

The Vulnerability of Small Countries in the Event of a Major Nuclear Accident in Their Territory:
Strategic Analysis and International Comparison

STRATEGIC WEAKNESS AND VULNERABILITY: Population in a 30 km radius around active nuclear power plants (percentage of inhabitants compared to the population of the country where the plant is located)

Table 2: Percentage of the number of inhabitants in a 30 km radius

Line No.	Nuclear Power Plant Name	Country Name	Percentage of no. of inhabitants in a 30 km radius Percentage ^{a,b}	1 = maximum potential impact Rank
1	Metsamor - Armenia	Armenia	25.47%	1
2	Kuosheng	Taiwan	23.34%	2
3	Jinshan - Chin Shan	Taiwan	20.05%	3
4	Krsko**	Slovenia	16.15%	4
5	Doel**	Belgium	13.63%	5
6	Beznau	Switzerland	12.92%	6
7	Goesgen	Switzerland	12.06%	7
8	Mühleberg	Switzerland	11.22%	8
9	Leibstadt	Switzerland	10.28%	9
10	Tihange**	Belgique	7.54%	10
11	Bohunice	Slovakia	7.10%	11
12	Kori II / Kori	Korea Rep.	6.65%	12
13	Pickering	Canada	6.16%	13
14	Mochovce	Slovakia	5.57%	14
15	Kanupp	Pakistan	4.44%	15
16	Dukovany	Czech Rep.	2.81%	16
17	Borssele**	Netherlands	2.62%	17
18	Temelin	Czech Rep.	2.57%	18
19	Wolsong	Korea Rep.	2.54%	19
20	Philippsburg	Germany	2.13%	20
21	Neckarwestheim	Germany	1.98%	21
22	Kozlodui	Bulgaria	1.89%	22
23	Paks	Hungary	1.84%	23
24	Hartlepool	United Kingdom	1.66%	24
25	Wolsong-Shin	Korea Rep.	1.46%	25
26	Fessenheim**	France	1.40%	26
27	Olkiluoto	Finland	1.37%	27
28	Darlington	Canada	1.22%	28
29	Cattenom**	France	1.20%	29
30	Ringhals	Sweden	1.05%	30
31	Bugey	France	1.05%	30
32	Heysham	United Kingdom	1.03%	32
33	St-Alban	France	0.92%	33
34	Hinkley Point B	United Kingdom	0.79%	34
35	Khmelnyskyi	Ukraine	0.78%	35
36	Tökai	Japan	0.72%	36
37	Zaporizhia	Ukraine	0.72%	36
38	Gravelines	France	0.69%	38
39	Hunterston	United Kingdom	0.63%	39
40	Grafenrheinfeld	Germany	0.62%	40
41	Cernavoda	Romania	0.61%	41
42	Grohnde	Germany	0.60%	42
43	Loviisa	Finland	0.57%	43
44	Emsland**	Germany	0.57%	43
45	Gentilly	Canada	0.52%	45
46	Gundremmingen	Germany	0.51%	46
47	Vandellos	Spain	0.47%	47
48	Pierrelatte (Tricastin)	France	0.46%	48
49	Dungeness	United Kingdom	0.44%	49
50	St-Laurent	France	0.43%	50
51	Atucha	Argentina	0.42%	51
52	Brokdorf	Germany	0.41%	52
53	Koeberg	South Africa	0.41%	52
54	Isar	Germany	0.39%	54
55	Chashma	Pakistan	0.38%	55
56	Cruas	France	0.37%	56
57	Indian Point	USA	0.34%	57
58	Hanbit	Korea Rep.	0.33%	58
59	Shimane	Japan	0.33%	58
60	Kashiwazaki-Kariwa	Japan	0.33%	58

61	Sizewell	United Kingdom	0.31%	61
62	Civaux	France	0.31%	61
63	Limerick	USA	0.31%	61
64	Chooz**	France	0.30%	64
65	Oskarshamn	Sweden	0.29%	65
66	South Ukraine	Ukraine	0.29%	65
67	Bushehr	Iran	0.28%	67
68	Golfech	France	0.28%	67
69	St-Martin en Ch. Penly	France	0.27%	69
70	Chinon	France	0.26%	70
71	Three Mile Island	USA	0.26%	70
72	Rivne - Rovno	Ukraine	0.26%	70
73	Flammanville	France	0.24%	73
74	Guangdong - Daya Bay	China	0.24%	73
75	McGuire	USA	0.24%	73
76	Forsmark	Sweden	0.23%	76
77	Lingao	China	0.23%	76
78	Beloyarsky	Russian Fed.	0.22%	78
79	Catawba	USA	0.22%	78
80	Paluel	France	0.21%	80
81	Le Blayais	France	0.20%	81
82	Embalse	Argentina	0.20%	81
83	Genkai	Japan	0.20%	81
84	Nogent-sur-Seine	France	0.19%	84
85	Dampierre	France	0.19%	84
86	Narora	India	0.19%	84
87	Monju	Japan	0.19%	84
88	Turkey Point	USA	0.18%	88
89	Onagawa	Japan	0.18%	88
90	Sendai	Japan	0.18%	88
91	Mihama	Japan	0.16%	91
92	Hanul - Uljin	Korea Rep.	0.16%	91
93	R. E. Ginna	USA	0.16%	91
94	Shika	Japan	0.16%	91
95	Belleville	France	0.15%	95
96	Takahama	Japan	0.15%	95
97	Beaver Valley	USA	0.14%	97
98	Sequoyah	USA	0.14%	97
99	Hope Creek	USA	0.13%	99
100	Surry	USA	0.13%	99
101	Seabrook	USA	0.13%	99
102	Asco	Spain	0.13%	99
103	Shearon Harris	USA	0.13%	99
104	Oyster Creek	USA	0.13%	99
105	Ohi	Japan	0.12%	105
106	Kursk	Russian Fed.	0.12%	105
107	Salem	USA	0.12%	105
108	Enrico Fermi	USA	0.12%	105
109	Waterford	USA	0.12%	105
110	Aljmaraz	Spain	0.12%	105
111	Ikata	Japan	0.11%	111
112	Volgodonsk-Rostov	Russian Fed.	0.11%	111
113	Peach Bottom	USA	0.11%	111
114	Maanschan	Taiwan	0.11%	111
115	Balakovo	Russian Fed.	0.11%	111
116	Novovoronezh	Russian Fed.	0.11%	111
117	St.Lucie	USA	0.11%	111
118	Dresden	USA	0.10%	118
119	Wylfa	United Kingdom	0.10%	118
120	Susquehanna	USA	0.10%	118
121	Millstone	USA	0.10%	118
122	Qinshan	China	0.10%	118
123	Bruce	Canada	0.10%	118
124	Fort Calhoun	USA	0.09%	124
125	Novovoronezh-2	Russian Fed.	0.09%	124
126	Torness	United Kingdom	0.09%	124
127	Cofrentes	Spain	0.09%	124
128	Pilgrim	USA	0.09%	124
129	Laguna Verde	Mexico	0.08%	129
130	Perry	USA	0.08%	129
131	Kakrapar	India	0.08%	129
132	Byron	USA	0.07%	132
133	Tianwan	China	0.07%	132
134	Angra	Brazil	0.07%	132
135	Quad Cities	USA	0.07%	132
136	Fuqing	China	0.07%	132

137	Duan Arnold	USA	0.07%	132
138	Kudankulam	India	0.06%	138
139	Tomari	Japan	0.06%	138
140	Smolensk	Russian Fed.	0.06%	138
141	Oconee	USA	0.06%	138
142	Higashidori	Japan	0.06%	138
143	Point Lepreau	Canada	0.06%	138
144	Browns Ferry	USA	0.05%	144
145	Leningrad 2	Russian Fed.	0.05%	144
146	Leningrad	Russian Fed.	0.05%	144
147	Ohma	Japan	0.05%	144
148	Monticello	USA	0.05%	144
149	Haiyang	China	0.05%	144
150	Diablo Canyon	USA	0.05%	144
151	Calvert Cliffs	USA	0.05%	144
152	Donald Cook	USA	0.05%	144
153	Tarapur	India	0.05%	144
154	Sanmen	China	0.05%	144
155	Madras	India	0.04%	155
156	Virgil C. Summer	USA	0.04%	155
157	Rajasthan	India	0.04%	155
158	Palisades	USA	0.04%	155
159	Braidwood	USA	0.04%	155
160	Brunswick	USA	0.04%	155
161	River Bend	USA	0.04%	155
162	Taishan	China	0.04%	155
163	Trillo	Spain	0.03%	163
164	Ningde	China	0.03%	163
165	Fitzpatrick	USA	0.03%	163
166	Prairie Island	USA	0.03%	163
167	Nine Mile Point	USA	0.03%	163
168	Lasalle	USA	0.03%	163
169	Davis Besse	USA	0.03%	163
170	Columbia	USA	0.03%	163
171	Kalinin	Russian Fed.	0.03%	163
172	Crystal River	USA	0.03%	163
173	North Anna	USA	0.03%	163
174	Watts Bar	USA	0.03%	163
175	Farley	USA	0.03%	163
176	H.B. Robinson	USA	0.03%	163
177	Kola	Russian Fed.	0.03%	163
178	Point Bach	USA	0.03%	163
179	Kaiga	India	0.03%	163
180	Arkansas one	USA	0.03%	163
181	Kewaunee	USA	0.02%	181
182	Comanche Peak	USA	0.02%	181
183	Hatch	USA	0.02%	181
184	Clinton	USA	0.02%	181
185	Hongyanhe	China	0.02%	181
186	Yangjiang	China	0.01%	186
187	Callaway	USA	0.01%	186
188	South Texas	USA	0.01%	186
189	Vogtle	USA	0.01%	186
190	Grand Gulf	USA	0.01%	186
191	Cooper	USA	0.01%	186
192	Palo Verde	USA	0.01%	186
193	Wolf Creek	USA	0.00%	193
194	Bilibino	Russian Fed.	0.00%	193
	Fukushima Dai'ni*	Japan	0.16%	
	Fukushima Da'ichi*	Japan	0.13%	

Table 2: The rank of each of the 194 nuclear power plants is calculated by comparing the population living in a 30 km radius with the population of the country where the plant is located. In some cases, the number of inhabitants includes people living on other sides of the border.

a) The percentages above are calculated based on data from Declan Butler:

<http://www.nature.com/news/2011/110421/full/472400a.html> / See links to the methodological indications in Table 1.

b) The number of inhabitants in a country used to calculate the percentages is from Wikipedia:

<http://fr.wikipedia.org> (Jan. 2015)

* Nuclear power plants definitively shut down after a Level 7 accident as defined by the International Nuclear and Radiological Event Scale (INES).

** Nuclear power plants that threaten urban areas in other countries. (For details about these sites, see Table 4.)

Author: Institut Biosphère, Geneva, 2015, www.institutbiosphere.ch

75	Cooper	USA							8	65
76	Crystal River	USA							8	65
77	Davis Besse	USA							8	65
78	Diablo Canyon	USA							8	65
79	Donald Cook	USA							8	65
80	Duan Arnold	USA							8	65
81	Farley	USA							8	65
82	Fitzpatrick	USA							8	65
83	Fort Calhoun	USA							8	65
84	Grand Gulf	USA							8	65
85	H.B. Robinson	USA							8	65
86	Hatch	USA							8	65
87	Hope Creek	USA							8	65
88	Kewaunee	USA							8	65
89	Lasalle	USA							8	65
90	Millstone	USA							8	65
91	Nine Mile Point	USA							8	65
92	North Anna	USA							8	65
93	Oconee	USA							8	65
94	Oyster Creek	USA							8	65
95	Palisades	USA							8	65
96	Palo Verde	USA							8	65
97	Pilgrim	USA							8	65
98	Point Bach	USA							8	65
99	Quad Cities	USA							8	65
100	R. E. Ginna	USA							8	65
101	River Bend	USA							8	65
102	Salem	USA							8	65
103	Seabrook	USA							8	65
104	Sequoyah	USA							8	65
105	Shearon Harris	USA							8	65
106	South Texas	USA							8	65
107	St.Lucie	USA							8	65
108	Surry	USA							8	65
109	Susquehanna	USA							8	65
110	Three Mile Island	USA							8	65
111	Virgil C. Summer	USA							8	65
112	Vogtle	USA							8	65
113	Waterford	USA							8	65
114	Watts Bar	USA							8	65
115	Wolf Creek	USA							8	65
116	Dungeness	United Kingdom							8	65
117	Heysham	United Kingdom							8	65
118	Sizewell	United Kingdom							8	65
119	Wylfa	United Kingdom							8	65
120	Khmelnyskyi	Ukraine							8	65
121	Rivne - Rovno	Ukraine							8	65
122	South Ukraine	Ukraine							8	65
123	Maanschan	Taiwan							8	65
124	Forsmark	Sweden							8	65
125	Oskarshamn	Sweden							8	65
126	Aljmaraz	Spain							8	65
127	Asco	Spain							8	65
128	Cofrentes	Spain							8	65
129	Trillo	Spain							8	65
130	Vandellos	Spain							8	65
131	Balakovo	Russian Fed.							8	65
132	Bilibino	Russian Fed.							8	65
133	Kalinin	Russian Fed.							8	65
134	Kola	Russian Fed.							8	65
135	Kursk	Russian Fed.							8	65
136	Leningrad	Russian Fed.							8	65
137	Leningrad 2	Russian Fed.							8	65
138	Smolensk	Russian Fed.							8	65
139	Volgodonsk-Rostov	Russian Fed.							8	65
140	Chashma	Pakistan							8	65
141	Laguna Verde	Mexico							8	65
142	Hanul - Uljin	Korea Rep.							8	65
143	Higashidori	Japan							8	65
144	Ikata	Japan							8	65
145	Kashiwazaki-Kariwa	Japan							8	65
146	Mihama	Japan							8	65
147	Monju	Japan							8	65
148	Ohi	Japan							8	65
149	Ohma	Japan							8	65
150	Sendai	Japan							8	65
151	Shika	Japan							8	65
152	Shimane	Japan							8	65
153	Takahama	Japan							8	65
154	Tokai	Japan							8	65
155	Tomari	Japan							8	65
156	Bushehr	Iran							8	65
157	Kaiga	India							8	65
158	Kakrapar	India							8	65
159	Kudankulam	India							8	65
160	Narora	India							8	65
161	Rajasthan	India							8	65
162	Tarapur	India							8	65
163	Paks	Hungary							8	65

164	Isar	Germany						8	65
165	Belleville	France						8	65
166	Cattenom	France						8	65
167	Chinon	France						8	65
168	Chooz**	France						8	65
169	Civaux	France						8	65
170	Cruas	France						8	65
171	Fessenheim**	France						8	65
172	Flammanville	France						8	65
173	Golfech	France						8	65
174	Gravelines	France						8	65
175	Nogent-sur-Seine	France						8	65
176	Paluel	France						8	65
177	Pierrelatte (Tricastin)	France						8	65
178	St-Martin en Ch. Penly	France						8	65
179	Fuqing	China						8	65
180	Haiyang	China						8	65
181	Hongyanhe	China						8	65
182	Ningde	China						8	65
183	Qinshan	China						8	65
184	Sanmen	China						8	65
185	Taishan	China						8	65
186	Tianwan	China						8	65
187	Yangjiang	China						8	65
188	Bruce	Canada						8	65
189	Gentilly	Canada						8	65
190	Point Lepreau	Canada						8	65
191	Kozlodui	Bulgaria						8	65
192	Angra	Brazil						8	65
193	Atucha	Argentina						8	65
194	Embalse	Argentina						8	65
	Chernobyl*	Ukraine						8	
	Fukushima Daichi*	Japan						8	
	Fukushima Daini*	Japan						8	

Table 5: The rank of each urban area is calculated in comparison to the country's population. The distance from urban areas to nuclear power plants is measured based on the location of the first densely constructed suburb. Of 194 nuclear power plants, 9 are less than 50 km from Rank 1 cities in their own country; 167 plants have at most one Rank 3 city within less than 30 km (6/7). However, 130 plants do not have a Rank 3 city within less than 50 km (2/3). This table does not take into consideration urban areas located in another country given the strategic perspective of the analysis.

* Nuclear power plants definitively shut down after a Level 7 accident as defined by the International Nuclear and Radiological Event Scale (INES).

** Nuclear power plants that threaten urban areas in other countries. These urban areas are not included in this table. (For details about these sites, see Table 4.)

Author: Institut Biosphère, Geneva, 2015, www.institutbiosphere.ch

The Vulnerability of Small Countries in the Event of a Major Nuclear Accident in Their Territory: Strategic Analysis and International Comparison

STRATEGIC WEAKNESS AND VULNERABILITY: Ranking of 194 active nuclear power plants according to their proximity to the main urban areas of the country in which the plant is located (the rank of each urban area is based on the country's main metropolitan area.)

Table 6: Cities according to metropolitan area approach			Population Urban Area (UA)		Population Urban Area (UA)		Population Urban Area (UA)		Proximity to main urban areas (Vulnerability)	
Line No.	Nuclear Power Plant (Metropolitan Area Exposed) Name	Country Name	Rank 1		Rank 2		Rank 3		Illustrative default case (Minimum 8)	1 = high vulnerability Rank
			Dist. to plant (km)		Dist. to plant (km)		Dist. to plant (km)			
			<=30	31 to 50	<=30	31 to 50	<=30	31 to 50		
No.	Name	Name	No. of UA Rank 1	No. of UA Rank 1	No. of UA Rank 2	No. of UA Rank 2	No. of UA Rank 3	No. of UA Rank 3		
1	Beznau (Zürich)	Switzerland	1				1		107	1
2	Metsamor (Erevan)	Armenia	1				1	1	93	2
3	Kuosheng (Taipei)	Taiwan	1				1		92	3
4	Jinshan (Taipei)	Taiwan	1				1		92	3
5	Koeberg (Capa Town)	South-Africa	1						88	5
6	Kanupp (Karachi)	Pakistan	1						88	5
7	Pickering (Toronto)	Canada	1						88	5
8	Leibstadt (Zürich)	Switzerland		1				1	85	8
9	Goesgen (Zürich)	Switzerland		1		1		1	85	8
10	Indian Point (New-York)	USA		1					66	10
11	Brokdorf (Hamburg)	Germany		1					66	10
12	Darlington (Toronto)	Canada		1					66	10
13	Bohunice	Slovakia			1	1		2	65	13
14	Doel	Belgium			1	1			63	14
15	Mühleberg	Switzerland			1		3	1	58	15
16	Philippsburg	Germany			1		2	1	54	16
17	Neckarwestheim	Germany			1		1	1	50	17
18	Kori II / Kori	Korea Rep.					1		49	18
19	Mochovce	Slovakia			1			2	47	19
20	Tihange**	Belgium			1			1	46	20
21	Turkey Point	USA			1				45	21
22	Limerick	USA				2			44	22
23	Enrico Fermi	USA				2			44	22
24	Dresden	USA				2			44	22
25	Lingao	China				2			44	22
26	Guangdong - Daya Bay	China				2			44	22
27	Zaporizhia	Ukraine				1	1		30	27
28	Grohnde	Germany				1		1	27	28
29	Ringhals	Sweden				1			26	29
30	Madras	India				1			26	29
31	Kakrapar	India				1			26	29
32	Dukovany	Czech Rep.				1			26	29
33	Grafenrheinfeld	Germany					2	1	17	33
34	St-Alban	France					2		16	34
35	Krsko**	Slovenia					1	2	14	35
36	Hinkley Point B	United Kingdom					1	1	13	36
37	Gundremmingen	Germany					1	1	13	36
38	Waterford	USA					1		12	38
39	Shearon Harris	USA					1		12	38
40	R. E. Ginna	USA					1		12	38
41	McGuire	USA					1		12	38
42	Fort Calhoun	USA					1		12	38
43	Catawba	USA					1		12	38
44	Borssele**	Netherlands					1		12	38
45	Wolsong-Shin	Korea Rep.					1		12	38
46	Wolsong	Korea Rep.					1		12	38
47	Bushehr	Iran					1		12	38
48	Bugey	France					1		12	38
49	Temelin	Czech Rep.					1		12	38
50	Sanmen	China						2	10	50
51	Surry	USA						1	9	51
52	Prairie Island	USA						1	9	51
53	Perry	USA						1	9	51
54	Peach Bottom	USA						1	9	51
55	Oconee	USA						1	9	51
56	Monticello	USA						1	9	51
57	Beaver Valley	USA						1	9	51
58	Torness	United Kingdom						1	9	51
59	Hunterston	United Kingdom						1	9	51
60	Hartlepool	United Kingdom						1	9	51
61	Khmelnyskyi	Ukraine						1	9	51
62	Novovoronezh-2	Russian Fed.						1	9	51

63	Novovoronezh	Russian Fed.		1	9	51
64	Beloyarsky	Russian Fed.		1	9	51
65	Cernavoda	Romania		1	9	51
66	Hanbit	Korea Rep.		1	9	51
67	Sendai	Japan		1	9	51
68	Onagawa	Japan		1	9	51
69	Genkai	Japan		1	9	51
70	Rajasthan	India		1	9	51
71	Narora	India		1	9	51
72	Isar	Germany		1	9	51
73	Emsland**	Germany		1	9	51
74	Le Blayais	France		1	9	51
75	Olkiluoto	Finland		1	9	51
76	Yangjiang	China		1	9	51
77	Qinshan	China		1	9	51
78	Fuqing	China		1	9	51
79	Wolf Creek	USA			8	79
80	Watts Bar	USA			8	79
81	Vogtle	USA			8	79
82	Virgil C. Summer	USA			8	79
83	Three Mile Island	USA			8	79
84	Susquehanna	USA			8	79
85	St. Lucie	USA			8	79
86	South Texas	USA			8	79
87	Sequoyah	USA			8	79
88	Seabrook	USA			8	79
89	Salem	USA			8	79
90	River Bend	USA			8	79
91	Quad Cities	USA			8	79
92	Point Bach	USA			8	79
93	Pilgrim	USA			8	79
94	Palo Verde	USA			8	79
95	Palisades	USA			8	79
96	Oyster Creek	USA			8	79
97	North Anna	USA			8	79
98	Nine Mile Point	USA			8	79
99	Millstone	USA			8	79
100	Lasalle	USA			8	79
101	Kewaunee	USA			8	79
102	Hope Creek	USA			8	79
103	Hatch	USA			8	79
104	H.B. Robinson	USA			8	79
105	Grand Gulf	USA			8	79
106	Fitzpatrick	USA			8	79
107	Farley	USA			8	79
108	Duan Arnold	USA			8	79
109	Donald Cook	USA			8	79
110	Diablo Canyon	USA			8	79
111	Davis Besse	USA			8	79
112	Crystal River	USA			8	79
113	Cooper	USA			8	79
114	Comanche Peak	USA			8	79
115	Columbia	USA			8	79
116	Clinton	USA			8	79
117	Calvert Cliffs	USA			8	79
118	Callaway	USA			8	79
119	Byron	USA			8	79
120	Brunswick	USA			8	79
121	Browns Ferry	USA			8	79
122	Braidwood	USA			8	79
123	Arkansas one	USA			8	79
124	Wylfa	United Kingdom			8	79
125	Sizewell	United Kingdom			8	79
126	Heysham	United Kingdom			8	79
127	Dungeness	United Kingdom			8	79
128	South Ukraine	Ukraine			8	79
129	Rivne - Rovno	Ukraine			8	79
130	Maanschan	Taiwan			8	79
131	Oskarshamn	Sweden			8	79
132	Forsmark	Sweden			8	79
133	Vandellos	Spain			8	79
134	Trillo	Spain			8	79
135	Cofrentes	Spain			8	79

136	Asco	Spain				8	79
137	Aljmaraz	Spain				8	79
138	Volgodonsk-Rostov	Russian Fed.				8	79
139	Smolensk	Russian Fed.				8	79
140	Leningrad 2	Russian Fed.				8	79
141	Leningrad	Russian Fed.				8	79
142	Kursk	Russian Fed.				8	79
143	Kola	Russian Fed.				8	79
144	Kalinin	Russian Fed.				8	79
145	Bilibino	Russian Fed.				8	79
146	Balakovo	Russian Fed.				8	79
147	Chashma	Pakistan				8	79
148	Laguna Verde	Mexico				8	79
149	Hanul - Uljin	Korea Rep.				8	79
150	Tomari	Japan				8	79
151	Tökai	Japan				8	79
152	Takahama	Japan				8	79
153	Shimane	Japan				8	79
154	Shika	Japan				8	79
155	Ohma	Japan				8	79
156	Ohi	Japan				8	79
157	Monju	Japan				8	79
158	Mihama	Japan				8	79
159	Kashiwazaki-Kariwa	Japan				8	79
160	Ikata	Japan				8	79
161	Higashidori	Japan				8	79
162	Tarapur	India				8	79
163	Kudankulam	India				8	79
164	Kaiga	India				8	79
165	Paks	Hungary				8	79
166	St-Martin en Ch. - Penly	France				8	79
167	St-Laurent	France				8	79
168	Pierrelatte (Tricastin)	France				8	79
169	Paluel	France				8	79
170	Nogent-sur-Seine	France				8	79
171	Gravelines	France				8	79
172	Golfech	France				8	79
173	Flammanville	France				8	79
174	Fessenheim**	France				8	79
175	Dampierre	France				8	79
176	Cruas	France				8	79
177	Civaux	France				8	79
178	Chooz**	France				8	79
179	Chinon	France				8	79
180	Cattenom	France				8	79
181	Belleville	France				8	79
182	Loviisa	Finland				8	79
183	Tianwan	China				8	79
184	Taishan	China				8	79
185	Ningde	China				8	79
186	Hongyanhe	China				8	79
187	Haiyang	China				8	79
188	Point Lepreau	Canada				8	79
189	Gentilly	Canada				8	79
190	Bruce	Canada				8	79
191	Kozlodui	Bulgaria				8	79
192	Angra	Brazil				8	79
193	Embalse	Argentina				8	79
194	Atucha	Argentina				8	79
	Fukushima Daiini*	Japan				8	
	Fukushima Daichi*	Japan				8	
	Chernobyl*	Ukraine				8	

Table 6: The rank of each urban area is calculated in comparison to the country's main metropolitan area. The distance from urban areas to nuclear power plants is measured based on the location of the first densely constructed suburb. Of 194 nuclear power plants, 12 are less than 50 km from Rank 1 cities in their own country; 156 plants have at most one Rank 3 city within 30 km or 50 km (4/5). However, 116 plants do not have any Rank 3 cities within less than 50 km (3/5). This table does not take into consideration urban areas located in another country given the strategic perspective of the analysis.

* Nuclear power plants definitively shut down after a Level 7 accident as defined by the International Nuclear and Radiological Event Scale (INES).

** Nuclear power plants that threaten urban areas in other countries. These urban areas are not included in this table. (For details about these sites, see Table 4.)

STRATEGIC WEAKNESS AND VULNERABILITY: Vulnerability of 31 countries in the event of a Level 7 major nuclear accident according to the INES at one of their active nuclear reactors.

Table 7: Summary of Tables 2, 3, 5, and 6			Vulnerability of population	Vulnerability according to territory	Rank of 194 nuclear power plants based on their proximity to main urban areas		Overall vulnerability	
Line No.	Nuclear Power Plant Name	Country Name	Percentage of population living in a 30 km radius of a nuclear power plant ^a	Impact of 2826 km ² exclusion zone	Note: Rank of each urban area depends on each country's population ("national population" approach)	Note: Rank of each urban area depends on the population of the country's metropolitan area ("metropolitan area" approach)	Potential vulnerability of each plant	Final rank: 1 = high vulnerability
			(see Table 2)	(see Table 3)	(see Table 5)	(see Table 6)	Cumulative rank Illustrative default case	Final rank
			Rank	Rank	Rank	Rank		
1	Metsamor	Armenia	1	2	2	2	7	1
2	Kuosheng	Taiwan	2	4	3	3	12	2
3	Jinshan	Taiwan	3	4	3	3	13	3
4	Beznau	Switzerland	6	5	1	1	13	3
5	Goesgen	Switzerland	7	5	8	8	28	5
6	Leibstadt	Switzerland	9	5	7	8	29	6
7	Doel	Belgium	5	3	9	14	31	7
8	Mühleberg	Switzerland	8	5	10	15	38	8
9	Tihange**	Belgium	10	3	12	20	45	9
10	Kanupp	Pakistan	15	21	5	5	46	10
11	Pickering	Canada	13	27	5	5	50	11
12	Kori II / Kori	Korea Rep.	12	10	11	18	51	12
13	Bohunice	Slovakia	11	7	24	13	55	13
14	Krsko**	Slovenia	4	1	23	35	63	14
15	Mochovce	Slovakia	14	7	25	19	65	15
16	Neckarwestheim	Germany	21	15	14	17	67	16
17	Dukovany	Czech Rep.	16	8	16	29	69	17
18	Philippsburg	Germany	20	15	20	16	71	18
19	Darlington	Canada	28	27	8	9	72	19
20	Borssele**	Netherlands	17	6	28	38	89	20
21	Ringhals	Sweden	30	17	16	29	92	21
22	Brokdorf	Germany	52	15	16	9	92	21
23	Temelin	Czech Rep.	18	8	28	38	92	21
24	Koeberg	South-Africa	52	22	14	5	93	24
25	Wolsong	Korea Rep.	19	10	28	38	95	25
26	Wolsong-Shin	Korea Rep.	25	10	28	38	101	26
27	Hinkley Point B	United Kingdom	34	13	25	36	108	27
28	St-Alban	France	33	20	21	34	108	27
29	Indian Point	USA	57	27	16	9	109	29
30	Hartlepool	United Kingdom	24	13	25	51	113	30
31	Olkiluoto	Finland	27	14	21	51	113	30
32	Grafenrheinfeld	Germany	40	15	28	33	116	32
33	Bugey	France	30	20	28	38	116	32
34	Zaporizhia	Ukraine	36	19	39	27	121	34
35	Grohnde	Germany	42	15	39	28	124	35
36	Gundremmingen	Germany	46	15	39	36	136	36
37	Hunterston	United Kingdom	39	13	39	51	142	37
38	Cernavoda	Romania	41	12	39	51	143	38
39	Emsland**	Germany	43	15	39	51	148	39
40	Limerick	USA	61	27	39	22	149	40
41	Hanbit	Korea Rep.	58	10	39	51	158	41
42	Guangdong - Daya Bay	China	73	27	39	22	161	42
43	Turkey Point	USA	88	27	28	21	164	43
44	Lingao	China	76	27	39	22	164	43
45	McGuire	USA	73	27	28	38	166	45
46	Khmelnytskyi	Ukraine	35	19	65	51	170	46
47	Catawba	USA	78	27	28	38	171	47
48	Loviisa	Finland	43	14	38	79	174	48
49	Paks	Hungary	23	9	65	79	176	49
50	St-Laurent	France	50	20	28	79	177	50
51	Kozlodui	Bulgaria	22	11	65	79	177	50
52	Isar	Germany	54	15	65	51	185	52
53	Genkai	Japan	81	16	39	51	187	53
54	Heysham	United Kingdom	32	13	65	79	189	54
55	Fessenheim**	France	26	20	65	79	190	55
56	Le Blayais	France	81	20	39	51	191	56
57	Enrico Fermi	USA	105	27	39	22	193	57
58	Bushehr	Iran. Islam. Rep.	67	23	65	38	193	57
59	Cattenom	France	29	20	65	79	193	57
60	Onagawa	Japan	88	16	39	51	194	60
61	Tokai	Japan	36	16	65	79	196	61
62	Beloyarsky	Russian Fed.	78	31	39	51	199	62
63	Gravelines	France	38	20	65	79	202	63
64	Dresden	USA	118	27	39	22	206	64
65	Dungeness	United Kingdom	49	13	65	79	206	64

66	Vandellos	Spain	47	18	65	79	209	66
67	Pierrelatte (Tricastin)	France	48	20	65	79	212	67
68	Beaver Valley	USA	97	27	39	51	214	68
69	Gentilly	Canada	45	27	65	79	216	69
70	Sizewell	United Kingdom	61	13	65	79	218	70
71	Kashiwazaki-Kariwa	Japan	58	16	65	79	218	70
72	Shimane	Japan	58	16	65	79	218	70
73	Chashma	Pakistan	55	21	65	79	220	73
74	Sendai	Japan	88	16	65	51	220	73
75	Cruas	France	56	20	65	79	220	73
76	Atucha	Argentina	51	25	65	79	220	73
77	R. E. Ginna	USA	91	27	65	38	221	77
78	Dampierre	France	84	20	39	79	222	78
79	Civaux	France	61	20	65	79	225	79
80	Oskarshamn	Sweden	65	17	65	79	226	80
81	Narora	India	84	26	65	51	226	80
82	Torness	United Kingdom	124	13	39	51	227	82
83	Peach Bottom	USA	111	27	39	51	228	83
84	South Ukraine	Ukraine	65	19	65	79	228	83
85	Chooz**	France	64	20	65	79	228	83
86	Shearon Harris	USA	99	27	65	38	229	86
87	Golfech	France	67	20	65	79	231	87
88	Novovoronezh	Russian Fed.	111	31	39	51	232	88
89	Rivne - Rovno	Ukraine	70	19	65	79	233	89
90	St-Martin en Ch. - Penly	France	69	20	65	79	233	89
91	Chinon	France	70	20	65	79	234	91
92	Waterford	USA	105	27	65	38	235	92
93	Forsmark	Sweden	76	17	65	79	237	93
94	Flammanville	France	73	20	65	79	237	93
95	Three Mile Island	USA	70	27	65	79	241	95
96	Surry	USA	99	27	65	51	242	96
97	Monju	Japan	84	16	65	79	244	97
98	Paluel	France	80	20	65	79	244	97
99	Novovoronezh-2	Russian Fed.	124	31	39	51	245	99
100	Hanul - Uljin	Korea Rep.	91	10	65	79	245	99
101	Perry	USA	129	27	39	51	246	101
102	Nogent-sur-Seine	France	84	20	65	79	248	102
103	Kakrapar	India	129	26	65	29	249	103
104	Madras	India	155	26	39	29	249	103
105	Embalse	Argentina	81	25	65	79	250	105
106	Mihama	Japan	91	16	65	79	251	106
107	Shika	Japan	91	16	65	79	251	106
108	Fort Calhoun	USA	124	27	65	38	254	108
109	Takahama	Japan	95	16	65	79	255	109
110	Maanschan	Taiwan	111	4	65	79	259	110
111	Bellevalle	France	95	20	65	79	259	110
112	Monticello	USA	144	27	39	51	261	112
113	Asco	Spain	99	18	65	79	261	112
114	Qinshan	China	118	27	65	51	261	112
115	Ohi	Japan	105	16	65	79	265	115
116	Aljmaraz	Spain	105	18	65	79	267	116
117	Sequoyah	USA	97	27	65	79	268	117
118	Hope Creek	USA	99	27	65	79	270	118
119	Oyster Creek	USA	99	27	65	79	270	118
120	Seabrook	USA	99	27	65	79	270	118
121	Ikata	Japan	111	16	65	79	271	121
122	Wylfa	United Kingdom	118	13	65	79	275	122
123	Fuqing	China	132	27	65	51	275	122
124	Salem	USA	105	27	65	79	276	124
125	Prairie Island	USA	163	27	39	51	280	125
126	Kursk	Russian Fed.	105	31	65	79	280	125
127	Oconee	USA	138	27	65	51	281	127
128	St.Lucie	USA	111	27	65	79	282	128
129	Cofrentes	Spain	124	18	65	79	286	129
130	Balakovo	Russian Fed.	111	31	65	79	286	129
131	Volgodonsk-Rostov	Russian Fed.	111	31	65	79	286	129
132	Sanmen	China	144	27	65	50	286	129
133	Millstone	USA	118	27	65	79	289	133
134	Susquehanna	USA	118	27	65	79	289	133
135	Bruce	Canada	118	27	65	79	289	133
136	Pilgrim	USA	124	27	65	79	295	136
137	Laguna Verde	Mexico	129	24	65	79	297	137
138	Rajasthan	India	155	26	65	51	297	137
139	Higashidori	Japan	138	16	65	79	298	139
140	Tomari	Japan	138	16	65	79	298	139
141	Byron	USA	132	27	65	79	303	141
142	Duan Arnold	USA	132	27	65	79	303	141
143	Quad Cities	USA	132	27	65	79	303	141
144	Tianwan	China	132	27	65	79	303	141
145	Angra	Brazil	132	27	65	79	303	141
146	Ohma	Japan	144	16	65	79	304	146
147	Kudankulam	India	138	26	65	79	308	147
148	Point Lepreau	Canada	138	27	65	79	309	148
149	Smolensk	Russian Fed.	138	31	65	79	313	149
150	Tarapur	India	144	26	65	79	314	150
151	Browns Ferry	USA	144	27	65	79	315	151
152	Calvert Cliffs	USA	144	27	65	79	315	151
153	Diablo Canyon	USA	144	27	65	79	315	151
154	Donald Cook	USA	144	27	65	79	315	151

155	Haiyang	China	144	27	65	79	315	151
156	Leningrad	Russian Fed.	144	31	65	79	319	156
157	Leningrad 2	Russian Fed.	144	31	65	79	319	156
158	Trillo	Spain	163	18	65	79	325	158
159	Braidwood	USA	155	27	65	79	326	159
160	Brunswick	USA	155	27	65	79	326	159
161	Palisades	USA	155	27	65	79	326	159
162	River Bend	USA	155	27	65	79	326	159
163	Virgil C. Summer	USA	155	27	65	79	326	159
164	Taishan	China	155	27	65	79	326	159
165	Yangjiang	China	186	27	65	51	329	165
166	Kaiga	India	163	26	65	79	333	166
167	Arkansas one	USA	163	27	65	79	334	167
168	Columbia	USA	163	27	65	79	334	167
169	Crystal River	USA	163	27	65	79	334	167
170	Davis Besse	USA	163	27	65	79	334	167
171	Farley	USA	163	27	65	79	334	167
172	Fitzpatrick	USA	163	27	65	79	334	167
173	H.B. Robinson	USA	163	27	65	79	334	167
174	Lasalle	USA	163	27	65	79	334	167
175	Nine Mile Point	USA	163	27	65	79	334	167
176	North Anna	USA	163	27	65	79	334	167
177	Point Bach	USA	163	27	65	79	334	167
178	Watts Bar	USA	163	27	65	79	334	167
179	Ningde	China	163	27	65	79	334	167
180	Kalinin	Russian Fed.	163	31	65	79	338	180
181	Kola	Russian Fed.	163	31	65	79	338	180
182	Clinton	USA	181	27	65	79	352	182
183	Comanche Peak	USA	181	27	65	79	352	182
184	Hatch	USA	181	27	65	79	352	182
185	Kewaunee	USA	181	27	65	79	352	182
186	Hongyanhe	China	181	27	65	79	352	182
187	Callaway	USA	186	27	65	79	357	187
188	Cooper	USA	186	27	65	79	357	187
189	Grand Gulf	USA	186	27	65	79	357	187
190	Palo Verde	USA	186	27	65	79	357	187
191	South Texas	USA	186	27	65	79	357	187
192	Vogtle	USA	186	27	65	79	357	187
193	Wolf Creek	USA	193	27	65	79	364	193
194	Bilibino	Russian Fed.	193	31	65	79	368	194

Table 7 summarizes the main results of Tables 2, 3, 5, and 6. It merges approaches that identify potential vulnerability based on the number of inhabitants living near a nuclear power plant (Table 2), territorial impact (Table 3), and urban areas near plants (Tables 5 and 6). The final rank can be considered robust.

a) The primary data are from Declan Butler's article in *Nature*: <http://www.nature.com/news/2011/110421/full/472400a.html>

** Nuclear power plants that threaten urban areas in other countries. (For details about these sites, see Table 4.)

Author: Institut Biosphère, Geneva, 2015, www.institutbiosphere.ch