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)

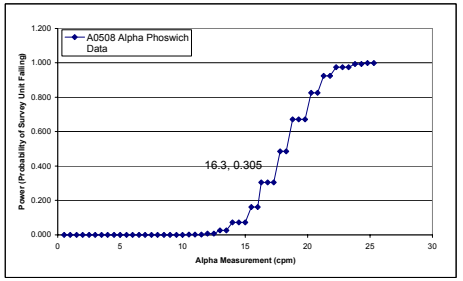
DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
13	R	13	167.5	0
17	R	17	176	0
12	R	12	165	0
4	R	4	134	0
18	R	18	177	0
9	R	9	160	0
8	R	8	157	0
16	R	16	174.5	0
4	R	4	134	0
7	R	7	154.5	0
4	R	4	134	0
9	R	9	160	0
14	R	14	169.5	0
5	R	5	144.5	0
14	R	14	169.5	0
12	R	12	165	0
16	R	16	174.5	0
11	R	11	162.5	0
15	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
Median	4.0
Reference Stats	
Count	150 *n*
SD	12
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	0.000
1	-1.029	-1.000	0.218338	0.098892	982.521	42717.6	206.6824	8.600707	0.000
1.5	-0.9872	-1.000	0.218338	0.098892	982.521	42717.6	206.6824	8.600707	0.000
2	-0.9454	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.000
2.5	-0.9036	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.000
3	-0.8617	-0.900	0.23975	0.113202	1078.875	46456.48	215.5377	7.80031	0.000
3.5	-0.8199	-0.800	0.262259	0.12892	1180.166	50125.49	223.8872	7.05699	0.000
4	-0.7781	-0.800	0.262259	0.12892	1180.166	50125.49	223.8872	7.05699	0.000
4.5	-0.7362	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.000
5	-0.6944	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.000
5.5	-0.6526	-0.700	0.310309	0.164691	1396.391	56982.12	238.7093	5.712995	0.000
6	-0.6107	-0.600	0.335687	0.18476	1510.592	60032.31	245.0149	5.099869	0.000
6.5	-0.5689	-0.600	0.335687	0.18476	1510.592	60032.31	245.0149	5.099869	0.000
7	-0.5271	-0.500	0.361837	0.206266	1628.267	62742.55	250.4846	4.518716	0.000
7.5	-0.4852	-0.500	0.361837	0.206266	1628.267	62742.55	250.4846	4.518716	0.000
8	-0.4434	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.000
8.5	-0.4016	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.000
9	-0.3598	-0.400	0.388649	0.229172	1748.921	65052.72	255.0544	3.964704	0.000
9.5	-0.3179	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.000
10	-0.2761	-0.300	0.416002	0.253419	1872.009	66909.18	258.6681	3.43346	0.000
10.5	-0.2343	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.002
11	-0.1924	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.002
11.5	-0.1506	-0.200	0.443769	0.27893	1996.961	68268.01	261.2815	2.920892	0.002
12	-0.1088	-0.100	0.471814	0.305606	2123.163	69096.42	262.862	2.42322	0.008
12.5	-0.0669	-0.100	0.471814	0.305606	2123.163	69096.42	262.862	2.42322	0.008
13	-0.0251	0.000	0.5	0.333333	2250	69374.73	263.3908	1.936801	0.026
13.5	0.0167	0.000	0.5	0.333333	2250	69374.73	263.3908	1.936801	0.026
14	0.0586	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.072
14.5	0.1004	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.072
15	0.1422	0.100	0.528186	0.361978	2376.837	69096.42	262.862	1.458174	0.072
15.5	0.1841	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.163
16	0.2259	0.200	0.556231	0.391392	2503.04	68268.01	261.2815	0.983981	0.163
16.3	**0.2510**	**0.300**	**0.583998**	**0.421415**	**2627.991**	**66909.18**	**258.6681**	**0.510865**	**0.305**
16.8	0.2928	0.300	0.583998	0.421415	2627.991	66909.18	258.6681	0.510865	0.305
17.3	0.3347	0.300	0.583998	0.421415	2627.991	66909.18	258.6681	0.510865	0.305
17.8	0.3765	0.400	0.611351	0.451875	2751.08	65053.54	255.056	0.035506	0.486
18.3	0.4183	0.400	0.611351	0.451875	2751.08	65053.54	255.056	0.035506	0.486
18.8	0.4601	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.672
19.3	0.5020	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.672
19.8	0.5438	0.500	0.638163	0.482593	2871.734	62743.37	250.4863	-0.44553	0.672
20.3	0.5856	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.825
20.8	0.6275	0.600	0.664313	0.513387	2989.409	60033.13	245.0166	-0.93574	0.825
21.3	0.6693	0.700	0.689691	0.544073	3103.61	56982.12	238.7093	-1.43888	0.925
21.8	0.7111	0.700	0.689691	0.544073	3103.61	56982.12	238.7093	-1.43888	0.925
22.3	0.7530	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.975
22.8	0.7948	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.975
23.3	0.8366	0.800	0.714196	0.574469	3213.882	53656.47	231.6387	-1.95885	0.975
23.8	0.8785	0.900	0.737741	0.604402	3319.835	50125.49	223.8872	-2.49991	0.994
24.3	0.9203	0.900	0.737741	0.604402	3319.835	50125.49	223.8872	-2.49991	0.994
24.8	0.9621	1.000	0.76025	0.633702	3421.125	46456.48	215.5377	-3.0667	0.999
25.3	1.0040	1.000	0.76025	0.633702	3421.125	46456.48	215.5377	-3.0667	0.999



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
4	S	-9.3	17	17
4	S	-9.3	17	17
8	S	-5.3	29.5	29.5
3	S	-10.3	12	12
3	S	-10.3	12	12
1	S	-12.3	2.5	2.5
2	S	-11.3	6.5	6.5
3	S	-10.3	12	12
2	S	-11.3	6.5	6.5
4	S	-9.3	17	17
7	S	-6.3	27	27
7	S	-6.3	27	27
4	S	-9.3	17	17
2	S	-11.3	6.5	6.5
4	S	-9.3	17	17
5	S	-8.3	22	22
5	S	-8.3	22	22
2	S	-11.3	6.5	6.5
0	S	-13.3	1	1
5	S	-8.3	22	22
2	S	-11.3	6.5	6.5
6	S	-7.3	25	25
2	S	-11.3	6.5	6.5
8	S	-5.3	29.5	29.5
5	S	-8.3	22	22
1	S	-12.3	2.5	2.5
3	S	-10.3	12	12
7	S	-6.3	27	27
3	S	-10.3	12	12
5	S	-8.3	22	22
	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

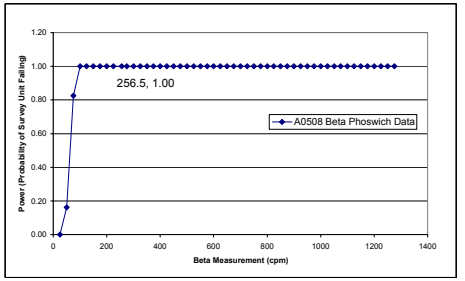
LBGR 40.5 *(For this calculation, LBGR = 3w for 2002 Igloo Background)*
(Reference Dataset - 2002 Igloo Beta Phoswich)

DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
234	R	234	130.5	0
255	R	255	151	0
272	R	272	160.5	0
206	R	206	81	0
283	R	283	169	0
199	R	199	64.5	0
235	R	235	132	0
202	R	202	72	0
220	R	220	104.5	0
215	R	215	96.5	0
183	R	183	44.5	0
225	R	225	112	0
213	R	213	93	0
243	R	243	138	0
203	R	203	74	0
252	R	252	148	0
197	R	197	60	0
226	R	226	113.5	0
220	R	220	104.5	0
181	R	181	40.5	0
222	R	222	107	0
231	R	231	124.5	0
241	R	241	136	0
228	R	228	117	0
277	R	277	166	0
260	R	260	156	0
387	R	387	178	0
216	R	216	99	0
596	R	596	180	0
163	R	163	20	0
155	R	155	10	0
171	R	171	30.5	0
228	R	228	117	0
196	R	196	57.5	0
237	R	237	134	0
172	R	172	33.5	0
253	R	253	149.5	0
216	R	216	99	0
191	R	191	56	0
231	R	231	124.5	0
204	R	204	76	0
231	R	231	124.5	0
162	R	162	18.5	0
171	R	171	30.5	0
197	R	197	60	0
246	R	246	141	0
166	R	166	23	0
198	R	198	62	0
169	R	169	27.5	0
162	R	162	18.5	0
256	R	256	152	0
233	R	233	128.5	0
179	R	179	36.5	0
260	R	260	156	0
248	R	248	143.5	0
212	R	212	91	0
211	R	211	90	0
229	R	229	119.5	0
430	R	430	179	0
134	R	134	5	0
334	R	334	175	0
168	R	168	25	0
205	R	205	78	0
170	R	170	29	0
210	R	210	87	0
274	R	274	164	0
243	R	243	138	0
229	R	229	119.5	0
159	R	159	13	0
187	R	187	47.5	0
202	R	202	72	0
224	R	224	111	0
168	R	168	25	0
185	R	185	46	0
173	R	173	35	0
233	R	233	128.5	0
169	R	169	27.5	0
182	R	182	42	0
200	R	200	67.5	0
168	R	168	25	0
240	R	240	135	0
215	R	215	96.5	0
181	R	181	40.5	0
197	R	197	60	0
214	R	214	94.5	0
216	R	216	99	0
199	R	199	64.5	0
249	R	249	145	0
209	R	209	84	0
138	R	138	7	0
199	R	199	64.5	0
189	R	189	53	0
248	R	248	143.5	0

Survey Unit Stats		
Count	30	*m*
SD	51	
Median	229.5	
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	0.6213	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	0.908882	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	173	0
337	R	337	176	0
281	R	281	168	0
222	R	222	107	0
199	R	199	64.5	0
187	R	187	47.5	0
232	R	232	127	0
188	R	188	49.5	0
246	R	246	141	0
204	R	204	76	0
286	R	286	170.5	0
189	R	189	53	0
264	R	264	159	0
206	R	206	81	0
204	R	204	76	0
202	R	202	72	0
188	R	188	49.5	0
280	R	280	167	0
226	R	226	113.5	0
196	R	196	57.5	0
259	R	259	154	0
234	R	234	130.5	0
183	R	183	44.5	0
272	R	272	160.5	0
369	R	369	177	0
286	R	286	170.5	0
223	R	223	109.5	0
206	R	206	81	0
206	R	206	81	0
251	R	251	147	0
111	R	111	3	0
253	R	253	149.5	0
222	R	222	107	0
230	R	230	121	0
276	R	276	165	0
246	R	246	141	0
260	R	260	156	0
228	R	228	117	0
236	R	236	133	0
164	R	164	21	0
223	R	223	109.5	0
179	R	179	36.5	0
218	R	218	102	0
189	R	189	53	0
200	R	200	67.5	0
172	R	172	33.5	0
156	R	156	11	0
243	R	243	138	0
257	R	257	153	0
214	R	214	94.5	0
250	R	250	146	0
231	R	231	124.5	0
219	R	219	103	0
206	R	206	81	0
180	R	180	38	0
299	R	299	172	0
129	R	129	4	0
199	S	158.5	12	12
191	S	150.5	9	9
251	S	210.5	88.5	88.5
116	S	75.5	1	1
361	S	320.5	174	174
313	S	272.5	162	162
253	S	212.5	92	92
257	S	216.5	101	101
230	S	189.5	55	55
250	S	209.5	85.5	85.5
212	S	171.5	32	32
250	S	209.5	85.5	85.5
221	S	180.5	39	39
178	S	137.5	6	6
200	S	159.5	14	14
229	S	188.5	51	51
223	S	182.5	43	43
202	S	161.5	16	16
202	S	161.5	16	16
202	S	161.5	16	16
241	S	200.5	69.5	69.5
251	S	210.5	88.5	88.5
206	S	165.5	22	22
241	S	200.5	69.5	69.5
271	S	230.5	122	122
267	S	226.5	115	115
314	S	273.5	163	163
301	S	260.5	158	158
186	S	145.5	8	8
141	S	100.5	2	2
		Sum =	16290	1916

* 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:	96	
Avg Rank S:	64	

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		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
1	S	1	S
2.5	S	2	S
2.5	S	3	R
6.5	S	4	R
6.5	S	5	R
6.5	S	6	S
6.5	S	7	R
6.5	S	8	S
6.5	S	9	S
12	S	10	R
12	S	11	R
12	S	12	S
12	S	13	R
12	S	14	S
17	S	16	S
17	S	16	S
17	S	16	S
17	S	18.5	R
17	S	18.5	R
22	S	20	R
22	S	21	R
22	S	22	S
22	S	23	R
22	S	25	R
25	S	25	R
27	S	25	R
27	S	27.5	R
27	S	27.5	R
29.5	S	29	R
29.5	S	30.5	R
39.5	R	30.5	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	36.5	R
39.5	R	36.5	R
39.5	R	38	R
39.5	R	39	S
39.5	R	40.5	R
39.5	R	40.5	R
39.5	R	42	R
39.5	R	43	S
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	49.5	R
60.5	R	49.5	R
60.5	R	51	S
60.5	R	53	R
60.5	R	53	R
60.5	R	53	R
60.5	R	55	S
60.5	R	56	R
60.5	R	57.5	R

60.5	R	57.5	R
60.5	R	60	R
60.5	R	60	R
60.5	R	60	R
60.5	R	62	R
60.5	R	64.5	R
60.5	R	64.5	R
60.5	R	64.5	R
60.5	R	64.5	R
60.5	R	67.5	R
60.5	R	67.5	R
60.5	R	69.5	S
60.5	R	69.5	S
60.5	R	72	R
60.5	R	72	R
87	R	72	R
87	R	74	R
87	R	76	R
87	R	76	R
87	R	76	R
87	R	78	R
87	R	81	R
87	R	81	R
87	R	81	R
87	R	81	R
87	R	81	R
87	R	84	R
87	R	85.5	S
87	R	85.5	S
87	R	87	R
87	R	88.5	S
87	R	88.5	S
87	R	90	R
87	R	91	R
87	R	92	S
87	R	93	R
87	R	94.5	R
87	R	94.5	R
87	R	96.5	R
87	R	96.5	R
87	R	99	R
87	R	99	R
87	R	99	R
87	R	101	S
115.5	R	102	R
115.5	R	103	R
115.5	R	104.5	R
115.5	R	104.5	R
115.5	R	107	R
115.5	R	107	R
115.5	R	107	R
115.5	R	109.5	R
115.5	R	109.5	R
115.5	R	111	R
115.5	R	112	R
115.5	R	113.5	R
115.5	R	113.5	R
115.5	R	115	S
115.5	R	117	R
115.5	R	117	R
115.5	R	117	R
115.5	R	119.5	R
115.5	R	119.5	R
115.5	R	121	R

115.5	R	122	S
115.5	R	124.5	R
115.5	R	124.5	R
115.5	R	124.5	R
115.5	R	124.5	R
115.5	R	127	R
115.5	R	128.5	R
115.5	R	128.5	R
134	R	130.5	R
134	R	130.5	R
134	R	132	R
134	R	133	R
134	R	134	R
134	R	135	R
134	R	136	R
134	R	138	R
134	R	138	R
144.5	R	138	R
144.5	R	141	R
144.5	R	141	R
144.5	R	141	R
144.5	R	143.5	R
144.5	R	143.5	R
144.5	R	145	R
144.5	R	146	R
144.5	R	147	R
144.5	R	148	R
144.5	R	149.5	R
144.5	R	149.5	R
152	R	151	R
152	R	152	R
152	R	153	R
154.5	R	154	R
154.5	R	156	R
157	R	156	R
157	R	156	R
157	R	158	S
160	R	159	R
160	R	160.5	R
160	R	160.5	R
162.5	R	162	S
162.5	R	163	S
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	R
172	R	173	R
174.5	R	174	S
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