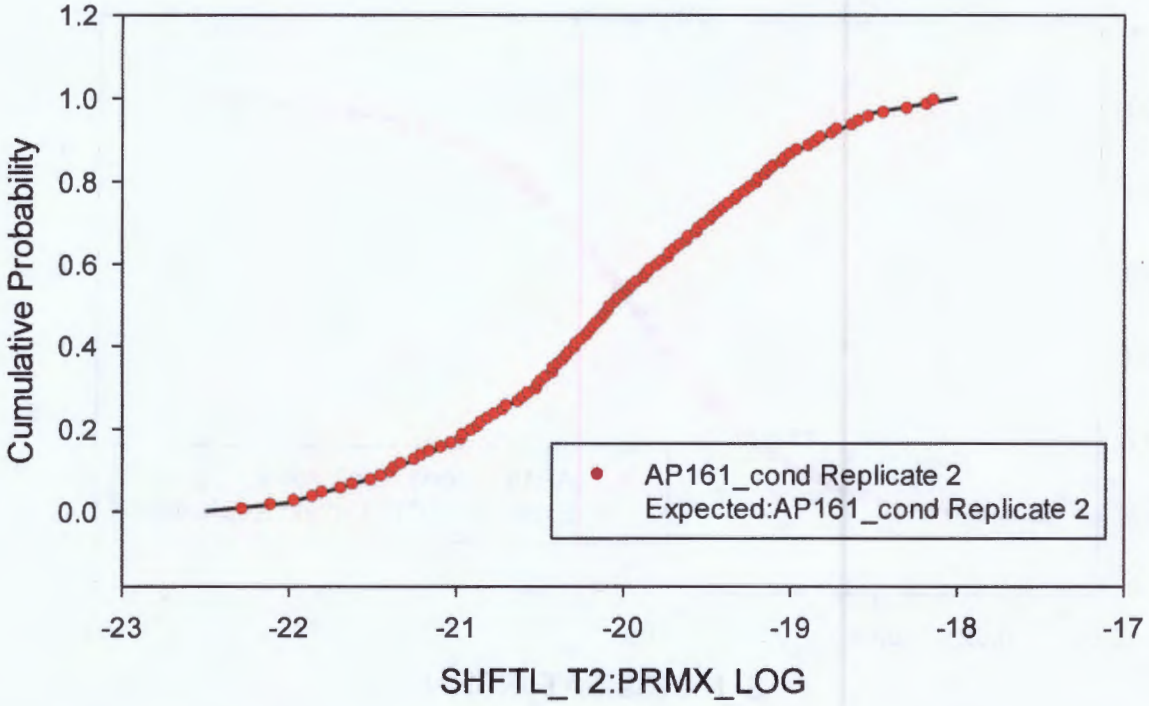

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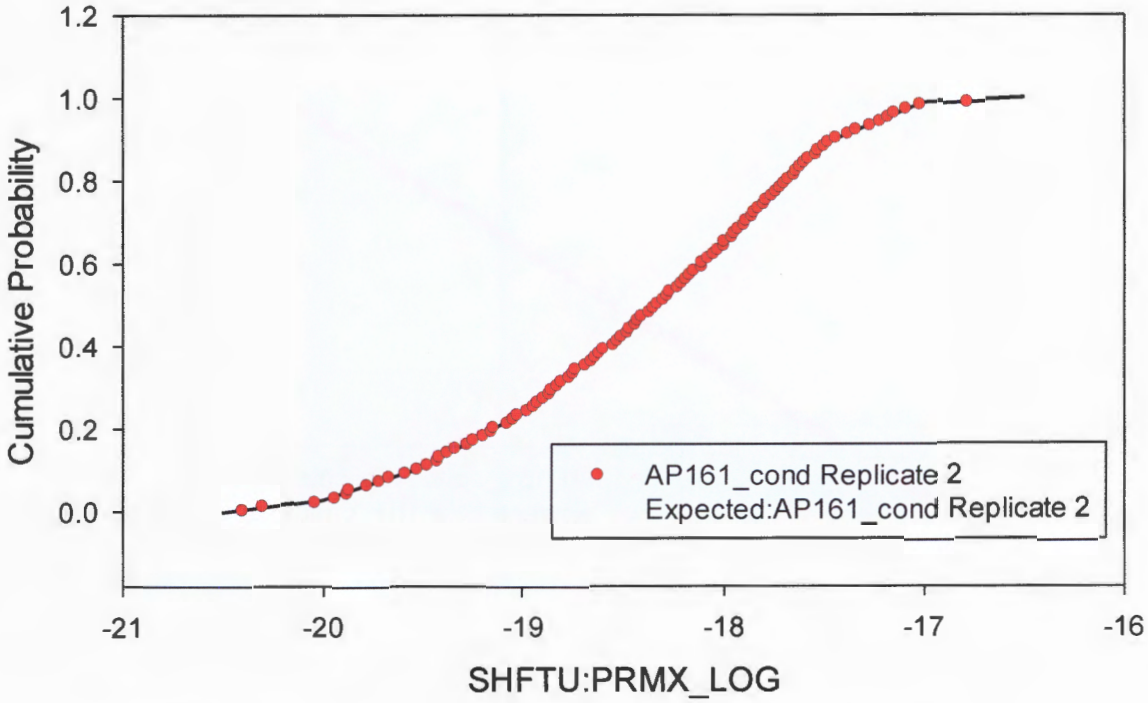

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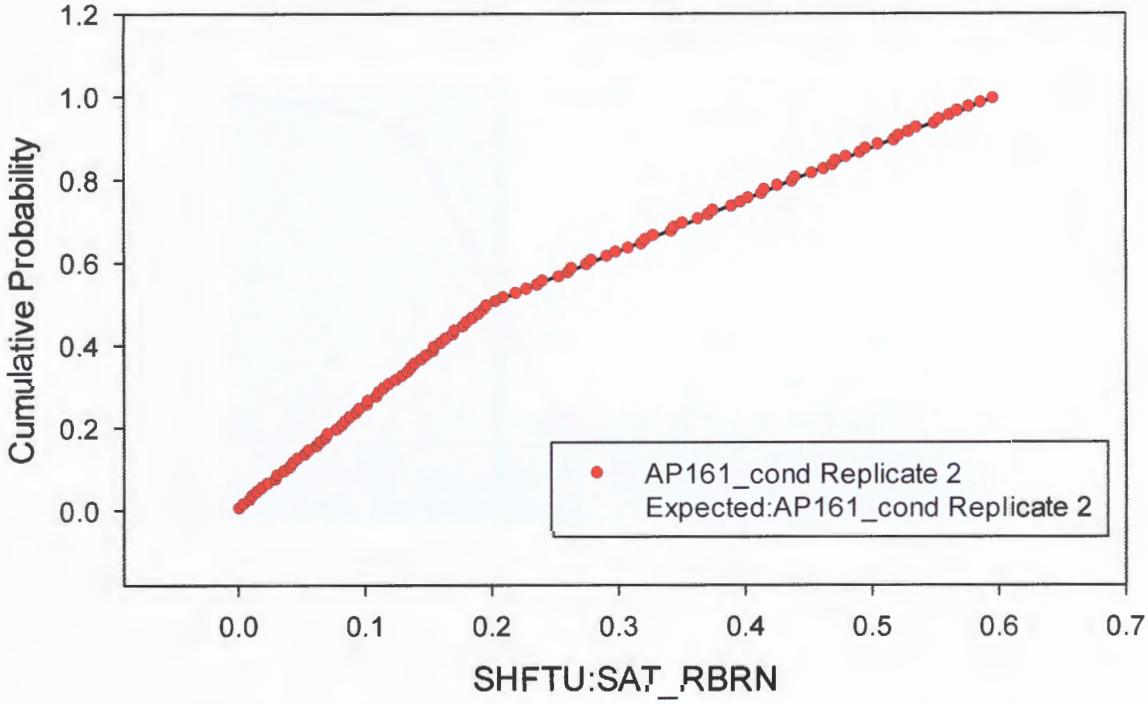

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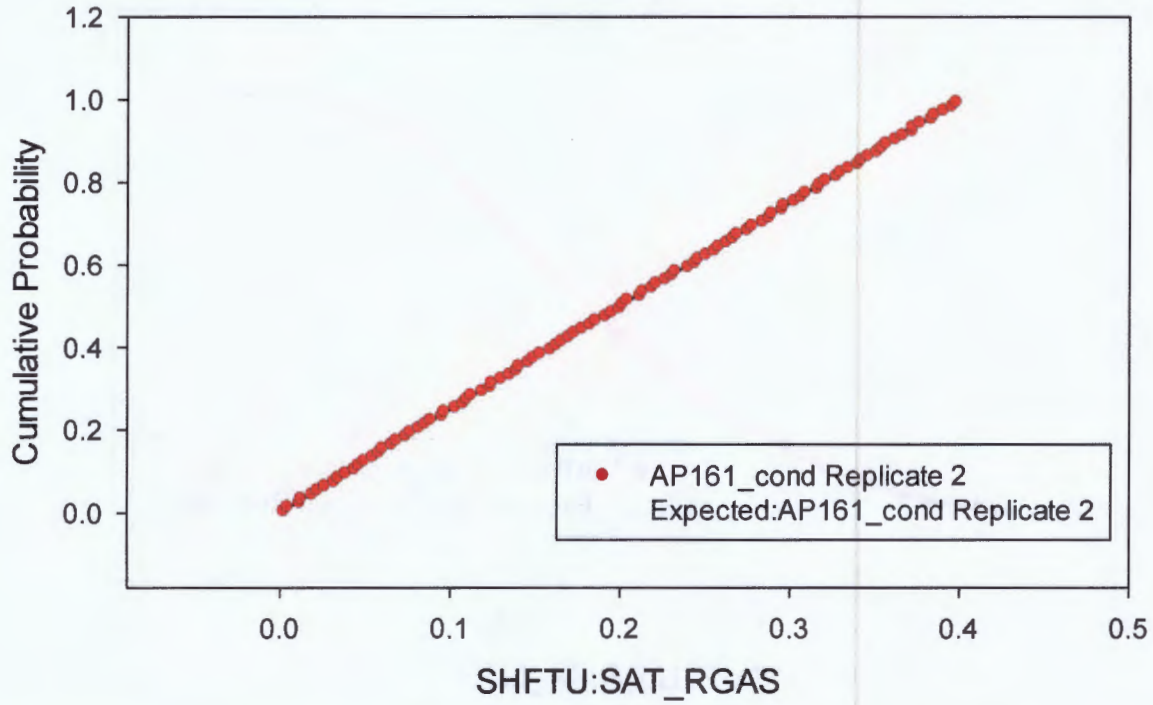

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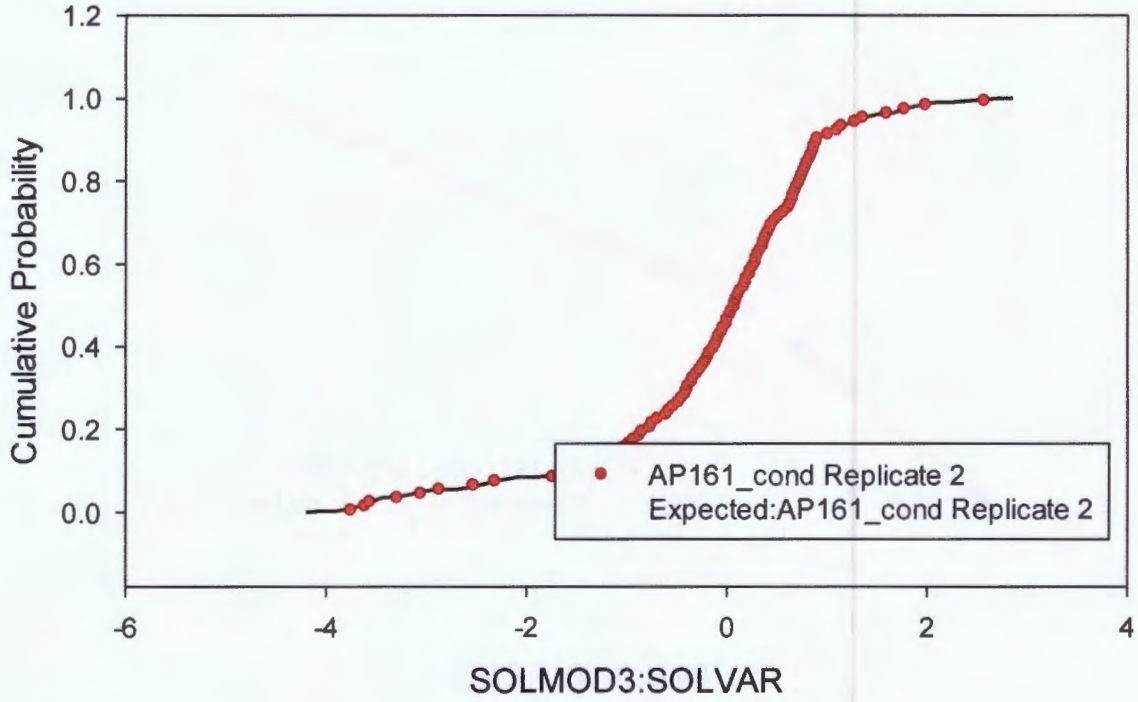

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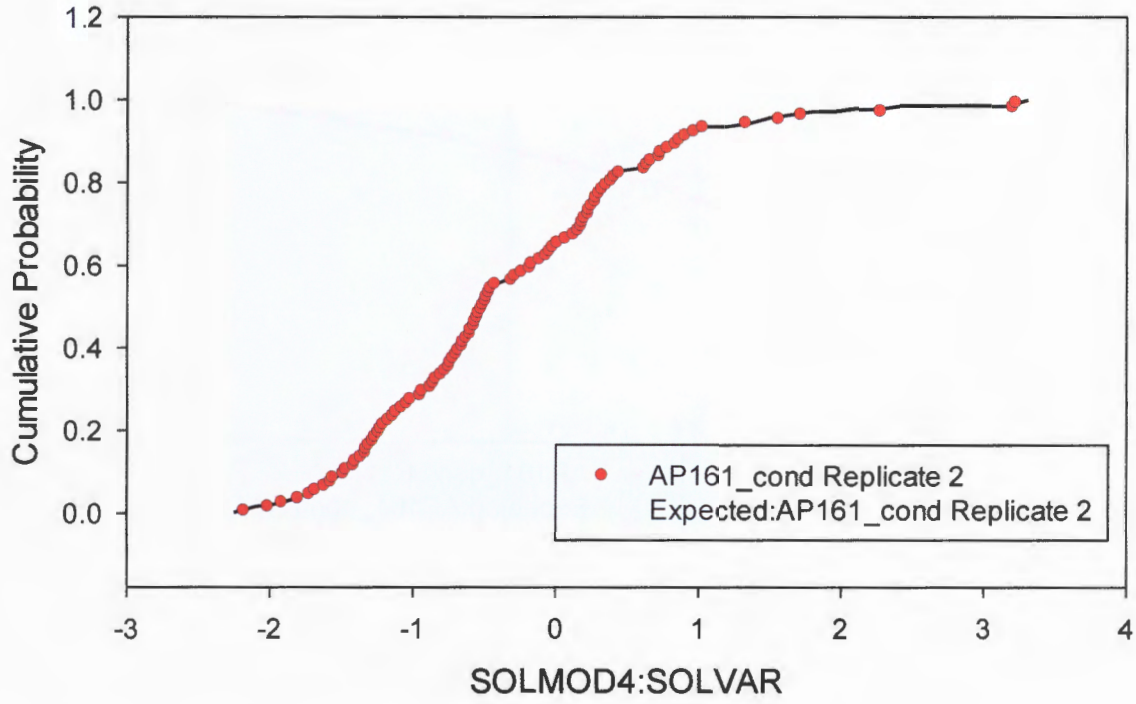

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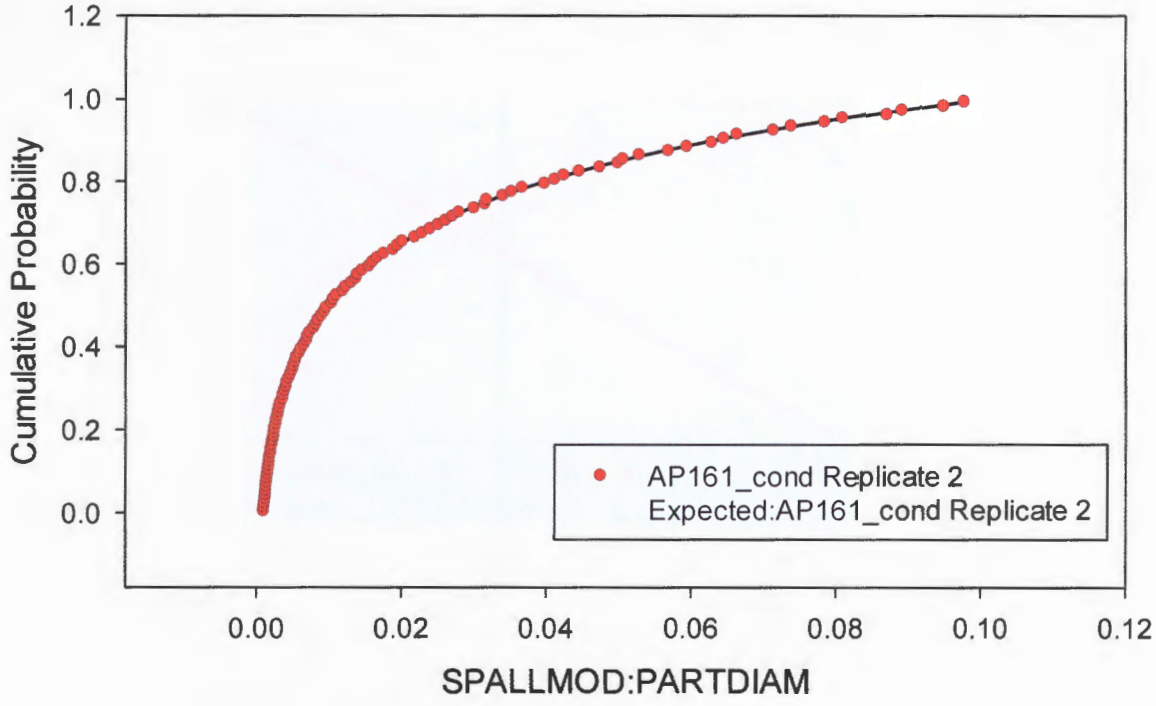

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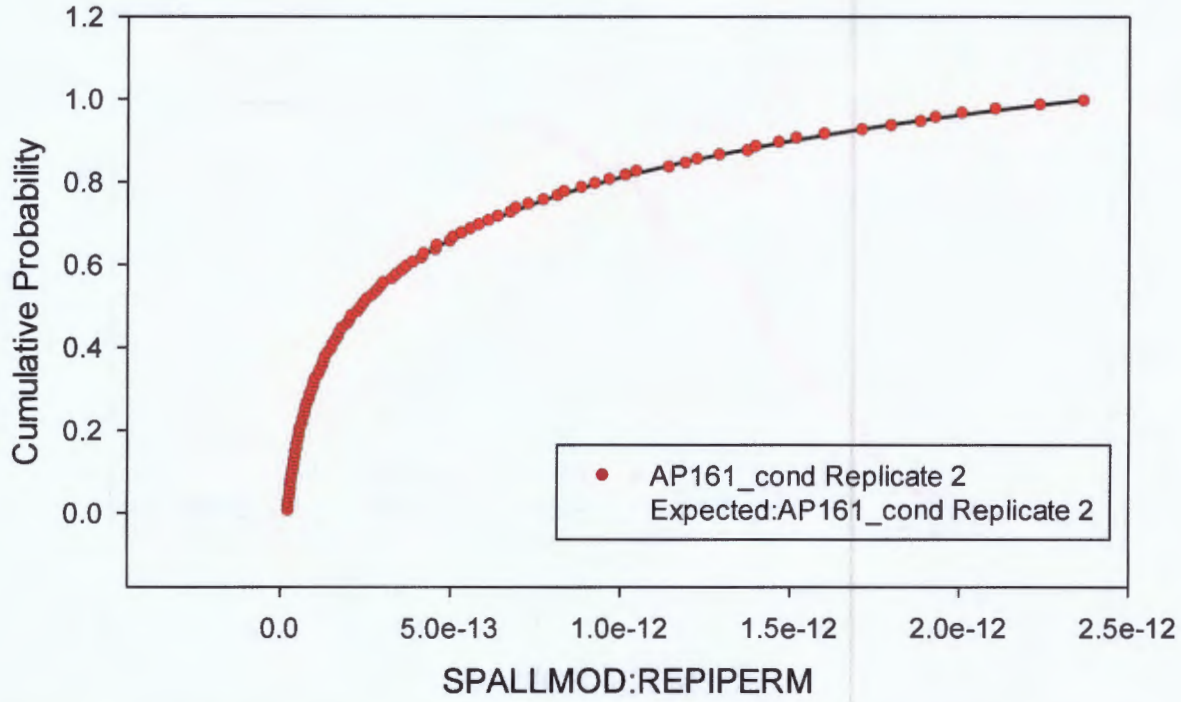

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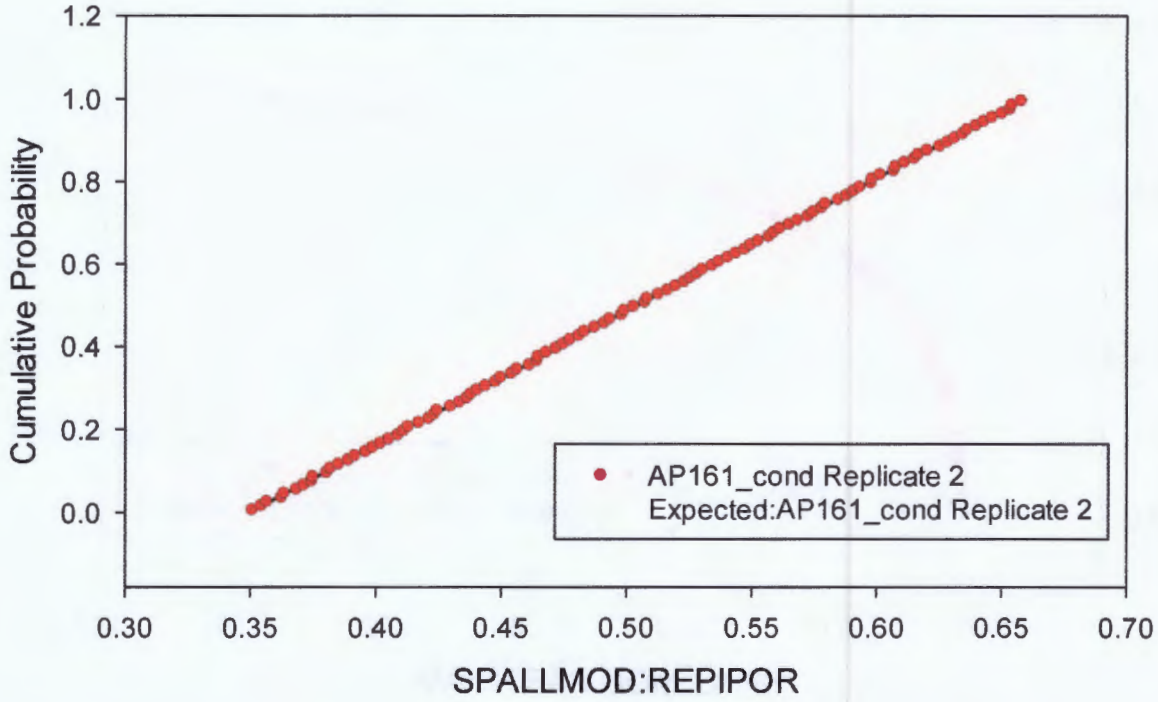

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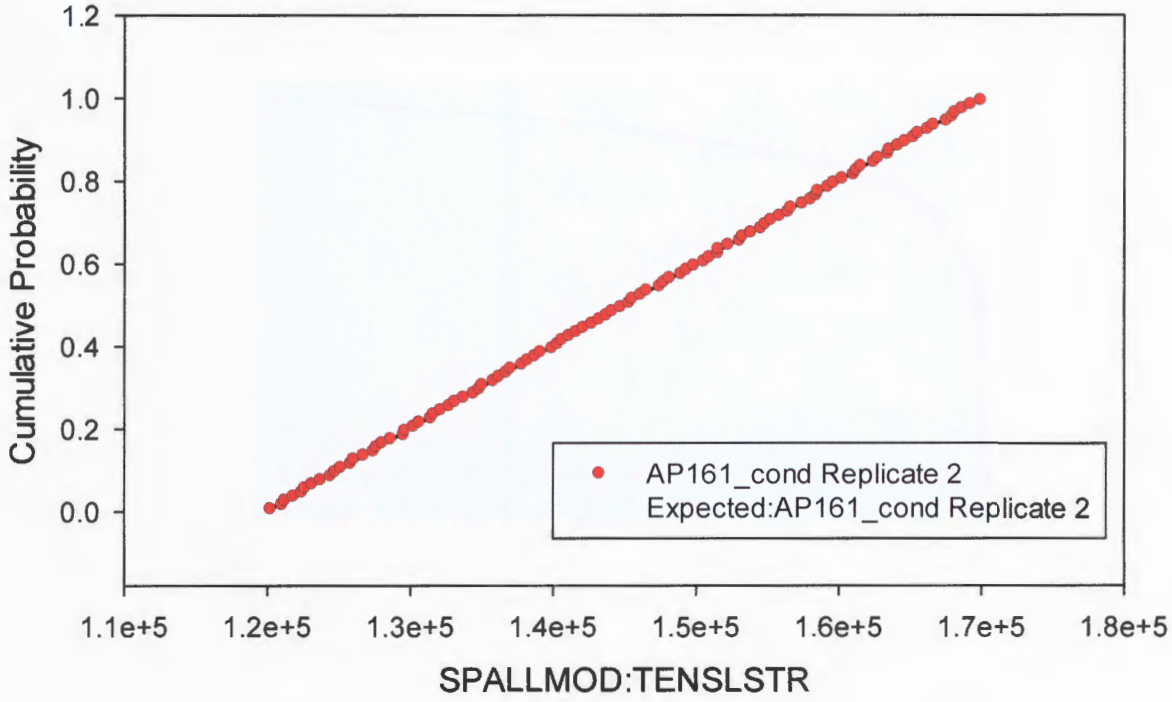

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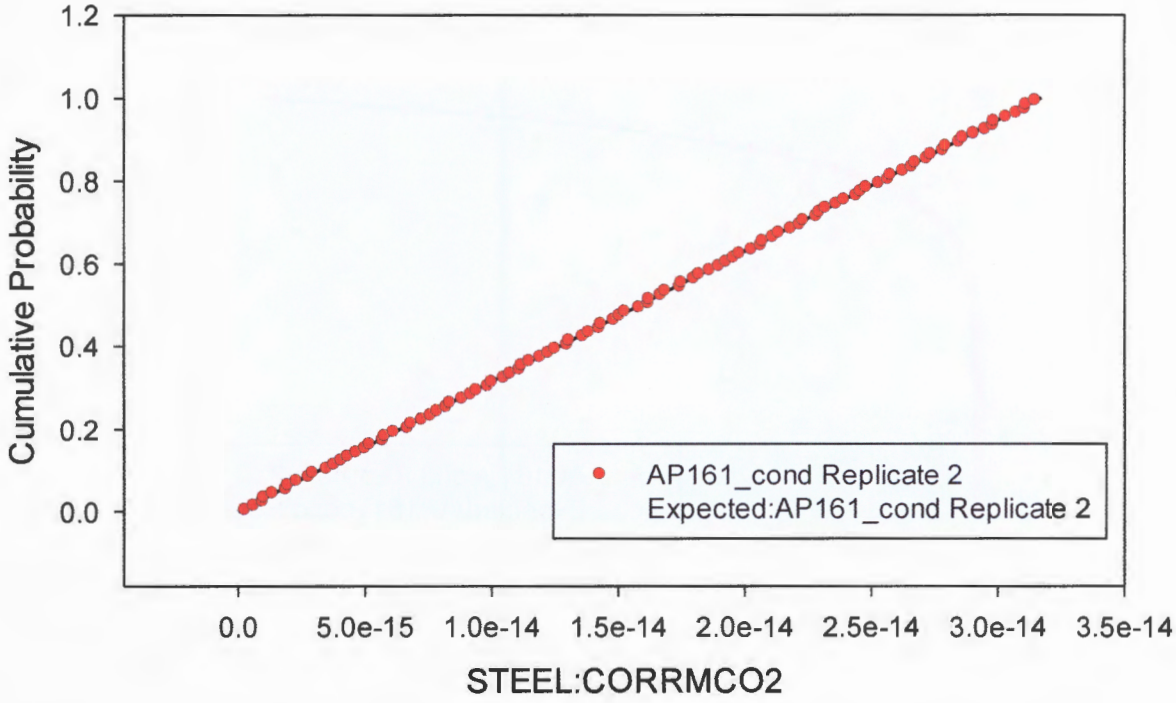

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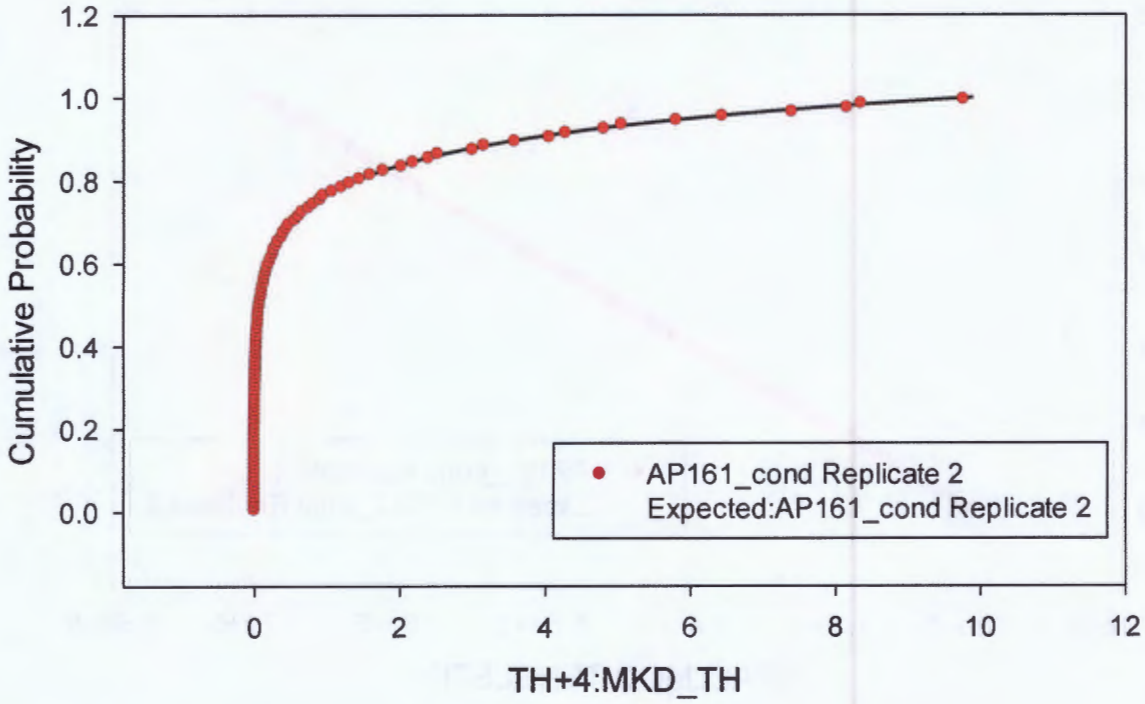

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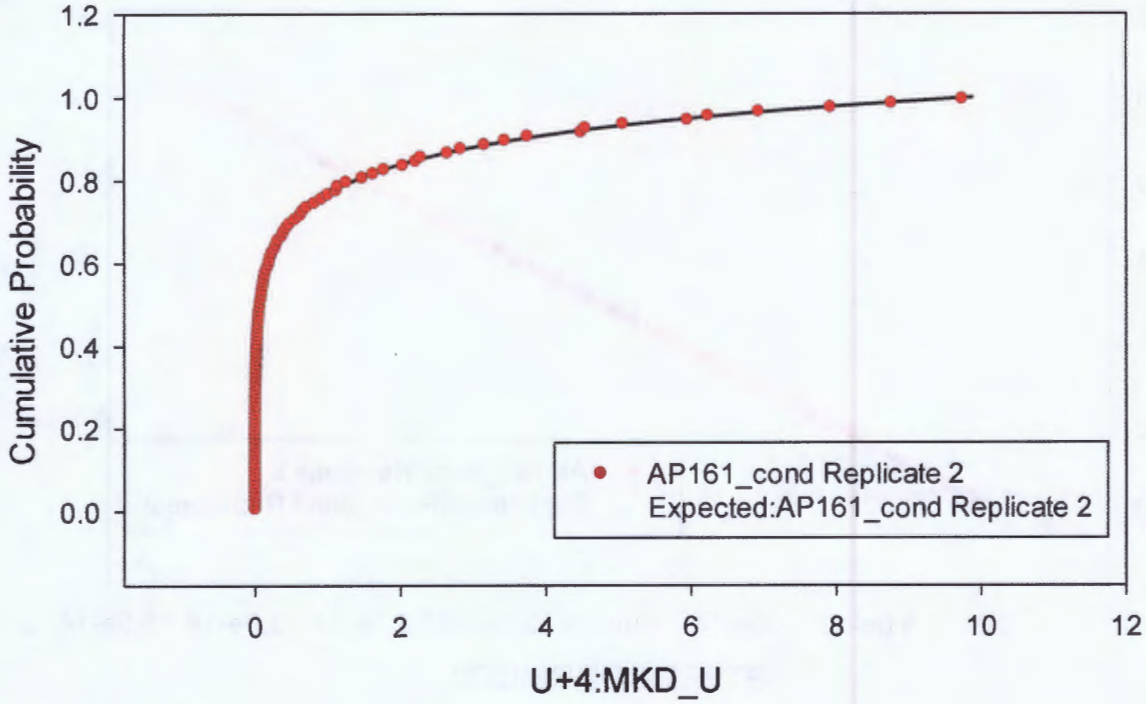

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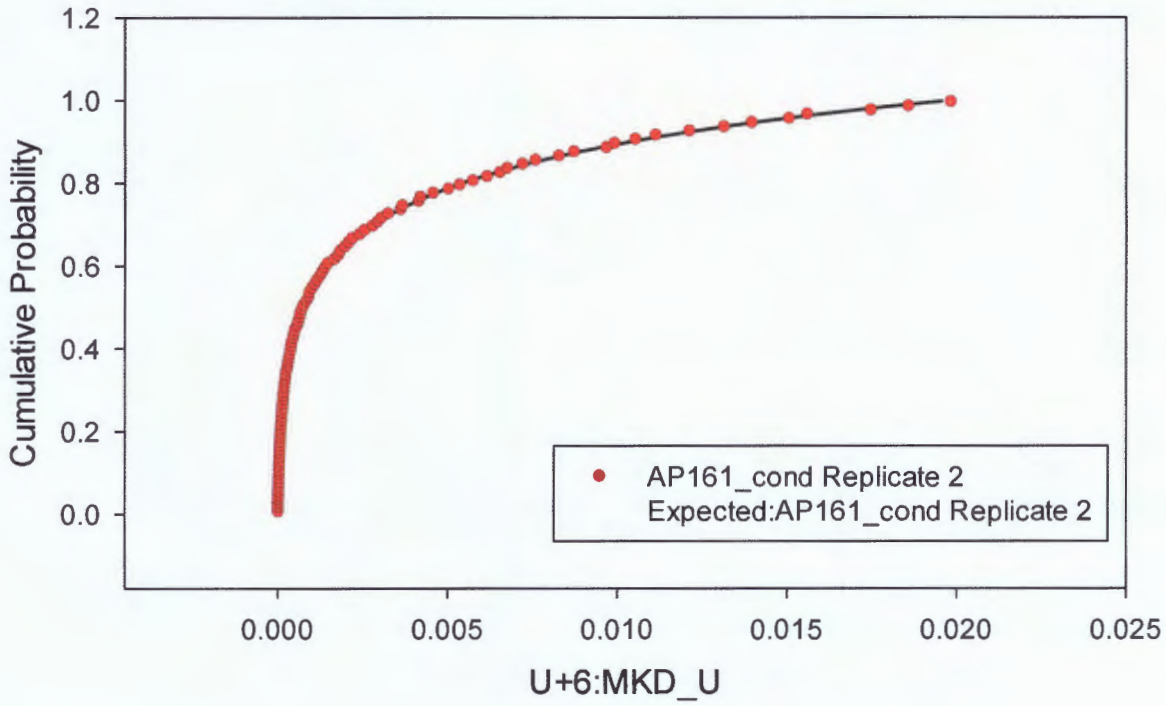

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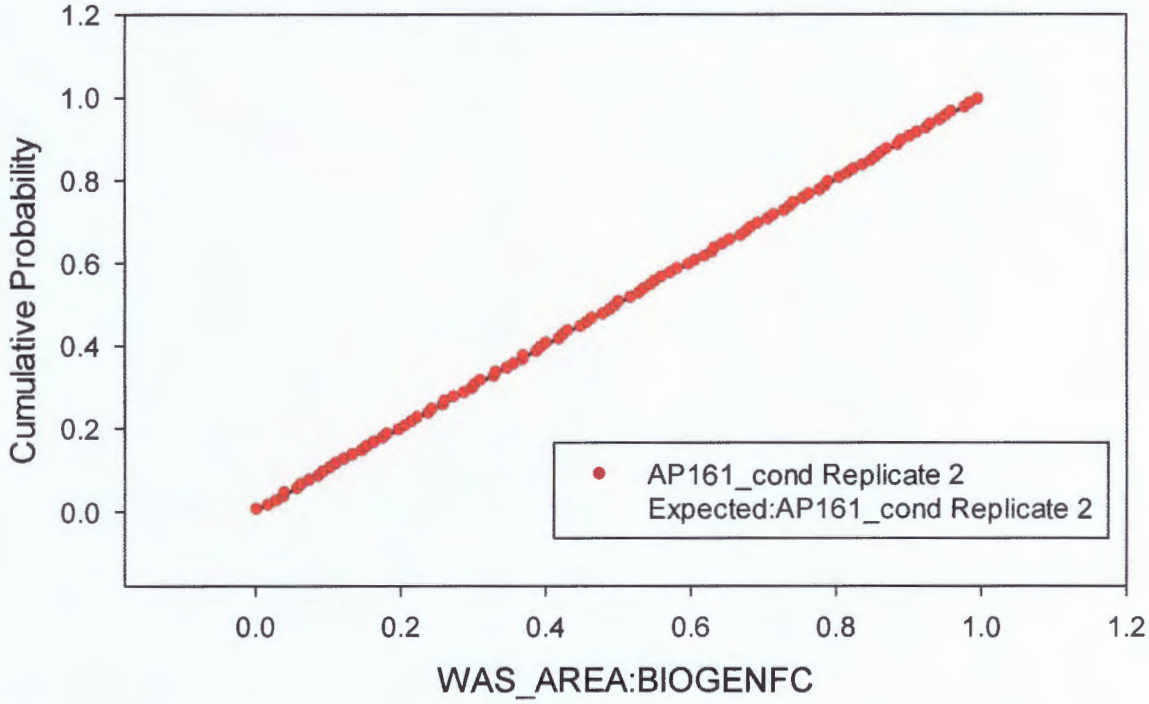

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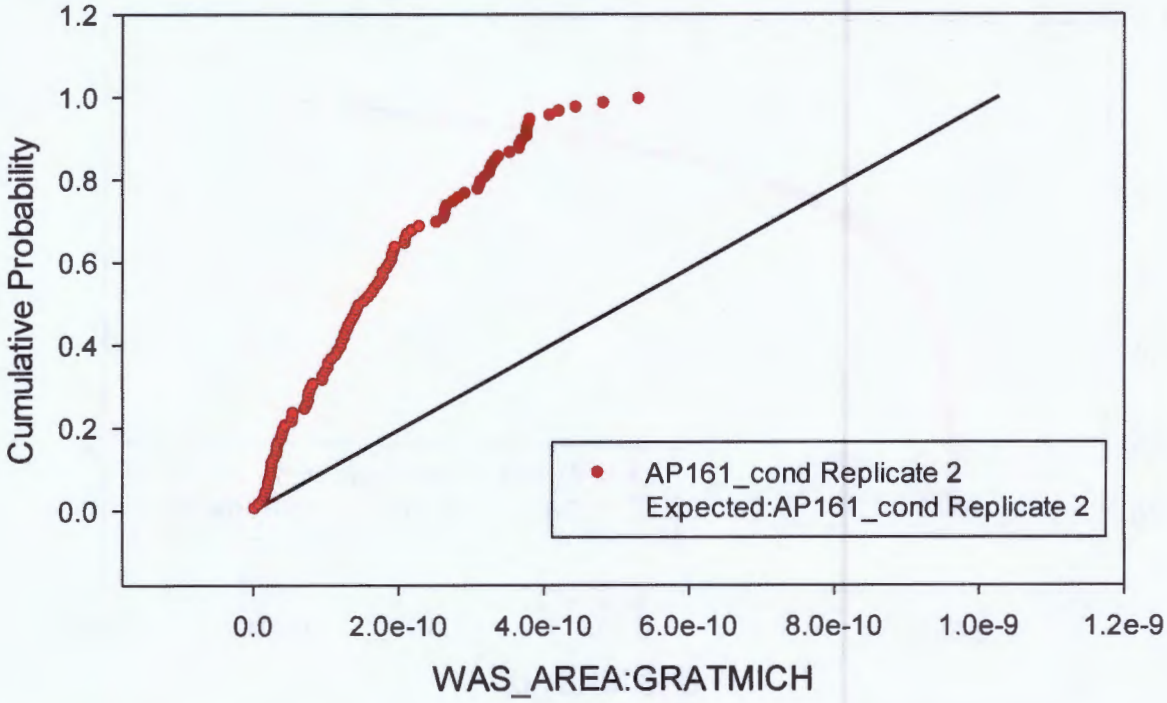

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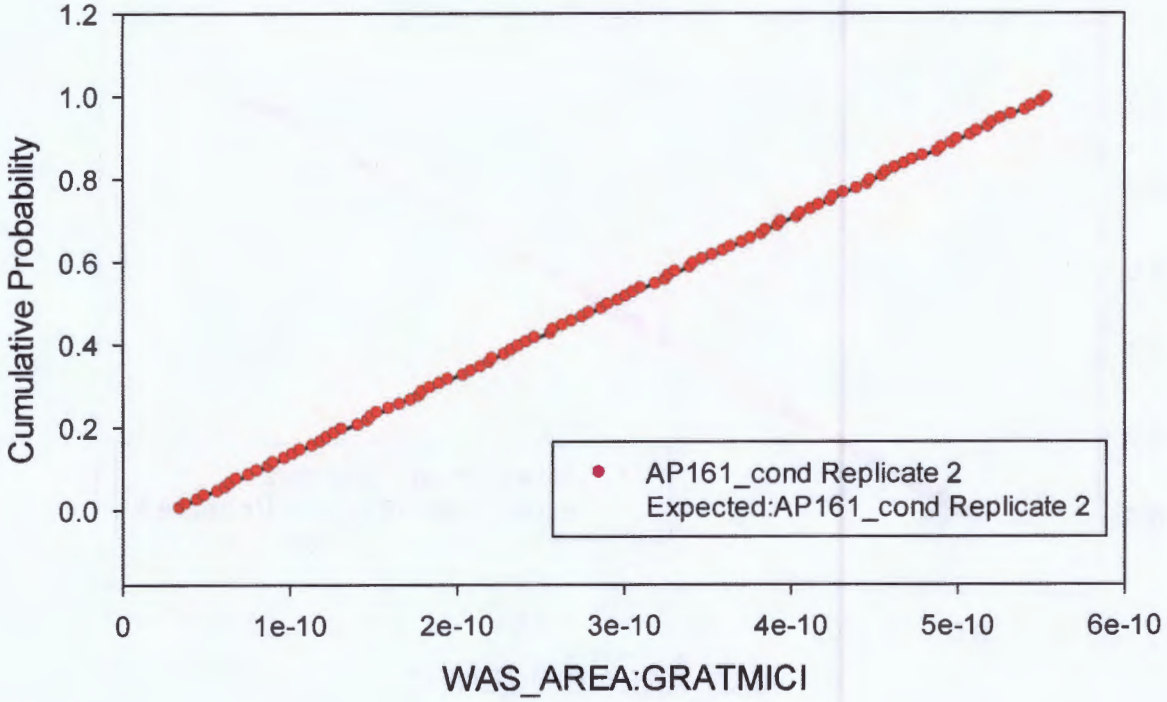

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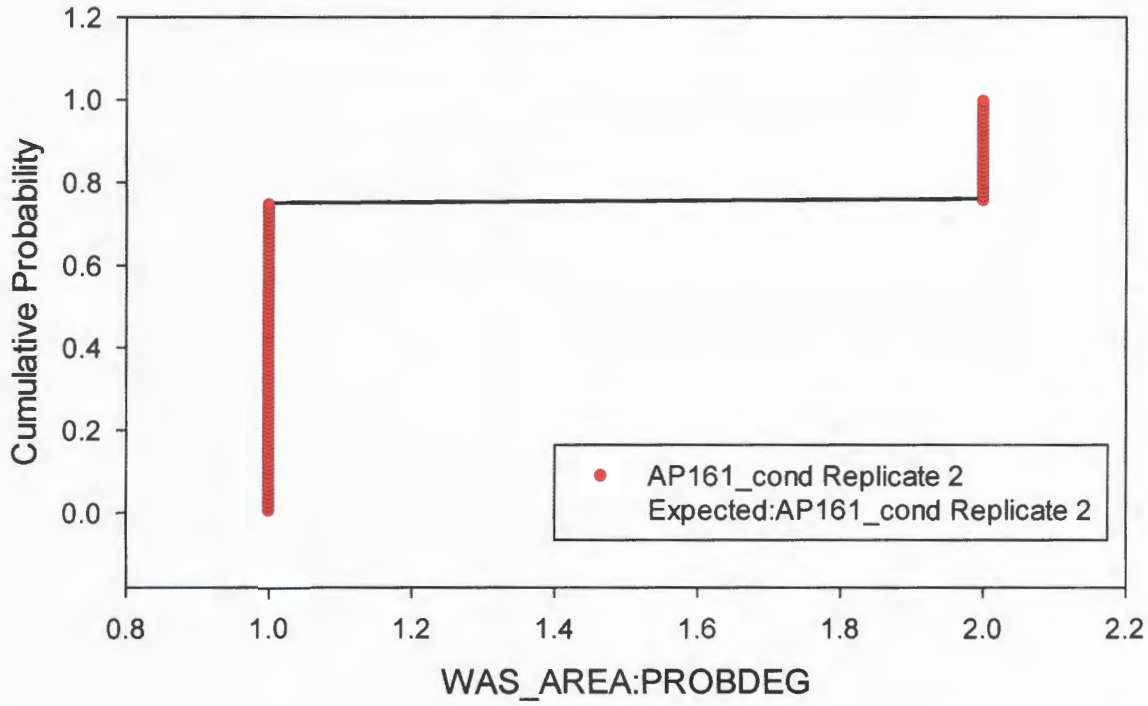

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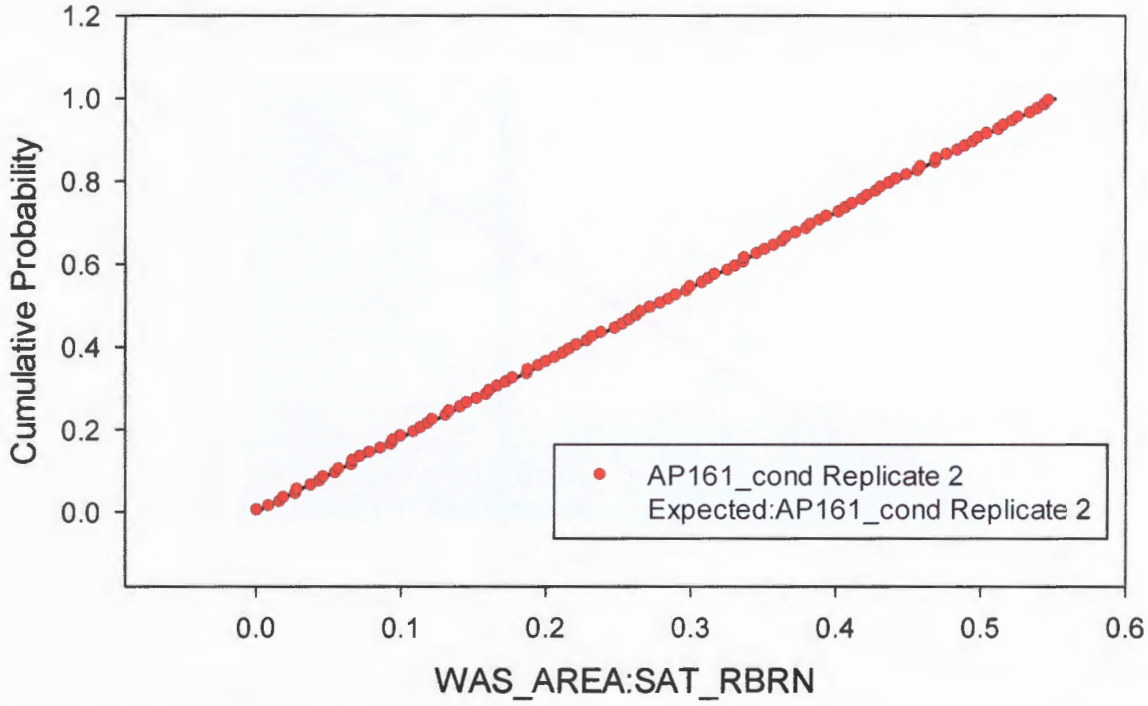

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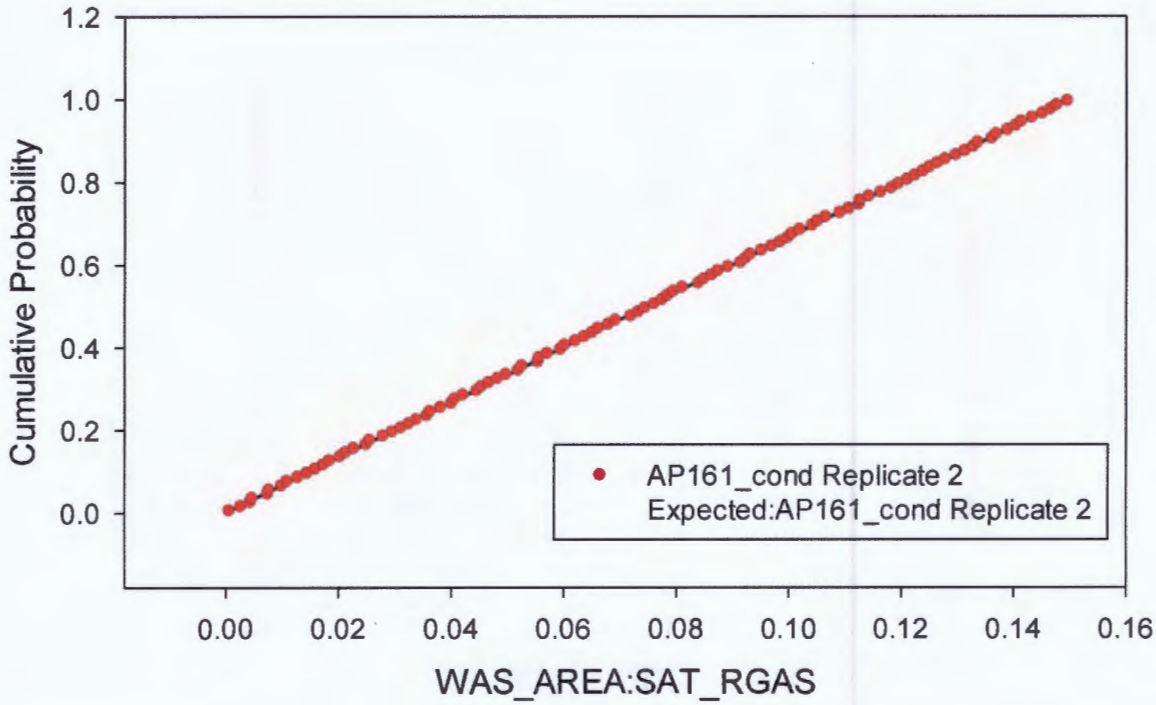

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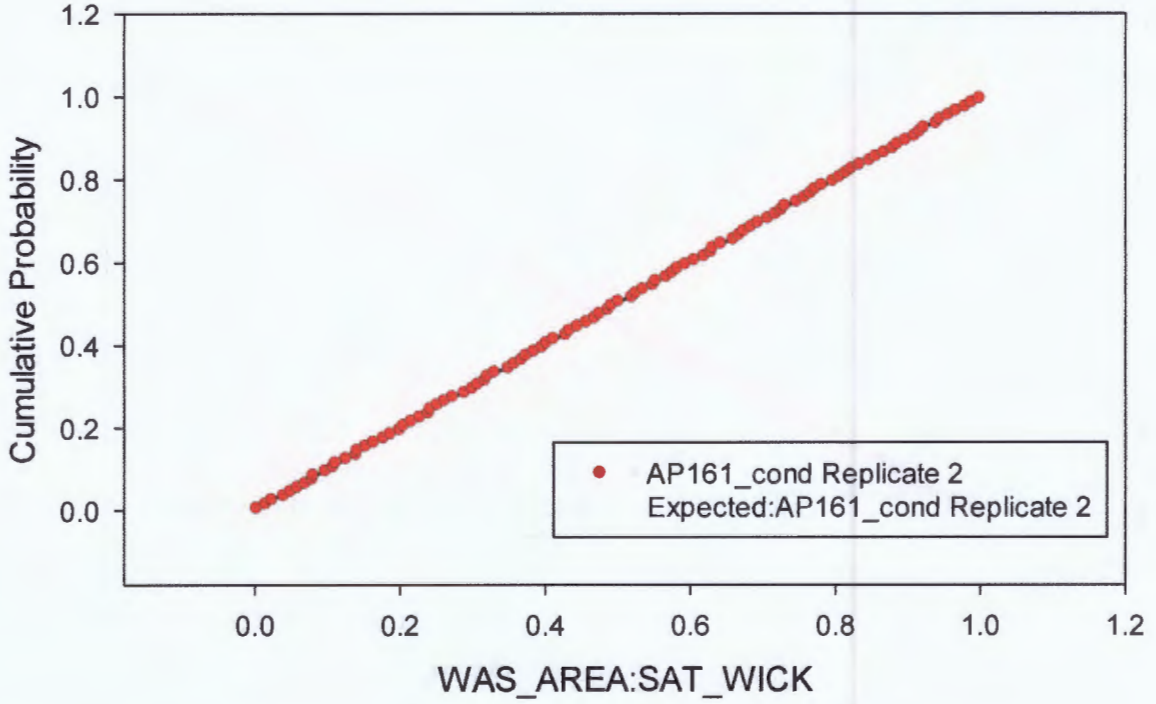

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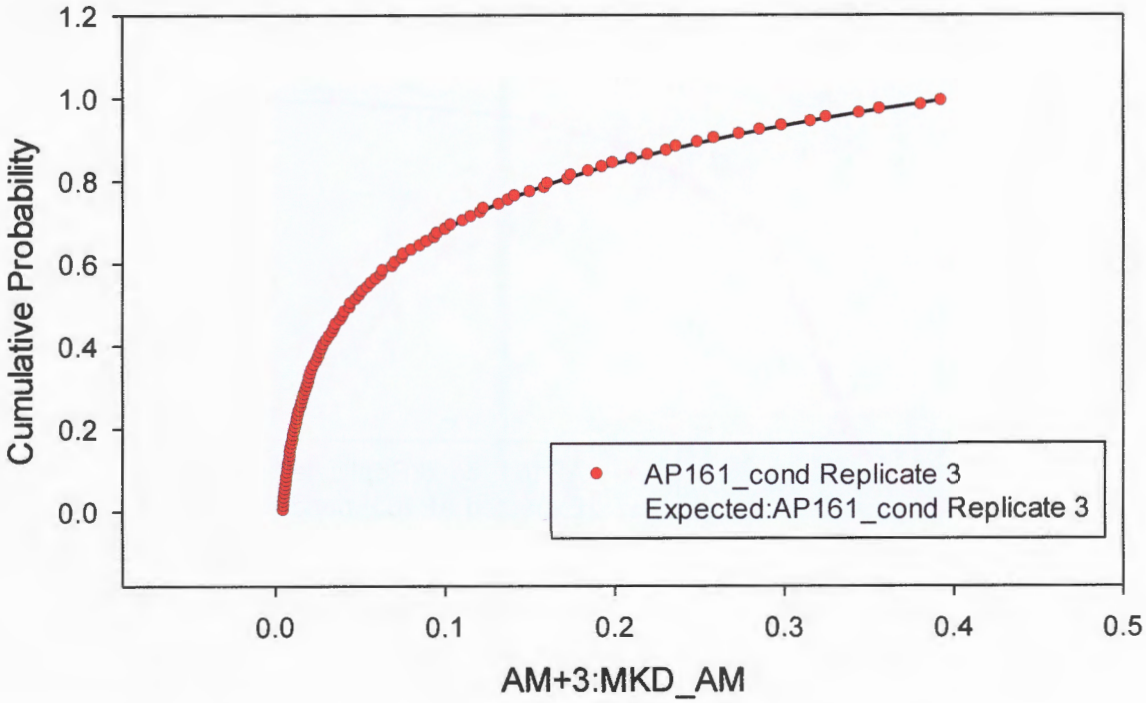

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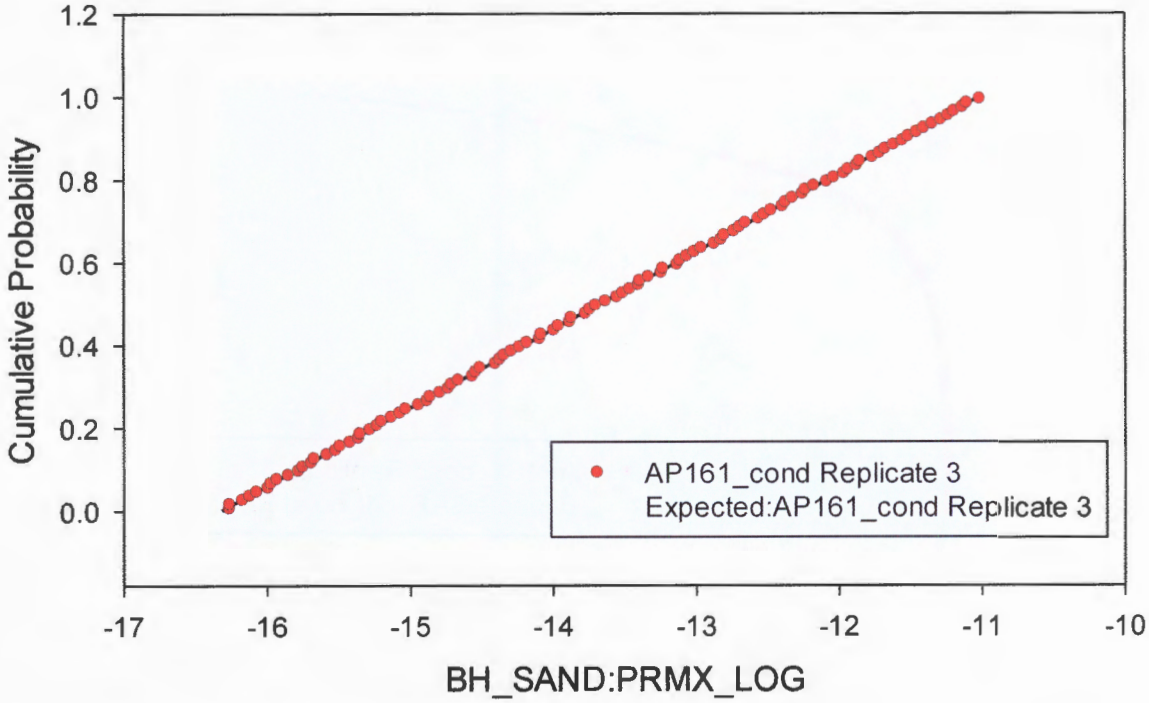

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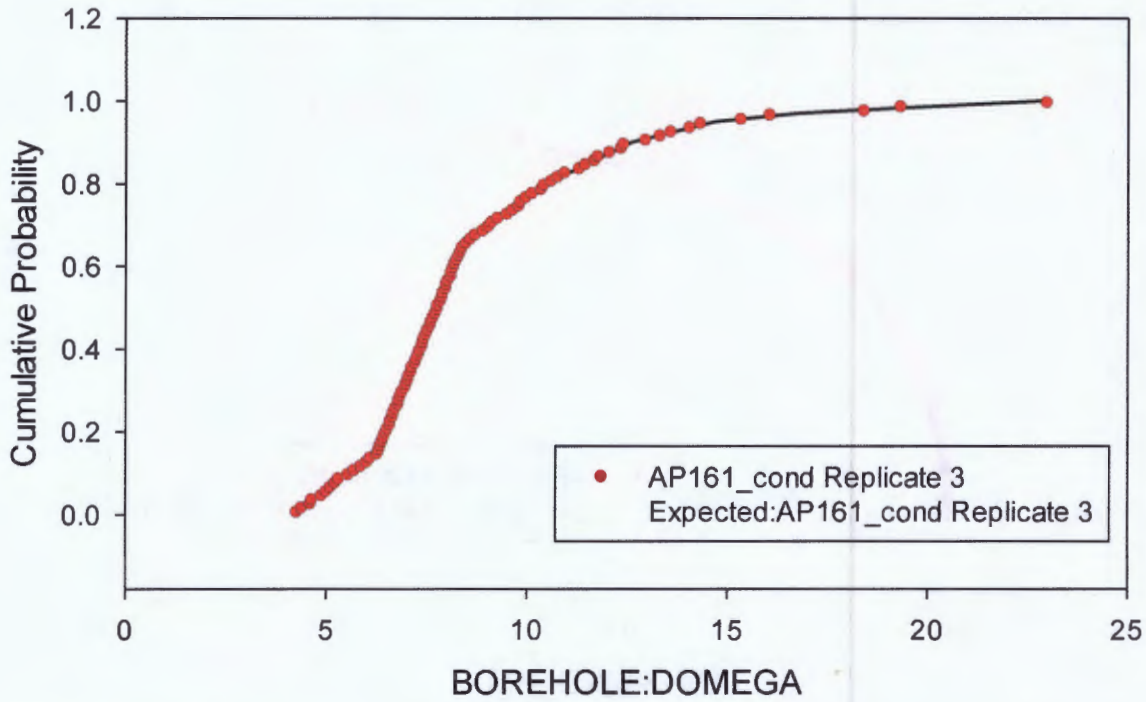

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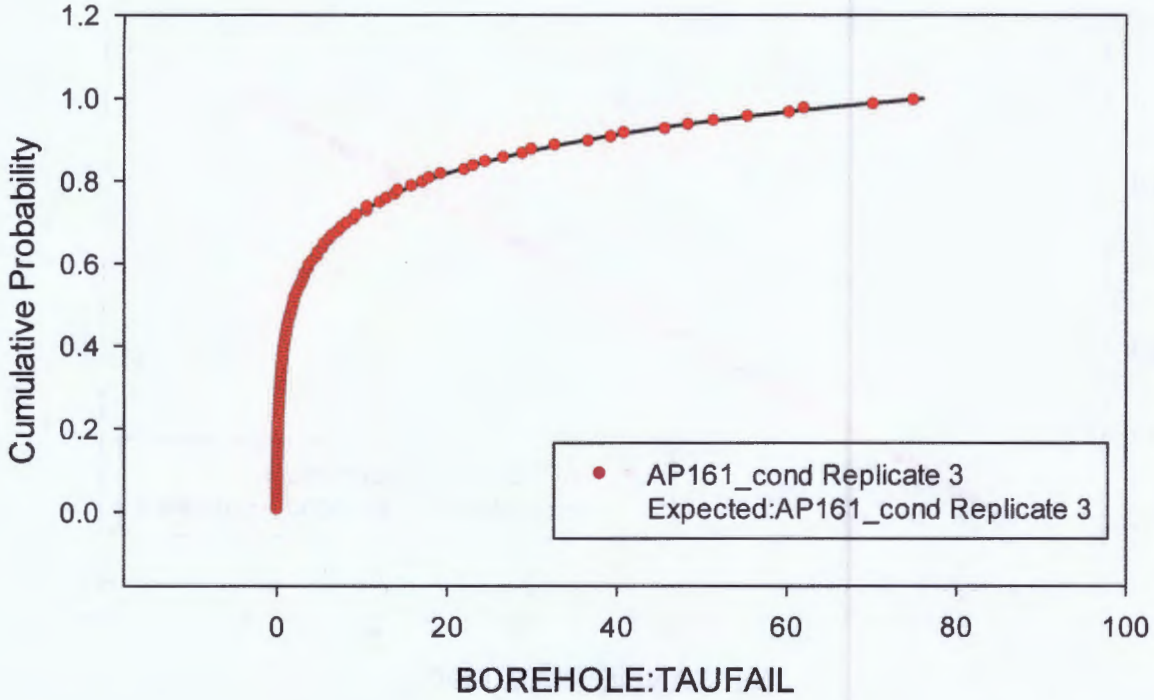

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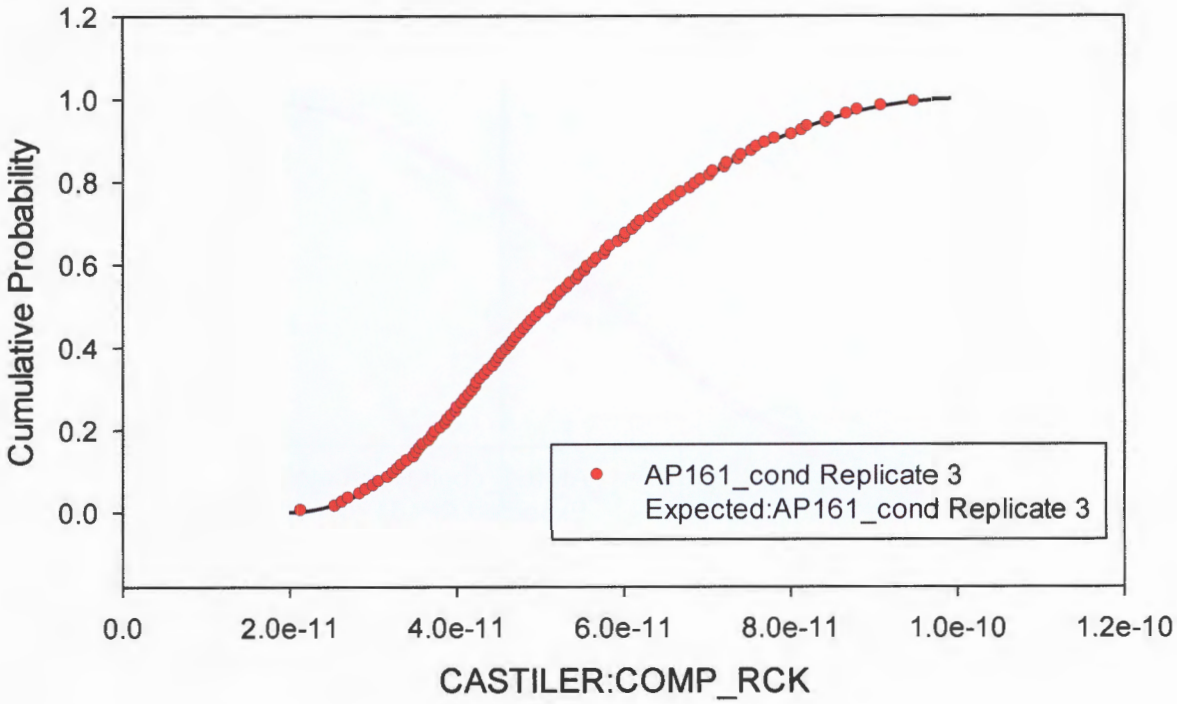

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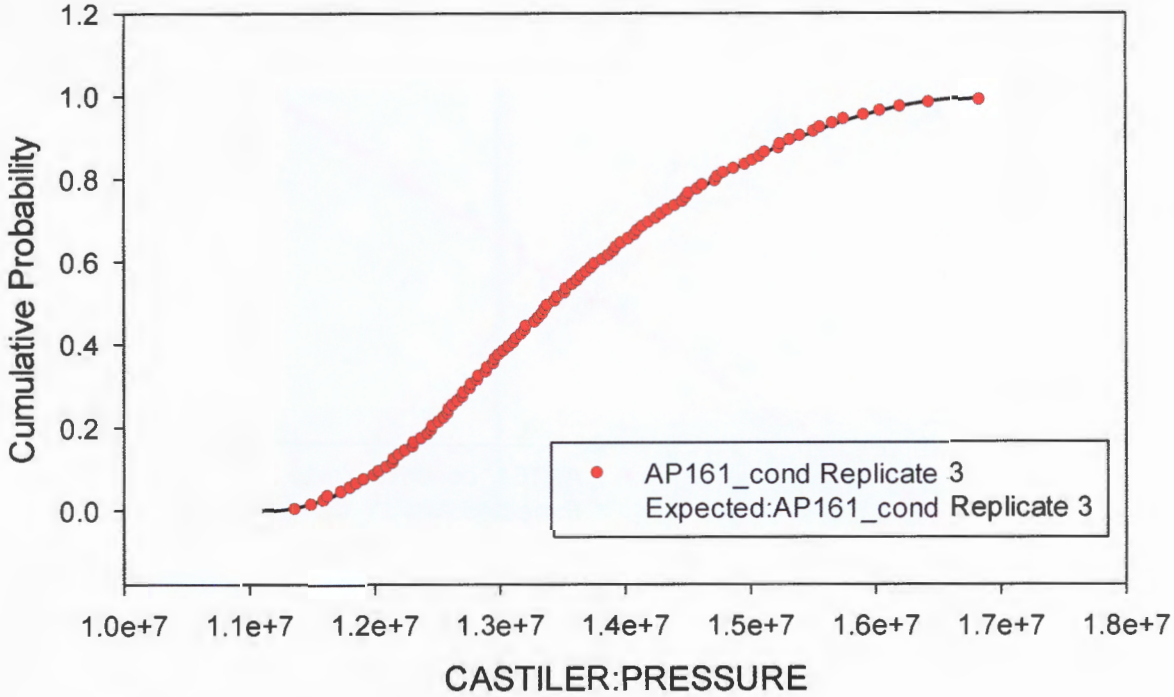

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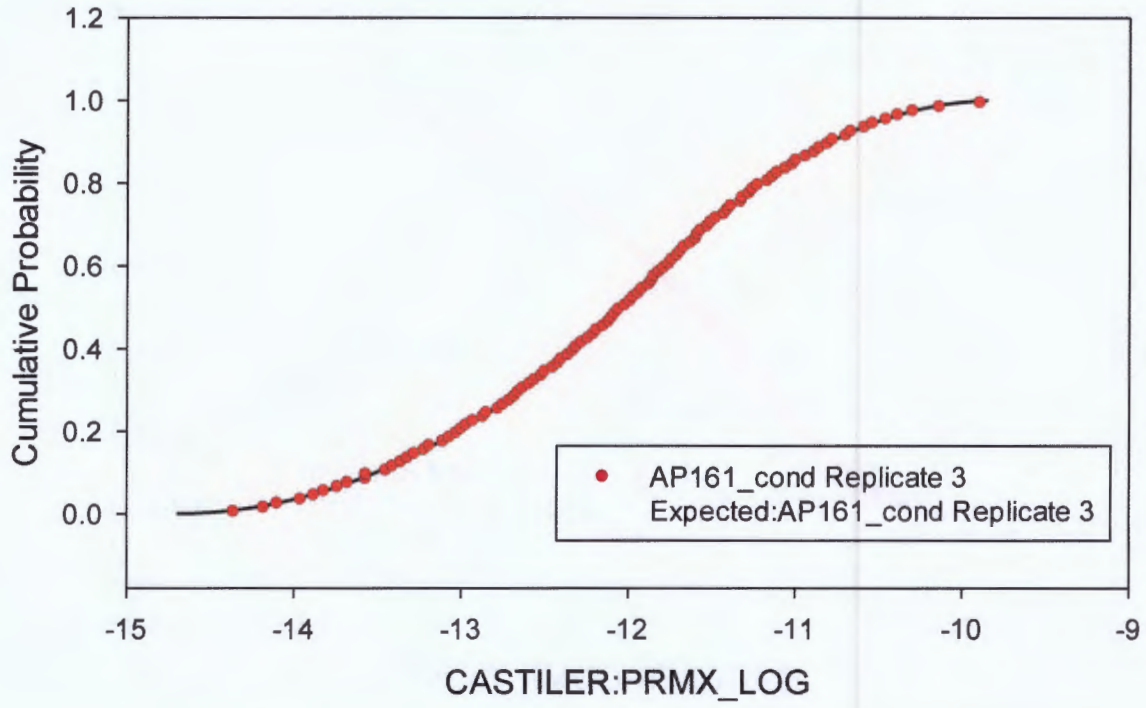

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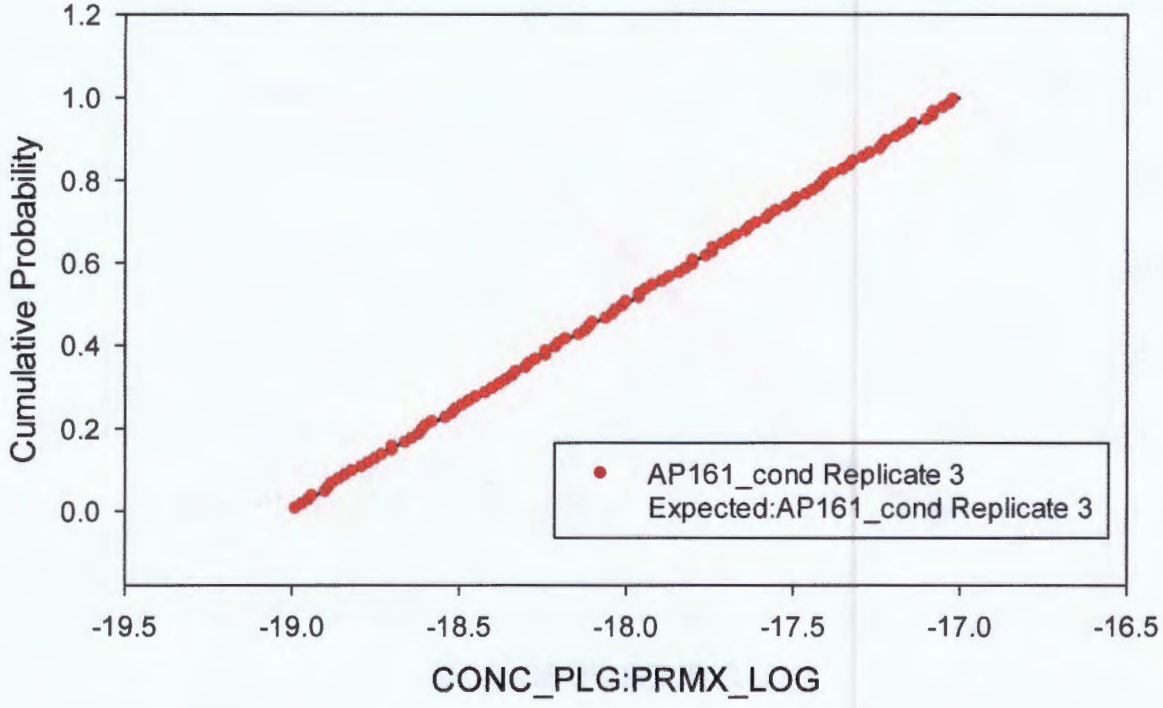

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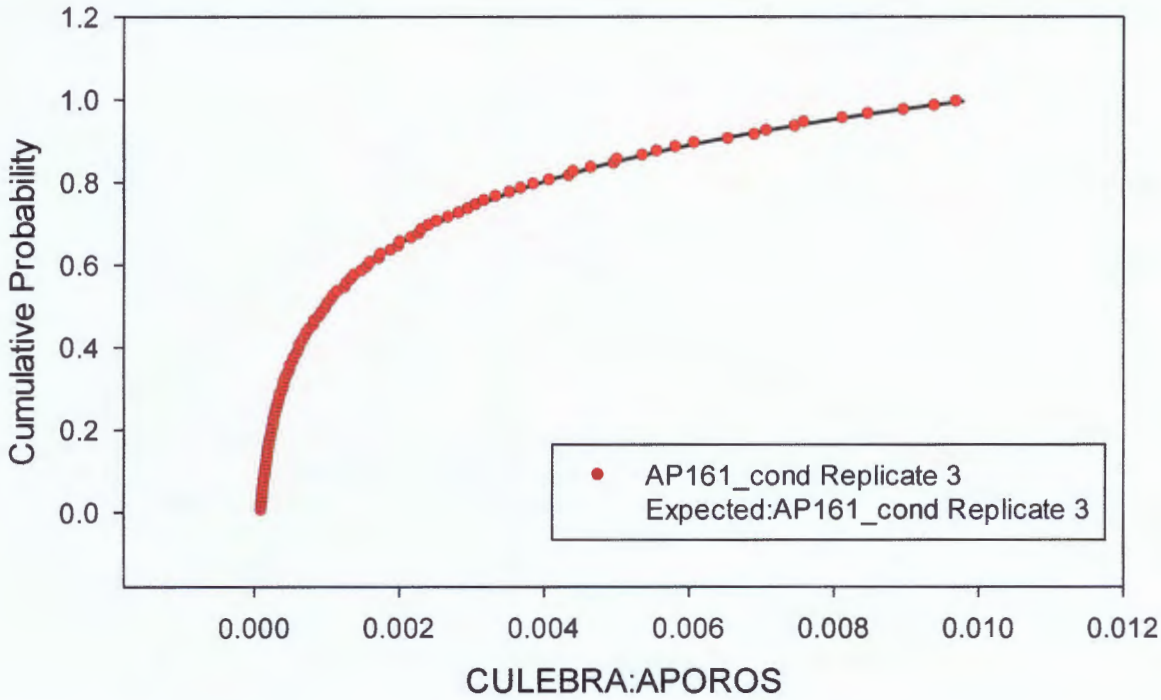

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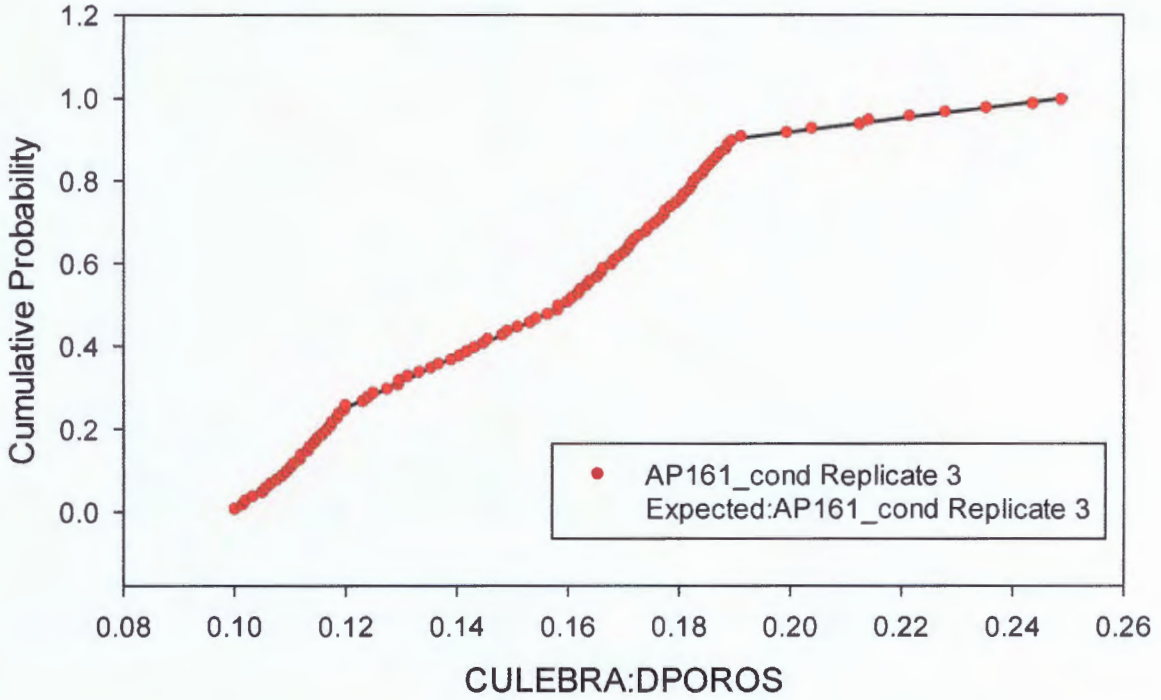

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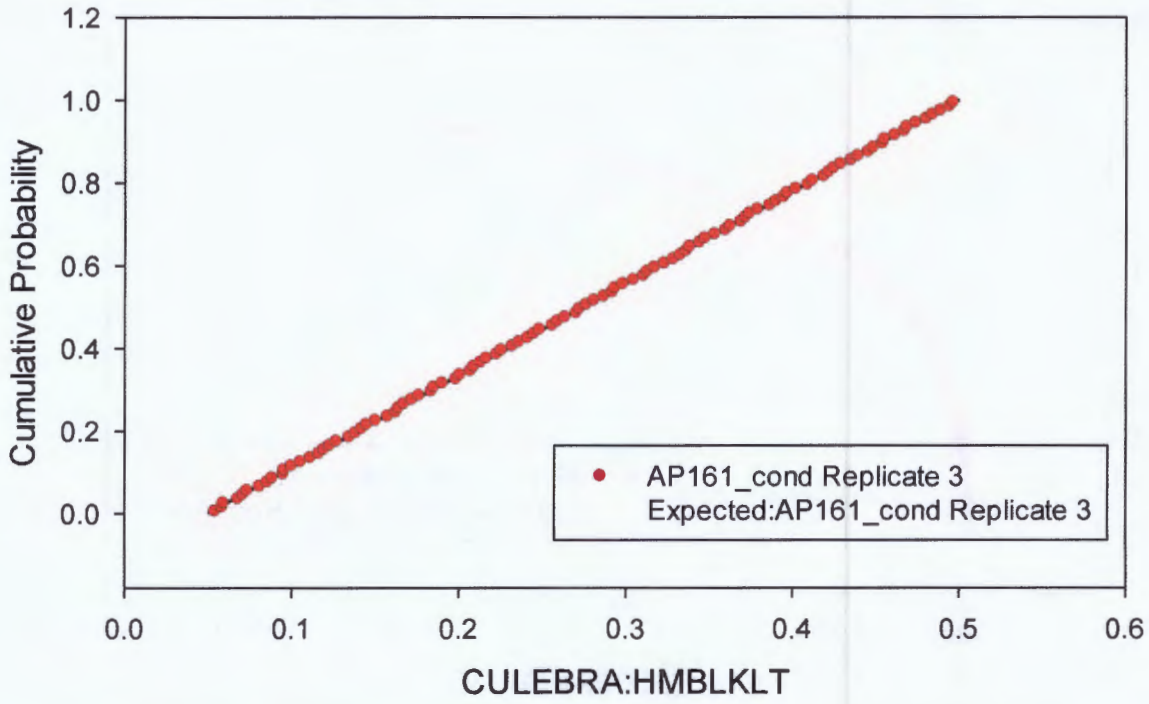

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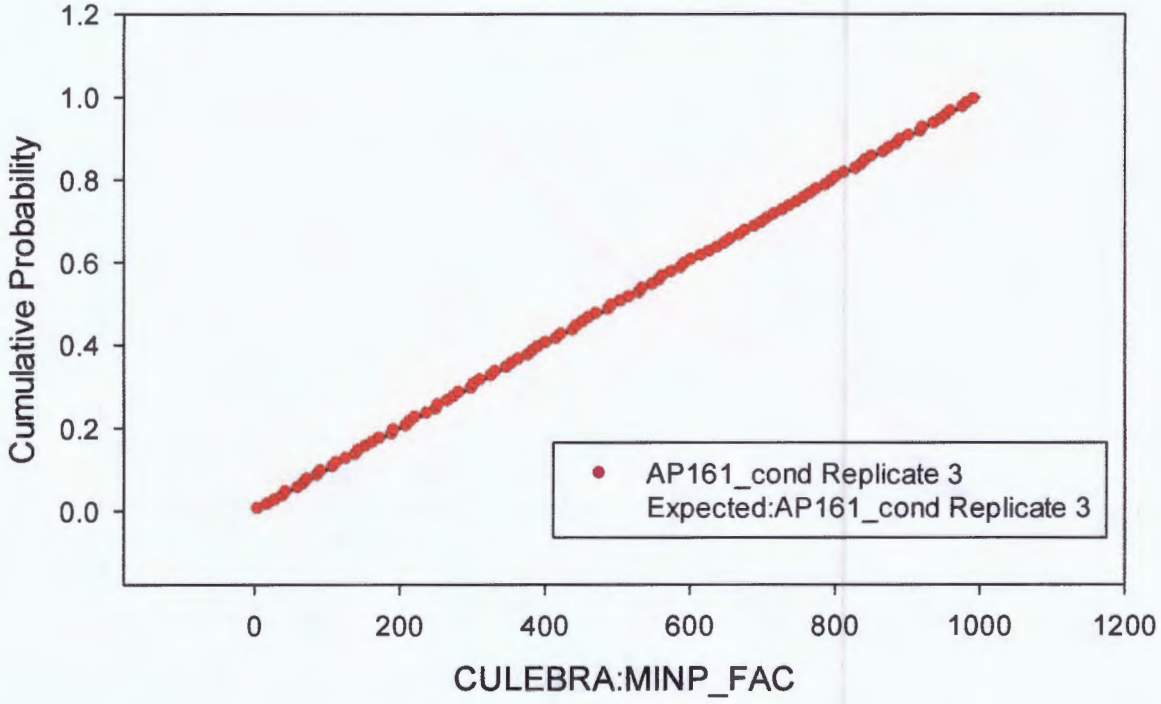

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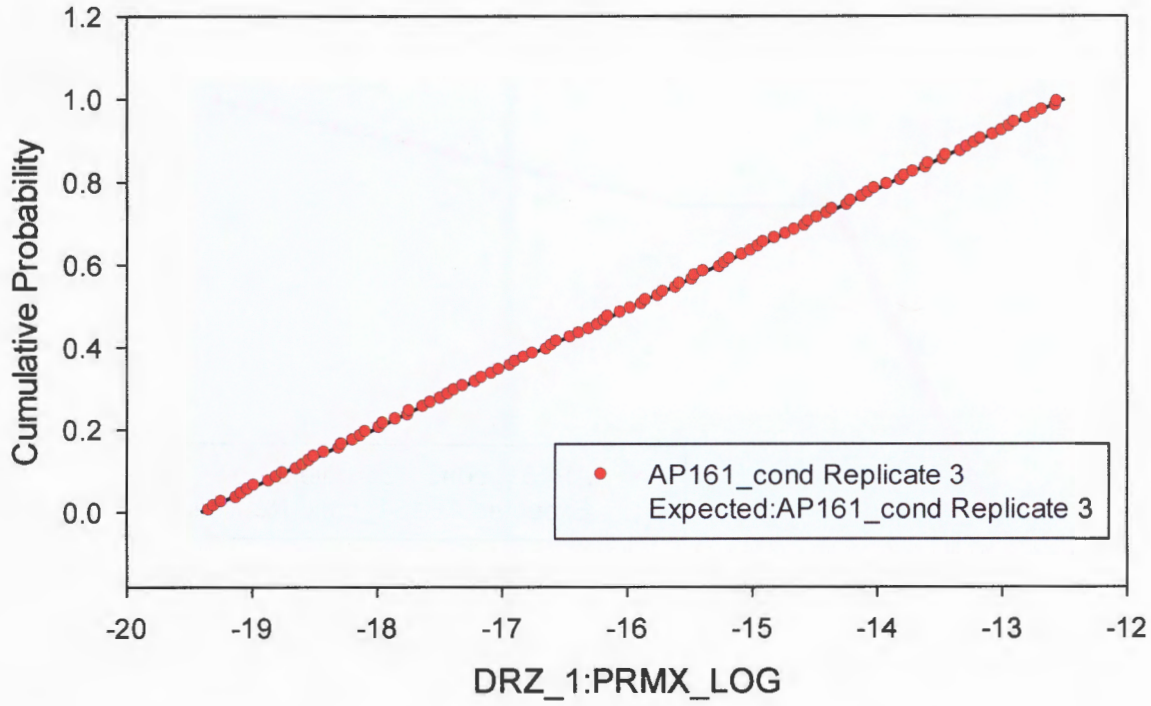

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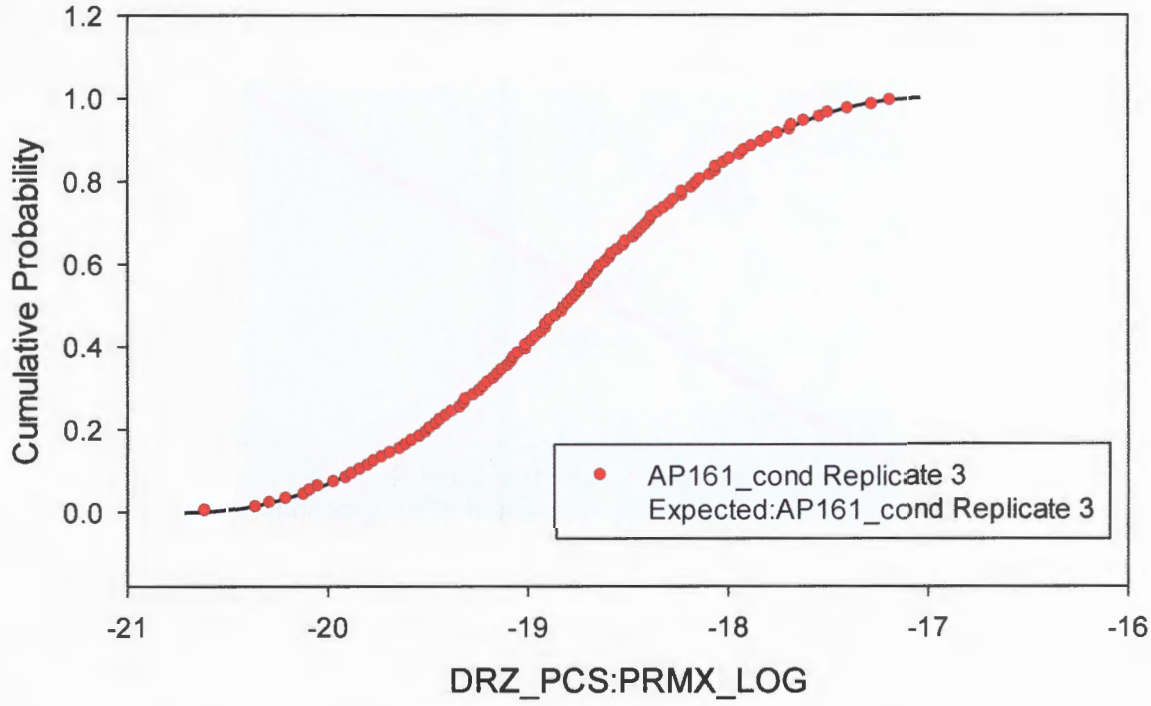

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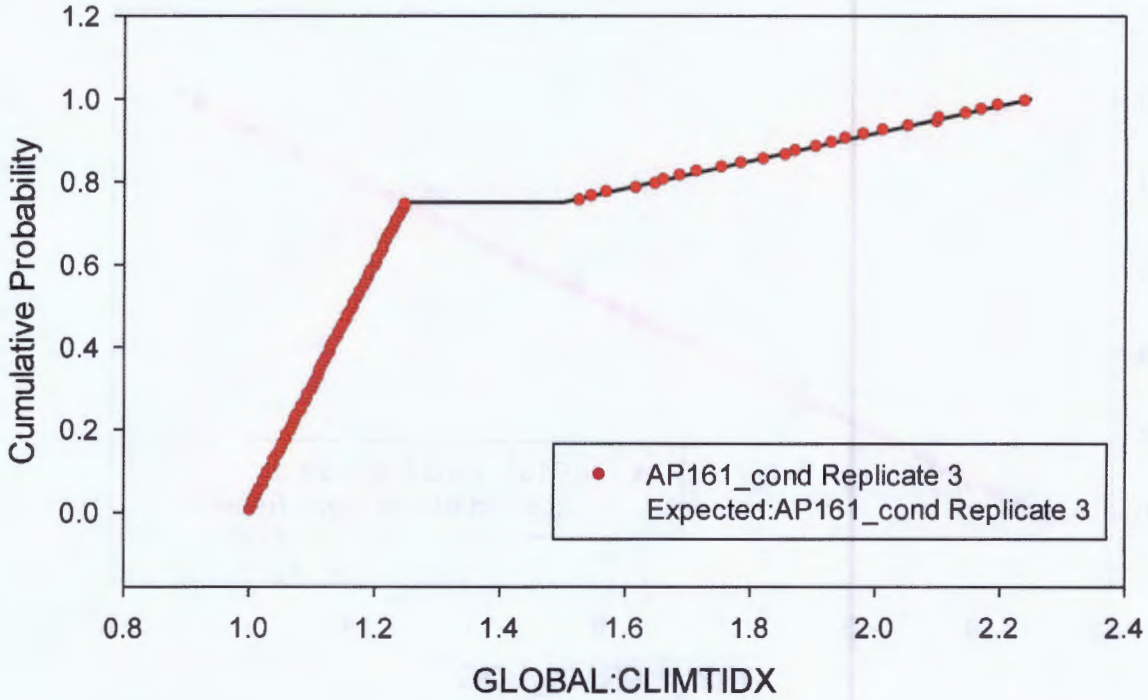

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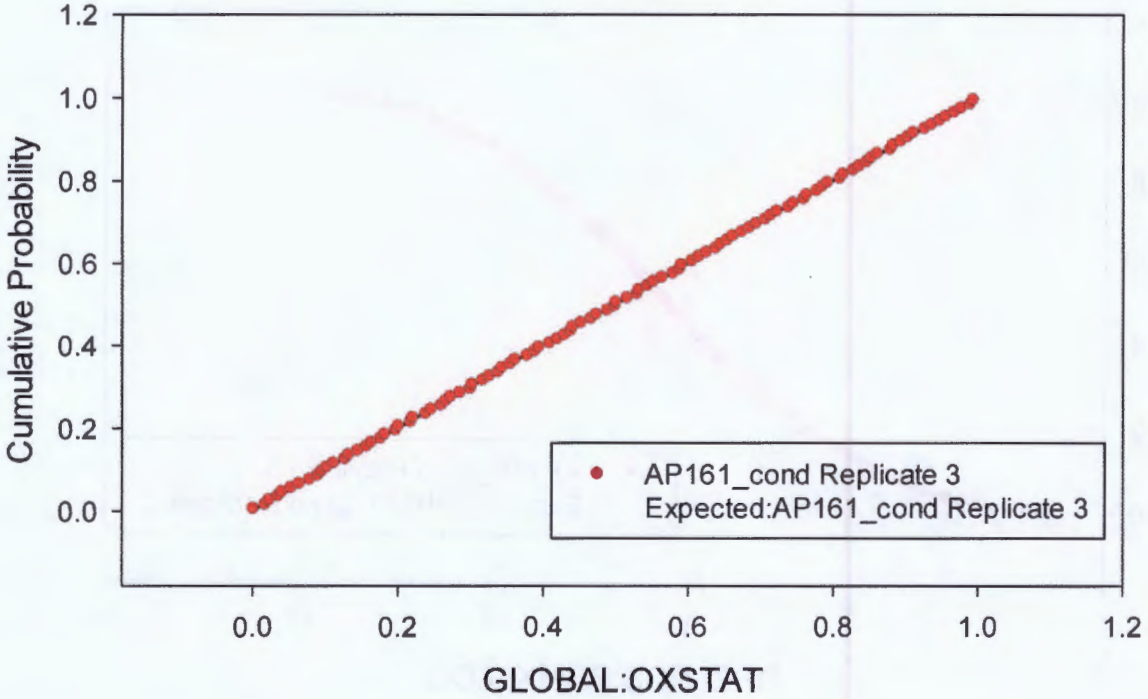

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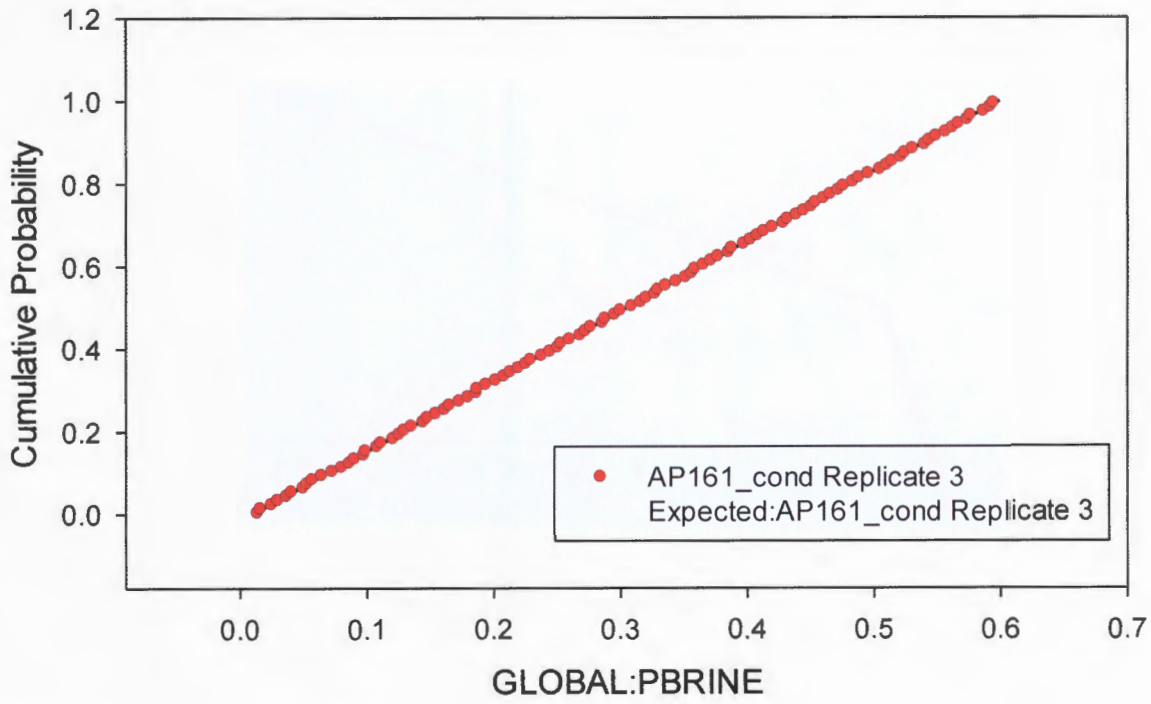

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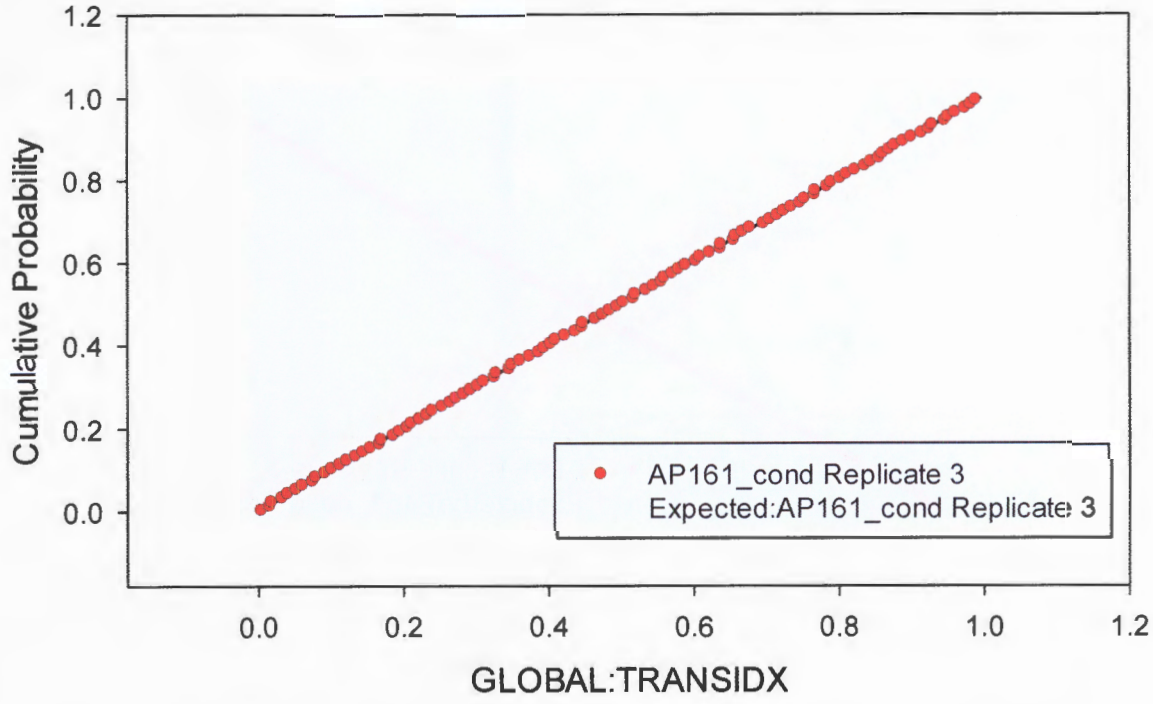

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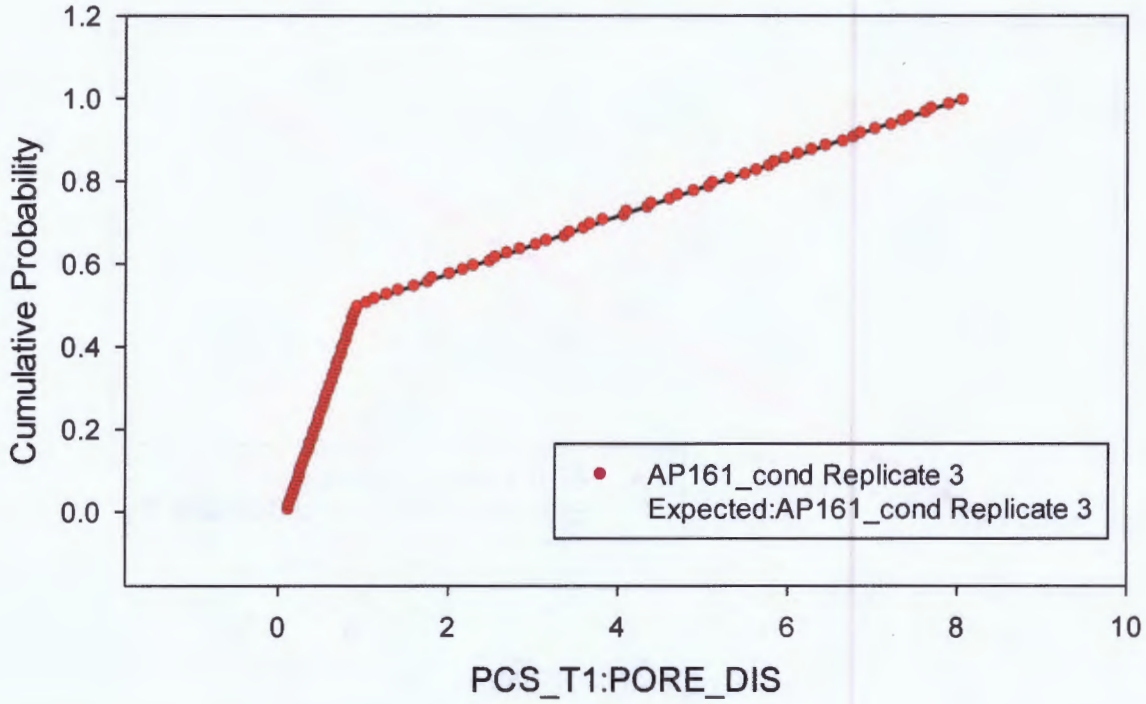

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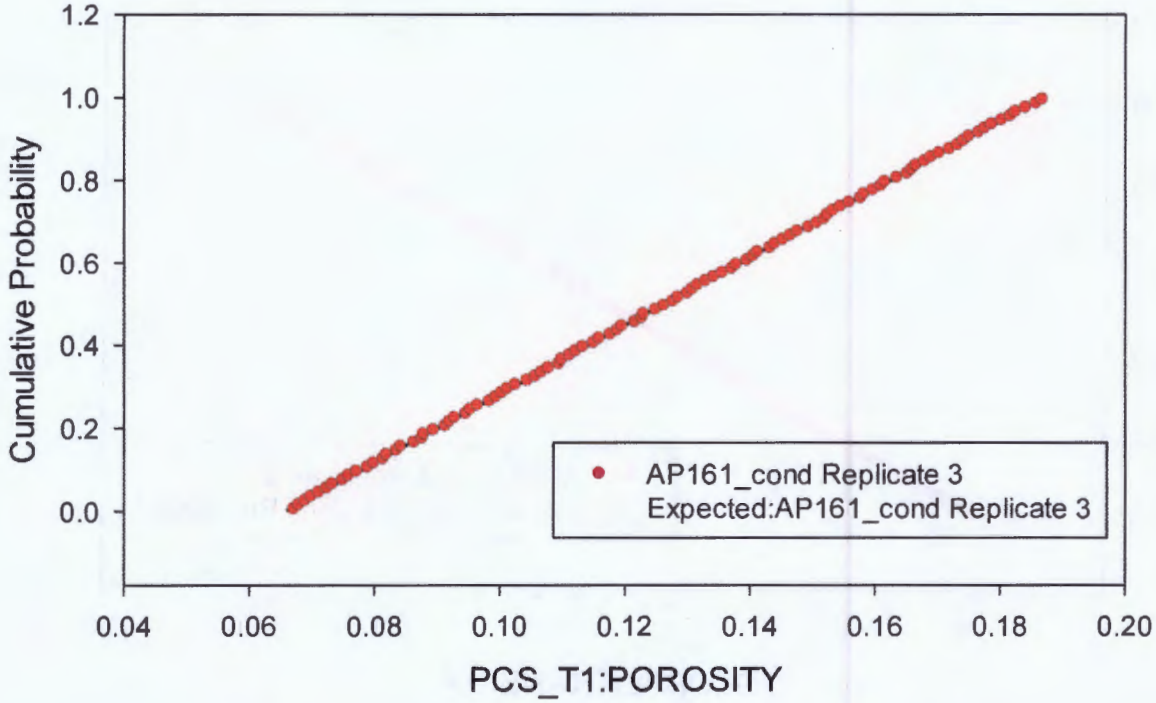

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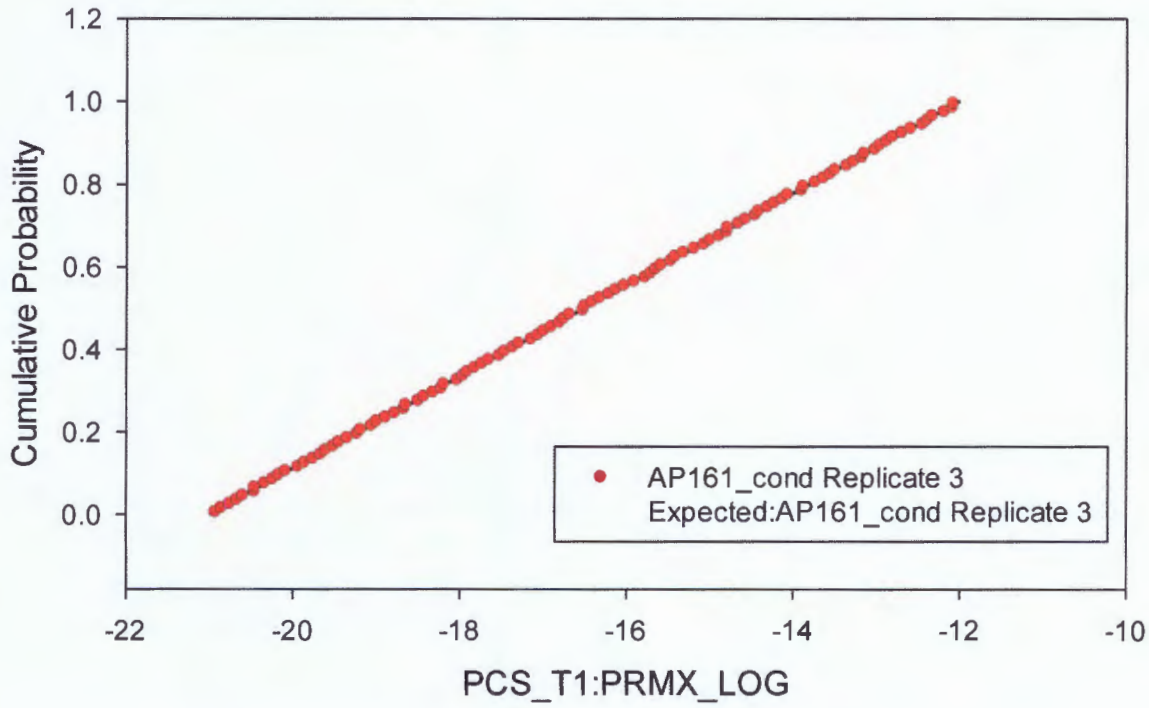

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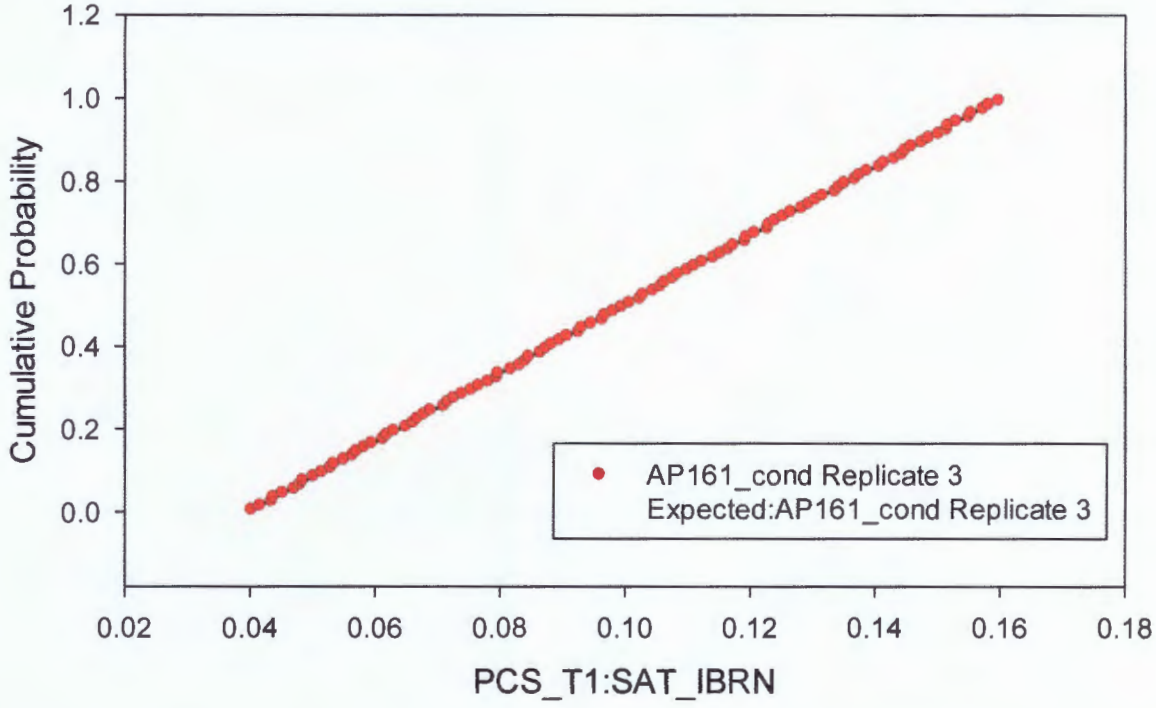

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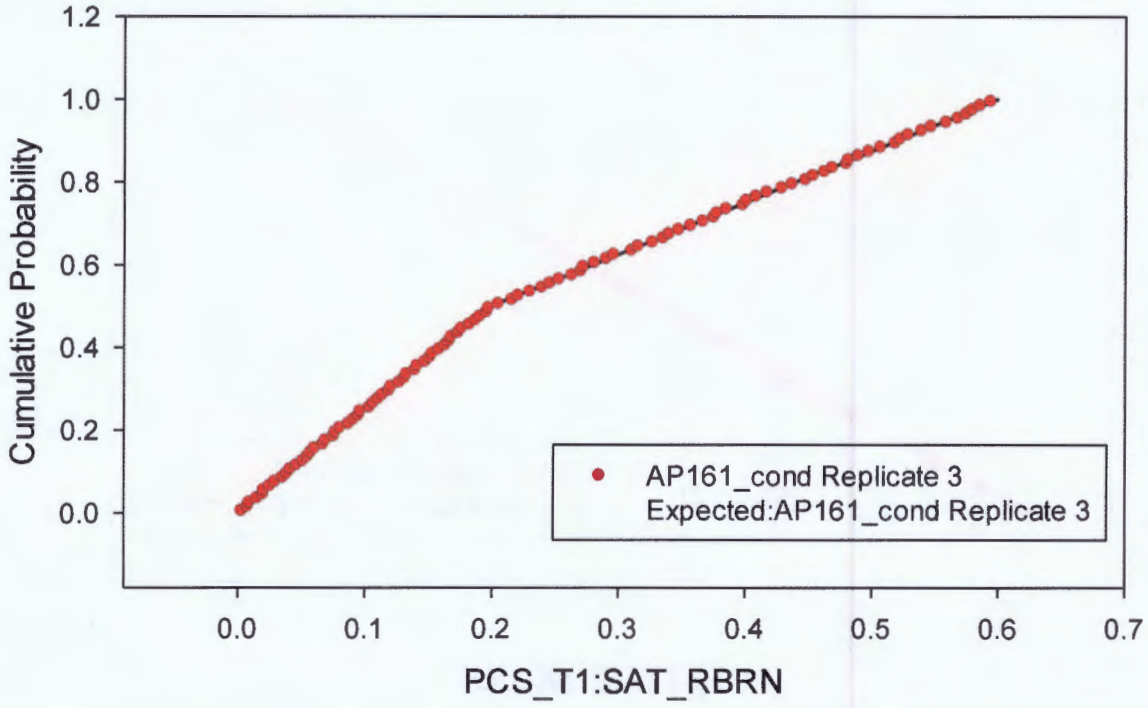

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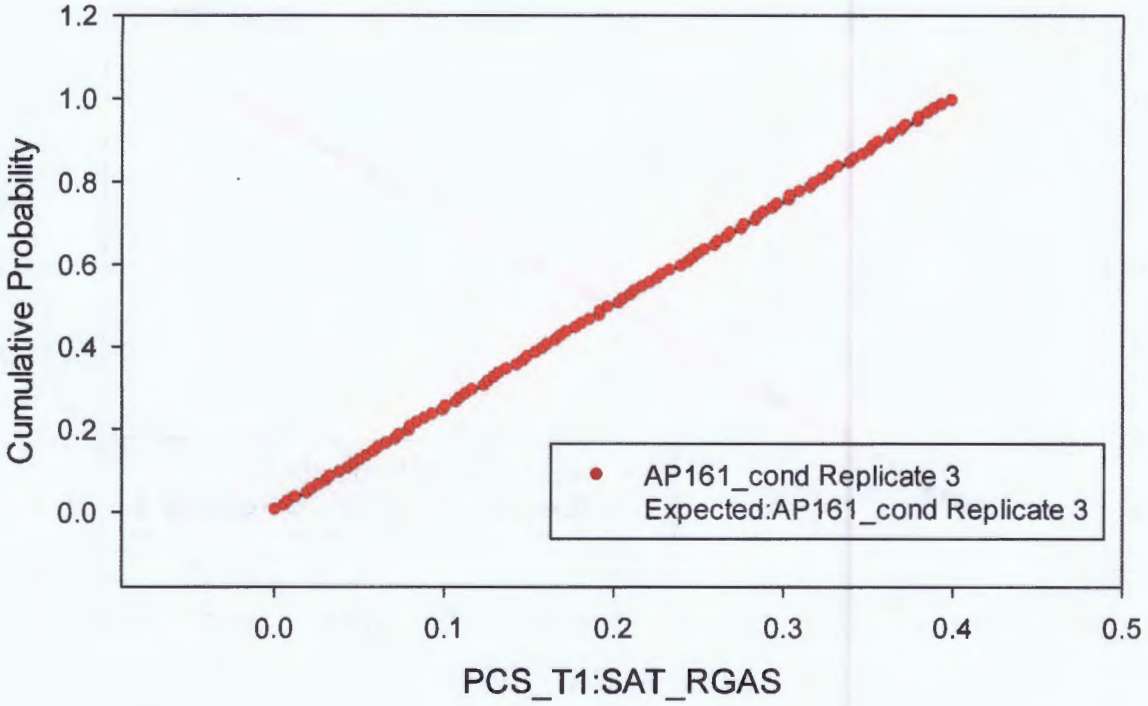

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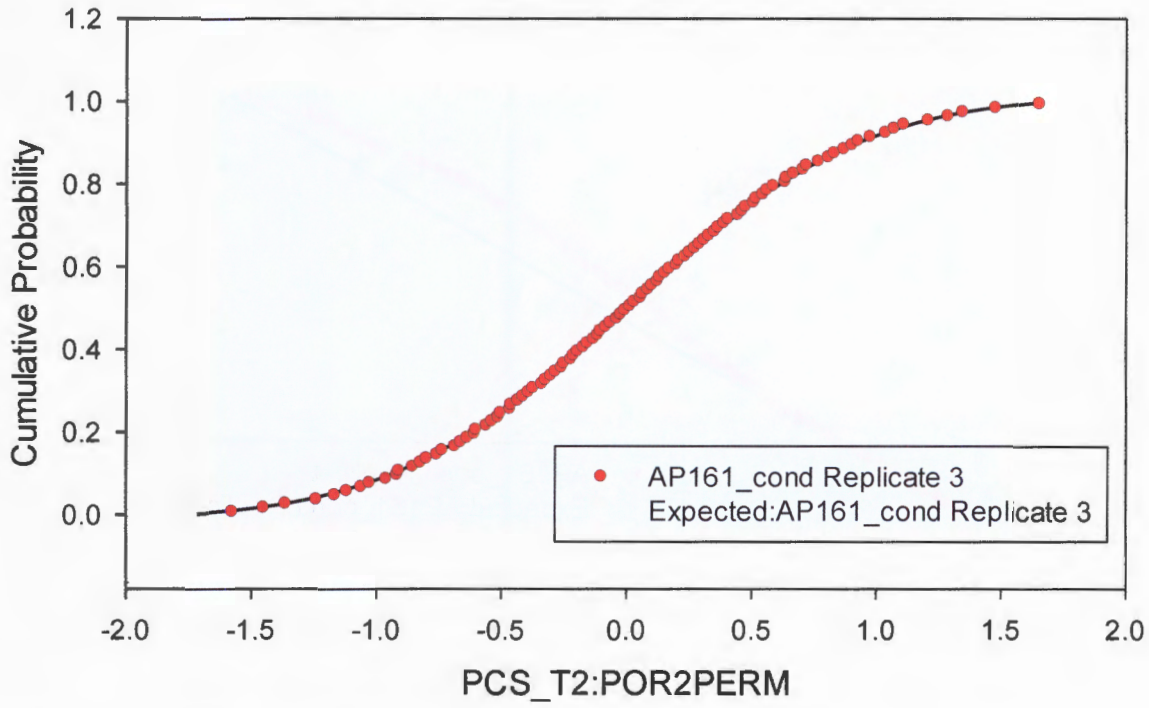

Figure 9 Q-Q plot for normal distribution that

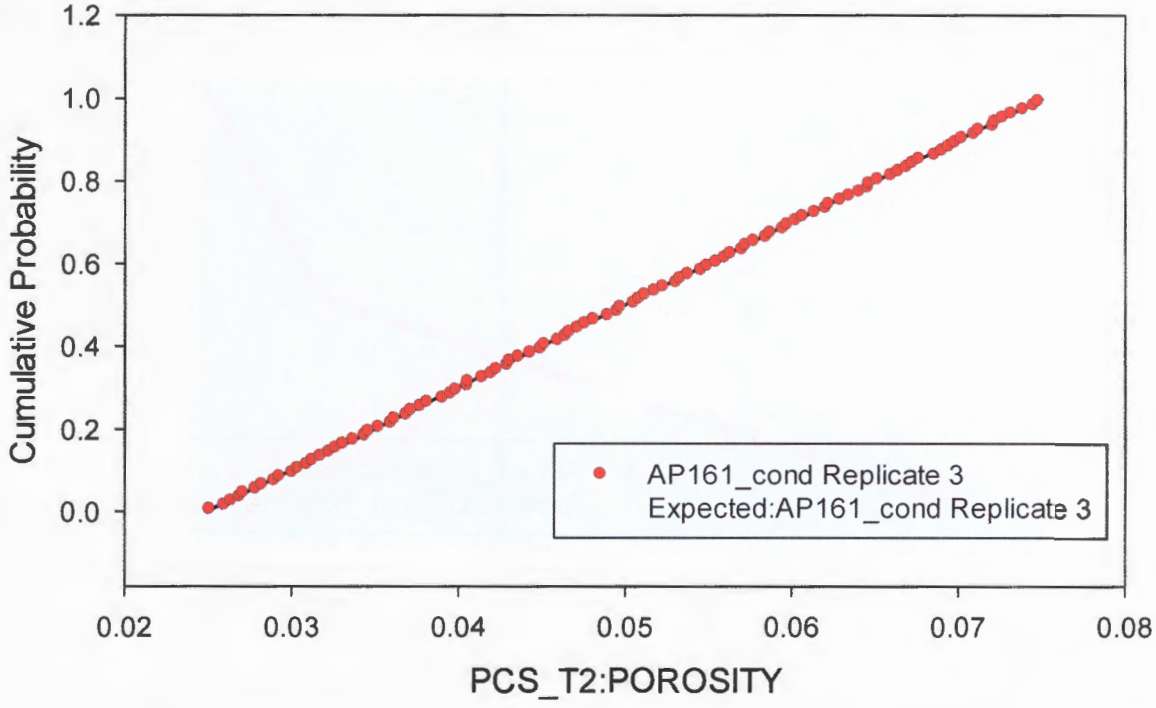

Figure 9 Q-Q plot for uniform distribution that

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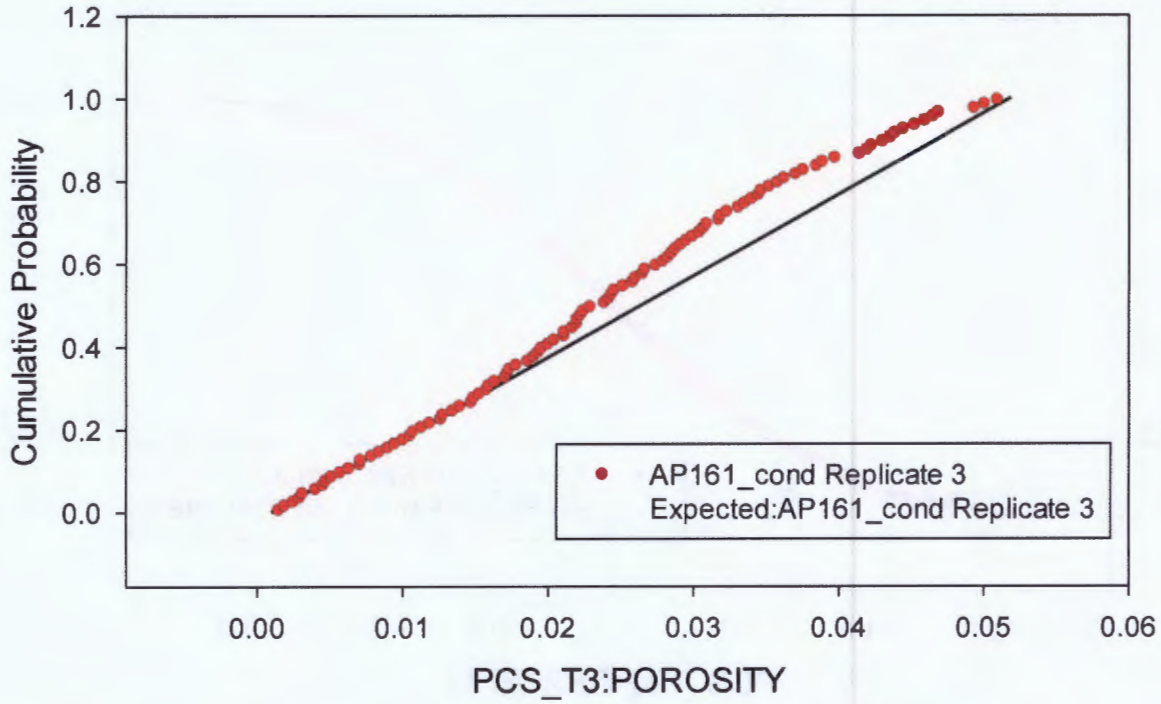

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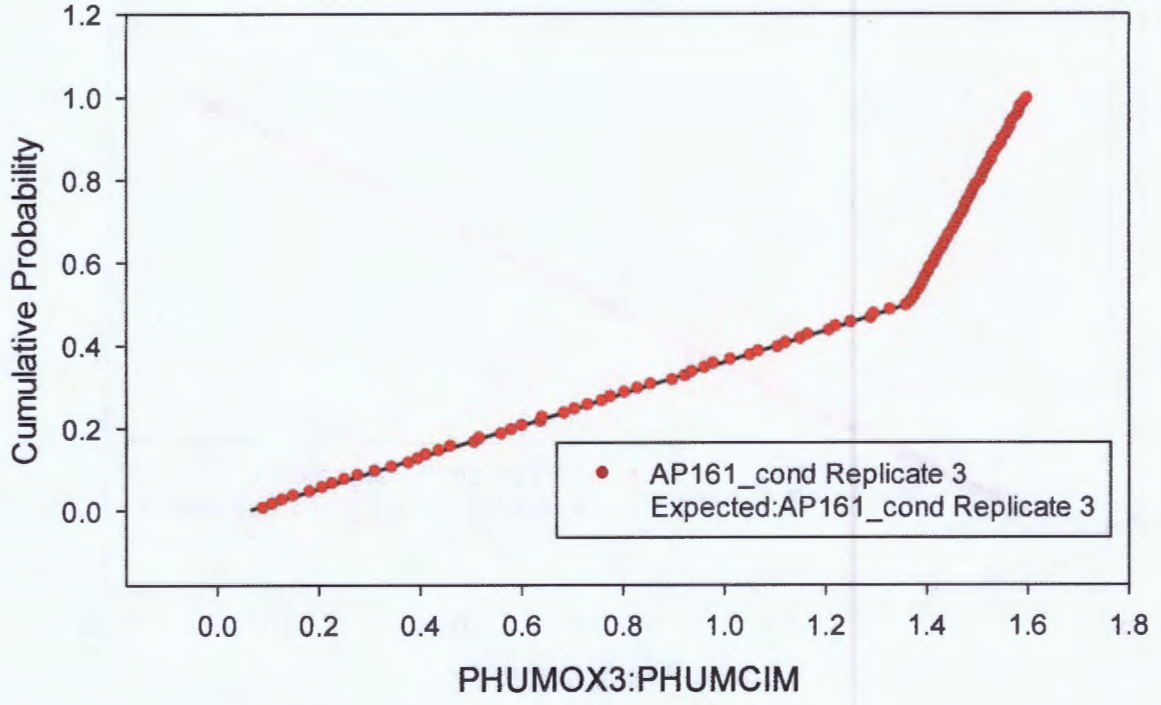

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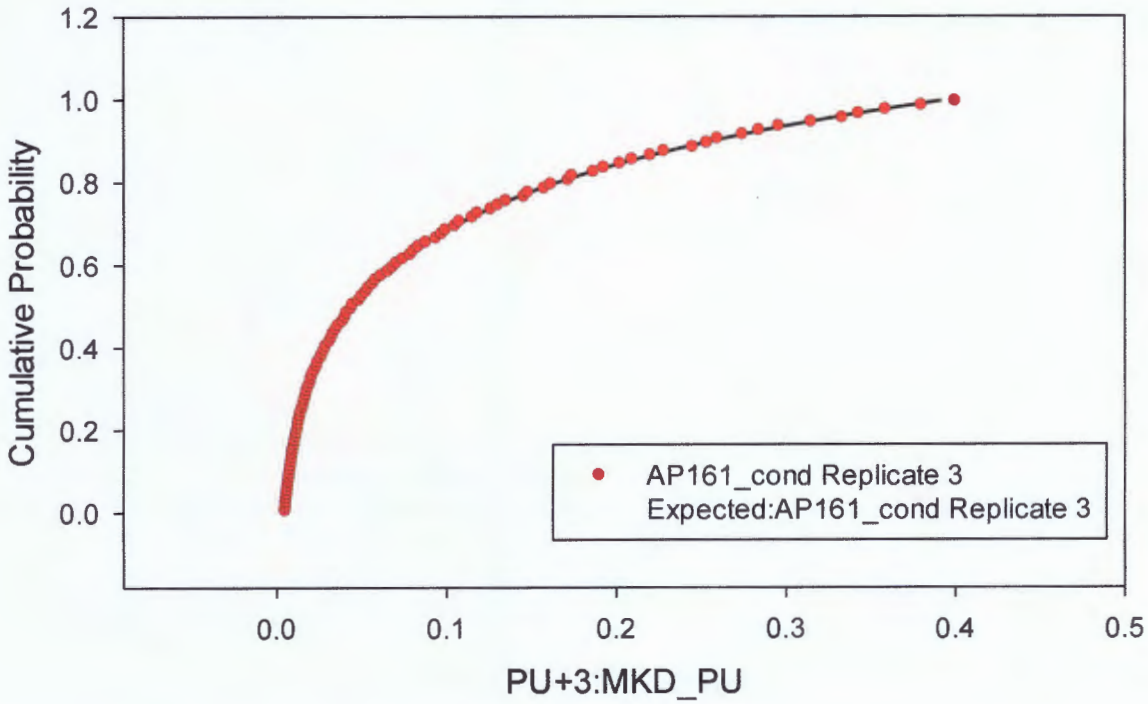

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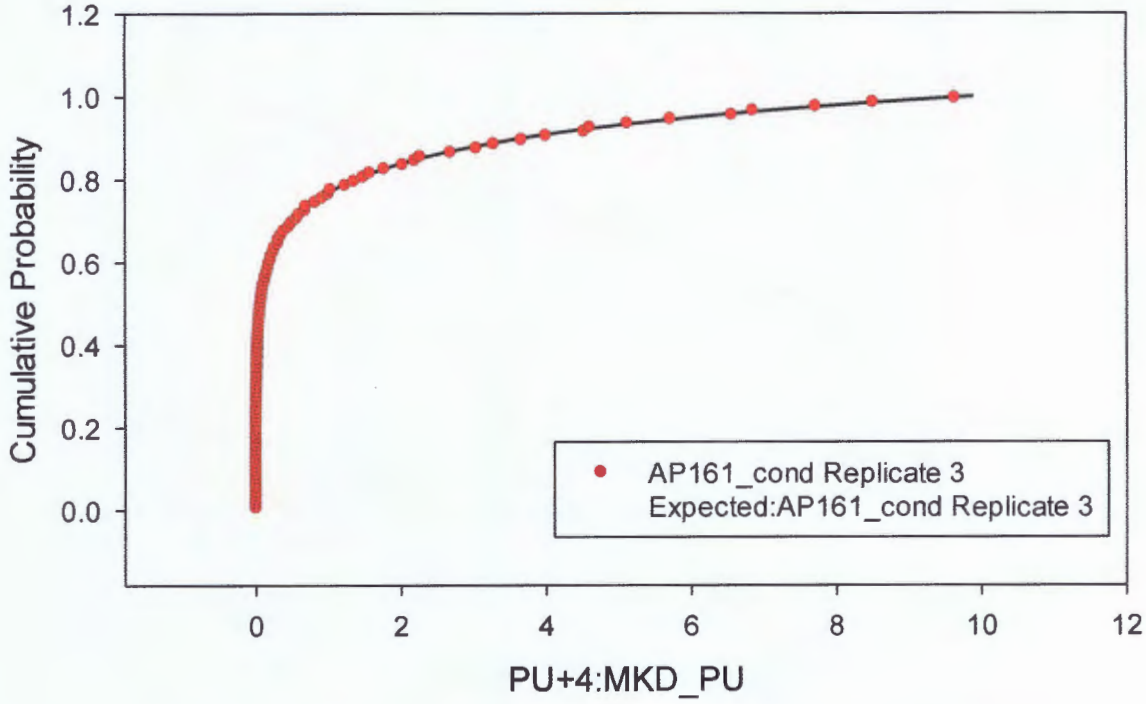

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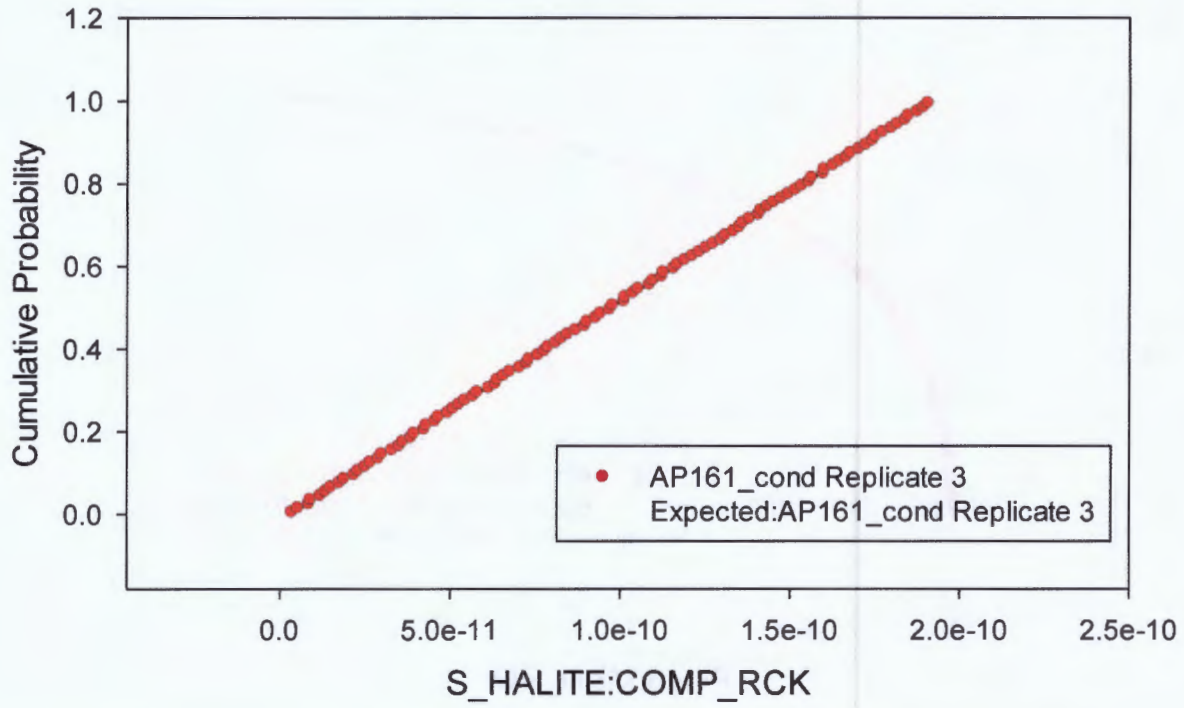

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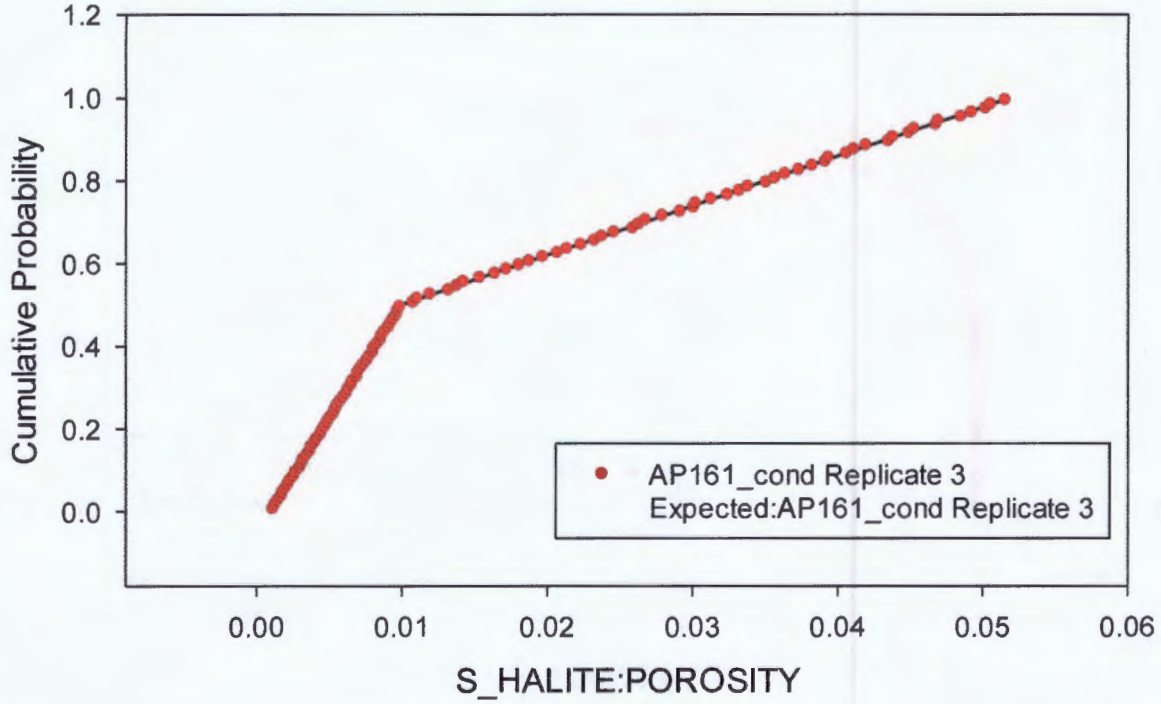

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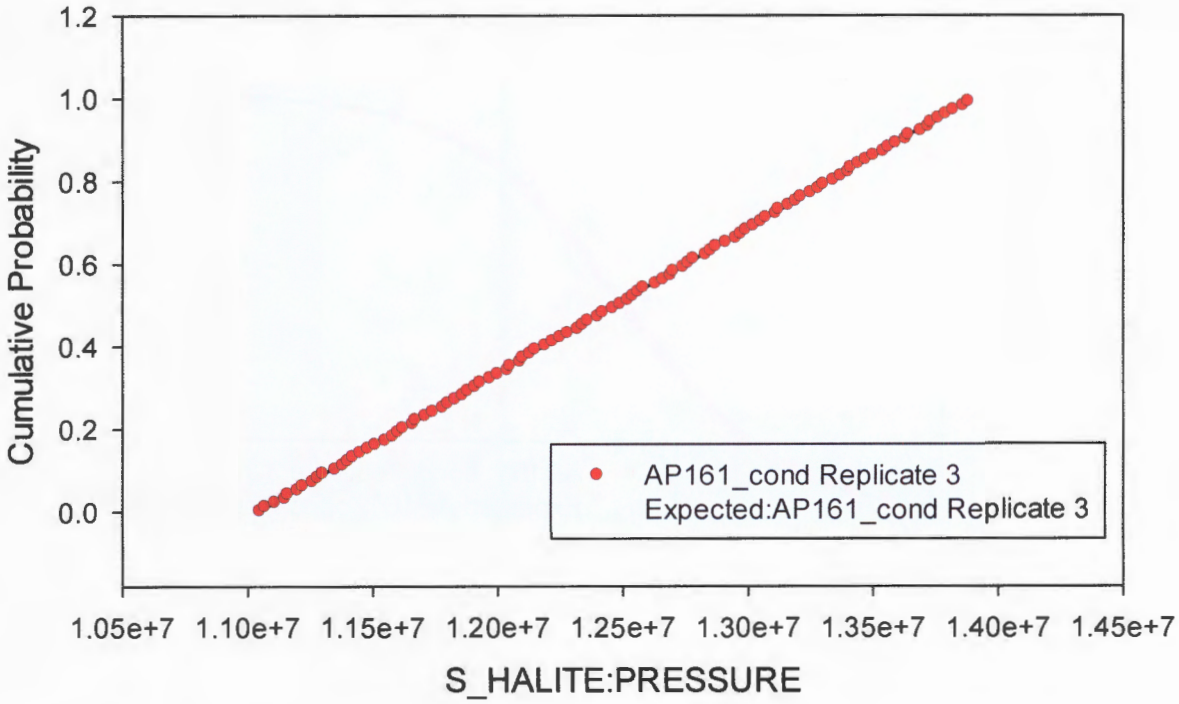

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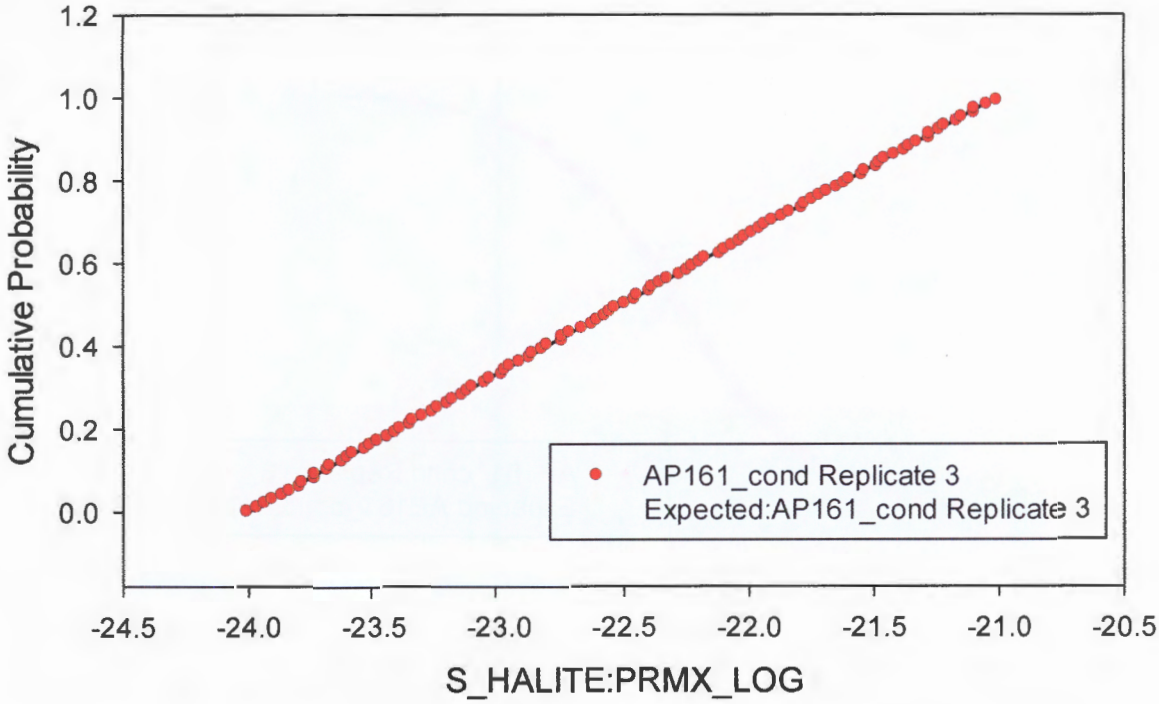

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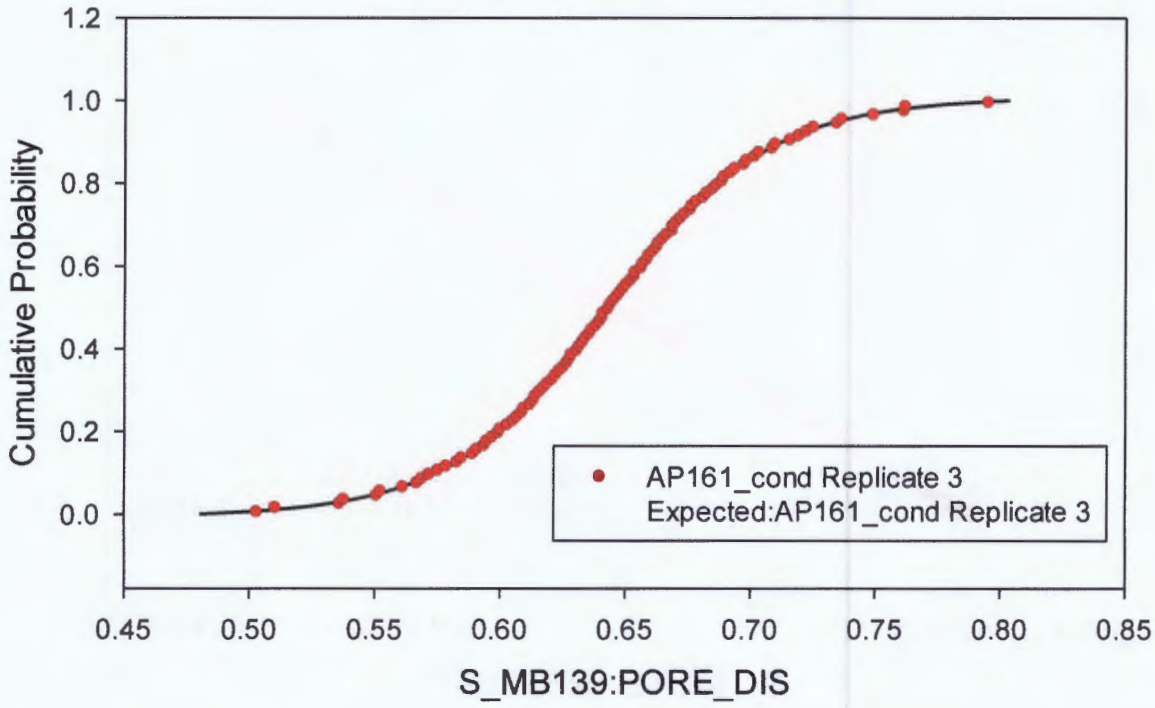

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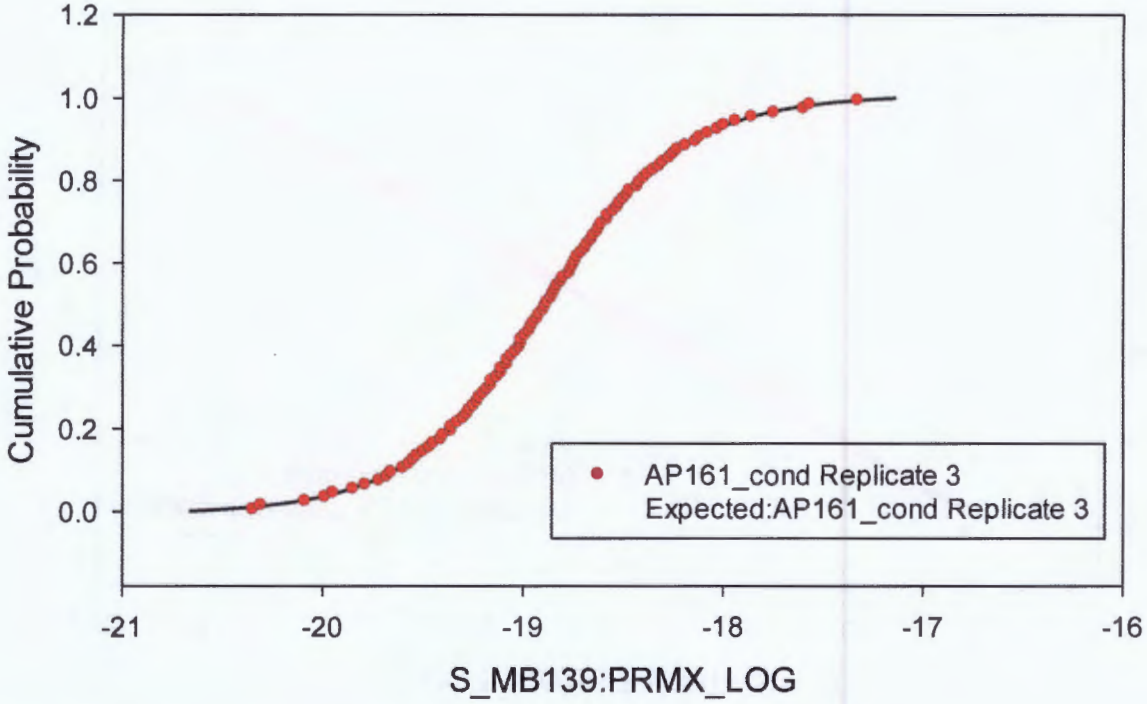

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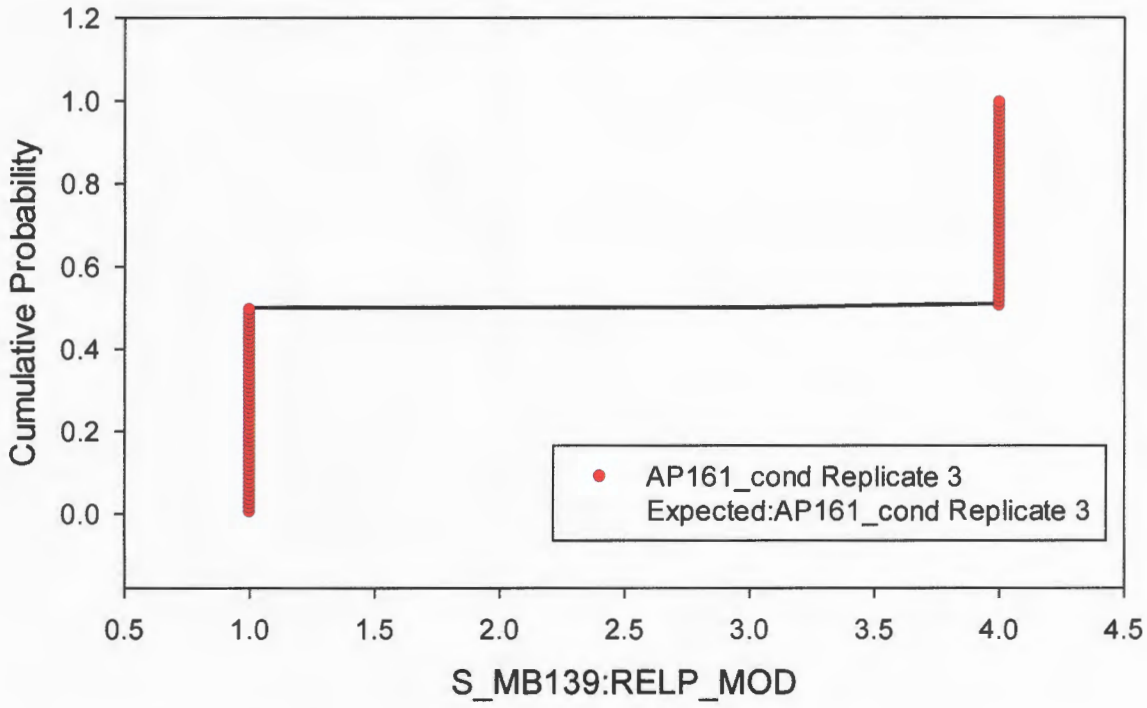

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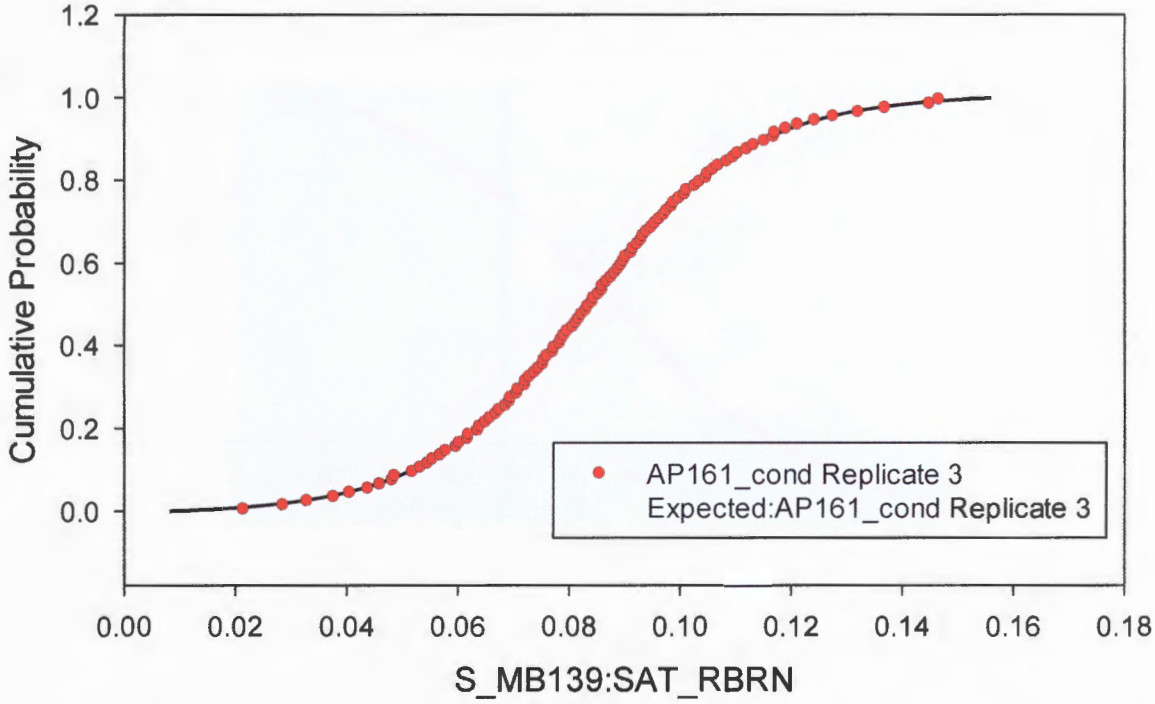

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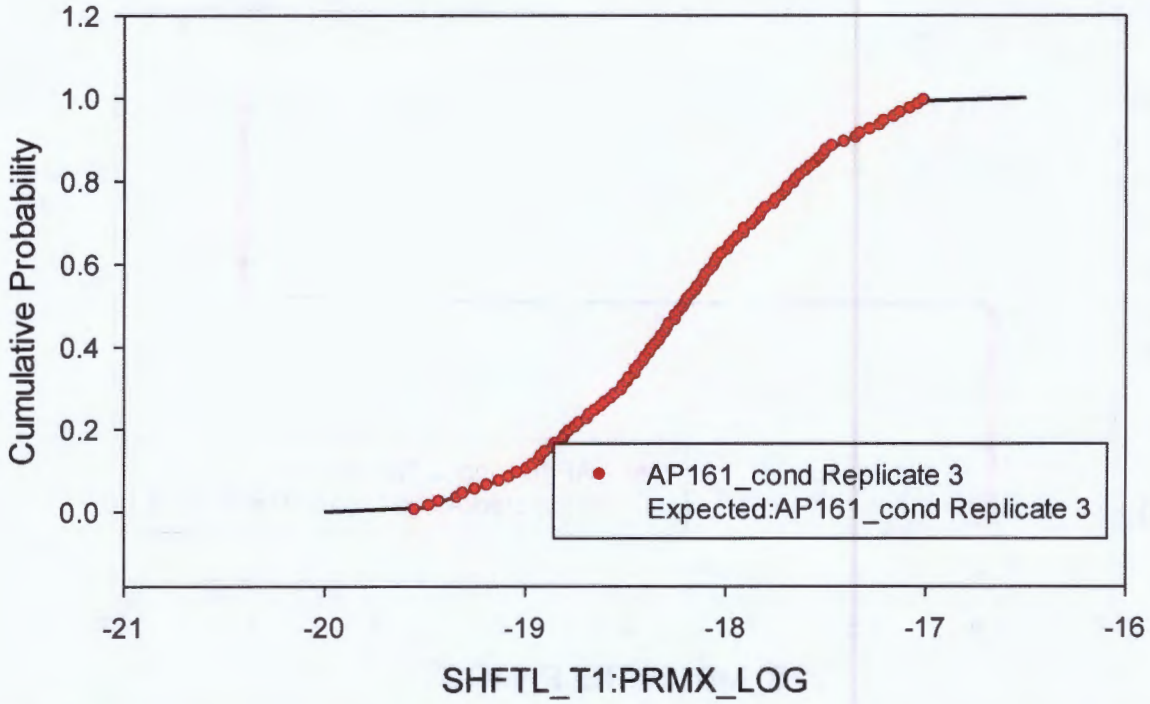

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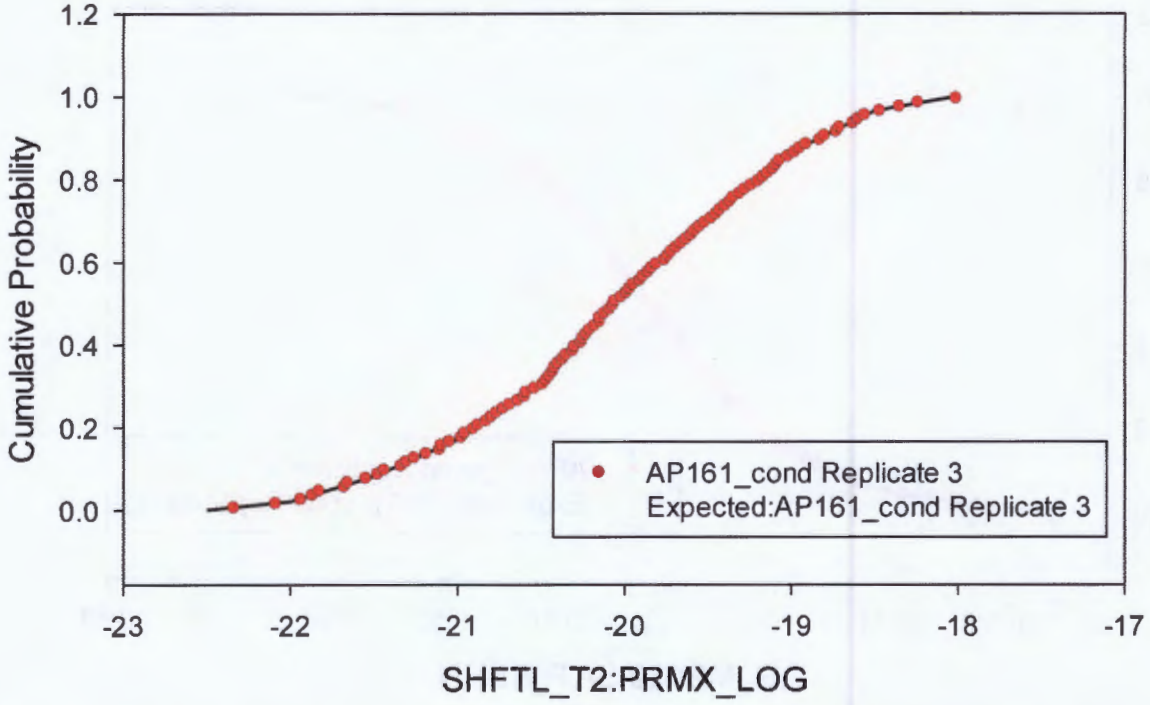

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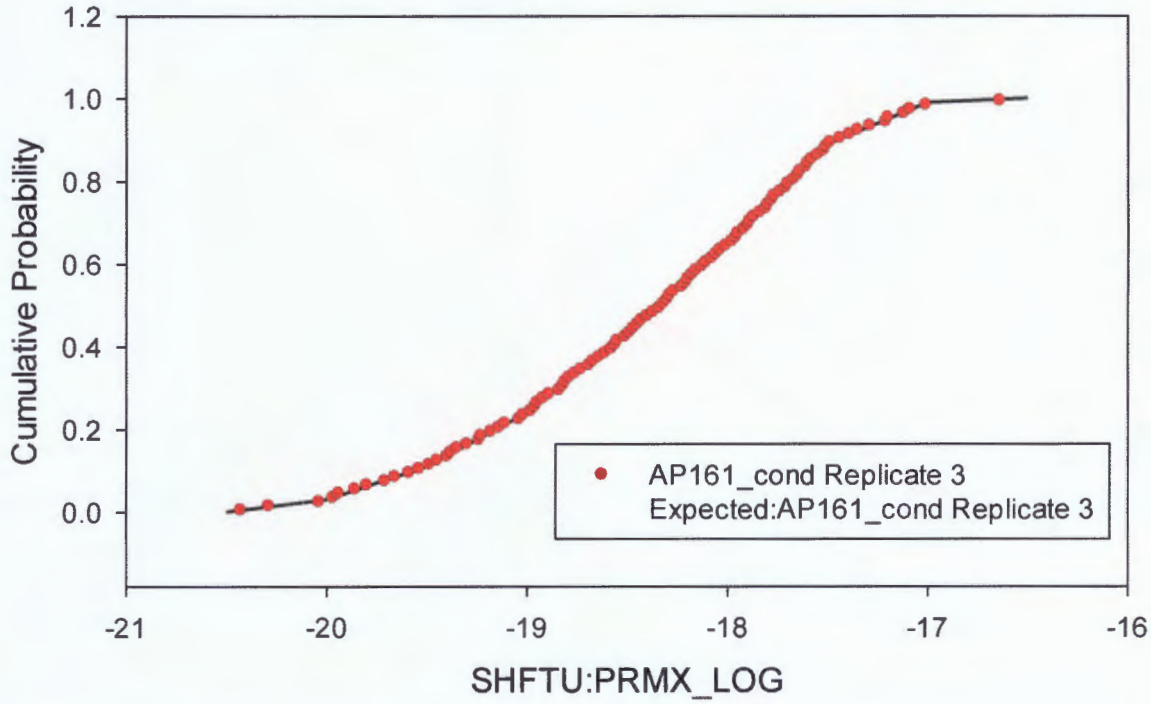

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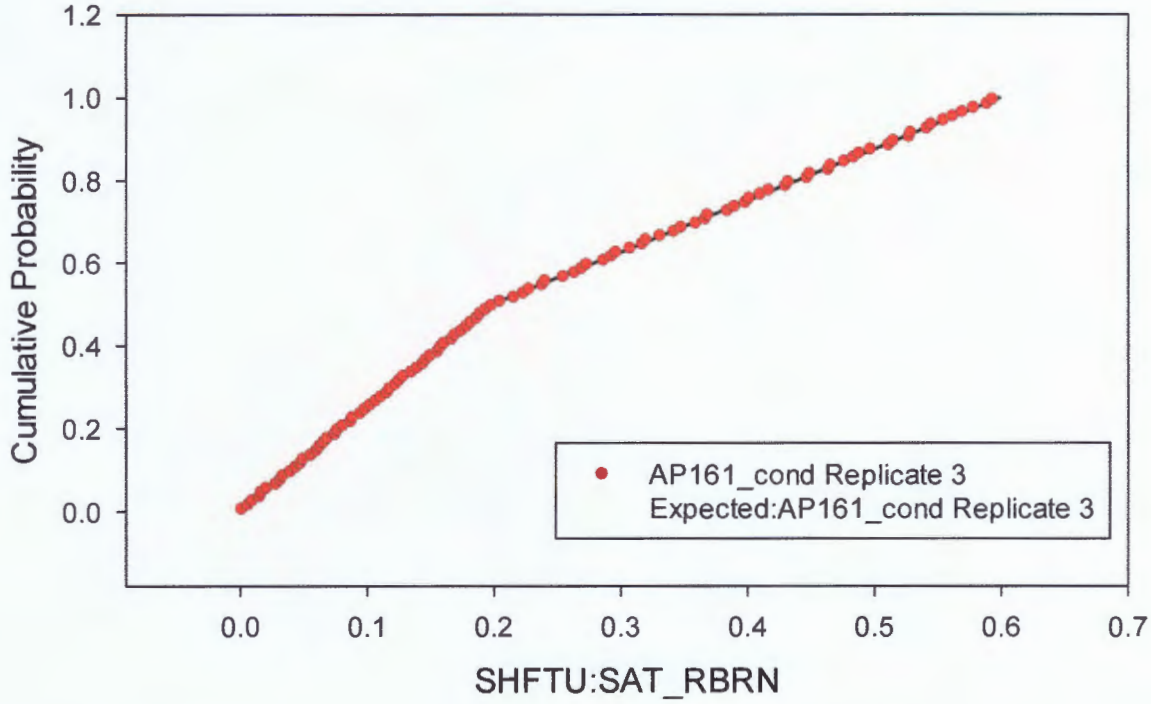

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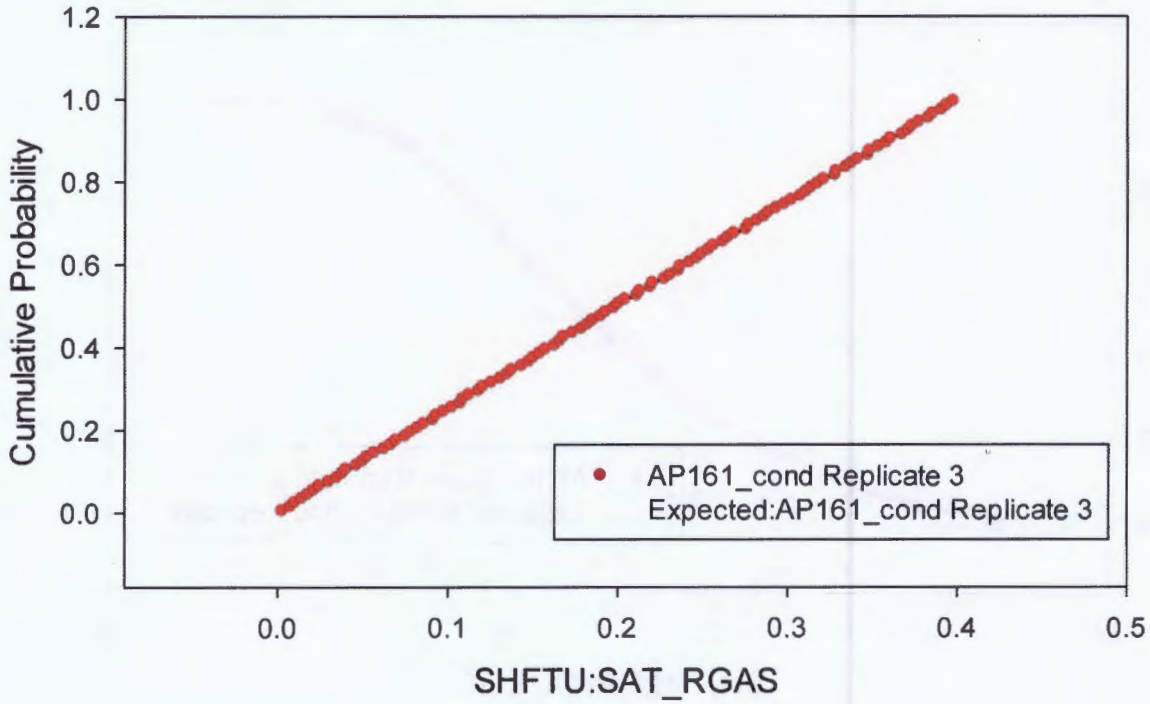

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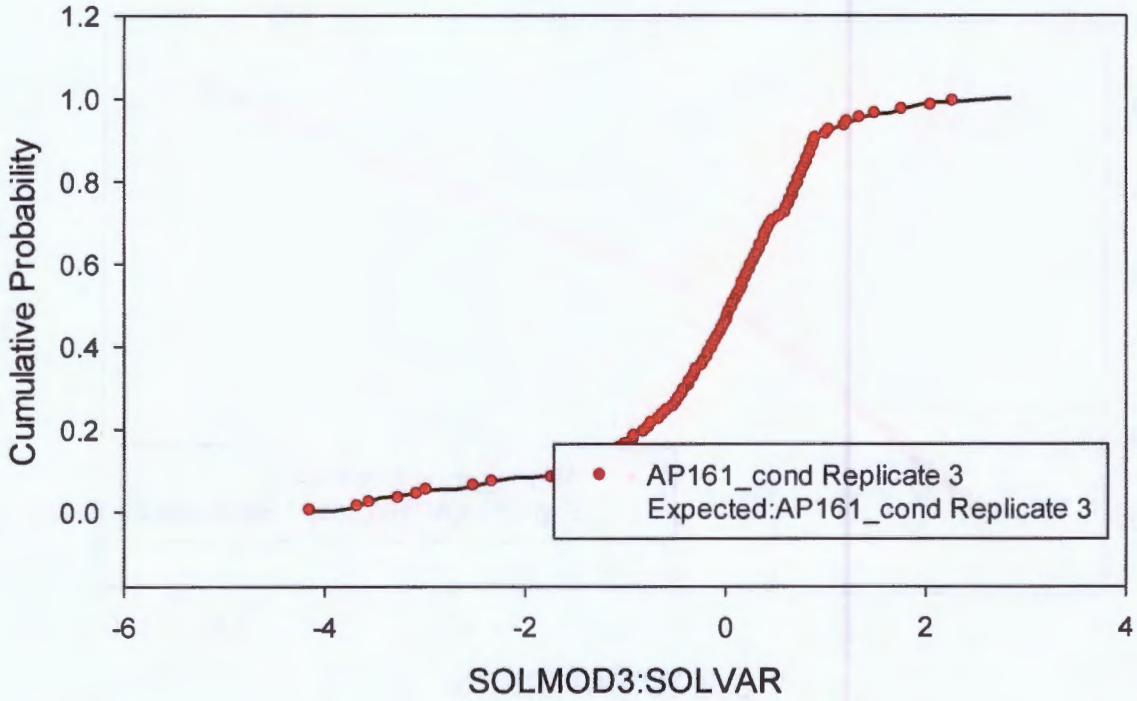

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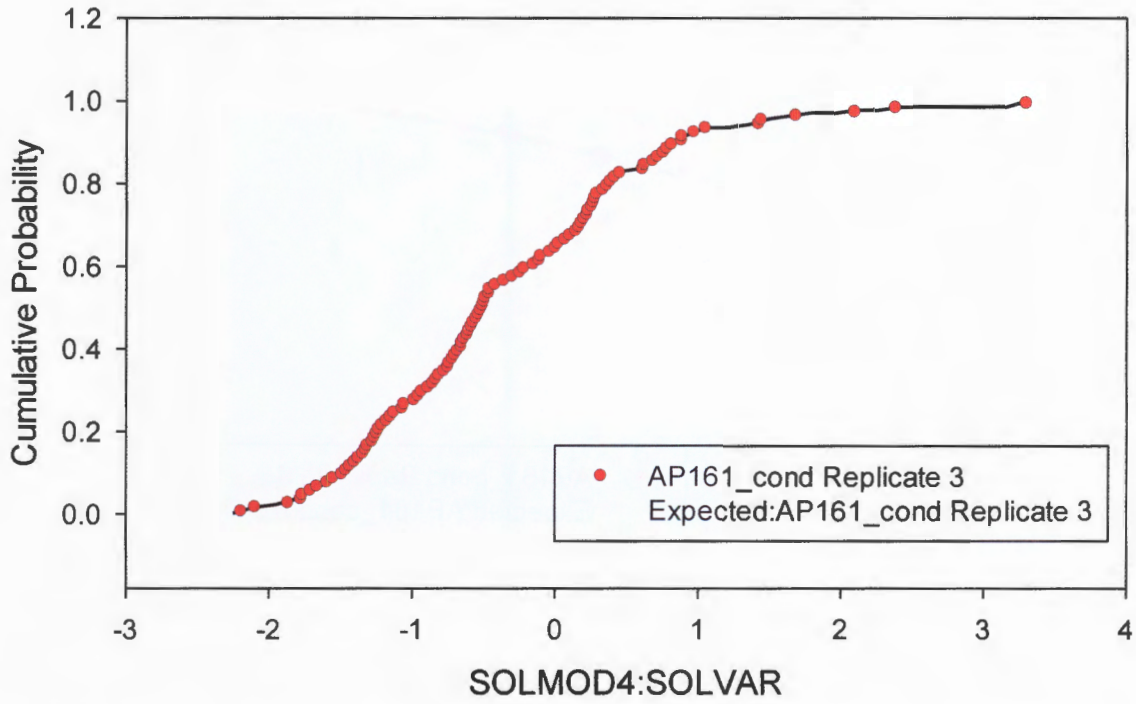

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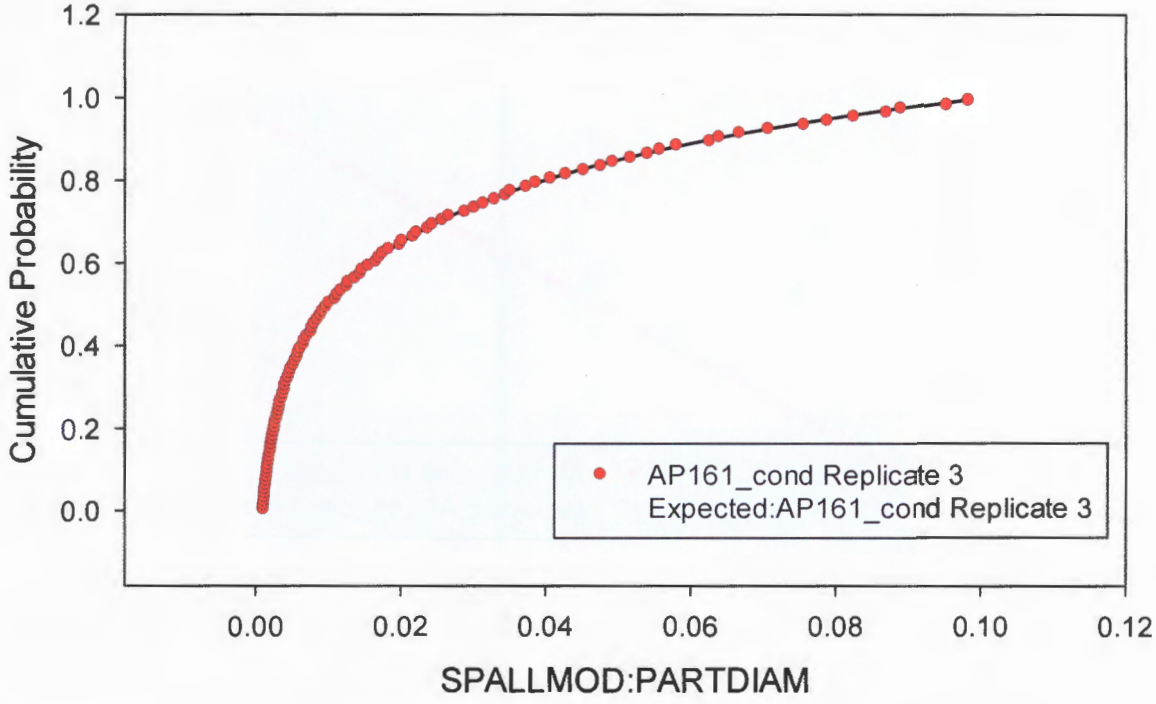

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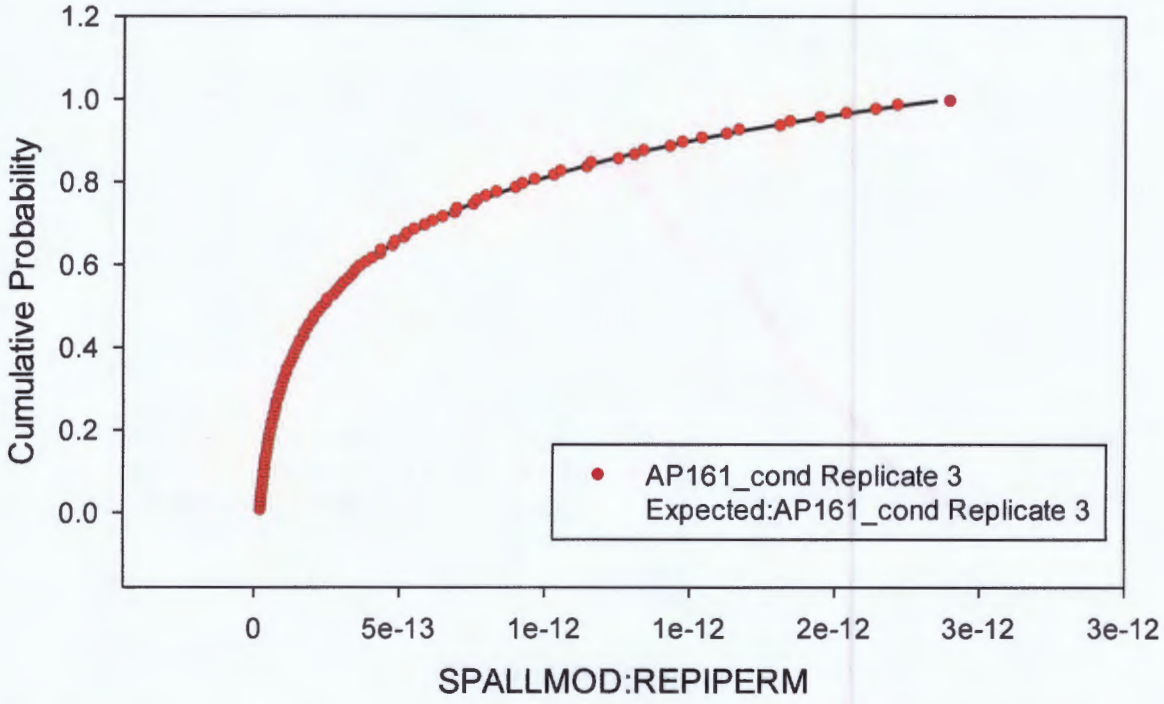

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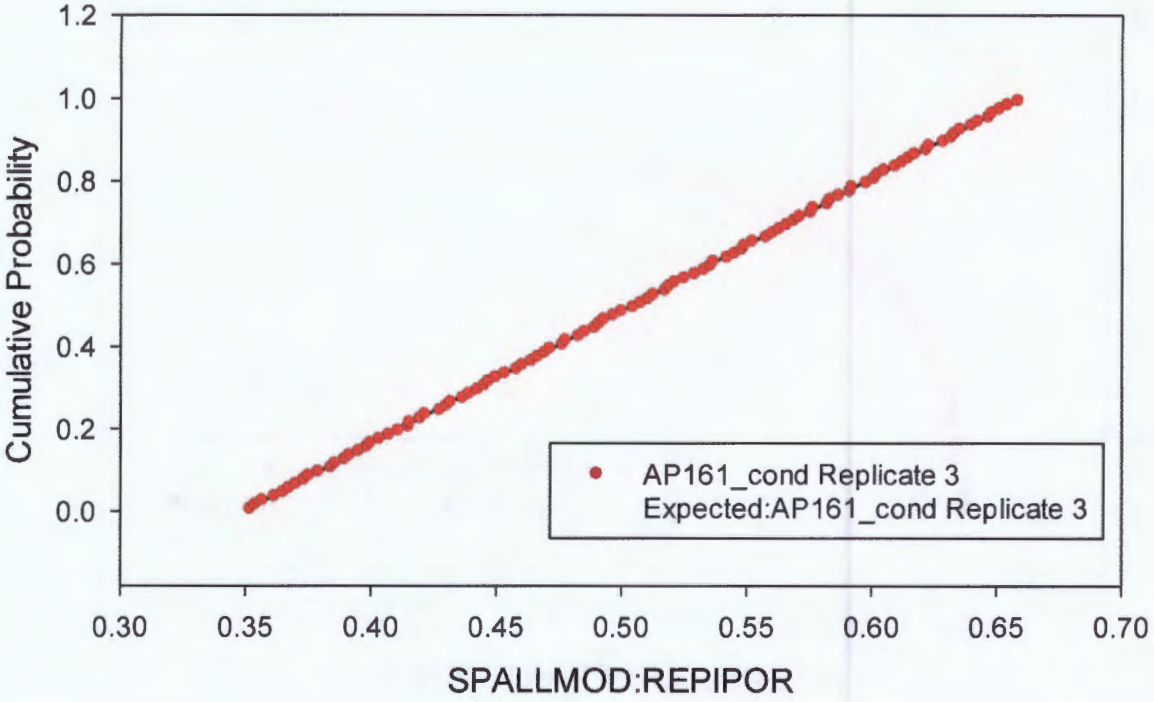

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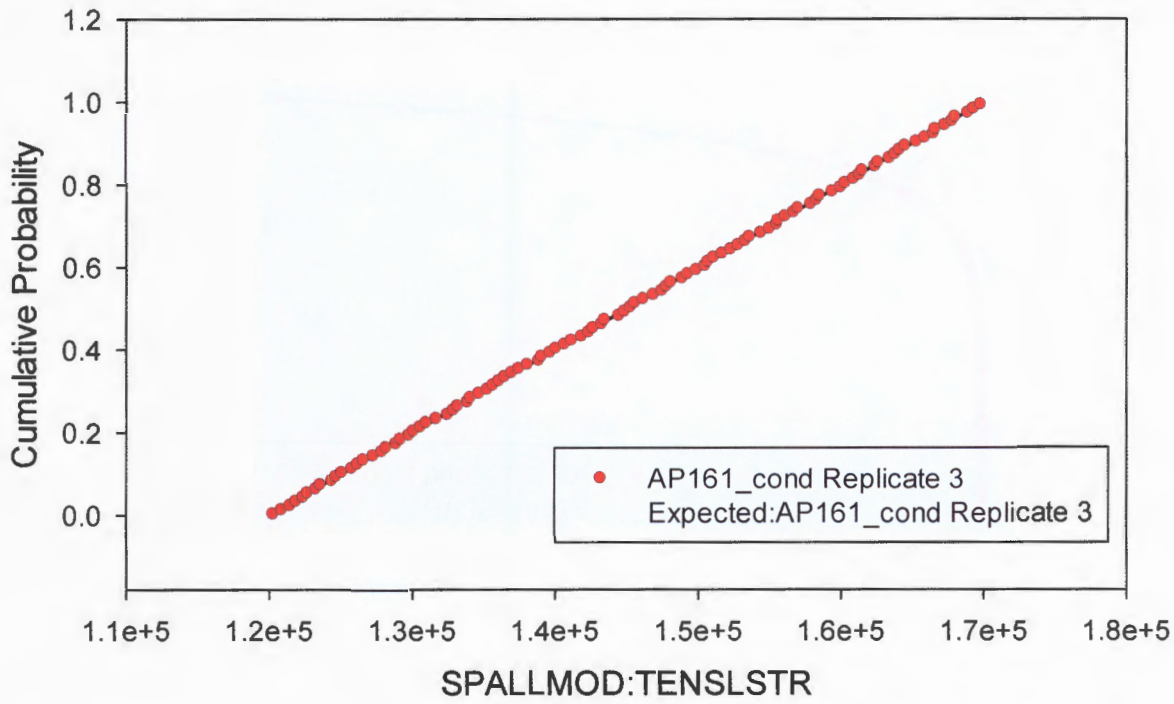

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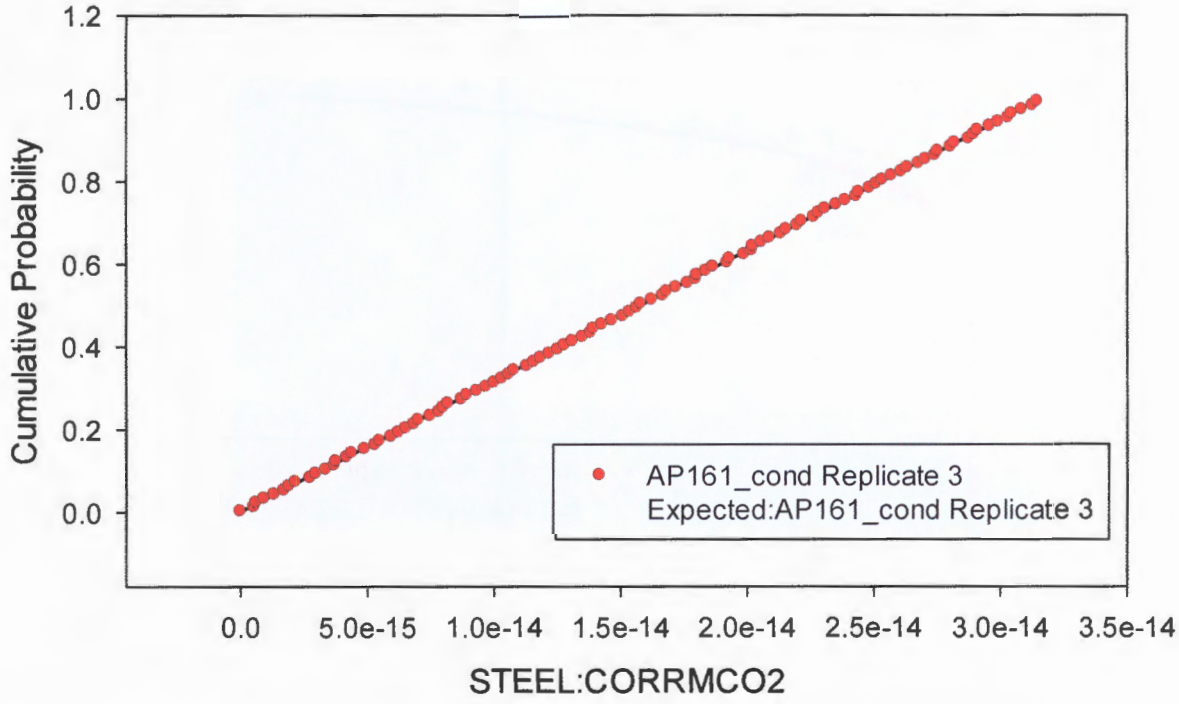

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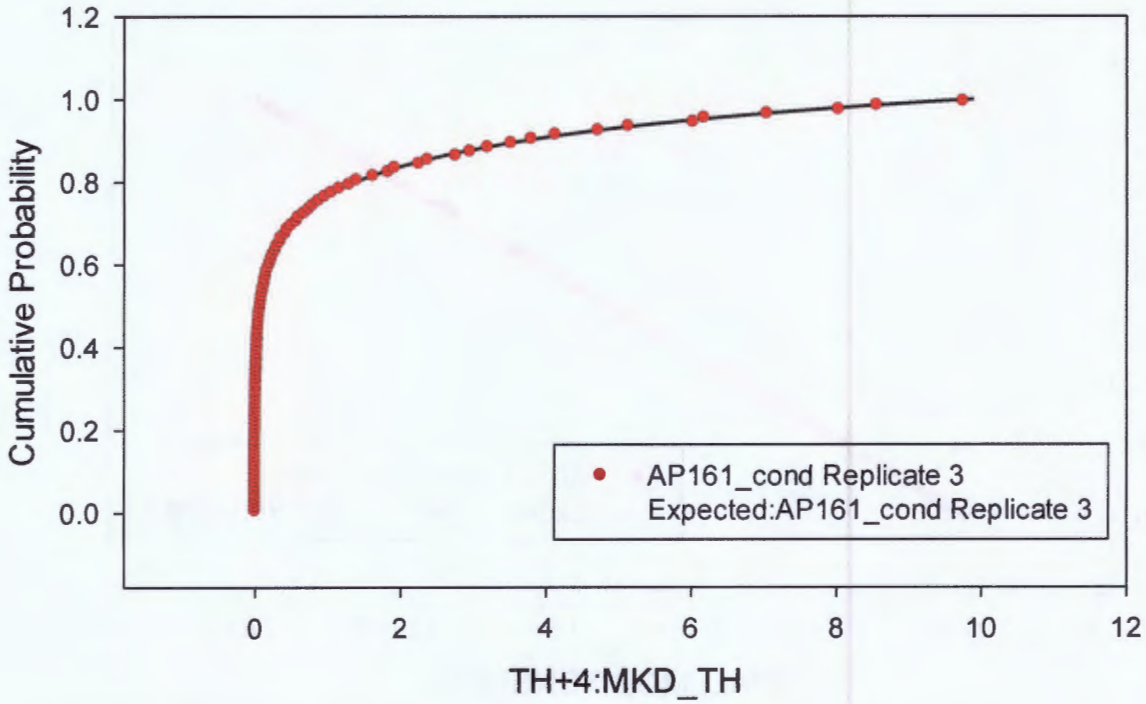

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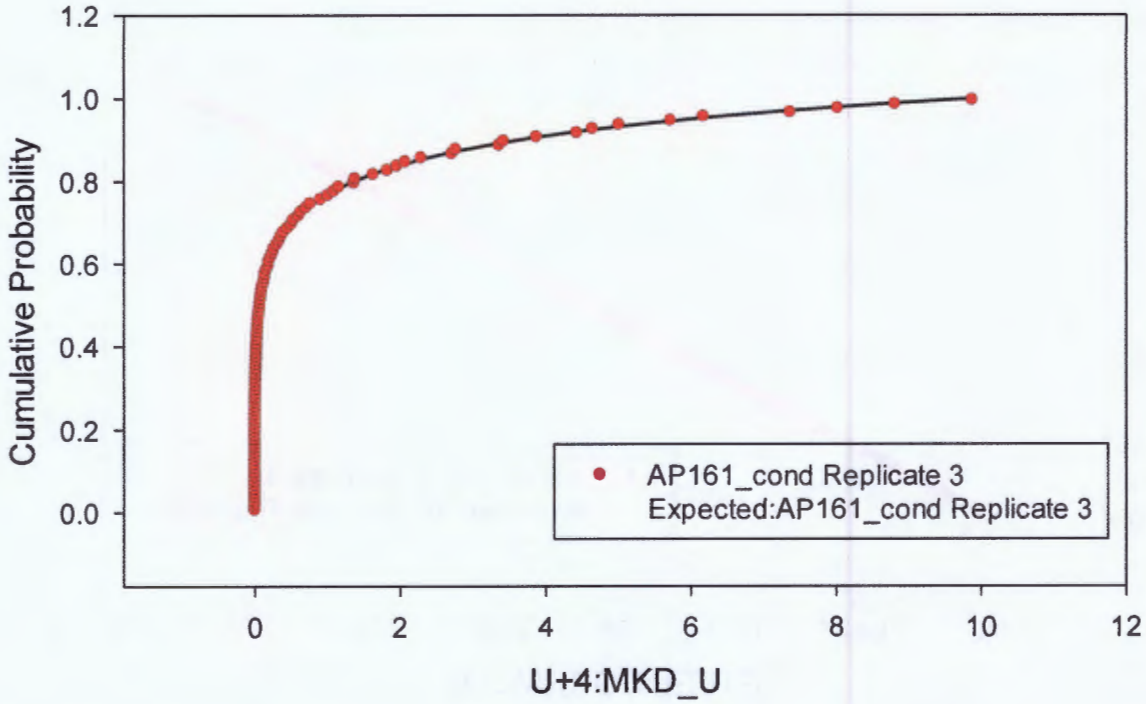

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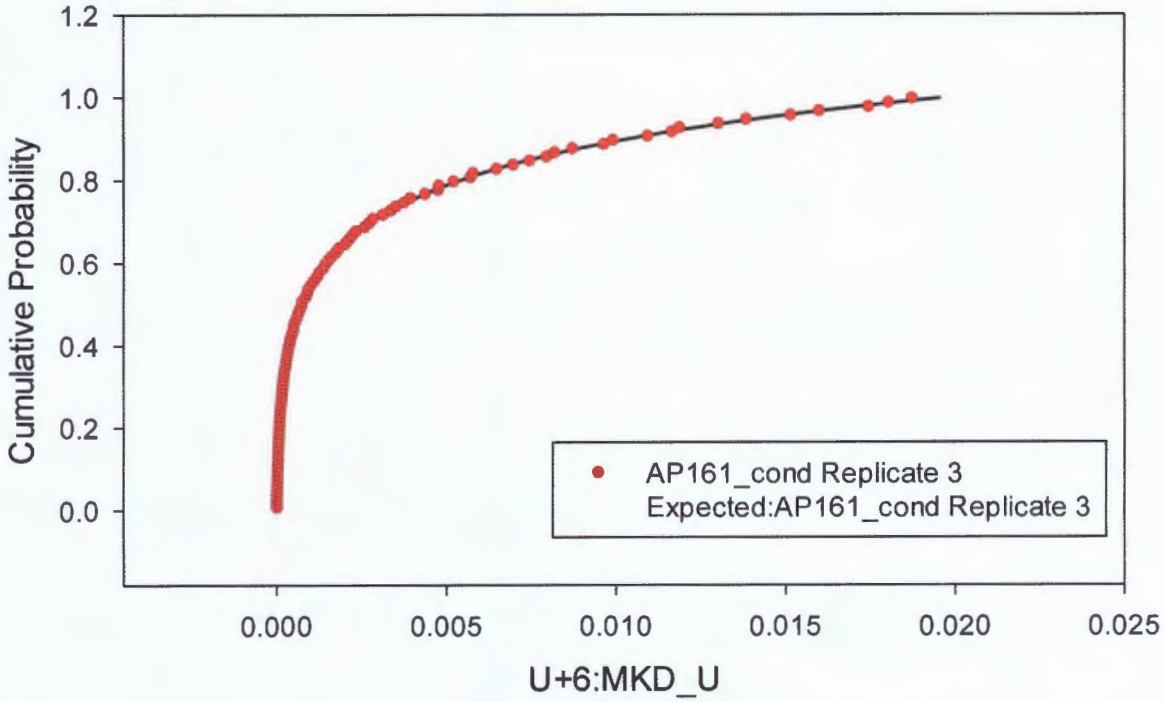

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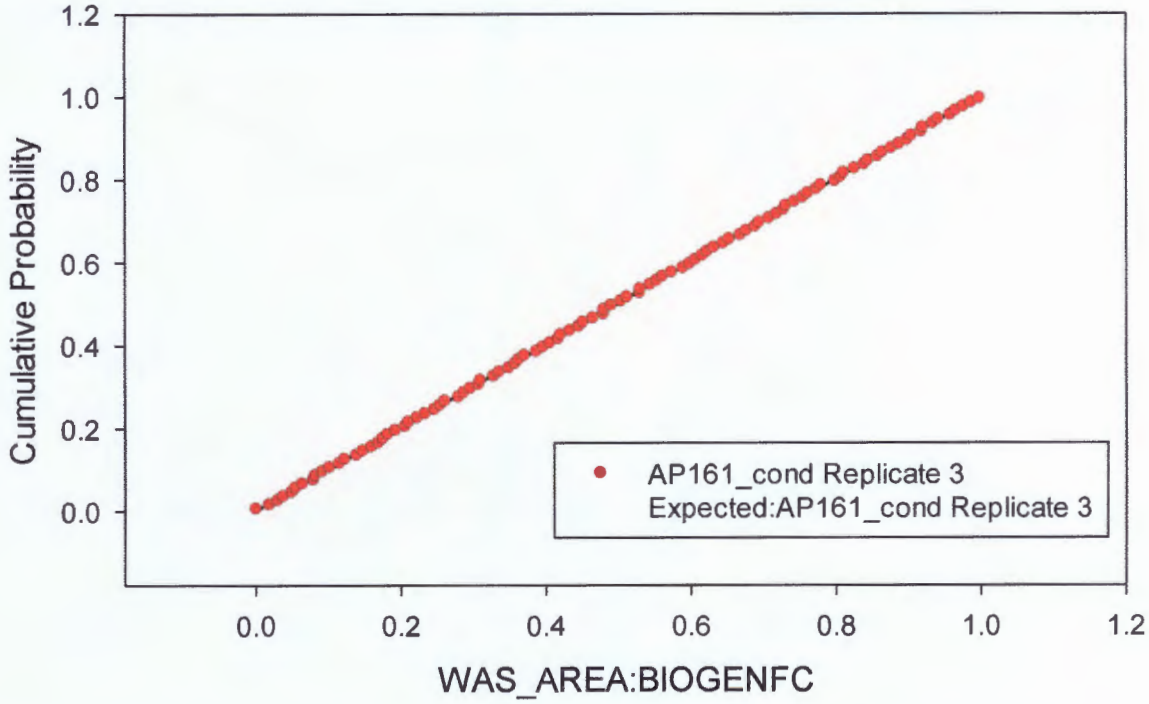

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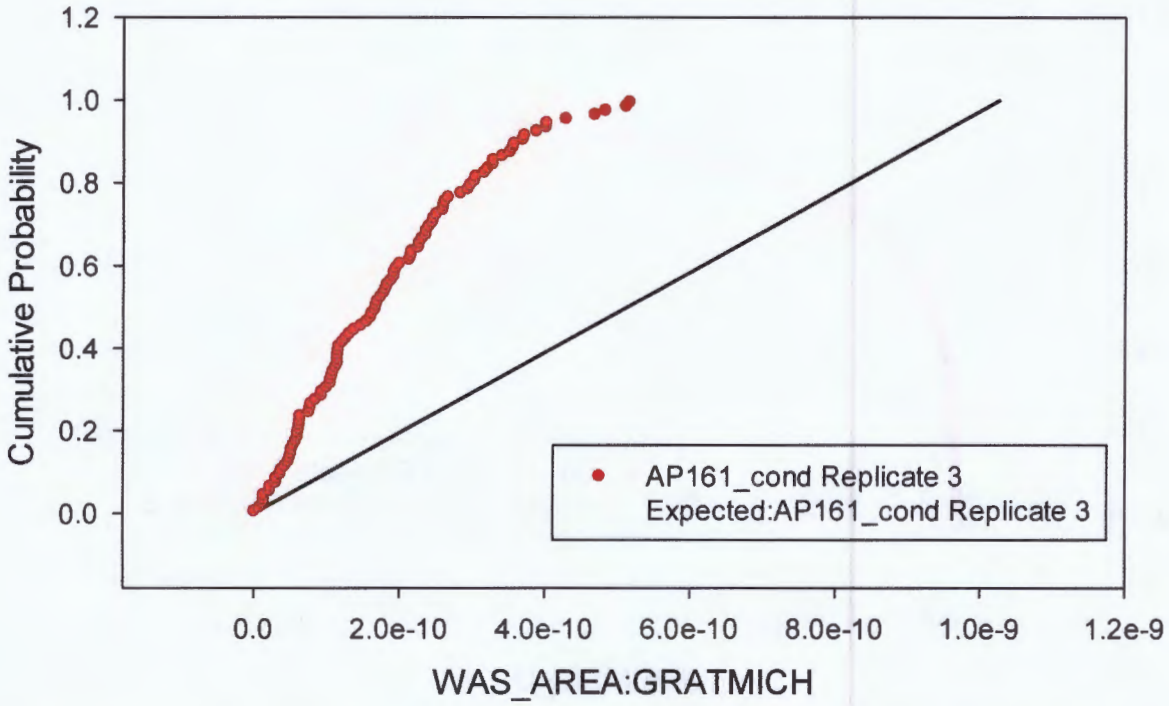

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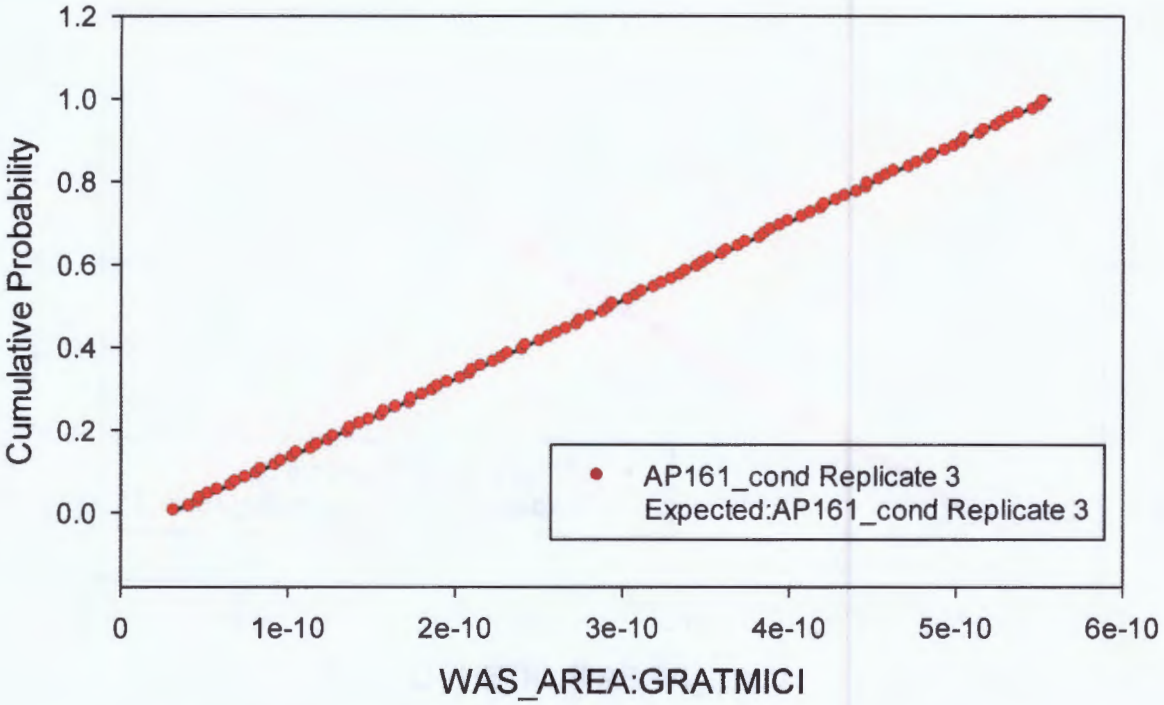

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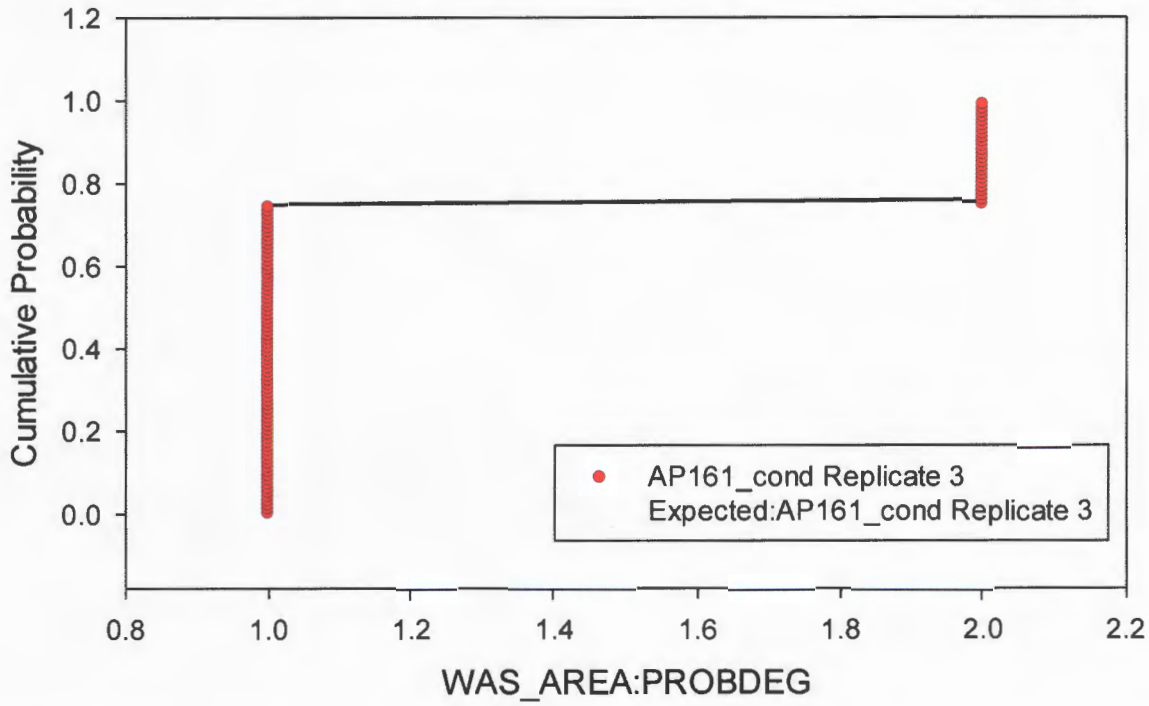

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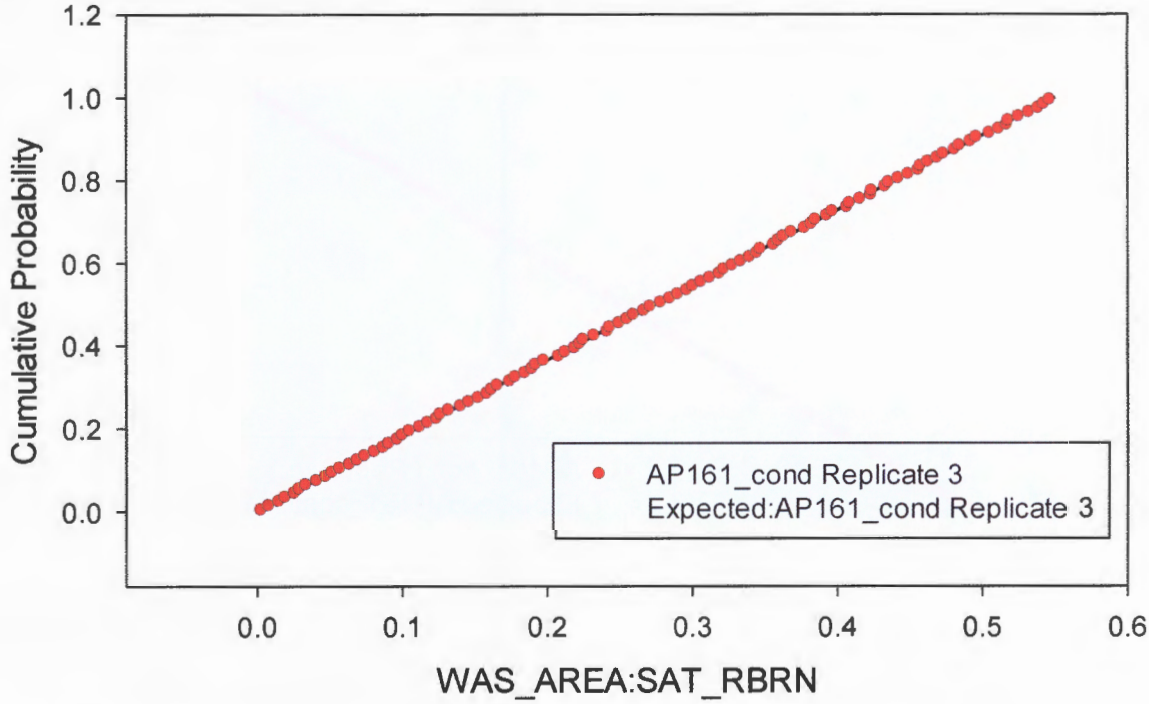

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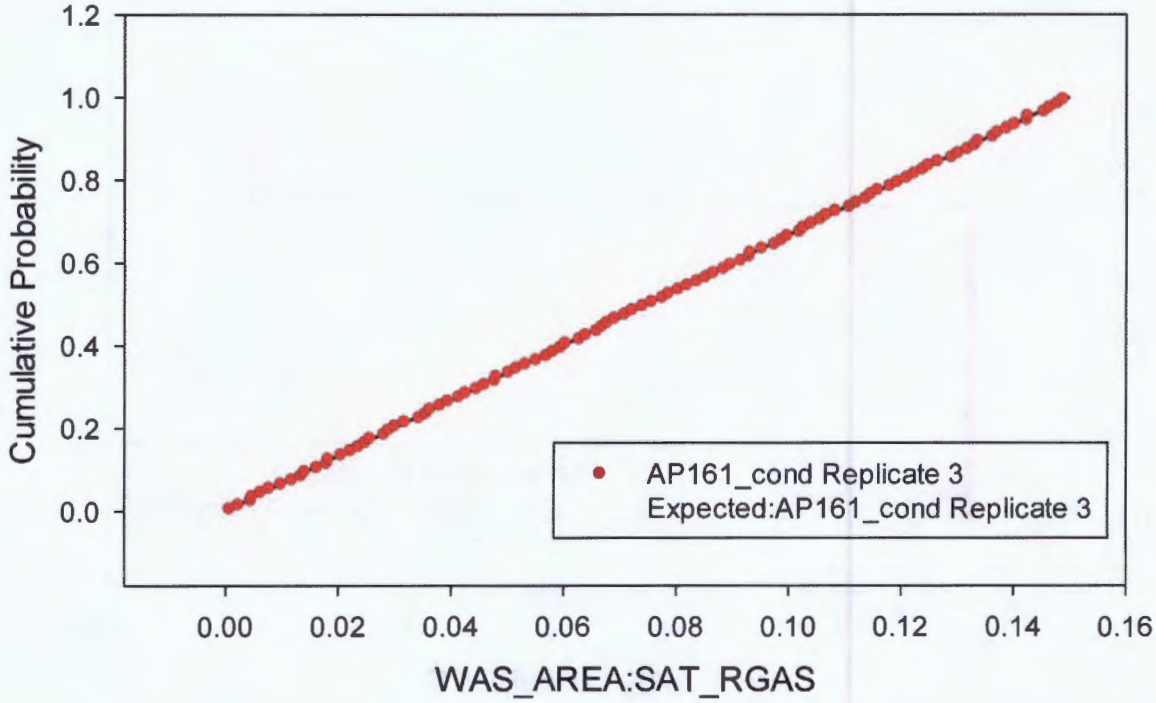

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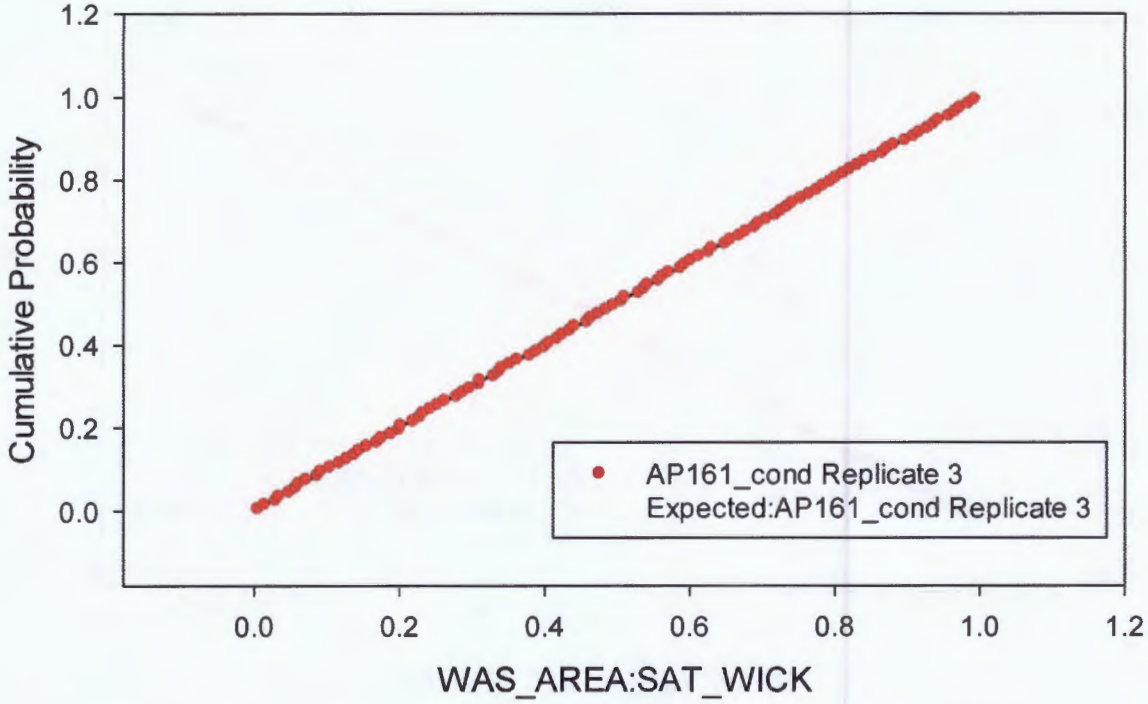

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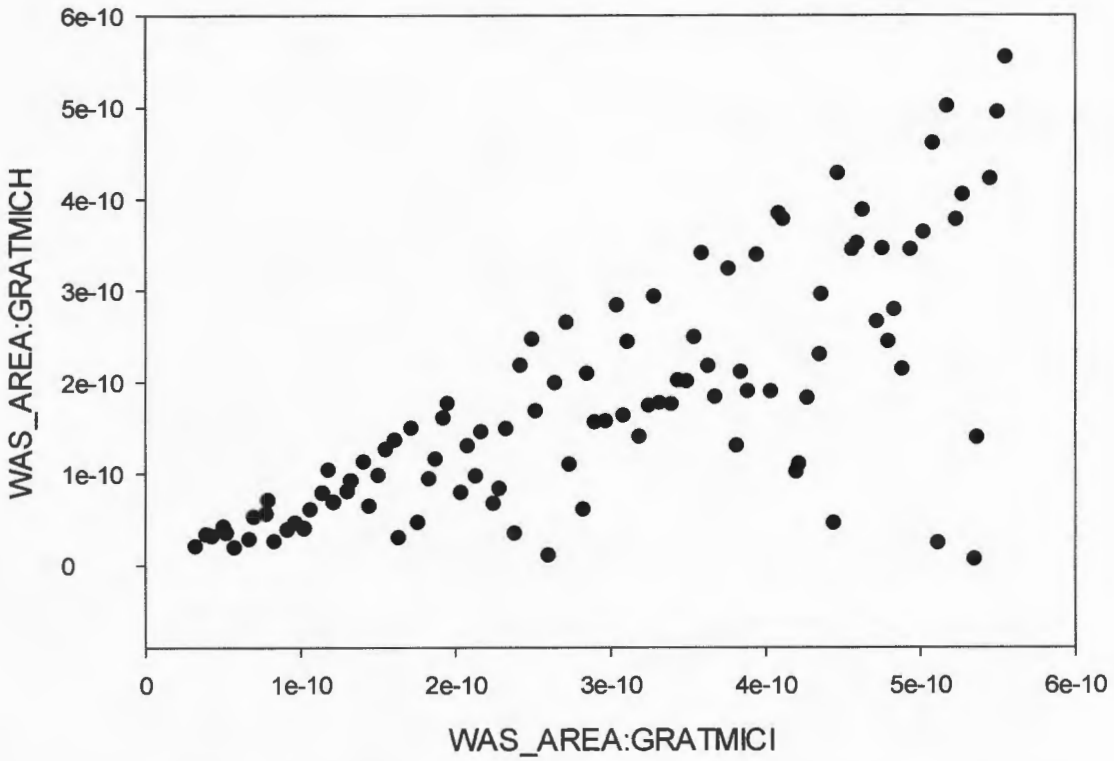

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Appendix I. Input file to PRELHS for Replicate 1

```
! TITLE:          PCS-2012 PRELHS (LHS1) Input File
! ANALYSIS PLAN: AP-161
! ANALYST:        Tom Kirchner
! CREATED:        July 2012
!
!  LHSCALC = PCS-2012 REALIZATION 1
!==========================================================================
!
!  DESCRIPTION:
!
!  WIPP PCS-2012 Performance Assessment Baseline Calculation,
!  aka  (AP161)
!
!  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 PCS-2012 PA
!
!  Changes from PABC09 analyses: CELLULS:FBETA removed
!                                Material CONC_PCS replaced by PCS_T1 for
4 properties
!                                      (PRMX_LOG, SAT_RBRN, SAT_RGAS, and
POR_DIS)
!                                PCS_T1:POROSITY added
!                                PCS_T2:POROSITY added
!                                PCS_T3:POROSITY added
!                                PCS_T2:POR2PERM added
!                                PCS_T1:SAT_IBRN added
!
!Also, LHS_EDIT should control 41<42, and 74<73<72 (WAS_AREA:GRATMICI <
WAS_AREA:GRATMICH and
!    PCS_T3:POROSITY < PCS_T2:POROSITY < PCS_T1:POROSITY)
!
!========= No Comments Allowed between *ECHOLHS and *ENDECHO
================
!
*ECHOLHS
TITLE PABC09, AP161, 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
```


Information Only

```
     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
```


Information Only

```
      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
```


Information Only

```
     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,  PCS_T1
     PROPERTIES, SAT_IBRN
!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,  PCS_T1
     PROPERTIES, PRMX_LOG
!49  BRAGFLO
     MATERIALS,  PCS_T1
     PROPERTIES, SAT_RGAS
!50  BRAGFLO
     MATERIALS,  PCS_T1
     PROPERTIES, SAT_RBRN
!51  BRAGFLO
     MATERIALS,  PCS_T1
     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
```


Information Only

```
     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,  PCS_T1
     PROPERTIES, POROSITY
!73
```


Information Only

```
     MATERIALS,  PCS_T2
     PROPERTIES, POROSITY
!74
     MATERIALS,  PCS_T3
     PROPERTIES, POROSITY
!75
     MATERIALS,  PCS_T2
     PROPERTIES, POR2PERM
!
!==========================================================================
!
*END
```

Appendix II. Input file to PRELHS for Replicate 2

```
! TITLE:          PCS-2012 PRELHS (LHS1) Input File
! ANALYSIS PLAN: AP-161
! ANALYST:        Tom Kirchner
! CREATED:        July 2012
!
!  LHSCALC = PCS-2012 REALIZATION 2
!==========================================================================
!
!  DESCRIPTION:
!
!  WIPP PCS-2012 Performance Assessment Baseline Calculation,
!  aka  (AP161)
!
!  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 PCS-2012 PA
!
!  Changes from PABC09 analyses: CELLULS:FBETA removed
!                                Material CONC_PCS replaced by PCS_T1 for
4 properties
!                                     (PRMX_LOG, SAT_RBRN, SAT_RGAS, and
POR_DIS)
!                                     PCS_T1:POROSITY added
!                                     PCS_T2:POROSITY added
!                                     PCS_T3:POROSITY added
!                                     PCS_T2:POR2PERM added
!                                     PCS_T1:SAT_IBRN added
!
!Also, LHS_EDIT should control 41<42, and 74<73<72 (WAS_AREA:GRATMICI <
WAS_AREA:GRATMICH and
!    PCS_T3:POROSITY < PCS_T2:POROSITY < PCS_T1:POROSITY)
!
!========= No Comments Allowed between *ECHOLHS and *ENDECHO
================
!
*ECHOLHS
```


Information Only

```
TITLE PABC09, AP161 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
```


Information Only

```
      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
```


Information Only

```
      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,  PCS_T1
      PROPERTIES, SAT_IBRN
!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,  PCS_T1
      PROPERTIES, PRMX_LOG
!49   BRAGFLO
      MATERIALS,  PCS_T1
      PROPERTIES, SAT_RGAS
!50   BRAGFLO
      MATERIALS,  PCS_T1
```


Information Only

```
     PROPERTIES, SAT_RBRN
!51  BRAGFLO
     MATERIALS,  PCS_T1
     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
```


Information Only

```
     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,  PCS_T1
     PROPERTIES, POROSITY
!73
     MATERIALS,  PCS_T2
     PROPERTIES, POROSITY
!74
     MATERIALS,  PCS_T3
     PROPERTIES, POROSITY
!75
     MATERIALS,  PCS_T2
     PROPERTIES, POR2PERM
!
!==============================================================================
!
*END
```


Information Only

Appendix III. Input file to PRELHS for Replicate 3

```
! TITLE:          PCS-2012 PRELHS (LHS1) Input File
! ANALYSIS PLAN: AP-161
! ANALYST:        Tom Kirchner
! CREATED:        July 2012
!
!  LHSCALC = PCS-2012 REALIZATION 3
!==========================================================================
!
!  DESCRIPTION:
!
!  WIPP PCS-2012 Performance Assessment Baseline Calculation,
!  aka  (AP161)
!
!  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 PCS-2012 PA
!
!  Changes from PABC09 analyses: CELLULS:FBETA removed
!                                Material CONC_PCS replaced by PCS_T1 for
4 properties
!                                     (PRMX_LOG, SAT_RBRN, SAT_RGAS, and
POR_DIS)
!                                     PCS_T1:POROSITY added
!                                     PCS_T2:POROSITY added
!                                     PCS_T3:POROSITY added
!                                     PCS_T2:POR2PERM added
!                                     PCS_T1:SAT_IBRN added
!
!Also, LHS_EDIT should control 41<42, and 74<73<72 (WAS_AREA:GRATMICI <
WAS_AREA:GRATMICH and
!    PCS_T3:POROSITY < PCS_T2:POROSITY < PCS_T1:POROSITY)
!
!========= No Comments Allowed between *ECHOLHS and *ENDECHO
================
!
*ECHOLHS
TITLE PABC09, AP161 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
```


Information Only

```
     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
```


Information Only

```
     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
```


Information Only

```
     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,  PCS_T1
     PROPERTIES, SAT_IBRN
!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,  PCS_T1
     PROPERTIES, PRMX_LOG
!49  BRAGFLO
     MATERIALS,  PCS_T1
     PROPERTIES, SAT_RGAS
!50  BRAGFLO
     MATERIALS,  PCS_T1
     PROPERTIES, SAT_RBRN
!51  BRAGFLO
     MATERIALS,  PCS_T1
     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
```


Information Only

```
     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,  PCS_T1
     PROPERTIES, POROSITY
!73
```


Information Only

```
     MATERIALS,  PCS_T2
     PROPERTIES, POROSITY
!74
     MATERIALS,  PCS_T3
     PROPERTIES, POROSITY
!75
     MATERIALS,  PCS_T2
     PROPERTIES, POR2PERM
!
!==========================================================================
!
*END
```

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

```
TITLE SDB: ParamDB            Calc: AP161        Ver: 2.00     07/27/12
16:17:03
TITLE PABC09, AP161, 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
```


Information Only

```
    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
        48          SPECIFIED    CONTINUOUS
   -4.20000E+00   0.00290
   -4.05000E+00   0.00000
   -3.90000E+00   0.00580
   -3.75000E+00   0.01150
   -3.60000E+00   0.01450
   -3.45000E+00   0.00290
   -3.30000E+00   0.00580
   -3.15000E+00   0.00860
   -3.00000E+00   0.00290
   -2.85000E+00   0.00000
   -2.70000E+00   0.00580
   -2.55000E+00   0.00870
   -2.40000E+00   0.00860
   -2.25000E+00   0.00580
   -2.10000E+00   0.00000
   -1.95000E+00   0.00290
   -1.80000E+00   0.00580
   -1.65000E+00   0.00580
   -1.50000E+00   0.00570
   -1.35000E+00   0.02610
   -1.20000E+00   0.02600
   -1.05000E+00   0.02890
   -9.00000E-01   0.02600
   -7.50000E-01   0.02890
   -6.00000E-01   0.03760
   -4.50000E-01   0.06070
   -3.00000E-01   0.05200
   -1.50000E-01   0.07220
    0.00000E+00   0.07810
    1.50000E-01   0.07800
    3.00000E-01   0.07800
    4.50000E-01   0.03470
    6.00000E-01   0.08380
    7.50000E-01   0.08960
    9.00000E-01   0.02030
    1.05000E+00   0.01440
    1.20000E+00   0.01450
    1.35000E+00   0.00860
    1.50000E+00   0.00290
    1.65000E+00   0.01160
    1.80000E+00   0.00860
    1.95000E+00   0.00580
    2.10000E+00   0.00000
    2.25000E+00   0.00290
    2.40000E+00   0.00290
    2.55000E+00   0.00290
    2.70000E+00   0.00000
```


Information Only

```
    2.85000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)        SOLMOD4    SOLVAR
        38          SPECIFIED     CONTINUOUS
   -2.25000E+00   0.01430
   -2.10000E+00   0.00710
   -1.95000E+00   0.01430
   -1.80000E+00   0.02860
   -1.65000E+00   0.02860
   -1.50000E+00   0.05000
   -1.35000E+00   0.07850
   -1.20000E+00   0.04290
   -1.05000E+00   0.03570
   -9.00000E-01   0.05710
   -7.50000E-01   0.08580
   -6.00000E-01   0.10710
   -4.50000E-01   0.02140
   -3.00000E-01   0.03570
   -1.50000E-01   0.04290
    0.00000E+00   0.03570
    1.50000E-01   0.09290
    3.00000E-01   0.05000
    4.50000E-01   0.00710
    6.00000E-01   0.04290
    7.50000E-01   0.03570
    9.00000E-01   0.02140
    1.05000E+00   0.00000
    1.20000E+00   0.00720
    1.35000E+00   0.01420
    1.50000E+00   0.00720
    1.65000E+00   0.00710
    1.80000E+00   0.00000
    1.95000E+00   0.00720
    2.10000E+00   0.00000
    2.25000E+00   0.00710
    2.40000E+00   0.00000
    2.55000E+00   0.00000
    2.70000E+00   0.00000
    2.85000E+00   0.00000
    3.00000E+00   0.00000
    3.15000E+00   0.01430
    3.30000E+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
```


Information Only

```
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
    5.00000E-04    1.00000E+01
LOGUNIFORM              PU+3      MKD_PU
    5.00000E-03    4.00000E-01
LOGUNIFORM              PU+4      MKD_PU
    5.00000E-04    1.00000E+01
LOGUNIFORM              TH+4      MKD_TH
    5.00000E-04    1.00000E+01
LOGUNIFORM              AM+3      MKD_AM
    5.00000E-03    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
```


Information Only

```
    0.00000E+00    1.02717E-09
UNIFORM                 PCS_T1    SAT_IBRN
    4.00000E-02    1.60000E-01
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
UNIFORM                 PCS_T1    PRMX_LOG
   -2.10000E+01   -1.20000E+01
UNIFORM                 PCS_T1    SAT_RGAS
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       PCS_T1    SAT_RBRN
         3          SPECIFIED    CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
USER DISTRIBUTION  (CUMULATIVE)       PCS_T1    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
```


Information Only

```
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
```


Information Only

```
UNIFORM                    PCS_T1     POROSITY
    6.60000E-02     1.87000E-01
UNIFORM                    PCS_T2     POROSITY
    2.50000E-02     7.50000E-02
UNIFORM                    PCS_T3     POROSITY
    1.00000E-03     5.19000E-02
NORMAL                     PCS_T2     POR2PERM
   -1.72000E+00     1.72000E+00
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
TITLE SDB: ParamDB            Calc: AP161        Ver: 2.00     07/27/12
16:17:03
```


Information Only

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

```
TITLE SDB: ParamDB            Calc: AP161        Ver: 2.00     07/27/12
16:17:28
TITLE PABC09, AP161 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
        48          SPECIFIED    CONTINUOUS
   -4.20000E+00   0.00290
   -4.05000E+00   0.00000
   -3.90000E+00   0.00580
   -3.75000E+00   0.01150
   -3.60000E+00   0.01450
   -3.45000E+00   0.00290
   -3.30000E+00   0.00580
```


Information Only

```
   -3.15000E+00   0.00860
   -3.00000E+00   0.00290
   -2.85000E+00   0.00000
   -2.70000E+00   0.00580
   -2.55000E+00   0.00870
   -2.40000E+00   0.00860
   -2.25000E+00   0.00580
   -2.10000E+00   0.00000
   -1.95000E+00   0.00290
   -1.80000E+00   0.00580
   -1.65000E+00   0.00580
   -1.50000E+00   0.00570
   -1.35000E+00   0.02610
   -1.20000E+00   0.02600
   -1.05000E+00   0.02890
   -9.00000E-01   0.02600
   -7.50000E-01   0.02890
   -6.00000E-01   0.03760
   -4.50000E-01   0.06070
   -3.00000E-01   0.05200
   -1.50000E-01   0.07220
    0.00000E+00   0.07810
    1.50000E-01   0.07800
    3.00000E-01   0.07800
    4.50000E-01   0.03470
    6.00000E-01   0.08380
    7.50000E-01   0.08960
    9.00000E-01   0.02030
    1.05000E+00   0.01440
    1.20000E+00   0.01450
    1.35000E+00   0.00860
    1.50000E+00   0.00290
    1.65000E+00   0.01160
    1.80000E+00   0.00860
    1.95000E+00   0.00580
    2.10000E+00   0.00000
    2.25000E+00   0.00290
    2.40000E+00   0.00290
    2.55000E+00   0.00290
    2.70000E+00   0.00000
    2.85000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)      SOLMOD4   SOLVAR
        38          SPECIFIED    CONTINUOUS
   -2.25000E+00   0.01430
   -2.10000E+00   0.00710
   -1.95000E+00   0.01430
   -1.80000E+00   0.02860
   -1.65000E+00   0.02860
   -1.50000E+00   0.05000
   -1.35000E+00   0.07850
   -1.20000E+00   0.04290
   -1.05000E+00   0.03570
   -9.00000E-01   0.05710
   -7.50000E-01   0.08580
```


Information Only

```
   -6.00000E-01   0.10710
   -4.50000E-01   0.02140
   -3.00000E-01   0.03570
   -1.50000E-01   0.04290
    0.00000E+00   0.03570
    1.50000E-01   0.09290
    3.00000E-01   0.05000
    4.50000E-01   0.00710
    6.00000E-01   0.04290
    7.50000E-01   0.03570
    9.00000E-01   0.02140
    1.05000E+00   0.00000
    1.20000E+00   0.00720
    1.35000E+00   0.01420
    1.50000E+00   0.00720
    1.65000E+00   0.00710
    1.80000E+00   0.00000
    1.95000E+00   0.00720
    2.10000E+00   0.00000
    2.25000E+00   0.00710
    2.40000E+00   0.00000
    2.55000E+00   0.00000
    2.70000E+00   0.00000
    2.85000E+00   0.00000
    3.00000E+00   0.00000
    3.15000E+00   0.01430
    3.30000E+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
```


Information Only

```
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
    5.00000E-04    1.00000E+01
LOGUNIFORM              PU+3      MKD_PU
    5.00000E-03    4.00000E-01
LOGUNIFORM              PU+4      MKD_PU
    5.00000E-04    1.00000E+01
LOGUNIFORM              TH+4      MKD_TH
    5.00000E-04    1.00000E+01
LOGUNIFORM              AM+3      MKD_AM
    5.00000E-03    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                 PCS_T1    SAT_IBRN
    4.00000E-02    1.60000E-01
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
UNIFORM                 PCS_T1    PRMX_LOG
   -2.10000E+01   -1.20000E+01
UNIFORM                 PCS_T1    SAT_RGAS
```


Information Only

```
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       PCS_T1    SAT_RBRN
         3          SPECIFIED    CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
USER DISTRIBUTION  (CUMULATIVE)       PCS_T1    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
```


Information Only

```
    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                 PCS_T1    POROSITY
    6.60000E-02    1.87000E-01
UNIFORM                 PCS_T2    POROSITY
    2.50000E-02    7.50000E-02
UNIFORM                 PCS_T3    POROSITY
    1.00000E-03    5.19000E-02
NORMAL                  PCS_T2    POR2PERM
   -1.72000E+00    1.72000E+00
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
```


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

```
TITLE SDB: ParamDB            Calc: AP161        Ver: 2.00     07/27/12
16:17:47
TITLE PABC09, AP161 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
        48          SPECIFIED    CONTINUOUS
   -4.20000E+00   0.00290
   -4.05000E+00   0.00000
   -3.90000E+00   0.00580
   -3.75000E+00   0.01150
   -3.60000E+00   0.01450
   -3.45000E+00   0.00290
   -3.30000E+00   0.00580
```


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```
   -3.15000E+00   0.00860
   -3.00000E+00   0.00290
   -2.85000E+00   0.00000
   -2.70000E+00   0.00580
   -2.55000E+00   0.00870
   -2.40000E+00   0.00860
   -2.25000E+00   0.00580
   -2.10000E+00   0.00000
   -1.95000E+00   0.00290
   -1.80000E+00   0.00580
   -1.65000E+00   0.00580
   -1.50000E+00   0.00570
   -1.35000E+00   0.02610
   -1.20000E+00   0.02600
   -1.05000E+00   0.02890
   -9.00000E-01   0.02600
   -7.50000E-01   0.02890
   -6.00000E-01   0.03760
   -4.50000E-01   0.06070
   -3.00000E-01   0.05200
   -1.50000E-01   0.07220
    0.00000E+00   0.07810
    1.50000E-01   0.07800
    3.00000E-01   0.07800
    4.50000E-01   0.03470
    6.00000E-01   0.08380
    7.50000E-01   0.08960
    9.00000E-01   0.02030
    1.05000E+00   0.01440
    1.20000E+00   0.01450
    1.35000E+00   0.00860
    1.50000E+00   0.00290
    1.65000E+00   0.01160
    1.80000E+00   0.00860
    1.95000E+00   0.00580
    2.10000E+00   0.00000
    2.25000E+00   0.00290
    2.40000E+00   0.00290
    2.55000E+00   0.00290
    2.70000E+00   0.00000
    2.85000E+00   0.00000
USER DISTRIBUTION  (CUMULATIVE)       SOLMOD4   SOLVAR
        38          SPECIFIED    CONTINUOUS
   -2.25000E+00   0.01430
   -2.10000E+00   0.00710
   -1.95000E+00   0.01430
   -1.80000E+00   0.02860
   -1.65000E+00   0.02860
   -1.50000E+00   0.05000
   -1.35000E+00   0.07850
   -1.20000E+00   0.04290
   -1.05000E+00   0.03570
   -9.00000E-01   0.05710
   -7.50000E-01   0.08580
```


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```
   -6.00000E-01   0.10710
   -4.50000E-01   0.02140
   -3.00000E-01   0.03570
   -1.50000E-01   0.04290
    0.00000E+00   0.03570
    1.50000E-01   0.09290
    3.00000E-01   0.05000
    4.50000E-01   0.00710
    6.00000E-01   0.04290
    7.50000E-01   0.03570
    9.00000E-01   0.02140
    1.05000E+00   0.00000
    1.20000E+00   0.00720
    1.35000E+00   0.01420
    1.50000E+00   0.00720
    1.65000E+00   0.00710
    1.80000E+00   0.00000
    1.95000E+00   0.00720
    2.10000E+00   0.00000
    2.25000E+00   0.00710
    2.40000E+00   0.00000
    2.55000E+00   0.00000
    2.70000E+00   0.00000
    2.85000E+00   0.00000
    3.00000E+00   0.00000
    3.15000E+00   0.01430
    3.30000E+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
```


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```
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
    5.00000E-04    1.00000E+01
LOGUNIFORM              PU+3      MKD_PU
    5.00000E-03    4.00000E-01
LOGUNIFORM              PU+4      MKD_PU
    5.00000E-04    1.00000E+01
LOGUNIFORM              TH+4      MKD_TH
    5.00000E-04    1.00000E+01
LOGUNIFORM              AM+3      MKD_AM
    5.00000E-03    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                 PCS_T1    SAT_IBRN
    4.00000E-02    1.60000E-01
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
UNIFORM                 PCS_T1    PRMX_LOG
   -2.10000E+01   -1.20000E+01
UNIFORM                 PCS_T1    SAT_RGAS
```


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```
    0.00000E+00    4.00000E-01
USER DISTRIBUTION  (CUMULATIVE)       PCS_T1    SAT_RBRN
         3          SPECIFIED    CONTINUOUS
    0.00000E+00   0.50000
    2.00000E-01   0.50000
    6.00000E-01   0.00000
USER DISTRIBUTION  (CUMULATIVE)       PCS_T1    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
```


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```
    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                 PCS_T1    POROSITY
    6.60000E-02    1.87000E-01
UNIFORM                 PCS_T2    POROSITY
    2.50000E-02    7.50000E-02
UNIFORM                 PCS_T3    POROSITY
    1.00000E-03    5.19000E-02
NORMAL                  PCS_T2    POR2PERM
   -1.72000E+00    1.72000E+00
CORRELATION MATRIX
    2
    53  54 -0.99
    61  62 -0.75
OUTPUT CORR HIST DATA
```


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Appendix VII. Comparison of Sampled Data to Expected Range

				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	AM+3	MKD_AM	1	5.0220E-03	3.9660E-01	9.0040E-02	5.0000E-03	4.0000E-01	9.0000E-02	0.04%	99.1%
AP161	AM+3	MKD_AM	2	5.1740E-03	3.8880E-01	9.0275E-02	5.0000E-03	4.0000E-01	9.0000E-02	0.31%	97.1%
AP161	AM+3	MKD_AM	3	5.2060E-03	3.9280E-01	8.9972E-02	5.0000E-03	4.0000E-01	9.0000E-02	0.03%	98.1%
AP161	BH_SAND	PRMX_LOG	1	-1.6300E+01	-1.1010E+01	-1.3648E+01	-1.6300E+01	-1.1000E+01	-1.3650E+01	0.01%	99.8%
AP161	BH_SAND	PRMX_LOG	2	-1.6290E+01	-1.1010E+01	-1.3649E+01	-1.6300E+01	-1.1000E+01	-1.3650E+01	0.01%	99.6%
AP161	BH_SAND	PRMX_LOG	3	-1.6250E+01	-1.1000E+01	-1.3647E+01	-1.6300E+01	-1.1000E+01	-1.3650E+01	0.02%	99.1%
AP161	BOREHOLE	DOMEGA	1	4.3370E+00	2.1650E+01	8.6254E+00	4.2000E+00	2.3000E+01	8.6300E+00	0.05%	92.1%
AP161	BOREHOLE	DOMEGA	2	4.2740E+00	2.2680E+01	8.6183E+00	4.2000E+00	2.3000E+01	8.6300E+00	0.14%	97.9%
AP161	BOREHOLE	DOMEGA	3	4.2740E+00	2.2990E+01	8.6407E+00	4.2000E+00	2.3000E+01	8.6300E+00	0.12%	99.6%
AP161	BOREHOLE	TAUFAIL	1	5.0040E-02	7.6740E+01	1.0500E+01	5.0000E-02	7.7000E+01	1.0500E+01	0.00%	99.7%
AP161	BOREHOLE	TAUFAIL	2	5.1040E-02	7.2230E+01	1.0427E+01	5.0000E-02	7.7000E+01	1.0500E+01	0.70%	93.8%
AP161	BOREHOLE	TAUFAIL	3	5.1200E-02	7.4990E+01	1.0521E+01	5.0000E-02	7.7000E+01	1.0500E+01	0.20%	97.4%
AP161	CASTILER	COMP_RCK	1	2.0740E-11	9.3580E-11	5.3286E-11	2.0000E-11	1.0000E-10	5.3000E-11	0.54%	91.1%
AP161	CASTILER	COMP_RCK	2	2.2830E-11	9.4830E-11	5.3349E-11	2.0000E-11	1.0000E-10	5.3000E-11	0.66%	90.0%

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AP161	CASTILER	COMP_RCK	3	2.1390E-11	9.4920E-11	5.3273E-11	2.0000E-11	1.0000E-10	5.3000E-11	0.51%	91.9%

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				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	CASTILER	PRESSURE	1	1.1200E+07	1.6500E+07	1.3595E+07	1.1100E+07	1.7000E+07	1.3600E+07	0.03%	89.8%
AP161	CASTILER	PRESSURE	2	1.1370E+07	1.6710E+07	1.3606E+07	1.1100E+07	1.7000E+07	1.3600E+07	0.04%	90.5%
AP161	CASTILER	PRESSURE	3	1.1380E+07	1.6850E+07	1.3602E+07	1.1100E+07	1.7000E+07	1.3600E+07	0.02%	92.7%
AP161	CASTILER	PRMX_LOG	1	-1.4470E+01	-9.9370E+00	-1.2099E+01	-1.4700E+01	-9.8000E+00	-1.2100E+01	0.01%	92.5%
AP161	CASTILER	PRMX_LOG	2	-1.4520E+01	-1.0050E+01	-1.2101E+01	-1.4700E+01	-9.8000E+00	-1.2100E+01	0.01%	91.2%
AP161	CASTILER	PRMX_LOG	3	-1.4360E+01	-9.8950E+00	-1.2096E+01	-1.4700E+01	-9.8000E+00	-1.2100E+01	0.03%	91.1%
AP161	CONC_PLG	PRMX_LOG	1	-1.8990E+01	-1.7010E+01	-1.8001E+01	-1.9000E+01	-1.7000E+01	-1.8000E+01	0.00%	99.0%
AP161	CONC_PLG	PRMX_LOG	2	-1.9000E+01	-1.7010E+01	-1.8000E+01	-1.9000E+01	-1.7000E+01	-1.8000E+01	0.00%	99.5%
AP161	CONC_PLG	PRMX_LOG	3	-1.8990E+01	-1.7020E+01	-1.7999E+01	-1.9000E+01	-1.7000E+01	-1.8000E+01	0.01%	98.5%
AP161	CULEBRA	APOROS	1	1.0140E-04	9.8170E-03	2.1380E-03	1.0000E-04	1.0000E-02	2.1000E-03	1.79%	98.1%
AP161	CULEBRA	APOROS	2	1.0220E-04	9.5810E-03	2.1522E-03	1.0000E-04	1.0000E-02	2.1000E-03	2.46%	95.7%
AP161	CULEBRA	APOROS	3	1.0140E-04	9.6960E-03	2.1448E-03	1.0000E-04	1.0000E-02	2.1000E-03	2.11%	96.9%
AP161	CULEBRA	DPOROS	1	1.0000E-01	2.4570E-01	1.5495E-01	1.0000E-01	2.5000E-01	1.6000E-01	3.21%	97.1%
AP161	CULEBRA	DPOROS	2	1.0000E-01	2.4750E-01	1.5499E-01	1.0000E-01	2.5000E-01	1.6000E-01	3.18%	98.3%
AP161	CULEBRA	DPOROS	3	1.0010E-01	2.4900E-01	1.5498E-01	1.0000E-01	2.5000E-01	1.6000E-01	3.19%	99.3%
AP161	CULEBRA	HMBLKLT	1	5.2590E-02	4.9880E-01	2.7524E-01	5.0000E-02	5.0000E-01	2.7500E-01	0.09%	99.2%
AP161	CULEBRA	HMBLKLT	2	5.3870E-02	4.9640E-01	2.7502E-01	5.0000E-02	5.0000E-01	2.7500E-01	0.01%	98.3%
AP161	CULEBRA	HMBLKLT	3	5.4100E-02	4.9640E-01	2.7484E-01	5.0000E-02	5.0000E-01	2.7500E-01	0.06%	98.3%
AP161	CULEBRA	MINP_FAC	1	1.0190E+00	9.9530E+02	5.0069E+02	1.0000E+00	1.0000E+03	5.0050E+02	0.04%	99.5%
AP161	CULEBRA	MINP_FAC	2	5.5620E+00	9.9620E+02	5.0051E+02	1.0000E+00	1.0000E+03	5.0050E+02	0.00%	99.2%

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AP161	CULEBRA	MINP_FAC	3	4.3420E+00	9.9240E+02	5.0036E+02	1.0000E+00	1.0000E+03	5.0050E+02	0.03%	98.9%

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				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	DRZ_1	PRMX_LOG	1	-1.9400E+01	-1.2510E+01	-1.5949E+01	-1.9400E+01	-1.2500E+01	-1.6000E+01	0.32%	99.9%
AP161	DRZ_1	PRMX_LOG	2	-1.9380E+01	-1.2560E+01	-1.5951E+01	-1.9400E+01	-1.2500E+01	-1.6000E+01	0.31%	98.8%
AP161	DRZ_1	PRMX_LOG	3	-1.9340E+01	-1.2560E+01	-1.5948E+01	-1.9400E+01	-1.2500E+01	-1.6000E+01	0.33%	98.3%
AP161	DRZ_PCS	PRMX_LOG	1	-2.0480E+01	-1.7200E+01	-1.8815E+01	-2.0699E+01	-1.7000E+01	-1.8816E+01	0.01%	88.7%
AP161	DRZ_PCS	PRMX_LOG	2	-2.0570E+01	-1.7170E+01	-1.8819E+01	-2.0699E+01	-1.7000E+01	-1.8816E+01	0.01%	91.9%
AP161	DRZ_PCS	PRMX_LOG	3	-2.0600E+01	-1.7180E+01	-1.8816E+01	-2.0699E+01	-1.7000E+01	-1.8816E+01	0.00%	92.5%
AP161	GLOBAL	CLIMTIDX	1	1.0010E+00	2.2350E+00	1.3121E+00	1.0000E+00	2.2500E+00	1.3100E+00	0.16%	98.7%
AP161	GLOBAL	CLIMTIDX	2	1.0020E+00	2.2480E+00	1.3128E+00	1.0000E+00	2.2500E+00	1.3100E+00	0.21%	99.7%
AP161	GLOBAL	CLIMTIDX	3	1.0020E+00	2.2400E+00	1.3121E+00	1.0000E+00	2.2500E+00	1.3100E+00	0.16%	99.0%
AP161	GLOBAL	OXSTAT	1	4.3770E-03	9.9540E-01	5.0010E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.02%	99.1%
AP161	GLOBAL	OXSTAT	2	7.8880E-03	9.9170E-01	5.0070E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.14%	98.4%
AP161	GLOBAL	OXSTAT	3	8.1050E-04	9.9350E-01	5.0016E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.03%	99.3%
AP161	GLOBAL	PBRINE	1	1.5250E-02	5.9770E-01	3.0496E-01	1.0000E-02	6.0000E-01	3.0500E-01	0.01%	98.7%
AP161	GLOBAL	PBRINE	2	1.3550E-02	5.9710E-01	3.0508E-01	1.0000E-02	6.0000E-01	3.0500E-01	0.03%	98.9%
AP161	GLOBAL	PBRINE	3	1.4130E-02	5.9490E-01	3.0522E-01	1.0000E-02	6.0000E-01	3.0500E-01	0.07%	98.4%
AP161	GLOBAL	TRANSIDX	1	7.9510E-03	9.9810E-01	4.9977E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.05%	99.0%
AP161	GLOBAL	TRANSIDX	2	6.8330E-03	9.9180E-01	4.9963E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.07%	98.5%
AP161	GLOBAL	TRANSIDX	3	6.6100E-03	9.9240E-01	5.0027E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.05%	98.6%
AP161	PCS_T1	PORE_DIS	1	1.1970E-01	8.0570E+00	2.5202E+00	1.1000E-01	8.1000E+00	2.5200E+00	0.01%	99.3%
AP161	PCS_T1	PORE_DIS	2	1.1040E-01	8.0170E+00	2.5170E+00	1.1000E-01	8.1000E+00	2.5200E+00	0.12%	99.0%

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AP161	PCS_T1	PORE_DIS	3	1.2600E-01	8.0650E+00	2.5231E+00	1.1000E-01	8.1000E+00	2.5200E+00	0.12%	99.4%

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				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	PCS_T1	POROSITY	1	6.6190E-02	1.8650E-01	1.2643E-01	6.6000E-02	1.8700E-01	1.2650E-01	0.05%	99.4%
AP161	PCS_T1	POROSITY	2	6.6540E-02	1.8660E-01	1.2651E-01	6.6000E-02	1.8700E-01	1.2650E-01	0.01%	99.2%
AP161	PCS_T1	POROSITY	3	6.7130E-02	1.8680E-01	1.2647E-01	6.6000E-02	1.8700E-01	1.2650E-01	0.03%	98.9%
AP161	PCS_T1	PRMX_LOG	1	-2.0940E+01	-1.2080E+01	-1.6499E+01	-2.1000E+01	-1.2000E+01	-1.6500E+01	0.01%	98.4%
AP161	PCS_T1	PRMX_LOG	2	-2.1000E+01	-1.2070E+01	-1.6503E+01	-2.1000E+01	-1.2000E+01	-1.6500E+01	0.02%	99.2%
AP161	PCS_T1	PRMX_LOG	3	-2.0930E+01	-1.2080E+01	-1.6502E+01	-2.1000E+01	-1.2000E+01	-1.6500E+01	0.01%	98.3%
AP161	PCS_T1	SAT_IBRN	1	4.0120E-02	1.6000E-01	1.0003E-01	4.0000E-02	1.6000E-01	1.0000E-01	0.03%	99.9%
AP161	PCS_T1	SAT_IBRN	2	4.1100E-02	1.5900E-01	9.9965E-02	4.0000E-02	1.6000E-01	1.0000E-01	0.04%	98.3%
AP161	PCS_T1	SAT_IBRN	3	4.0200E-02	1.5980E-01	9.9965E-02	4.0000E-02	1.6000E-01	1.0000E-01	0.03%	99.7%
AP161	PCS_T1	SAT_RBRN	1	1.9560E-03	5.9540E-01	2.5009E-01	0.0000E+00	6.0000E-01	2.5000E-01	0.04%	98.9%
AP161	PCS_T1	SAT_RBRN	2	6.9290E-04	5.9460E-01	2.4978E-01	0.0000E+00	6.0000E-01	2.5000E-01	0.09%	99.0%
AP161	PCS_T1	SAT_RBRN	3	2.9130E-03	5.9380E-01	2.5013E-01	0.0000E+00	6.0000E-01	2.5000E-01	0.05%	98.5%
AP161	PCS_T1	SAT_RGAS	1	9.6070E-04	3.9780E-01	2.0010E-01	0.0000E+00	4.0000E-01	2.0000E-01	0.05%	99.2%
AP161	PCS_T1	SAT_RGAS	2	2.7790E-03	3.9900E-01	2.0019E-01	0.0000E+00	4.0000E-01	2.0000E-01	0.09%	99.1%
AP161	PCS_T1	SAT_RGAS	3	5.9480E-04	3.9940E-01	1.9982E-01	0.0000E+00	4.0000E-01	2.0000E-01	0.09%	99.7%
AP161	PCS_T2	POR2PERM	1	-1.6280E+00	1.6770E+00	5.6467E-04	-1.7200E+00	1.7200E+00	0.0000E+00	200.00%	96.1%
AP161	PCS_T2	POR2PERM	2	-1.5800E+00	1.7040E+00	1.1361E-03	-1.7200E+00	1.7200E+00	0.0000E+00	200.00%	95.5%
AP161	PCS_T2	POR2PERM	3	-1.5770E+00	1.6490E+00	1.1791E-03	-1.7200E+00	1.7200E+00	0.0000E+00	200.00%	93.8%
AP161	PCS_T2	POROSITY	1	2.5110E-02	7.4680E-02	4.9999E-02	2.5000E-02	7.5000E-02	5.0000E-02	0.00%	99.1%
AP161	PCS_T2	POROSITY	2	2.5480E-02	7.4660E-02	4.9990E-02	2.5000E-02	7.5000E-02	5.0000E-02	0.02%	98.4%

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AP161	PCS_T2	POROSITY	3	2.5030E-02	7.4690E-02	5.0003E-02	2.5000E-02	7.5000E-02	5.0000E-02	0.01%	99.3%

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Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	PCS_T3	POROSITY	1	1.4370E-03	5.1710E-02	2.6468E-02	1.0000E-03	5.1900E-02	5.0000E-02	61.55%	98.8%
AP161	PCS_T3	POROSITY	2	1.4620E-03	5.1820E-02	2.6493E-02	1.0000E-03	5.1900E-02	5.0000E-02	61.46%	98.9%
AP161	PCS_T3	POROSITY	3	1.4910E-03	5.1620E-02	2.6441E-02	1.0000E-03	5.1900E-02	5.0000E-02	61.64%	98.5%
AP161	PHUMOX3	PHUMCIM	1	8.4750E-02	1.5980E+00	1.1019E+00	6.5000E-02	1.6000E+00	1.1000E+00	0.17%	98.6%
AP161	PHUMOX3	PHUMCIM	2	7.8790E-02	1.5990E+00	1.1012E+00	6.5000E-02	1.6000E+00	1.1000E+00	0.11%	99.0%
AP161	PHUMOX3	PHUMCIM	3	9.0390E-02	1.6000E+00	1.1012E+00	6.5000E-02	1.6000E+00	1.1000E+00	0.11%	98.3%
AP161	PU+3	MKD_PU	1	5.0200E-03	3.9600E-01	9.0271E-02	5.0000E-03	4.0000E-01	9.0000E-02	0.30%	99.0%
AP161	PU+3	MKD_PU	2	5.0610E-03	3.9480E-01	9.0160E-02	5.0000E-03	4.0000E-01	9.0000E-02	0.18%	98.7%
AP161	PU+3	MKD_PU	3	5.0360E-03	3.9980E-01	9.0145E-02	5.0000E-03	4.0000E-01	9.0000E-02	0.16%	99.9%
AP161	PU+4	MKD_PU	1	5.1950E-04	9.6900E+00	1.0052E+00	5.0000E-04	1.0000E+01	1.0000E+00	0.51%	96.9%
AP161	PU+4	MKD_PU	2	5.2120E-04	9.5510E+00	1.0141E+00	5.0000E-04	1.0000E+01	1.0000E+00	1.40%	95.5%
AP161	PU+4	MKD_PU	3	5.3760E-04	9.6400E+00	1.0128E+00	5.0000E-04	1.0000E+01	1.0000E+00	1.28%	96.4%
AP161	S_HALITE	COMP_RCK	1	3.7690E-12	1.9170E-10	9.7462E-11	2.9400E-12	1.9200E-10	9.7500E-11	0.04%	99.4%
AP161	S_HALITE	COMP_RCK	2	3.2040E-12	1.9010E-10	9.7516E-11	2.9400E-12	1.9200E-10	9.7500E-11	0.02%	98.9%
AP161	S_HALITE	COMP_RCK	3	3.4650E-12	1.9060E-10	9.7436E-11	2.9400E-12	1.9200E-10	9.7500E-11	0.07%	99.0%
AP161	S_HALITE	POROSITY	1	1.1270E-03	5.1150E-02	1.8230E-02	1.0000E-03	5.1900E-02	1.8200E-02	0.17%	98.3%
AP161	S_HALITE	POROSITY	2	1.0540E-03	5.1150E-02	1.8224E-02	1.0000E-03	5.1900E-02	1.8200E-02	0.13%	98.4%
AP161	S_HALITE	POROSITY	3	1.1080E-03	5.1560E-02	1.8243E-02	1.0000E-03	5.1900E-02	1.8200E-02	0.24%	99.1%
AP161	S_HALITE	PRESSURE	1	1.1060E+07	1.3890E+07	1.2465E+07	1.1040E+07	1.3890E+07	1.2470E+07	0.04%	99.3%
AP161	S_HALITE	PRESSURE	2	1.1050E+07	1.3880E+07	1.2464E+07	1.1040E+07	1.3890E+07	1.2470E+07	0.05%	99.3%
AP161	S_HALITE	PRESSURE	3	1.1050E+07	1.3880E+07	1.2466E+07	1.1040E+07	1.3890E+07	1.2470E+07	0.03%	99.3%
AP161	S_HALITE	PRMX_LOG	1	-2.3970E+01	-2.1010E+01	-2.2499E+01	-2.4000E+01	-2.1000E+01	-2.2500E+01	0.00%	98.7%

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Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	S_HALITE	PRMX_LOG	2	-2.4000E+01	-2.1010E+01	-2.2500E+01	-2.4000E+01	-2.1000E+01	-2.2500E+01	0.00%	99.7%
AP161	S_HALITE	PRMX_LOG	3	-2.4000E+01	-2.1000E+01	-2.2502E+01	-2.4000E+01	-2.1000E+01	-2.2500E+01	0.01%	100.0%
AP161	S_MB139	PORE_DIS	1	4.9930E-01	8.0180E-01	6.4383E-01	4.9053E-01	8.4178E-01	6.4360E-01	0.04%	86.1%
AP161	S_MB139	PORE_DIS	2	4.9960E-01	7.9860E-01	6.4367E-01	4.9053E-01	8.4178E-01	6.4360E-01	0.01%	85.1%
AP161	S_MB139	PORE_DIS	3	5.0300E-01	7.9520E-01	6.4362E-01	4.9053E-01	8.4178E-01	6.4360E-01	0.00%	83.2%
AP161	S_MB139	PRMX_LOG	1	-2.0440E+01	-1.7140E+01	-1.8880E+01	-2.1000E+01	-1.7100E+01	-1.8890E+01	0.05%	84.6%
AP161	S_MB139	PRMX_LOG	2	-2.0660E+01	-1.7230E+01	-1.8883E+01	-2.1000E+01	-1.7100E+01	-1.8890E+01	0.04%	87.9%
AP161	S_MB139	PRMX_LOG	3	-2.0350E+01	-1.7330E+01	-1.8884E+01	-2.1000E+01	-1.7100E+01	-1.8890E+01	0.03%	77.4%
AP161	S_MB139	RELP_MOD	1	1.0000E+00	4.0000E+00	2.5000E+00	1.0000E+00	4.0000E+00	4.0000E+00	46.15%	100.0%
AP161	S_MB139	RELP_MOD	2	1.0000E+00	4.0000E+00	2.5000E+00	1.0000E+00	4.0000E+00	4.0000E+00	46.15%	100.0%
AP161	S_MB139	RELP_MOD	3	1.0000E+00	4.0000E+00	2.5000E+00	1.0000E+00	4.0000E+00	4.0000E+00	46.15%	100.0%
AP161	S_MB139	SAT_RBRN	1	1.5000E-02	1.5710E-01	8.3627E-02	7.7846E-03	1.7401E-01	8.3620E-02	0.01%	85.5%
AP161	S_MB139	SAT_RBRN	2	2.1280E-02	1.5680E-01	8.3789E-02	7.7846E-03	1.7401E-01	8.3620E-02	0.20%	81.5%
AP161	S_MB139	SAT_RBRN	3	2.1350E-02	1.4650E-01	8.3763E-02	7.7846E-03	1.7401E-01	8.3620E-02	0.17%	75.3%
AP161	SHFTL_T1	PRMX_LOG	1	-1.9970E+01	-1.6870E+01	-1.8214E+01	-2.0000E+01	-1.6500E+01	-1.8000E+01	1.18%	88.6%
AP161	SHFTL_T1	PRMX_LOG	2	-1.9930E+01	-1.7010E+01	-1.8214E+01	-2.0000E+01	-1.6500E+01	-1.8000E+01	1.18%	83.4%
AP161	SHFTL_T1	PRMX_LOG	3	-1.9550E+01	-1.7010E+01	-1.8210E+01	-2.0000E+01	-1.6500E+01	-1.8000E+01	1.16%	72.6%
AP161	SHFTL_T2	PRMX_LOG	1	-2.2360E+01	-1.8030E+01	-2.0063E+01	-2.2500E+01	-1.8000E+01	-1.9800E+01	1.32%	96.2%

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AP161	SHFTL_T2	PRMX_LOG	2	-2.2280E+01	-1.8140E+01	-2.0064E+01	-2.2500E+01	-1.8000E+01	-1.9800E+01	1.32%	92.0%

Information Only

				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	SHFTL_T2	PRMX_LOG	3	-2.2340E+01	-1.8010E+01	-2.0065E+01	-2.2500E+01	-1.8000E+01	-1.9800E+01	1.33%	96.2%
AP161	SHFTU	PRMX_LOG	1	-2.0480E+01	-1.6930E+01	-1.8422E+01	-2.0500E+01	-1.6500E+01	-1.8200E+01	1.21%	88.8%
AP161	SHFTU	PRMX_LOG	2	-2.0400E+01	-1.6780E+01	-1.8420E+01	-2.0500E+01	-1.6500E+01	-1.8200E+01	1.20%	90.5%
AP161	SHFTU	PRMX_LOG	3	-2.0430E+01	-1.6640E+01	-1.8421E+01	-2.0500E+01	-1.6500E+01	-1.8200E+01	1.21%	94.8%
AP161	SHFTU	SAT_RBRN	1	1.7920E-03	5.9980E-01	2.5011E-01	0.0000E+00	6.0000E-01	2.5000E-01	0.04%	99.7%
AP161	SHFTU	SAT_RBRN	2	2.7560E-03	5.9740E-01	2.5008E-01	0.0000E+00	6.0000E-01	2.5000E-01	0.03%	99.1%
AP161	SHFTU	SAT_RBRN	3	9.6720E-04	5.9340E-01	2.5007E-01	0.0000E+00	6.0000E-01	2.5000E-01	0.03%	98.7%
AP161	SHFTU	SAT_RGAS	1	9.0910E-04	3.9790E-01	2.0013E-01	0.0000E+00	4.0000E-01	2.0000E-01	0.07%	99.2%
AP161	SHFTU	SAT_RGAS	2	2.0540E-03	3.9780E-01	1.9999E-01	0.0000E+00	4.0000E-01	2.0000E-01	0.00%	98.9%
AP161	SHFTU	SAT_RGAS	3	2.6970E-03	3.9760E-01	1.9997E-01	0.0000E+00	4.0000E-01	2.0000E-01	0.01%	98.7%
AP161	SOLMOD3	SOLVAR	1	-3.8830E+00	2.4390E+00	-1.4695E-01	-4.2000E+00	2.7000E+00	-1.4200E-01	3.42%	91.6%
AP161	SOLMOD3	SOLVAR	2	-3.7570E+00	2.5670E+00	-1.3553E-01	-4.2000E+00	2.7000E+00	-1.4200E-01	4.66%	91.7%
AP161	SOLMOD3	SOLVAR	3	-4.1540E+00	2.2650E+00	-1.4769E-01	-4.2000E+00	2.7000E+00	-1.4200E-01	3.93%	93.0%
AP161	SOLMOD4	SOLVAR	1	-2.1670E+00	3.2440E+00	-3.4862E-01	-2.2500E+00	3.3000E+00	-3.4600E-01	0.75%	97.5%
AP161	SOLMOD4	SOLVAR	2	-2.1840E+00	3.2140E+00	-3.3934E-01	-2.2500E+00	3.3000E+00	-3.4600E-01	1.94%	97.3%
AP161	SOLMOD4	SOLVAR	3	-2.1960E+00	3.2910E+00	-3.4969E-01	-2.2500E+00	3.3000E+00	-3.4600E-01	1.06%	98.9%
AP161	SPALLMOD	PARTDIAM	1	1.0090E-03	9.6550E-02	2.1478E-02	1.0000E-03	1.0000E-01	2.1500E-02	0.10%	96.5%
AP161	SPALLMOD	PARTDIAM	2	1.0010E-03	9.7620E-02	2.1560E-02	1.0000E-03	1.0000E-01	2.1500E-02	0.28%	97.6%
AP161	SPALLMOD	PARTDIAM	3	1.0420E-03	9.8220E-02	2.1569E-02	1.0000E-03	1.0000E-01	2.1500E-02	0.32%	98.2%

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AP161	SPALLMOD	REPIPERM	1	2.4240E-14	2.3160E-12	5.1466E-13	2.4000E-14	2.4000E-12	5.1600E-13	0.26%	96.5%

Information Only

				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	SPALLMOD	REPIPERM	2	2.4940E-14	2.3680E-12	5.1489E-13	2.4000E-14	2.4000E-12	5.1600E-13	0.22%	98.6%
AP161	SPALLMOD	REPIPERM	3	2.4470E-14	2.3970E-12	5.1606E-13	2.4000E-14	2.4000E-12	5.1600E-13	0.01%	99.9%
AP161	SPALLMOD	REPIPOR	1	3.5090E-01	6.5790E-01	5.0482E-01	3.5000E-01	6.6000E-01	5.0500E-01	0.04%	99.0%
AP161	SPALLMOD	REPIPOR	2	3.5070E-01	6.5790E-01	5.0501E-01	3.5000E-01	6.6000E-01	5.0500E-01	0.00%	99.1%
AP161	SPALLMOD	REPIPOR	3	3.5170E-01	6.5850E-01	5.0508E-01	3.5000E-01	6.6000E-01	5.0500E-01	0.02%	99.0%
AP161	SPALLMOD	TENSLSTR	1	1.2050E+05	1.6990E+05	1.4499E+05	1.2000E+05	1.7000E+05	1.4500E+05	0.01%	98.8%
AP161	SPALLMOD	TENSLSTR	2	1.2020E+05	1.6990E+05	1.4497E+05	1.2000E+05	1.7000E+05	1.4500E+05	0.02%	99.4%
AP161	SPALLMOD	TENSLSTR	3	1.2030E+05	1.6980E+05	1.4501E+05	1.2000E+05	1.7000E+05	1.4500E+05	0.00%	99.0%
AP161	STEEL	CORRMCO2	1	2.1650E-16	3.1590E-14	1.5849E-14	0.0000E+00	3.1700E-14	1.5850E-14	0.01%	99.0%
AP161	STEEL	CORRMCO2	2	2.3720E-16	3.1440E-14	1.5860E-14	0.0000E+00	3.1700E-14	1.5850E-14	0.06%	98.4%
AP161	STEEL	CORRMCO2	3	5.5960E-17	3.1540E-14	1.5855E-14	0.0000E+00	3.1700E-14	1.5850E-14	0.03%	99.3%
AP161	TH+4	MKD_TH	1	5.2030E-04	9.6890E+00	1.0108E+00	5.0000E-04	1.0000E+01	1.0000E+00	1.07%	96.9%
AP161	TH+4	MKD_TH	2	5.2540E-04	9.7620E+00	1.0153E+00	5.0000E-04	1.0000E+01	1.0000E+00	1.52%	97.6%
AP161	TH+4	MKD_TH	3	5.2410E-04	9.7480E+00	1.0098E+00	5.0000E-04	1.0000E+01	1.0000E+00	0.97%	97.5%
AP161	U+4	MKD_U	1	5.4480E-04	9.4190E+00	1.0034E+00	5.0000E-04	1.0000E+01	1.0000E+00	0.34%	94.2%
AP161	U+4	MKD_U	2	5.2020E-04	9.7440E+00	1.0082E+00	5.0000E-04	1.0000E+01	1.0000E+00	0.81%	97.4%

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AP161	U+4	MKD_U	3	5.0740E-04	9.8830E+00	1.0138E+00	5.0000E-04	1.0000E+01	1.0000E+00	1.38%	98.8%
AP161	U+6	MKD_U	1	3.1430E-05	1.9660E-02	3.0715E-03	3.0000E-05	2.0000E-02	3.1000E-03	0.92%	98.3%

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				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	U+6	MKD_U	2	3.1100E-05	1.9860E-02	3.0796E-03	3.0000E-05	2.0000E-02	3.1000E-03	0.66%	99.3%
AP161	U+6	MKD_U	3	3.0650E-05	1.8760E-02	3.0749E-03	3.0000E-05	2.0000E-02	3.1000E-03	0.81%	93.8%
AP161	WAS_AREA	BIOGENFC	1	2.8190E-03	9.9660E-01	5.0055E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.11%	99.4%
AP161	WAS_AREA	BIOGENFC	2	1.8050E-03	9.9670E-01	5.0033E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.07%	99.5%
AP161	WAS_AREA	BIOGENFC	3	2.6460E-04	9.9900E-01	5.0033E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.07%	99.9%
AP161	WAS_AREA	GRATMICH	1	5.5740E-12	1.0240E-09	5.1335E-10	0.0000E+00	1.0272E-09	5.1359E-10	0.05%	99.1%
AP161	WAS_AREA	GRATMICH	2	2.6550E-12	1.0170E-09	5.1354E-10	0.0000E+00	1.0272E-09	5.1359E-10	0.01%	98.8%
AP161	WAS_AREA	GRATMICH	3	6.7330E-13	1.0260E-09	5.1376E-10	0.0000E+00	1.0272E-09	5.1359E-10	0.03%	99.8%
AP161	WAS_AREA	GRATMICI	1	3.2590E-11	5.5550E-10	2.9402E-10	3.0827E-11	5.5692E-10	2.9387E-10	0.05%	99.4%
AP161	WAS_AREA	GRATMICI	2	3.4030E-11	5.5340E-10	2.9363E-10	3.0827E-11	5.5692E-10	2.9387E-10	0.08%	98.7%
AP161	WAS_AREA	GRATMICI	3	3.1480E-11	5.5230E-10	2.9375E-10	3.0827E-11	5.5692E-10	2.9387E-10	0.04%	99.0%
AP161	WAS_AREA	PROBDEG	1	1.0000E+00	2.0000E+00	1.2500E+00	1.0000E+00	2.0000E+00	1.2500E+00	0.00%	100.0%
AP161	WAS_AREA	PROBDEG	2	1.0000E+00	2.0000E+00	1.2500E+00	1.0000E+00	2.0000E+00	1.2500E+00	0.00%	100.0%
AP161	WAS_AREA	PROBDEG	3	1.0000E+00	2.0000E+00	1.2500E+00	1.0000E+00	2.0000E+00	1.2500E+00	0.00%	100.0%
AP161	WAS_AREA	SAT_RBRN	1	2.7080E-03	5.5090E-01	2.7620E-01	0.0000E+00	5.5200E-01	2.7600E-01	0.07%	99.3%

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AP161	WAS_AREA	SAT_RBRN	2	6.6340E-04	5.4700E-01	2.7587E-01	0.0000E+00	5.5200E-01	2.7600E-01	0.05%	99.0%

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				Observed			Parameter Database				
Analysis	Material	Property	Rep	Minimum	Maximum	Mean	Minimum	Maximum	Mean	RPD of Means	% Range Covered
AP161	WAS_AREA	SAT_RBRN	3	3.9740E-03	5.4820E-01	2.7631E-01	0.0000E+00	5.5200E-01	2.7600E-01	0.11%	98.6%
AP161	WAS_AREA	SAT_RGAS	1	7.7230E-04	1.4850E-01	7.4990E-02	0.0000E+00	1.5000E-01	7.5000E-02	0.01%	98.5%
AP161	WAS_AREA	SAT_RGAS	2	6.3450E-04	1.4960E-01	7.4972E-02	0.0000E+00	1.5000E-01	7.5000E-02	0.04%	99.3%
AP161	WAS_AREA	SAT_RGAS	3	7.0690E-04	1.4880E-01	7.5076E-02	0.0000E+00	1.5000E-01	7.5000E-02	0.10%	98.7%
AP161	WAS_AREA	SAT_WICK	1	3.0550E-03	9.9240E-01	5.0024E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.05%	98.9%
AP161	WAS_AREA	SAT_WICK	2	2.3240E-03	9.9930E-01	5.0047E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.09%	99.7%
AP161	WAS_AREA	SAT_WICK	3	4.4040E-03	9.9270E-01	4.9988E-01	0.0000E+00	1.0000E+00	5.0000E-01	0.02%	98.8%

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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:

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

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 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 variables that were modified by LHS_EDIT have 1 more digit stored in the Parameter 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.

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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 can 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 PCS-2012 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_AP161_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_AP161.AP161_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 of the LHS transfer file and the LHS_EDIT output file. There have been no changes to LHS_EDIT since the test documented in Kirchner (2009). The data for WAS_AREA:GRATMICI and WAS_AREA:GRATMICH were extracted from these files and put into tables using the "Load LHS File" function of the Access database CCDFGF_Analysis. The maximum and minimum for the distribution of WAS_AREA:GRATMICH were obtained from the PA Parameter Database (PAPDB) table ParamAttributes. The query TestLHS_EDIT was used to compare the values produced by LHS_Edit to independently computed values.

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```
SELECT LHS_ParamValues.Vector, LHS_ParamValues.Value AS GRATMICI, LHS_ParamValues_1.Value AS GRATMICH,
ParamAttributes.value AS [Min], ParamAttributes_1.value AS [Max], IIf([GRATMICH]>[GRATMICI],([GRATMICH]-[Min])/([Max]-
[Min])*([GRATMICI]-[Min])+[Min],[GRATMICH]) AS TestValue, LHS_ParamValues_2.Value AS ConditionedValue,
IIf((Abs([ConditionedValue]-[TestValue])/[ConditionedValue]>0.001) Or [ConditionedValue]>[GRATMICI],"error","") AS
ErrorFlag

FROM LHS_FileNames AS LHS_FileNames_1 INNER JOIN ((((LHS_ParamValues INNER JOIN LHS_FileNames ON
LHS_ParamValues.FileID = LHS_FileNames.FileID) INNER JOIN LHS_ParamValues AS LHS_ParamValues_1 ON
(LHS_ParamValues.Vector = LHS_ParamValues_1.Vector) AND (LHS_FileNames.FileID = LHS_ParamValues_1.FileID)) INNER
JOIN ((AnalysisToVersion INNER JOIN ParamAttributes ON AnalysisToVersion.VersionNumber =
ParamAttributes.VersionNumber) INNER JOIN ParamAttributes AS ParamAttributes_1 ON AnalysisToVersion.VersionNumber =
ParamAttributes_1.VersionNumber) ON (LHS_ParamValues_1.Property = AnalysisToVersion.Property) AND
(LHS_ParamValues_1.Material = AnalysisToVersion.Material) AND (LHS_ParamValues_1.Property =
ParamAttributes_1.Property) AND (LHS_ParamValues_1.Material = ParamAttributes_1.Material) AND
(LHS_ParamValues_1.Property = ParamAttributes.Property) AND (LHS_ParamValues_1.Material = ParamAttributes.Material))
INNER JOIN LHS_ParamValues AS LHS_ParamValues_2 ON (LHS_ParamValues_1.Vector = LHS_ParamValues_2.Vector) AND
(LHS_ParamValues_1.Property = LHS_ParamValues_2.Property) AND (LHS_ParamValues_1.Material =
LHS_ParamValues_2.Material)) ON LHS_FileNames_1.FileID = LHS_ParamValues_2.FileID

WHERE (((LHS_ParamValues.Material)="WAS_AREA") AND ((LHS_ParamValues.Property)="GRATMICI") AND
((LHS_ParamValues_1.Material)="WAS_AREA") AND ((LHS_ParamValues_1.Property)="GRATMICH") AND
((LHS_FileNames.Analysis)="ap161") AND ((LHS_FileNames.Replicate)=1) AND ((ParamAttributes.Attribute)="Minimum") AND
((AnalysisToVersion.Analysis)="ap161") AND ((AnalysisToVersion.Code)="BRAGFLO") AND
((ParamAttributes_1.Attribute)="Maximum") AND ((LHS_FileNames_1.Analysis)="ap161_cond") AND
((LHS_FileNames_1.Replicate)=1))

ORDER BY LHS_ParamValues.Vector;
```

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The "Test Value" was computed using the formula "IIf([GRATMICH] > [GRATMICI],([GRATMICH]-[Min])/([Max]-[Min])*([GRATMICI]-[Min])+[Min],[GRATMICH])", where Min is the minimum and Max is the maximum for the distribution of WAS_AREA:GRATMICH. This formula is equivalent to Eq. 2. The Error Flag field was set to "Error" if the conditioned value did not equal the Test Value to within 0.1 % or if the conditioned value exceeded the value of WAS_AREA:GRATMICI. No such errors were observed. The CCDFGF_Analysis.mdb and the associated CCDFGF_Data.mdb files are contained in the CCDFGF_Analysis.zip file and stored in the library LIBAP161_LHS.

□a□□□□□r□a□□□□□t r□□□t□□□o□in□in□□□□h□□ntly □om□□t□□ □al□□□□□□t □al□□□for WAS_AREA: □□□□□1□□□

Vector	GRATMICI	GRATMICH	Test Value	Conditioned GRATMICH	Error Flag
1	2.386E-10	3.388E-11	3.388E-11	3.388E-11	

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2	7.815E-11	7.244E-10	5.511E-11	5.511E-11
3	3.285E-10	2.922E-10	2.922E-10	2.922E-10
4	7.927E-11	9.082E-10	7.009E-11	7.009E-11
5	5.275E-10	7.871E-10	4.042E-10	4.042E-10
6	4.086E-10	9.649E-10	3.838E-10	3.838E-10
7	5.085E-10	4.603E-10	4.603E-10	4.603E-10
8	3.044E-10	9.548E-10	2.830E-10	2.829E-10
9	5.452E-10	7.937E-10	4.213E-10	4.213E-10
10	3.320E-10	1.764E-10	1.764E-10	1.764E-10
11	5.351E-10	5.574E-12	5.574E-12	5.574E-12
12	1.215E-10	5.749E-10	6.800E-11	6.800E-11
13	3.190E-10	4.495E-10	1.396E-10	1.396E-10
14	1.305E-10	6.290E-10	7.991E-11	7.991E-11
15	1.833E-10	5.237E-10	9.346E-11	9.345E-11
16	1.717E-10	8.889E-10	1.486E-10	1.486E-10
17	2.606E-10	1.032E-11	1.032E-11	1.032E-11
18	3.259E-11	6.244E-10	1.981E-11	1.981E-11
19	1.924E-10	8.524E-10	1.597E-10	1.597E-10
20	2.853E-10	7.522E-10	2.089E-10	2.089E-10
21	4.886E-10	2.134E-10	2.134E-10	2.134E-10
22	2.248E-10	3.043E-10	6.660E-11	6.660E-11
23	2.082E-10	6.378E-10	1.293E-10	1.293E-10
24	3.950E-11	8.538E-10	3.283E-11	3.283E-11
25	4.442E-10	4.511E-11	4.511E-11	4.511E-11
26	1.143E-10	7.013E-10	7.804E-11	7.804E-11
27	2.332E-10	6.518E-10	1.480E-10	1.480E-10
28	4.361E-10	6.953E-10	2.952E-10	2.952E-10
29	4.324E-11	7.338E-10	3.089E-11	3.089E-11
30	3.814E-10	1.294E-10	1.294E-10	1.294E-10
31	9.191E-11	4.245E-10	3.798E-11	3.798E-11
32	2.648E-10	1.980E-10	1.980E-10	1.980E-10
33	4.720E-10	2.652E-10	2.652E-10	2.652E-10
34	4.038E-10	4.806E-10	1.889E-10	1.889E-10
35	2.497E-10	1.012E-09	2.460E-10	2.460E-10
36	1.507E-10	6.626E-10	9.721E-11	9.721E-11
37	4.595E-10	3.513E-10	3.513E-10	3.513E-10
38	3.887E-10	5.004E-10	1.894E-10	1.894E-10
39	3.592E-10	9.742E-10	3.407E-10	3.407E-10
40	3.539E-10	2.486E-10	2.486E-10	2.486E-10

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41	4.200E-10	1.010E-10	1.010E-10	1.010E-10	
42	1.611E-10	8.643E-10	1.356E-10	1.356E-10	
43	4.470E-10	9.822E-10	4.274E-10	4.274E-10	
44	5.175E-10	9.931E-10	5.003E-10	5.003E-10	
45	8.357E-11	3.108E-10	2.529E-11	2.529E-11	
46	2.521E-10	6.831E-10	1.677E-10	1.676E-10	
47	1.027E-10	3.940E-10	3.939E-11	3.939E-11	
48	2.285E-10	3.723E-10	8.282E-11	8.282E-11	
49	3.250E-10	1.735E-10	1.735E-10	1.735E-10	
50	5.025E-10	3.628E-10	3.628E-10	3.628E-10	
51	2.718E-10	9.993E-10	2.644E-10	2.644E-10	
52	5.368E-10	1.380E-10	1.380E-10	1.380E-10	
53	3.494E-10	5.884E-10	2.001E-10	2.001E-10	
54	2.902E-10	5.489E-10	1.551E-10	1.551E-10	
55	4.835E-10	2.779E-10	2.779E-10	2.779E-10	
56	5.058E-11	8.385E-10	4.129E-11	4.129E-11	
57	4.563E-10	7.754E-10	3.445E-10	3.444E-10	
58	3.086E-10	5.417E-10	1.627E-10	1.627E-10	
59	4.218E-10	1.097E-10	1.097E-10	1.097E-10	
60	5.232E-10	7.400E-10	3.769E-10	3.769E-10	
61	1.067E-10	5.755E-10	5.978E-11	5.978E-11	
62	3.634E-10	6.134E-10	2.170E-10	2.170E-10	
63	1.409E-10	8.140E-10	1.117E-10	1.117E-10	
64	6.744E-11	4.164E-10	2.734E-11	2.734E-11	
65	5.117E-10	2.362E-11	2.362E-11	2.362E-11	
66	9.678E-11	4.838E-10	4.558E-11	4.558E-11	
67	1.952E-10	9.249E-10	1.758E-10	1.758E-10	
68	2.828E-10	6.035E-11	6.035E-11	6.035E-11	
69	3.945E-10	8.815E-10	3.386E-10	3.385E-10	
70	1.636E-10	1.862E-10	2.966E-11	2.966E-11	
71	5.503E-10	9.219E-10	4.939E-10	4.939E-10	
72	2.421E-10	2.177E-10	2.177E-10	2.177E-10	
73	4.759E-10	3.455E-10	3.455E-10	3.455E-10	
74	3.438E-10	6.009E-10	2.011E-10	2.011E-10	
75	2.973E-10	1.563E-10	1.563E-10	1.563E-10	
76	5.555E-10	1.024E-09	5.538E-10	5.538E-10	
77	1.757E-10	2.672E-10	4.571E-11	4.570E-11	
78	1.444E-10	6.379E-11	6.379E-11	6.379E-11	
79	1.327E-10	9.124E-11	9.124E-11	9.124E-11	

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80	7.024E-11	7.611E-10	5.205E-11	5.204E-11
81	3.677E-10	5.104E-10	1.827E-10	1.827E-10
82	1.180E-10	8.947E-10	1.028E-10	1.028E-10
83	2.038E-10	7.849E-11	7.849E-11	7.849E-11
84	5.259E-11	6.730E-10	3.446E-11	3.446E-11
85	4.794E-10	2.433E-10	2.433E-10	2.433E-10
86	5.762E-11	3.288E-10	1.844E-11	1.844E-11
87	4.940E-10	7.164E-10	3.445E-10	3.445E-10
88	2.739E-10	4.093E-10	1.091E-10	1.091E-10
89	4.272E-10	4.368E-10	1.817E-10	1.817E-10
90	1.873E-10	1.148E-10	1.148E-10	1.148E-10
91	3.111E-10	8.042E-10	2.436E-10	2.436E-10
92	1.552E-10	8.290E-10	1.253E-10	1.253E-10
93	4.354E-10	2.292E-10	2.292E-10	2.292E-10
94	4.629E-10	3.874E-10	3.874E-10	3.874E-10
95	3.842E-10	5.618E-10	2.101E-10	2.101E-10
96	3.763E-10	3.229E-10	3.229E-10	3.229E-10
97	3.397E-10	5.294E-10	1.751E-10	1.751E-10
98	4.116E-10	9.420E-10	3.775E-10	3.775E-10
99	2.171E-10	1.445E-10	1.445E-10	1.445E-10
100	2.134E-10	4.645E-10	9.650E-11	9.650E-11

Acceptance Criteria

The acceptance criteria for the test is that an independent calculation of the conditioned value for WAS_AREA:GRATMICH 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:GRATMICH exceeded WAS_AREA:GRATMICI.

1.5. 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.

Information Only

```
      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
```


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```
      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
```


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```
!     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
```


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```
      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
```


Information Only