Spreadsheet Formulas for the Wilcoxon Rank Sum Test and Power Calculation

Wilcoxon Rank Sum Test, per NUREG-1505

LBGR 13.3 *(For this calculation, LBGR = 3w for 2002 Igloo Background)*

(Reference Dataset - 2002 Igloo Alpha Phoswich)

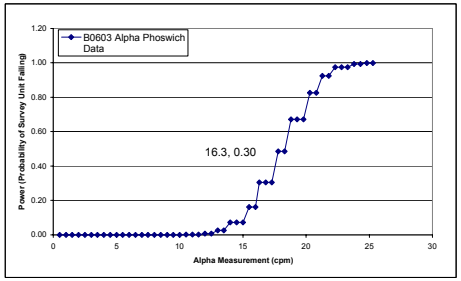
DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
13	R	13	167.5	0
17	R	17	176	0
12	R	12	165	0
4	R	4	134	0
18	R	18	177	0
9	R	9	160	0
8	R	8	157	0
16	R	16	174.5	0
4	R	4	134	0
7	R	7	154.5	0
4	R	4	134	0
9	R	9	160	0
14	R	14	169.5	0
5	R	5	144.5	0
14	R	14	169.5	0
12	R	12	165	0
16	R	16	174.5	0
11	R	11	162.5	0
15	R	15	172	0
6	R	6	152	0
5	R	5	144.5	0
4	R	4	134	0
1	R	1	60.5	0
9	R	9	160	0
12	R	12	165	0
15	R	15	172	0
15	R	15	172	0
6	R	6	152	0
111	R	111	180	0
8	R	8	157	0
3	R	3	115.5	0
3	R	3	115.5	0
3	R	3	115.5	0
4	R	4	134	0
6	R	6	152	0
11	R	11	162.5	0
5	R	5	144.5	0
5	R	5	144.5	0
3	R	3	115.5	0
2	R	2	87	0
3	R	3	115.5	0
4	R	4	134	0
4	R	4	134	0
5	R	5	144.5	0
3	R	3	115.5	0
5	R	5	144.5	0
2	R	2	87	0
2	R	2	87	0
5	R	5	144.5	0
2	R	2	87	0
5	R	5	144.5	0
5	R	5	144.5	0
3	R	3	115.5	0
2	R	2	87	0
5	R	5	144.5	0
8	R	8	157	0
2	R	2	87	0
3	R	3	115.5	0
86	R	86	179	0
2	R	2	87	0
1	R	1	60.5	0
5	R	5	144.5	0
3	R	3	115.5	0
1	R	1	60.5	0
2	R	2	87	0
0	R	0	39.5	0
0	R	0	39.5	0
2	R	2	87	0
1	R	1	60.5	0
2	R	2	87	0
3	R	3	115.5	0
1	R	1	60.5	0
0	R	0	39.5	0
0	R	0	39.5	0
2	R	2	87	0
0	R	0	39.5	0
0	R	0	39.5	0
1	R	1	60.5	0
0	R	0	39.5	0
1	R	1	60.5	0
0	R	0	39.5	0
0	R	0	39.5	0
3	R	3	115.5	0
3	R	3	115.5	0
1	R	1	60.5	0
2	R	2	87	0
1	R	1	60.5	0
3	R	3	115.5	0
13	R	13	167.5	0
3	R	3	115.5	0
2	R	2	87	0
1	R	1	60.5	0
2	R	2	87	0

	Survey Unit Stats	
Count	30	*m*
SD	2.1	
Median	1.0	
	Reference Stats	
Count	150	*n*
SD	12.0	
Median	3.0	
Critical Value	3225.6	
Bkgd Median plus LBGR	16.3	

Retrospective Power Curve Calculatior *p1* and *p2* pull data from Table 10-3 shee

From Example in Section 10.5 of NUREG-1505

C Measurement	(C-LBGR)/SD	Rounded	p1	p2	E(Wmw)	Var(Wmw)	SD(Wmw)	z	Power
0.5	-1.071	-1.100	0.198072	0.085944	891.324	38971.48	197.412	9.466557	0.00
1	-1.029	-1.000	0.218338	0.098892	982.521	42717.6	206.6824	8.600707	0.00
1.5	-0.9872	-1.000	0.218338	0.098892	982.521	42717.6	206.6824	8.600707	0.00
2	-0.9454	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.00
2.5	-0.9036	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.00
3	-0.8617	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.00
3.5	-0.8199	-0.800	0.262259	0.12892	1180.166	50125.49	223.8872	7.05699	0.00
4	-0.7781	-0.800	0.262259	0.12892	1180.166	50125.49	223.8872	7.05699	0.00
4.5	-0.7362	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.00
5	-0.6944	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.00
5.5	-0.6526	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.00
6	-0.6107	-0.600	0.335687	0.18476	1510.592	60032.31	245.0149	5.099869	0.00
6.5	-0.5689	-0.600	0.335687	0.18476	1510.592	60032.31	245.0149	5.099869	0.00
7	-0.5271	-0.500	0.361837	0.206266	1628.267	62742.55	250.4846	4.518716	0.00
7.5	-0.4852	-0.500	0.361837	0.206266	1628.267	62742.55	250.4846	4.518716	0.00
8	-0.4434	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.00
8.5	-0.4016	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.00
9	-0.3598	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.00
9.5	-0.3179	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.00
10	-0.2761	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.00
10.5	-0.2343	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.00
11	-0.1924	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.00
11.5	-0.1506	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.00
12	-0.1088	-0.100	0.471814	0.305606	2123.163	69096.42	262.862	2.42322	0.01
12.5	-0.0669	-0.100	0.471814	0.305606	2123.163	69096.42	262.862	2.42322	0.01
13	-0.0251	0.000	0.5	0.333333	2250	69374.73	263.3908	1.936801	0.03
13.5	0.0167	0.000	0.5	0.333333	2250	69374.73	263.3908	1.936801	0.03
14	0.0586	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.07
14.5	0.1004	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.07
15	0.1422	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.07
15.5	0.1841	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.16
16	0.2259	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.16
16.3	**0.2510**	**0.300**	**0.583998**	**0.421415**	**2627.991**	**66909.18**	**258.6681**	**0.510865**	**0.30**
16.8	0.2928	0.300	0.583998	0.421415	2627.991	66909.18	258.6681	0.510865	0.30
17.3	0.3347	0.300	0.583998	0.421415	2627.991	66909.18	258.6681	0.510865	0.30
17.8	0.3765	0.400	0.611351	0.451875	2751.08	65053.54	255.056	0.035506	0.49
18.3	0.4183	0.400	0.611351	0.451875	2751.08	65053.54	255.056	0.035506	0.49
18.8	0.4601	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.67
19.3	0.5020	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.67
19.8	0.5438	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.67
20.3	0.5856	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.83
20.8	0.6275	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.83
21.3	0.6693	0.700	0.689691	0.544073	3103.61	56982.12	238.7093	-1.43888	0.92
21.8	0.7111	0.700	0.689691	0.544073	3103.61	56982.12	238.7093	-1.43888	0.92
22.3	0.7530	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.97
22.8	0.7948	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.97
23.3	0.8366	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.97
23.8	0.8785	0.900	0.737741	0.604402	3319.835	50125.49	223.8872	-2.49991	0.99
24.3	0.9203	0.900	0.737741	0.604402	3319.835	50125.49	223.8872	-2.49991	0.99
24.8	0.9621	1.000	0.76025	0.633702	3421.125	46456.48	215.5377	-3.0667	1.00
25.3	1.0040	1.000	0.76025	0.633702	3421.125	46456.48	215.5377	-3.0667	1.00



Based on the number of measurements and the observed standard deviation, a survey unit with a median measurement equal to the background median plus the LBGR (16.3) will have a 0.30 probability that the survey unit will **correctly** fail (i.e., the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR [i.e., the survey unit is indistinguishable from background] is rejected).

3	R	3	115.5	0
3	R	3	115.5	0
3	R	3	115.5	0
3	R	3	115.5	0
2	R	2	87	0
0	R	0	39.5	0
2	R	2	87	0
2	R	2	87	0
1	R	1	60.5	0
0	R	0	39.5	0
3	R	3	115.5	0
1	R	1	60.5	0
1	R	1	60.5	0
0	R	0	39.5	0
1	R	1	60.5	0
2	R	2	87	0
3	R	3	115.5	0
2	R	2	87	0
1	R	1	60.5	0
2	R	2	87	0
3	R	3	115.5	0
4	R	4	134	0
3	R	3	115.5	0
1	R	1	60.5	0
3	R	3	115.5	0
5	R	5	144.5	0
3	R	3	115.5	0
3	R	3	115.5	0
1	R	1	60.5	0
2	R	2	87	0
2	R	2	87	0
3	R	3	115.5	0
1	R	1	60.5	0
2	R	2	87	0
4	R	4	134	0
2	R	2	87	0
2	R	2	87	0
2	R	2	87	0
1	R	1	60.5	0
0	R	0	39.5	0
1	R	1	60.5	0
3	R	3	115.5	0
1	R	1	60.5	0
7	R	7	154.5	0
0	R	0	39.5	0
2	R	2	87	0
1	R	1	60.5	0
2	R	2	87	0
0	R	0	39.5	0
0	R	0	39.5	0
1	R	1	60.5	0
2	R	2	87	0
1	R	1	60.5	0
0	R	0	39.5	0
0	R	0	39.5	0
34	R	34	178	0
3	R	3	115.5	0
0	S	-13.3	5.5	5.5
3	S	-10.3	25	25
4	S	-9.3	27.5	27.5
2	S	-11.3	20.5	20.5
0	S	-13.3	5.5	5.5
1	S	-12.3	14	14
1	S	-12.3	14	14
0	S	-13.3	5.5	5.5
0	S	-13.3	5.5	5.5
2	S	-11.3	20.5	20.5
3	S	-10.3	25	25
2	S	-11.3	20.5	20.5
2	S	-11.3	20.5	20.5
2	S	-11.3	20.5	20.5
5	S	-8.3	29	29
1	S	-12.3	14	14
2	S	-11.3	20.5	20.5
1	S	-12.3	14	14
3	S	-10.3	25	25
0	S	-13.3	5.5	5.5
0	S	-13.3	5.5	5.5
1	S	-12.3	14	14
1	S	-12.3	14	14
0	S	-13.3	5.5	5.5
0	S	-13.3	5.5	5.5
1	S	-12.3	14	14
0	S	-13.3	5.5	5.5
4	S	-9.3	27.5	27.5
10	S	-3.3	30	30
0	S	-13.3	5.5	5.5
		Sum =	16290	465

* This spreadsheet is originally designed to work with a set of twenty measurements, 10 from the survey unit (S) and 10 from the background reference area (R).
If a different number of measurements have been performed, it is necessary to modify the spreadsheet to account for the change in the number of measurements.

# of R:	150	*n*
# of S:	30	*m*
Avg Rank R:	106	
Avg Rank S:	16	

For *m* or *n* greater than 20, the critical value (k) can be calculated for Scenario B from

$$\boxed{\frac{m(n+m+1)}{2} + z\sqrt{\frac{nm(n+m+1)}{12}}}$$

z = 97.5% percentile of standard normal distribution = 1.960

k =	3225.6

Since the sum of survey unit ranks is less than the critical value, the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR (i.e., the survey unit is indistinguishable from background) is accepted and the survey unit passes.*Scenario B*

Spreadsheet Formulas for the Wilcoxon Rank Sum Test and Power Calculation

Wilcoxon Rank Sum Test, per NUREG-1505

LBGR 40.5 *(For this calculation, LBGR = 3w for 2002 Igloo Background)*
(Reference Dataset - 2002 Igloo Beta Phoswich)

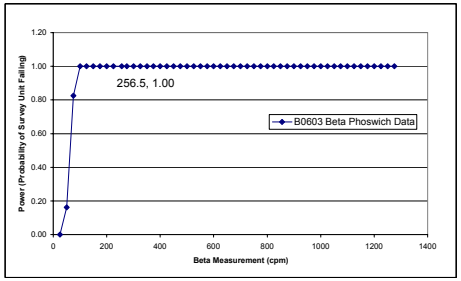
DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
234	R	234	134.5	0
255	R	255	155	0
272	R	272	163.5	0
206	R	206	91	0
283	R	283	170	0
199	R	199	75.5	0
235	R	235	136	0
202	R	202	82	0
220	R	220	109.5	0
215	R	215	102.5	0
183	R	183	50.5	0
225	R	225	117	0
213	R	213	99	0
243	R	243	142	0
203	R	203	84	0
252	R	252	152	0
197	R	197	71	0
226	R	226	118.5	0
220	R	220	109.5	0
181	R	181	47.5	0
222	R	222	112	0
231	R	231	128.5	0
241	R	241	140	0
228	R	228	121	0
277	R	277	167	0
260	R	260	160	0
387	R	387	178	0
216	R	216	105	0
596	R	596	180	0
163	R	163	29	0
155	R	155	22	0
171	R	171	39.5	0
228	R	228	121	0
196	R	196	68.5	0
237	R	237	138	0
172	R	172	41.5	0
253	R	253	153.5	0
216	R	216	105	0
191	R	191	65	0
231	R	231	128.5	0
204	R	204	86	0
231	R	231	128.5	0
162	R	162	27.5	0
171	R	171	39.5	0
197	R	197	71	0
246	R	246	145	0
166	R	166	32	0
198	R	198	73	0
169	R	169	36.5	0
162	R	162	27.5	0
256	R	256	156	0
233	R	233	132.5	0
179	R	179	44.5	0
260	R	260	160	0
248	R	248	147.5	0
212	R	212	97	0
211	R	211	96	0
229	R	229	123.5	0
430	R	430	179	0
134	R	134	11	0
334	R	334	175	0
168	R	168	34	0
205	R	205	88	0
170	R	170	38	0
210	R	210	95	0
274	R	274	165	0
243	R	243	142	0
229	R	229	123.5	0
159	R	159	25	0
187	R	187	56.5	0
202	R	202	82	0
224	R	224	116	0
168	R	168	34	0
185	R	185	54	0
173	R	173	43	0
233	R	233	132.5	0
169	R	169	36.5	0
182	R	182	49	0
200	R	200	78.5	0
168	R	168	34	0
240	R	240	139	0
215	R	215	102.5	0
181	R	181	47.5	0
197	R	197	71	0
214	R	214	100.5	0
216	R	216	105	0
199	R	199	75.5	0
249	R	249	149	0
209	R	209	94	0
138	R	138	13	0
199	R	199	75.5	0
189	R	189	62	0
248	R	248	147.5	0

Survey Unit Stats		
Count	30	*m*
SD	35	
Median	190.5	
Reference Stats		
Count	150	*n*
SD	56	
Median	216	
Critical Value	3225.6	
Bkgd Median plus LBGR	256.5	

Retrospective Power Curve Calculatior *p1* and *p2* pull data from Table 10-3 shee

From Example in Section 10.5 of NUREG-1505

C Measurement	(C-LBGR)/SD	Rounded	p1	p2	E(Wmw)	Var(Wmw)	SD(Wmw)	z	Power
25	-0.279	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.00
50	0.171	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.16
75	0.6213	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.83
100	1.0716	1.100	0.781662	0.662216	3517.479	42717.6	206.6824	-3.66429	1.00
125	1.5218	1.500	0.838901	0.741698	3775.055	31683.57	177.9988	-5.70183	1.00
150	1.9721	2.000	0.910445	0.848605	4097.003	16497.03	128.4408	-10.4084	1.00
175	2.4223	2.400	0.948062	0.908982	4266.279	8542.986	92.42827	-16.2953	1.00
200	2.8725	2.900	0.976143	0.956616	4392.644	3184.926	56.43515	-28.9271	1.00
225	3.3228	3.300	0.988174	0.977981	4446.783	1275.474	35.71378	-47.2268	1.00
256.5	**3.8901**	**3.900**	**0.993336**	**0.98741**	**4470.012**	**597.8393**	**24.45075**	**-69.9314**	**1.00**
275	4.2233	4.200	0.997661	0.995497	4489.475	149.3452	12.22069	-141.509	1.00
300	4.6735	4.700	0.997661	0.995497	4489.475	149.3452	12.22069	-141.509	1.00
325	5.1238	5.100	0.999796	0.999599	4499.082	6.616729	2.5723	-676.028	1.00
350	5.5740	5.600	0.999796	0.999599	4499.082	6.616729	2.5723	-676.028	1.00
375	6.0242	6.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
400	6.4745	6.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
425	6.9247	6.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
450	7.3750	7.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
475	7.8252	7.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
500	8.2755	8.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
525	8.7257	8.700	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
550	9.1759	9.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
575	9.6262	9.600	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
600	10.0764	10.100	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
625	10.5267	10.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
650	10.9769	11.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
675	11.4272	11.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
700	11.8774	11.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
725	12.3276	12.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
750	12.7779	12.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
775	13.2281	13.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
800	13.6784	13.700	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
825	14.1286	14.100	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
850	14.5789	14.600	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
875	15.0291	15.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
900	15.4793	15.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
925	15.9296	15.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
950	16.3798	16.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
975	16.8301	16.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1000	17.2803	17.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1025	17.7306	17.700	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1050	18.1808	18.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1075	18.6310	18.600	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1100	19.0813	19.100	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1125	19.5315	19.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1150	19.9818	20.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1175	20.4320	20.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1200	20.8823	20.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1225	21.3325	21.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1250	21.7827	21.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1275	22.2330	22.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00



Based on the number of measurements and the observed standard deviation, a survey unit with a median measurement equal to the background median plus the LBGR (256.5) will have a 1.0 probability that the survey unit will **correctly** fail (i.e., the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR [i.e., the survey unit is indistinguishable from background] is rejected).

317	R	317	174	0
337	R	337	176	0
281	R	281	169	0
222	R	222	112	0
199	R	199	75.5	0
187	R	187	56.5	0
232	R	232	131	0
188	R	188	59.5	0
246	R	246	145	0
204	R	204	86	0
286	R	286	171.5	0
189	R	189	62	0
264	R	264	162	0
206	R	206	91	0
204	R	204	86	0
202	R	202	82	0
188	R	188	59.5	0
280	R	280	168	0
226	R	226	118.5	0
196	R	196	68.5	0
259	R	259	158	0
234	R	234	134.5	0
183	R	183	50.5	0
272	R	272	163.5	0
369	R	369	177	0
286	R	286	171.5	0
223	R	223	114.5	0
206	R	206	91	0
206	R	206	91	0
251	R	251	151	0
111	R	111	3	0
253	R	253	153.5	0
222	R	222	112	0
230	R	230	126	0
276	R	276	166	0
246	R	246	145	0
260	R	260	160	0
228	R	228	121	0
236	R	236	137	0
164	R	164	31	0
223	R	223	114.5	0
179	R	179	44.5	0
218	R	218	107	0
189	R	189	62	0
200	R	200	78.5	0
172	R	172	41.5	0
156	R	156	23	0
243	R	243	142	0
257	R	257	157	0
214	R	214	100.5	0
250	R	250	150	0
231	R	231	128.5	0
219	R	219	108	0
206	R	206	91	0
180	R	180	46	0
299	R	299	173	0
129	R	129	8	0
163	S	122.5	6	6
124	S	83.5	1	1
204	S	163.5	30	30
174	S	133.5	10	10
176	S	135.5	12	12
172	S	131.5	9	9
225	S	184.5	52.5	52.5
169	S	128.5	7	7
199	S	158.5	24	24
225	S	184.5	52.5	52.5
195	S	154.5	21	21
231	S	190.5	64	64
182	S	141.5	14	14
202	S	161.5	26	26
161	S	120.5	5	5
186	S	145.5	17	17
184	S	143.5	15.5	15.5
192	S	151.5	20	20
184	S	143.5	15.5	15.5
188	S	147.5	18	18
253	S	212.5	98	98
233	S	192.5	66	66
189	S	148.5	19	19
241	S	200.5	80	80
226	S	185.5	55	55
155	S	114.5	4	4
234	S	193.5	67	67
228	S	187.5	58	58
270	S	229.5	125	125
130	S	89.5	2	2
		Sum =	16290	994

* This spreadsheet is originally designed to work with a set of twenty measurements, 10 from the survey unit (S) and 10 from the background reference area (R).
If a different number of measurements have been performed, it is necessary to modify the spreadsheet to account for the change in the number of measurements.

# of R:	150	*n*
# of S:	30	*m*
Avg Rank R:	102	
Avg Rank S:	33	

For m or n greater than 20, the critical value (k) can be calculated for Scenario B from

$$\boxed{\frac{m(n+m+1)}{2} + z\sqrt{\frac{nm(n+m+1)}{12}}}$$

z = 97.5% percentile of standard normal distribution = 1.960

k =	3225.6

Since the sum of survey unit ranks is less than the critical value, the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR (i.e., the survey unit is indistinguishable from background) is accepted and the survey unit passes.*Scenario B*

Quantile Test

per Section 7 of NUREG-1505		From Table A.7	
n (Survey)	30	*r*	6
m (Ref)	150	*k*	4
alpha/2	0.025	*alpha*	0.025

If *k* of the *r* largest ranks are from the survey unit, the null hypoth
(30,100) in Table A.7

Alpha Phoswich Ranks		Beta Phoswich Ranks	
Sorted Ranks	Location	Sorted Ranks	Location
5.5	S	1	S
5.5	S	2	S
5.5	S	3	R
5.5	S	4	S
5.5	S	5	S
5.5	S	6	S
5.5	S	7	S
5.5	S	8	R
5.5	S	9	S
5.5	S	10	S
14	S	11	R
14	S	12	S
14	S	13	R
14	S	14	S
14	S	15.5	S
14	S	15.5	S
14	S	17	S
20.5	S	18	S
20.5	S	19	S
20.5	S	20	S
20.5	S	21	S
20.5	S	22	R
20.5	S	23	R
25	S	24	S
25	S	25	R
25	S	26	S
27.5	S	27.5	R
27.5	S	27.5	R
29	S	29	R
30	S	30	S
39.5	R	31	R
39.5	R	32	R
39.5	R	34	R
39.5	R	34	R
39.5	R	34	R
39.5	R	36.5	R
39.5	R	36.5	R
39.5	R	38	R
39.5	R	39.5	R
39.5	R	39.5	R
39.5	R	41.5	R
39.5	R	41.5	R
39.5	R	43	R
39.5	R	44.5	R
39.5	R	44.5	R
39.5	R	46	R
39.5	R	47.5	R
39.5	R	47.5	R
60.5	R	49	R
60.5	R	50.5	R
60.5	R	50.5	R
60.5	R	52.5	S
60.5	R	52.5	S
60.5	R	54	R
60.5	R	55	S
60.5	R	56.5	R
60.5	R	56.5	R

60.5	R	58	S
60.5	R	59.5	R
60.5	R	59.5	R
60.5	R	62	R
60.5	R	62	R
60.5	R	62	R
60.5	R	64	S
60.5	R	65	R
60.5	R	66	S
60.5	R	67	S
60.5	R	68.5	R
60.5	R	68.5	R
60.5	R	71	R
60.5	R	71	R
60.5	R	71	R
87	R	73	R
87	R	75.5	R
87	R	75.5	R
87	R	75.5	R
87	R	75.5	R
87	R	78.5	R
87	R	78.5	R
87	R	80	S
87	R	82	R
87	R	82	R
87	R	82	R
87	R	84	R
87	R	86	R
87	R	86	R
87	R	86	R
87	R	88	R
87	R	91	R
87	R	91	R
87	R	91	R
87	R	91	R
87	R	91	R
87	R	94	R
87	R	95	R
87	R	96	R
87	R	97	R
87	R	98	S
87	R	99	R
87	R	100.5	R
87	R	100.5	R
115.5	R	102.5	R
115.5	R	102.5	R
115.5	R	105	R
115.5	R	105	R
115.5	R	105	R
115.5	R	107	R
115.5	R	108	R
115.5	R	109.5	R
115.5	R	109.5	R
115.5	R	112	R
115.5	R	112	R
115.5	R	112	R
115.5	R	114.5	R
115.5	R	114.5	R
115.5	R	116	R
115.5	R	117	R
115.5	R	118.5	R
115.5	R	118.5	R
115.5	R	121	R
115.5	R	121	R

115.5	R	121	R
115.5	R	123.5	R
115.5	R	123.5	R
115.5	R	125	S
115.5	R	126	R
115.5	R	128.5	R
115.5	R	128.5	R
115.5	R	128.5	R
134	R	128.5	R
134	R	131	R
134	R	132.5	R
134	R	132.5	R
134	R	134.5	R
134	R	134.5	R
134	R	136	R
134	R	137	R
134	R	138	R
144.5	R	139	R
144.5	R	140	R
144.5	R	142	R
144.5	R	142	R
144.5	R	142	R
144.5	R	145	R
144.5	R	145	R
144.5	R	145	R
144.5	R	147.5	R
144.5	R	147.5	R
144.5	R	149	R
144.5	R	150	R
152	R	151	R
152	R	152	R
152	R	153.5	R
154.5	R	153.5	R
154.5	R	155	R
157	R	156	R
157	R	157	R
157	R	158	R
160	R	160	R
160	R	160	R
160	R	160	R
162.5	R	162	R
162.5	R	163.5	R
165	R	163.5	R
165	R	165	R
165	R	166	R
167.5	R	167	R
167.5	R	168	R
169.5	R	169	R
169.5	R	170	R
172	R	171.5	R
172	R	171.5	R
172	R	173	R
174.5	R	174	R
174.5	R	175	R
176	R	176	R
177	R	177	R
178	R	178	R
179	R	179	R
180	R	180	R
0 of top 6 from S		**0 of top 6 from S**	

If the r-th largest measurement is among a group of tied (equal-in-value) measurements, increase r to include the tied measurements. Also increase k by the same amount (EPA 230-R-94-004).

r=7
k=5
0 of top 7 from S

hesis is rejected.

Reproduction of Table 10-3 from NUREG-1505

(C-LBGR)/SD	p1	p2
-6.0	0.00001	0
-5.0	0.000204	0.00001
-4.0	0.002339	0.000174
-3.5	0.006664	0.000738
-3.0	0.016947	0.00269
-2.5	0.03855	0.008465
-2.0	0.07865	0.023066
-1.9	0.089555	0.027714
-1.8	0.101546	0.033114
-1.7	0.114666	0.039348
-1.6	0.12895	0.046501
-1.5	0.144422	0.054656
-1.4	0.161099	0.063897
-1.3	0.178985	0.074301
-1.2	0.198072	0.085944
-1.1	0.218338	0.098892
-1.0	0.23975	0.113202
-0.9	0.262259	0.12892
-0.8	0.285804	0.146077
-0.7	0.310309	0.164691
-0.6	0.335687	0.18476
-0.5	0.361837	0.206266
-0.4	0.388649	0.229172
-0.3	0.416002	0.253419
-0.2	0.443769	0.27893
-0.1	0.471814	0.305606
0.0	0.5	0.333333
0.1	0.528186	0.361978
0.2	0.556231	0.391392
0.3	0.583998	0.421415
0.4	0.611351	0.451875
0.5	0.638163	0.482593
0.6	0.664313	0.513387
0.7	0.689691	0.544073
0.8	0.714196	0.574469
0.9	0.737741	0.604402
1.0	0.76025	0.633702
1.1	0.781662	0.662216
1.2	0.801928	0.6898
1.3	0.821015	0.716331
1.4	0.838901	0.741698
1.5	0.855578	0.765812
1.6	0.87105	0.788602
1.7	0.885334	0.810016
1.8	0.898454	0.830022
1.9	0.910445	0.848605
2.0	0.92135	0.865767
2.1	0.931218	0.881527
2.2	0.940103	0.895917
2.3	0.948062	0.908982
2.4	0.955157	0.920777
2.5	0.96145	0.931365
2.6	0.967004	0.940817
2.7	0.971881	0.949208
2.8	0.976143	0.956616
2.9	0.979848	0.963118
3.0	0.983053	0.968795
3.1	0.985811	0.973725
3.2	0.988174	0.977981
3.3	0.990188	0.981636
3.4	0.991895	0.984758
3.5	0.993336	0.98741
4.0	0.997661	0.995497
5.0	0.999796	0.999599
6.0	0.999989	0.999978