

Spreadsheet Formulas for the Wilcoxon Rank Sum Test and Power Calculation

Wilcoxon Rank Sum Test, per NUREG-1505

LBGR 2.6 (For this calculation, LBGR = 3σ for Building 2078 Background)

(Reference Dataset - Building 2078 Alpha Hand-held)

DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
2	R	2	45	0
0	R	0	28	0
3	R	3	51	0
2	R	2	45	0
2	R	2	45	0
5	R	5	55	0
1	R	1	37	0
2	R	2	45	0
1	R	1	37	0
0	R	0	28	0
2	R	2	45	0
3	R	3	51	0
3	R	3	51	0
3	R	3	51	0
4	R	4	54	0
2	R	2	45	0
1	R	1	37	0
1	R	1	37	0
0	R	0	28	0
0	R	0	28	0
1	R	1	37	0
1	R	1	37	0
3	R	3	51	0
2	R	2	45	0
0	R	0	28	0
0	R	0	28	0
0	R	0	28	0
1	R	1	37	0
1	R	1	37	0
0	R	0	28	0
1	S	-1.6	17.5	17.5
0	S	-2.6	7.5	7.5
0	S	-2.6	7.5	7.5
2	S	-0.6	22	22
1	S	-1.6	17.5	17.5
0	S	-2.6	7.5	7.5
0	S	-2.6	7.5	7.5
0	S	-2.6	7.5	7.5
2	S	-0.6	22	22
0	S	-2.6	7.5	7.5
0	S	-2.6	7.5	7.5
1	S	-1.6	17.5	17.5
0	S	-2.6	7.5	7.5
1	S	-1.6	17.5	17.5
0	S	-2.6	7.5	7.5
2	S	-0.6	22	22
0	S	-2.6	7.5	7.5
0	S	-2.6	7.5	7.5
Sum =				270

* 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: 32
of S: 23
Avg Rank R: 40
Avg Rank S: 12

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 = 1.90

$k = 758.9$

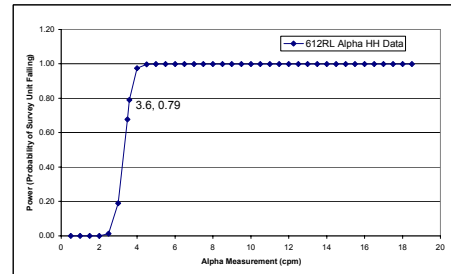
Since the sum of survey unit ranks is less than the critical value, the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR (i.e., the survey unit is indistinguishable from background) is accepted and the survey unit passes Scenario B

Retrospective Power Curve Calculation

From Example in Section 10.5 of NUREG-1505

$p1$ and $p2$ pull data from Table 10-3 sheet

Measurement	(C-LBGR)/SD	Rounded	p1	p2	E(Wmw)	Var(Wmw)	SD(Wmw)	z	Power
0.5	-1.592	-1.600	0.12895	0.046501	94.9072	1335.897	36.54992	10.60086	0.00
1	-1.213	-1.200	0.18072	0.085944	145.781	2070.546	45.56913	7.38629	0.00
1.5	-0.834	-0.800	0.262259	0.12892	193.0226	2665.403	51.62754	5.604474	0.00
2	-0.455	-0.500	0.361837	0.206266	266.312	3330.614	57.71147	3.743724	0.00
2.5	-0.076	-0.100	0.471814	0.305606	347.2551	3665.328	60.54196	2.23172	0.01
3	0.303	0.300	0.583998	0.421415	429.8225	3550.126	59.59203	0.881885	0.19
3.5	0.682	0.700	0.689691	0.544073	507.6129	3027.005	55.01823	-0.45884	0.68
3.6	0.758	0.800	0.714196	0.574469	525.6483	2851.651	53.40085	-0.81048	0.79
4	1.061	1.100	0.781662	0.662216	575.3032	2274.414	47.69081	-1.94871	0.97
4.5	1.440	1.400	0.821015	0.716331	604.267	1881.272	43.37363	-2.81045	1.00
5	1.819	1.800	0.855334	0.810018	651.6058	1173.847	34.26145	-4.9396	1.00
5.5	2.198	2.200	0.931218	0.881527	685.3764	649.5738	25.48674	-7.96527	1.00
6	2.577	2.600	0.96145	0.931365	707.6272	320.0577	17.89916	-12.5912	1.00
6.5	2.956	3.000	0.979648	0.963118	721.1681	141.0559	11.8767	-20.1066	1.00
7	3.335	3.300	0.988174	0.977981	727.2961	71.24145	8.440465	-29.0183	1.00
7.5	3.714	3.700	0.993336	0.98741	731.0653	33.96955	5.828341	-42.6755	1.00
8	4.093	4.100	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00
8.5	4.472	4.500	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00
9	4.851	4.900	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00
9.5	5.229	5.200	0.997796	0.995599	735.8499	0.442031	0.664854	-381.259	1.00
10	5.608	5.600	0.997796	0.995599	735.8499	0.442031	0.664854	-381.259	1.00
10.5	5.987	6.000	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00
11	6.366	6.400	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00
11.5	6.745	6.700	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00
12	7.124	7.100	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00
12.5	7.503	7.500	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
13	7.882	7.900	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
13.5	8.261	8.300	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
14	8.640	8.600	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
14.5	9.019	9.000	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
15	9.398	9.400	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
15.5	9.777	9.800	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
16	10.156	10.200	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
16.5	10.535	10.500	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
17	10.914	10.900	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
17.5	11.293	11.300	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
18	11.672	11.700	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1
18.5	12.051	12.100	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1



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 (3.6) will have a 0.79 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).

Spreadsheet Formulas for the Wilcoxon Rank Sum Test and Power Calculation

Wilcoxon Rank Sum Test, per NUREG-1505

LBGR 327.7 (For this calculation, LBGR = 3w for Building 2078 Background)
(Reference Dataset - Building 2078 Beta Hand-held)

DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS
192	R	192	48	0
172	R	172	42	0
170	R	170	40.5	0
182	R	182	46	0
173	R	173	43.5	0
170	R	170	40.5	0
173	R	173	43.5	0
163	R	163	39	0
160	R	160	37.5	0
175	R	175	45	0
160	R	160	37.5	0
153	R	153	35	0
156	R	156	36	0
136	R	136	31	0
150	R	150	33.5	0
150	R	150	33.5	0
141	R	141	32	0
291	R	291	50	0
112	R	112	26	0
110	R	110	25	0
128	R	128	28	0
134	R	134	29.5	0
119	R	119	27	0
99	R	99	24	0
186	R	186	47	0
134	R	134	29.5	0
336	R	336	55	0
320	R	320	52	0
326	R	326	53	0
233	R	233	49	0
315	R	315	51	0
327	R	327	54	0
146	S	-161.7	15	19
157	S	-170.7	18	19
165	S	-162.7	19	19
217	S	-110.7	23	23
191	S	-136.7	20.5	20.5
206	S	-121.7	22	22
191	S	-136.7	20.5	20.5
148	S	-179.7	16	16
133	S	-194.7	12.5	12.5
156	S	-171.7	17	17
103	S	-224.7	9	9
81	S	-246.7	3	3
135	S	-192.7	14	14
109	S	-218.7	11	11
61	S	-266.7	1	1
75	S	-252.7	2	2
108	S	-219.7	10	10
87	S	-240.7	4.5	4.5
87	S	-240.7	4.5	4.5
89	S	-239.7	6	6
91	S	-236.7	7	7
92	S	-235.7	8	8
133	S	-194.7	12.5	12.5
Sum =			1540	270

* 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: 32 n
of S: 23 m
Avg Rank R: 40
Avg Rank S: 12

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 = 758.9

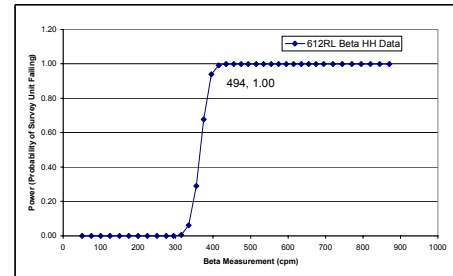
Since the sum of survey unit ranks is less than the critical value, the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR (i.e., the survey unit is indistinguishable from background) is accepted and the survey unit passes. Scenario B

Retrospective Power Curve Calculation

From Example in Section 10.5 of NUREG-1505

p1 and p2 pull data from Table 10-3 sheet

C	Measurement	(C-LBGR)/SD	Rounded	p1	p2	E(Wmw)	Var(Wmw)	SD(Wmw)	z	Power
50	-3.939	-3.900	0.002339	0.000174	1.721504	8.787609	2.96439	162.14	0.00	0.00
75	-3.584	-3.600	0.002339	0.000174	1.721504	8.787609	2.96439	162.14	0.00	0.00
100	-3.2296	-3.200	0.006664	0.000738	4.904704	33.96955	5.828341	81.92094	0.00	0.00
125	-2.8750	-2.900	0.016947	0.00269	12.47299	113.0638	10.63315	44.1915	0.00	0.00
150	-2.5204	-2.500	0.03859	0.008465	28.3728	320.0577	17.89016	25.3768	0.00	0.00
175	-2.1658	-2.200	0.03859	0.008465	28.3728	320.0577	17.89016	25.3768	0.00	0.00
200	-1.8112	-1.800	0.101546	0.033114	74.73786	1023.755	31.99618	12.73696	0.00	0.00
225	-1.4566	-1.500	0.144422	0.054656	106.2946	1508.849	38.84391	9.681653	0.00	0.00
250	-1.1021	-1.100	0.198072	0.085944	145.781	2076.546	45.56913	7.38629	0.00	0.00
275	-0.7475	-0.700	0.310309	0.164691	228.3874	3027.005	55.01823	4.616296	0.00	0.00
295	-0.4638	-0.500	0.361637	0.206286	286.312	3330.614	57.71147	3.743724	0.00	0.00
315	-0.1801	-0.200	0.443769	0.27893	326.614	3621.698	60.18055	2.588109	0.00	0.00
335	0.1035	0.100	0.528186	0.361978	388.7449	3665.328	60.54196	1.546414	0.06	0.06
355	0.3872	0.400	0.611351	0.451875	449.9543	3452.372	58.75689	0.551654	0.29	0.29
375	0.6709	0.700	0.689691	0.544073	507.6126	3027.005	55.01823	-0.45884	0.68	0.68
395	0.9545	1.000	0.76025	0.633702	569.544	2471.797	49.71717	-1.5523	0.94	0.94
415	1.2382	1.200	0.801928	0.6898	590.219	2076.546	45.56913	-2.36676	0.99	0.99
435	1.5219	1.500	0.838901	0.741698	617.4311	1691.257	41.12489	-3.28422	1.00	1.00
455	1.8055	1.800	0.885334	0.810016	651.6058	1173.847	34.26145	-4.9396	1.00	1.00
475	2.0892	2.100	0.92135	0.865767	678.1136	761.5328	27.59598	-7.0933	1.00	1.00
494	2.3587	2.400	0.948062	0.908982	697.7736	462.4919	21.50563	-10.0163	1.00	1.00
515	2.6566	2.700	0.967004	0.940817	711.7149	263.4603	16.23146	-14.1298	1.00	1.00
535	2.9402	2.900	0.976143	0.956616	718.4412	174.9148	13.22553	-17.8498	1.00	1.00
555	3.2239	3.200	0.985811	0.973725	725.5569	90.07388	9.490726	-25.6239	1.00	1.00
575	3.5076	3.500	0.991895	0.984758	730.0347	43.7706	6.615935	-37.4349	1.00	1.00
595	3.7912	3.800	0.993336	0.98741	731.0953	33.96955	5.828341	-42.6755	1.00	1.00
615	4.0749	4.100	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00	1.00
635	4.3586	4.400	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00	1.00
655	4.6422	4.500	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00	1.00
675	4.9259	4.900	0.997661	0.995497	734.2785	8.829561	2.971458	-84.7768	1.00	1.00
695	5.2096	5.200	0.999796	0.999599	735.8499	0.442031	0.664854	-381.259	1.00	1.00
720	5.5642	5.600	0.999796	0.999599	735.8499	0.442031	0.664854	-381.259	1.00	1.00
745	5.9187	5.900	0.999796	0.999599	735.8499	0.442031	0.664854	-381.259	1.00	1.00
770	6.2733	6.300	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00	1.00
795	6.6279	6.600	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00	1.00
820	6.9825	7.000	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00	1.00
845	7.3371	7.300	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00	1.00
870	7.6917	7.700	0.999989	0.999978	735.9919	0.008091	0.089949	-2819.64	1.00	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 (494) 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).

Spreadsheet Formulas for the Wilcoxon Rank Sum Test and Power Calculation**Wilcoxon Rank Sum Test, per NUREG-1505**

LBGR 3 (For this calculation, LBGR = 3e for Building 2078 Background)

(Reference Dataset - Building 2078 Alpha Floor Monitor)

DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS	
5	R	5	15.5	0	
3	R	3	9.5	0	
13	R	13	36.5	0	
6	R	6	18	0	
8	R	8	25.5	0	
8	R	8	25.5	0	
8	R	8	25.5	0	
6	R	6	18	0	
4	R	4	13.5	0	
7	R	7	21.5	0	
11	R	11	32	0	
12	R	12	34.5	0	
10	R	10	29	0	
10	R	10	29	0	
12	R	12	34.5	0	
7	R	7	21.5	0	
2	R	2	5.5	0	
3	R	3	9.5	0	
1	R	1	4	0	
3	R	3	9.5	0	
4	R	4	13.5	0	
8	R	8	25.5	0	
3	R	3	9.5	0	
7	R	7	21.5	0	
13	R	13	36.5	0	
7	R	7	21.5	0	
6	R	6	18	0	
11	R	11	32	0	
11	R	11	32	0	
5	R	5	15.5	0	
10	R	10	29	0	
6	S	3	9.5	9.5	
3	S	0	2	2	
3	S	0	2	2	
3	S	0	2	2	
6	S	3	9.5	9.5	
5	S	2	5.5	5.5	
Sum =				703	30.5

* 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: 31
of S: 6
Avg Rank R: 21.6954839
Avg Rank S: 5.1

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

$$k = 161.568$$

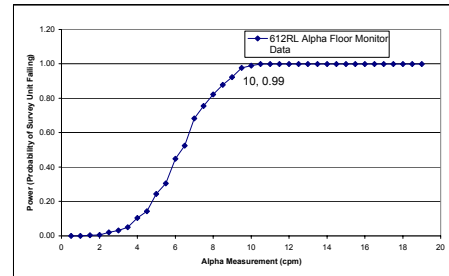
Since the sum of survey unit ranks is less than the critical value, the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR (i.e., the survey unit is indistinguishable from background) is accepted and the survey unit passes Scenario B.

Retrospective Power Curve Calculator

From Example in Section 10.5 of NUREG-1505

p1 and p2 pull data from Table 10-3 sheet

Survey Unit Stats	C	Measurement	(C-LBGR)/SD	Rounded	p1	p2	E(Wmw)	Var(Wmw)	SD(Wmw)	z	Power
Count	6	0.5	-0.728	0	0.310309	0.164691	57.71747	535.9759	23.15115	3.557075	0.00
SD	1.5	1	-0.583	0	0.335687	0.19476	62.43778	564.3048	23.7551	3.267934	0.00
Median	4	1.5	-0.437	0	0.388649	0.229172	72.28871	610.9049	24.71649	2.742265	0.00
Reference Stats		2	-0.291	0	0.416002	0.253419	77.37637	628.1288	25.0625	2.501407	0.01
Count	31	2.5	-0.146	0	0.471814	0.305606	87.7574	648.4165	25.46402	2.054289	0.02
SD	3.4	3	0.000	0	0.5	0.333333	93	650.9976	25.51465	1.844739	0.03
Median	7	3.5	0.146	0	0.528186	0.361978	98.2426	648.4165	25.46402	1.642524	0.05
		4	0.291	0	0.583998	0.421415	108.6236	628.1288	25.0625	1.254633	0.10
		4.5	0.437	0	0.611351	0.451875	113.7113	610.9122	24.71664	1.06635	0.14
		5	0.583	0	0.664313	0.513387	123.5622	564.312	23.75525	0.694621	0.24
		5.5	0.728	0	0.686691	0.544073	128.2825	535.9759	23.15115	0.509061	0.31
		6	0.874	0	0.737741	0.604402	137.2198	472.2443	21.73118	0.131058	0.45
		6.5	1.020	1	0.76025	0.633702	141.4065	438.1091	20.93106	-0.06395	0.53
		7	1.165	1	0.801928	0.68898	149.1586	368.3892	19.19347	-0.47364	0.68
		7.5	1.311	1	0.821015	0.716331	152.7088	333.6256	18.27363	-0.69176	0.76
		8	1.457	1	0.838901	0.741698	156.0356	300.3765	17.33137	-0.92132	0.82
		8.5	1.602	1	0.855578	0.765812	159.1375	268.1557	16.37546	-1.16453	0.88
		9	1.748	1	0.87105	0.788602	162.0153	237.5971	15.41419	-1.42385	0.92
		9.5	1.894	1	0.886454	0.830022	167.1124	182.3783	13.50475	-2.0026	0.98
		10	2.039	2	0.910445	0.844605	169.3428	158.0323	12.57109	-2.32875	0.99
		10.5	2.185	2	0.931218	0.881527	173.2065	116.0812	10.7741	-3.07577	1.00
		11	2.331	2	0.940103	0.895917	174.8592	98.41632	9.9205	-3.50701	1.00
		11.5	2.476	2	0.955157	0.920777	177.6592	69.27834	8.323361	-4.51636	1.00
		12	2.622	2	0.96145	0.931365	178.6297	57.51861	7.584115	-5.11082	1.00
		12.5	2.768	2	0.971881	0.949208	180.7699	38.85277	6.233159	-6.52987	1.00
		13	2.914	2	0.976143	0.956616	181.5626	31.6127	5.622517	-7.3801	1.00
		13.5	3.059	3	0.983053	0.968795	182.8479	20.52137	4.530052	-8.4436	1.00
		14	3.205	3	0.985811	0.973725	183.3608	16.39644	4.049252	-10.6916	1.00
		14.5	3.351	3	0.990188	0.981636	184.175	10.24076	3.201372	-13.7776	1.00
		15	3.496	3	0.991895	0.984758	184.4925	8.040661	2.835606	-15.6667	1.00
		15.5	3.642	3	0.993336	0.98741	184.7605	6.262554	2.50251	-17.8591	1.00
		16	3.788	3	0.993336	0.98741	184.7605	6.262554	2.50251	-17.8591	1.00
		16.5	3.933	3	0.993336	0.98741	184.7605	6.262554	2.50251	-17.8591	1.00
		17	4.079	4	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1.00
		17.5	4.225	4	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1.00
		18	4.370	4	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1
		18.5	4.516	4	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1
		19	4.662	4	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1



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 (10) will have a 0.99 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).

Spreadsheet Formulas for the Wilcoxon Rank Sum Test and Power Calculation**Wilcoxon Rank Sum Test, per NUREG-1505**LBGR 686.9 (For this calculation, LBGR = 3σ for Building 2078 Background)
(Reference Dataset - Building 2078 Beta Floor Monitor)

DATA	AREA	ADJUSTED DATA	RANKS	SURVEY AREA RANKS	
1209	R	1209	37	0	
1138	R	1138	35	0	
1110	R	1110	31	0	
1131	R	1131	34	0	
1082	R	1082	25	0	
1112	R	1112	32	0	
1097	R	1097	27.5	0	
1078	R	1078	24	0	
1069	R	1069	23	0	
1100	R	1100	30	0	
1065	R	1065	22	0	
1098	R	1098	29	0	
1139	R	1139	36	0	
1126	R	1126	33	0	
1086	R	1086	26	0	
1097	R	1097	27.5	0	
892	R	892	18	0	
945	R	945	21	0	
859	R	859	17	0	
903	R	903	20	0	
895	R	895	19	0	
858	R	858	16	0	
816	R	816	15	0	
722	R	722	13	0	
654	R	654	9	0	
716	R	716	12	0	
628	R	628	7	0	
712	R	712	11	0	
644	R	644	8	0	
694	R	694	10	0	
815	R	815	14	0	
922	S	235.1	6	6	
896	S	209.1	4	4	
843	S	156.1	1	1	
855	S	168.1	2	2	
862	S	175.1	3	3	
903	S	216.1	5	5	
Sum =		703	21		

* 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: 31
of S: 6
Avg Rank R: 22
Avg Rank S: 3.5

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 = 1.90

$k = 161.568$

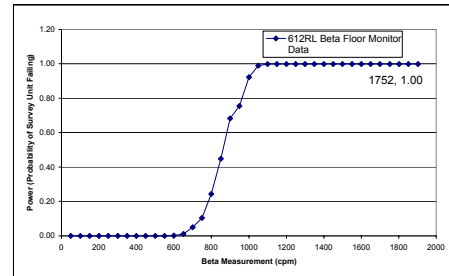
Since the sum of survey unit ranks is less than the critical value, the null hypothesis that the difference between the survey unit median and the background median is less than the LBGR (i.e., the survey unit is indistinguishable from background) is accepted and the survey unit passes Scenario B.

Retrospective Power Curve Calculation

From Example in Section 10.5 of NUREG-1505

p1 and p2 pull data from Table 10-3 sheet

C	Measurement	(C-LBGR)/SD	Rounded	p1	p2	E(Wmw)	Var(Wmw)	SD(Wmw)	z	Power
30	-3.495	-3.500	0.006664	0.000738	1.239504	6.262554	2.50251	55.47566	0.00	
100	-3.220	-3.200	0.006664	0.000738	1.239504	6.262554	2.50251	55.47566	0.00	
150	-2.946	-2.900	0.016947	0.00269	3.152142	20.52863	4.530853	30.21853	0.00	
200	-2.672	-2.700	0.016947	0.00269	3.152142	20.52863	4.530853	30.21853	0.00	
250	-2.397	-2.400	0.03855	0.008465	7.1703	57.51881	7.584115	17.52315	0.00	
300	-2.123	-2.100	0.03855	0.008465	7.1703	57.51881	7.584115	17.52315	0.00	
350	-1.849	-1.800	0.101546	0.033114	18.88756	182.3783	13.50475	8.973162	0.00	
400	-1.574	-1.600	0.12895	0.046501	23.9847	237.5899	15.41395	7.531046	0.00	
450	-1.300	-1.300	0.178985	0.074301	33.29121	333.9256	18.27363	5.84321	0.00	
500	-1.026	-1.000	0.218338	0.098892	40.61087	403.2976	20.08227	4.952478	0.00	
550	-0.751	-0.800	0.262259	0.12892	48.78017	472.2443	21.73118	4.20077	0.00	
600	-0.477	-0.500	0.381837	0.206266	67.30168	589.4657	24.27891	2.997094	0.00	
650	-0.202	-0.200	0.443769	0.27893	82.54103	640.7332	25.31271	2.272647	0.01	
700	0.072	0.100	0.528186	0.381978	98.2426	648.4165	25.46402	1.642524	0.05	
750	0.346	0.300	0.583998	0.421415	108.6236	628.1288	25.0825	1.254633	0.10	
800	0.621	0.600	0.664313	0.513387	123.5622	564.312	23.75525	0.694921	0.24	
850	0.895	0.900	0.737741	0.604402	137.2198	472.2443	21.73118	0.131058	0.45	
900	1.169	1.200	0.801928	0.6898	149.1586	368.3892	19.19347	-0.47364	0.68	
950	1.444	1.400	0.821015	0.716331	152.7088	333.9256	18.27363	-0.69176	0.76	
1000	1.718	1.700	0.87105	0.788602	162.0153	237.5971	15.41419	-1.42365	0.92	
1050	1.992	2.000	0.910445	0.848605	169.3428	158.0323	12.57109	-2.32875	0.99	
1100	2.267	2.300	0.940103	0.895917	174.8592	98.41632	9.9205	-3.50701	1.00	
1150	2.541	2.500	0.955157	0.920777	177.6592	69.27834	8.323361	-4.51636	1.00	
1200	2.815	2.800	0.971881	0.949208	180.7699	38.85277	6.233199	-6.52967	1.00	
1250	3.090	3.100	0.983053	0.968795	182.8479	20.52137	4.530352	-8.4436	1.00	
1300	3.364	3.400	0.990188	0.981636	184.175	10.24878	3.201372	-13.7776	1.00	
1350	3.639	3.600	0.993336	0.98741	184.7605	6.262554	2.50251	-17.8591	1.00	
1400	3.913	3.900	0.993336	0.98741	184.7605	6.262554	2.50251	-17.8591	1.00	
1450	4.187	4.200	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1.00	
1500	4.462	4.500	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1.00	
1550	4.736	4.700	0.997661	0.995497	185.5649	1.6638	1.289884	-35.2722	1.00	
1600	5.010	5.000	0.999796	0.999599	185.9621	0.088412	0.297342	-154.348	1.00	
1650	5.285	5.300	0.999796	0.999599	185.9621	0.088412	0.297342	-154.348	1.00	
1700	5.559	5.600	0.999796	0.999599	185.9621	0.088412	0.297342	-154.348	1.00	
1752	5.844	5.800	0.999796	0.999599	185.9621	0.088412	0.297342	-154.348	1.00	
1802	6.119	6.100	0.999989	0.999978	185.998	0.002045	0.045223	-1015.64	1	
1852	6.393	6.400	0.999989	0.999978	185.998	0.002045	0.045223	-1015.64	1	
1902	6.667	6.700	0.999989	0.999978	185.998	0.002045	0.045223	-1015.64	1	



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 (1752) 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).

Quantile Test

per Section 7 of NUREG-1505

n (Survey) 23

m (Ref) 32

alpha/2 0.025

From Table A.7

 r 7 k 6 α 0.029If k of the r largest ranks are from the survey unit, the null hypothesis is rejected (25,30) in Table A.7**Alpha Hand-held Ranks**

Sorted Ranks Location

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

7.5 S

17.5 S

17.5 S

17.5 S

17.5 S

17.5 S

17.5 S

22 S

22 S

22 S

28 R

28 R

28 R

28 R

28 R

28 R

28 R

28 R

28 R

37 R

37 R

37 R

37 R

37 R

37 R

37 R

37 R

45 R

45 R

45 R

45 R

45 R

45 R

45 R

51 R

51 R

51 R

51 R

51 R

54 R

55 R

Beta Hand-held Ranks

Sorted Ranks Location

1 S

2 S

3 S

4.5 S

4.5 S

6 S

7 S

8 S

9 S

10 S

11 S

12.5 S

12.5 S

14 S

15 S

16 S

17 S

18 S

19 S

20.5 S

20.5 S

22 S

23 S

24 R

25 R

26 R

27 R

28 R

29.5 R

29.5 R

31 R

32 R

33.5 R

33.5 R

35 R

36 R

37.5 R

37.5 R

39 R

40.5 R

40.5 R

42 R

43.5 R

43.5 R

45 R

46 R

47 R

48 R

49 R

50 R

51 R

52 R

53 R

54 R

55 R

0 of top 7 from S

0 of top 7 from S

thesis is rejected.

Quantile Test

per Section 7 of NUREG-1505

From Table A.7

If k of the r largest ranks are from the survey unit, the null hypothesis is rejected (5,30) in Table A.7

n (Survey) 6

 r 6

m (Ref) 31

 k 3

alpha/2 0.025

alpha 0.026

Alpha FM Ranks

Beta FM Ranks

Sorted Ranks Location Sorted Ranks Location

2 S 1 S

2 S 2 S

2 S 3 S

4 R 4 S

5.5 R 5 S

5.5 S 6 S

9.5 R 7 R

9.5 R 8 R

9.5 R 9 R

9.5 R 10 R

9.5 S 11 R

9.5 S 12 R

13.5 R 13 R

13.5 R 14 R

15.5 R 15 R

15.5 R 16 R

18 R 17 R

18 R 18 R

18 R 19 R

21.5 R 20 R

21.5 R 21 R

21.5 R 22 R

21.5 R 23 R

25.5 R 24 R

25.5 R 25 R

25.5 R 26 R

25.5 R 27.5 R

29 R 27.5 R

29 R 29 R

29 R 30 R

32 R 31 R

32 R 32 R

32 R 33 R

34.5 R 34 R

34.5 R 35 R

36.5 R 36 R

36.5 R 37 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).

 $r=7$ $k=4$

0 of top 7 from S

thesis 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