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)

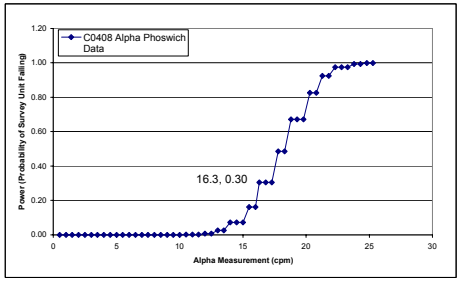
DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
13	R	13	167.5	0
17	R	17	176	0
12	R	12	165	0
4	R	4	134	0
18	R	18	177	0
9	R	9	160	0
8	R	8	157	0
16	R	16	174.5	0
4	R	4	134	0
7	R	7	154.5	0
4	R	4	134	0
9	R	9	160	0
14	R	14	169.5	0
5	R	5	144.5	0
14	R	14	169.5	0
12	R	12	165	0
16	R	16	174.5	0
11	R	11	162.5	0
15	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 Calculator *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	-0.987	-1.000	0.218338	0.098892	982.521	42717.6	206.6824	8.600707	0.00
2	-0.945	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.00
2.5	-0.904	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.00
3	-0.862	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.00
3.5	-0.820	-0.800	0.262259	0.12892	1180.166	50125.49	223.8872	7.05699	0.00
4	-0.778	-0.800	0.262259	0.12892	1180.166	50125.49	223.8872	7.05699	0.00
4.5	-0.736	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.00
5	-0.694	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.00
5.5	-0.653	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.00
6	-0.611	-0.600	0.335687	0.18476	1510.592	60032.31	245.0149	5.099869	0.00
6.5	-0.569	-0.600	0.335687	0.18476	1510.592	60032.31	245.0149	5.099869	0.00
7	-0.527	-0.500	0.361837	0.206266	1628.267	62742.55	250.4846	4.518716	0.00
7.5	-0.485	-0.500	0.361837	0.206266	1628.267	62742.55	250.4846	4.518716	0.00
8	-0.443	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.00
8.5	-0.402	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.00
9	-0.360	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.00
9.5	-0.318	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.00
10	-0.276	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.00
10.5	-0.234	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.00
11	-0.192	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.00
11.5	-0.151	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.00
12	-0.109	-0.100	0.471814	0.305606	2123.163	69096.42	262.862	2.42322	0.01
12.5	-0.067	-0.100	0.471814	0.305606	2123.163	69096.42	262.862	2.42322	0.01
13	-0.025	0.000		0.5	0.333333	2250	69374.73	263.3908	1.936801	0.03
13.5	0.017	0.000		0.5	0.333333	2250	69374.73	263.3908	1.936801	0.03
14	0.059	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.07
14.5	0.100	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.07
15	0.142	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.07
15.5	0.184	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.16
16	0.226	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.16
16.3	**0.251**	**0.300**	**0.583998**	**0.421415**	**2627.991**	**66909.18**	**258.6681**	**0.510865**	**0.30**
16.8	0.293	0.300	0.583998	0.421415	2627.991	66909.18	258.6681	0.510865	0.30
17.3	0.335	0.300	0.583998	0.421415	2627.991	66909.18	258.6681	0.510865	0.30
17.8	0.376	0.400	0.611351	0.451875	2751.08	65053.54	255.056	0.035506	0.49
18.3	0.418	0.400	0.611351	0.451875	2751.08	65053.54	255.056	0.035506	0.49
18.8	0.460	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.67
19.3	0.502	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.67
19.8	0.544	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.67
20.3	0.586	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.83
20.8	0.627	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.83
21.3	0.669	0.700	0.689691	0.544073	3103.61	56982.12	238.7093	-1.43888	0.92
21.8	0.711	0.700	0.689691	0.544073	3103.61	56982.12	238.7093	-1.43888	0.92
22.3	0.753	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.97
22.8	0.795	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.97
23.3	0.837	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.97
23.8	0.878	0.900	0.737741	0.604402	3319.835	50125.49	223.8872	-2.49991	0.99
24.3	0.920	0.900	0.737741	0.604402	3319.835	50125.49	223.8872	-2.49991	0.99
24.8	0.962	1.000	0.76025	0.633702	3421.125	46456.48	215.5377	-3.0667	1.00
25.3	1.004	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
2	S	-11.3	25	25
1	S	-12.3	18	18
0	S	-13.3	7	7
2	S	-11.3	25	25
0	S	-13.3	7	7
0	S	-13.3	7	7
0	S	-13.3	7	7
0	S	-13.3	7	7
0	S	-13.3	7	7
1	S	-12.3	18	18
2	S	-11.3	25	25
1	S	-12.3	18	18
2	S	-11.3	25	25
0	S	-13.3	7	7
1	S	-12.3	18	18
1	S	-12.3	18	18
0	S	-13.3	7	7
0	S	-13.3	7	7
4	S	-9.3	29	29
0	S	-13.3	7	7
1	S	-12.3	18	18
2	S	-11.3	25	25
0	S	-13.3	7	7
1	S	-12.3	18	18
0	S	-13.3	7	7
1	S	-12.3	18	18
0	S	-13.3	7	7
1	S	-12.3	18	18
11	S	-2.3	30	30
3	S	-10.3	28	28
		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

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

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

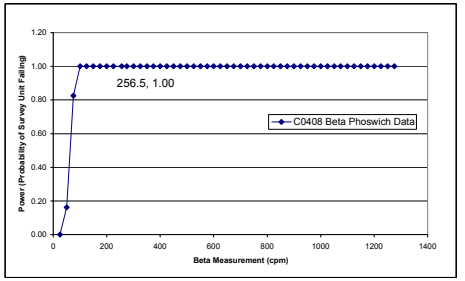
LBGR 40.5 *(For this calculation, LBGR = 3w for 2002 Igloo Background)*
(Reference Dataset - 2002 Igloo Beta Phoswich)

DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
234	R	234	133.5	0
255	R	255	154	0
272	R	272	162.5	0
206	R	206	92	0
283	R	283	169	0
199	R	199	77.5	0
235	R	235	135	0
202	R	202	83	0
220	R	220	109.5	0
215	R	215	102.5	0
183	R	183	59.5	0
225	R	225	117	0
213	R	213	99	0
243	R	243	141	0
203	R	203	85	0
252	R	252	151	0
197	R	197	73	0
226	R	226	118.5	0
220	R	220	109.5	0
181	R	181	56.5	0
222	R	222	112	0
231	R	231	127.5	0
241	R	241	139	0
228	R	228	121	0
277	R	277	166	0
260	R	260	159	0
387	R	387	178	0
216	R	216	105	0
596	R	596	180	0
163	R	163	35	0
155	R	155	27	0
171	R	171	45.5	0
228	R	228	121	0
196	R	196	70.5	0
237	R	237	137	0
172	R	172	47.5	0
253	R	253	152.5	0
216	R	216	105	0
191	R	191	69	0
231	R	231	127.5	0
204	R	204	87	0
231	R	231	127.5	0
162	R	162	33.5	0
171	R	171	45.5	0
197	R	197	73	0
246	R	246	144	0
166	R	166	38	0
198	R	198	75	0
169	R	169	42.5	0
162	R	162	33.5	0
256	R	256	155	0
233	R	233	131.5	0
179	R	179	53.5	0
260	R	260	159	0
248	R	248	146.5	0
212	R	212	98	0
211	R	211	97	0
229	R	229	123.5	0
430	R	430	179	0
134	R	134	18	0
334	R	334	175	0
168	R	168	40	0
205	R	205	89	0
170	R	170	44	0
210	R	210	96	0
274	R	274	164	0
243	R	243	141	0
229	R	229	123.5	0
159	R	159	31	0
187	R	187	62.5	0
202	R	202	83	0
224	R	224	116	0
168	R	168	40	0
185	R	185	61	0
173	R	173	50	0
233	R	233	131.5	0
169	R	169	42.5	0
182	R	182	58	0
200	R	200	80.5	0
168	R	168	40	0
240	R	240	138	0
215	R	215	102.5	0
181	R	181	56.5	0
197	R	197	73	0
214	R	214	100.5	0
216	R	216	105	0
199	R	199	77.5	0
249	R	249	148	0
209	R	209	95	0
138	R	138	20	0
199	R	199	77.5	0
189	R	189	67	0
248	R	248	146.5	0

Survey Unit Stats	
Count	30 *m*
SD	35
Median	175
Reference Stats	
Count	150 *n*
SD	56
Median	216
Critical Value	3225.6
Bkgd Median plus LBGR	256.5

Retrospective Power Curve Calculator *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	0.621	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.83
100	1.072	1.100	0.781662	0.662216	3517.479	42717.6	206.6824	-3.66429	1.00
125	1.522	1.500	0.838901	0.741698	3775.055	31683.57	177.9988	-5.70183	1.00
150	1.972	2.000	0.910445	0.848605	4097.003	16497.03	128.4408	-10.4084	1.00
175	2.422	2.400	0.948062	0.908882	4266.279	8542.986	92.42827	-16.2953	1.00
200	2.873	2.900	0.976143	0.956616	4392.644	3184.926	56.43515	-28.9271	1.00
225	3.323	3.300	0.988174	0.977981	4446.783	1275.474	35.71378	-47.2268	1.00
256.5	**3.890**	**3.900**	**0.993336**	**0.98741**	**4470.012**	**597.8393**	**24.45075**	**-69.9314**	**1.00**
275	4.223	4.200	0.997661	0.995497	4489.475	149.3452	12.22069	-141.509	1.00
300	4.674	4.700	0.997661	0.995497	4489.475	149.3452	12.22069	-141.509	1.00
325	5.124	5.100	0.999796	0.999599	4499.082	6.616729	2.5723	-676.028	1.00
350	5.574	5.600	0.999796	0.999599	4499.082	6.616729	2.5723	-676.028	1.00
375	6.024	6.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
400	6.474	6.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
425	6.925	6.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
450	7.375	7.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
475	7.825	7.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
500	8.275	8.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
525	8.726	8.700	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
550	9.176	9.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
575	9.626	9.600	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
600	10.076	10.100	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
625	10.527	10.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
650	10.977	11.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
675	11.427	11.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
700	11.877	11.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
725	12.328	12.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
750	12.778	12.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
775	13.228	13.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
800	13.678	13.700	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
825	14.129	14.100	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
850	14.579	14.600	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
875	15.029	15.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
900	15.479	15.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
925	15.930	15.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
950	16.380	16.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
975	16.830	16.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1000	17.280	17.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1025	17.731	17.700	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1050	18.181	18.200	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1075	18.631	18.600	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1100	19.081	19.100	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1125	19.532	19.500	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1150	19.982	20.000	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1175	20.432	20.400	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1200	20.882	20.900	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1225	21.332	21.300	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1250	21.783	21.800	0.999989	0.999978	4499.951	0.0494	0.222262	-7827.77	1.00
1275	22.233	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	168	0
222	R	222	112	0
199	R	199	77.5	0
187	R	187	62.5	0
232	R	232	130	0
188	R	188	64.5	0
246	R	246	144	0
204	R	204	87	0
286	R	286	170.5	0
189	R	189	67	0
264	R	264	161	0
206	R	206	92	0
204	R	204	87	0
202	R	202	83	0
188	R	188	64.5	0
280	R	280	167	0
226	R	226	118.5	0
196	R	196	70.5	0
259	R	259	157	0
234	R	234	133.5	0
183	R	183	59.5	0
272	R	272	162.5	0
369	R	369	177	0
286	R	286	170.5	0
223	R	223	114.5	0
206	R	206	92	0
206	R	206	92	0
251	R	251	150	0
111	R	111	3	0
253	R	253	152.5	0
222	R	222	112	0
230	R	230	125	0
276	R	276	165	0
246	R	246	144	0
260	R	260	159	0
228	R	228	121	0
236	R	236	136	0
164	R	164	37	0
223	R	223	114.5	0
179	R	179	53.5	0
218	R	218	107	0
189	R	189	67	0
200	R	200	80.5	0
172	R	172	47.5	0
156	R	156	29	0
243	R	243	141	0
257	R	257	156	0
214	R	214	100.5	0
250	R	250	149	0
231	R	231	127.5	0
219	R	219	108	0
206	R	206	92	0
180	R	180	55	0
299	R	299	173	0
129	R	129	13	0
213	S	172.5	49	49
157	S	116.5	7	7
190	S	149.5	26	26
172	S	131.5	15	15
181	S	140.5	21	21
156	S	115.5	6	6
172	S	131.5	15	15
189	S	148.5	24.5	24.5
163	S	122.5	9.5	9.5
202	S	161.5	32	32
159	S	118.5	8	8
216	S	175.5	51	51
172	S	131.5	15	15
174	S	133.5	17	17
163	S	122.5	9.5	9.5
204	S	163.5	36	36
144	S	103.5	2	2
167	S	126.5	12	12
165	S	124.5	11	11
155	S	114.5	4.5	4.5
176	S	135.5	19	19
187	S	146.5	23	23
155	S	114.5	4.5	4.5
189	S	148.5	24.5	24.5
219	S	178.5	52	52
196	S	155.5	28	28
182	S	141.5	22	22
332	S	291.5	172	172
199	S	158.5	30	30
142	S	101.5	1	1
		Sum =	16290	747

* 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:	104	
Avg Rank S:	25	

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

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

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

n (Survey)	30	*r*	6
m (Ref)	150	*k*	4
alpha/2	0.025	*alpha*	0.025

From Table A.7

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
7	S	1	S
7	S	2	S
7	S	3	R
7	S	4.5	S
7	S	4.5	S
7	S	6	S
7	S	7	S
7	S	8	S
7	S	9.5	S
7	S	9.5	S
7	S	11	S
7	S	12	S
7	S	13	R
18	S	15	S
18	S	15	S
18	S	15	S
18	S	17	S
18	S	18	R
18	S	19	S
18	S	20	R
18	S	21	S
18	S	22	S
25	S	23	S
25	S	24.5	S
25	S	24.5	S
25	S	26	S
25	S	27	R
28	S	28	S
29	S	29	R
30	S	30	S
39.5	R	31	R
39.5	R	32	S
39.5	R	33.5	R
39.5	R	33.5	R
39.5	R	35	R
39.5	R	36	S
39.5	R	37	R
39.5	R	38	R
39.5	R	40	R
39.5	R	40	R
39.5	R	40	R
39.5	R	42.5	R
39.5	R	42.5	R
39.5	R	44	R
39.5	R	45.5	R
39.5	R	45.5	R
39.5	R	47.5	R
39.5	R	47.5	R
60.5	R	49	S
60.5	R	50	R
60.5	R	51	S
60.5	R	52	S
60.5	R	53.5	R
60.5	R	53.5	R
60.5	R	55	R
60.5	R	56.5	R
60.5	R	56.5	R

60.5	R	58	R
60.5	R	59.5	R
60.5	R	59.5	R
60.5	R	61	R
60.5	R	62.5	R
60.5	R	62.5	R
60.5	R	64.5	R
60.5	R	64.5	R
60.5	R	67	R
60.5	R	67	R
60.5	R	67	R
60.5	R	69	R
60.5	R	70.5	R
60.5	R	70.5	R
60.5	R	73	R
87	R	73	R
87	R	73	R
87	R	75	R
87	R	77.5	R
87	R	77.5	R
87	R	77.5	R
87	R	77.5	R
87	R	80.5	R
87	R	80.5	R
87	R	83	R
87	R	83	R
87	R	83	R
87	R	85	R
87	R	87	R
87	R	87	R
87	R	87	R
87	R	89	R
87	R	92	R
87	R	92	R
87	R	92	R
87	R	92	R
87	R	92	R
87	R	95	R
87	R	96	R
87	R	97	R
87	R	98	R
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	R
115.5	R	127.5	R
115.5	R	127.5	R
115.5	R	127.5	R
115.5	R	127.5	R
134	R	130	R
134	R	131.5	R
134	R	131.5	R
134	R	133.5	R
134	R	133.5	R
134	R	135	R
134	R	136	R
134	R	137	R
134	R	138	R
144.5	R	139	R
144.5	R	141	R
144.5	R	141	R
144.5	R	141	R
144.5	R	144	R
144.5	R	144	R
144.5	R	144	R
144.5	R	146.5	R
144.5	R	146.5	R
144.5	R	148	R
144.5	R	149	R
144.5	R	150	R
152	R	151	R
152	R	152.5	R
152	R	152.5	R
154.5	R	154	R
154.5	R	155	R
157	R	156	R
157	R	157	R
157	R	159	R
160	R	159	R
160	R	159	R
160	R	161	R
162.5	R	162.5	R
162.5	R	162.5	R
165	R	164	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	170.5	R
172	R	170.5	R
172	R	172	S
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

ɳesis 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