

**75 Jahre wird**

28. Dipl.-Ing. Hans-J. Fröhlich, Berzhahn

**70 Jahre werden**

5. Dr. Hartmut Lauer, Montferrier sur Lez/F
6. Dr. Michael Micklinghoff, Hemmingen
6. Dr. Roland Schenkel, Baden-Baden
7. Dr. Mohammad Ali Movahed, Kelkheim
11. Dipl.-Ing. Alexander Hüttmeler, Röttenbach
20. Dr. Karl-Heinz Trummer, Baiersdorf

**65 Jahre wird**

10. Dipl.-Ing. (FH) Stefan Felber, Burgau

**60 Jahre wird**

30. Peter Schira, Hördt

**50 Jahre werden**

1. Dipl.-Ing. Thomas Lexow, Hanau
29. Dipl.-Ing. Thomas Kluth, Wachtendonk

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**KTG Inside**

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# Nuclear Power Plants: 2016 atw Compact Statistics

## Editorial

**At** the end of the last year 2016 (key date: 31 December 2016), nuclear power plants were operating in 31 countries worldwide (cf. **Table 1**). In total, **450 nuclear power plants** were operating on the key date, which means the highest number of units since the first start of an commercial nuclear power plant in 1956. This means that the number increased by 8 units compared to the previous year's number on 31 December 2015 (442) due to first criticalities on the one hand and shut-downs on the other. The **gross power output** of these nuclear power plant units<sup>1</sup> amounted to around 421 GWe\*, the **net power output** was approximately 397 GWe. This means that the available gross capacity was about 11 GW, i.e. 3 % and the net capacity about 9 GW above the previous year's values of about 409 GWe gross and 388 GWe net.

Ten (10) nuclear power plants **started (nuclear) operation**<sup>1</sup> in four countries in 2016. Six units reached initial criticality, were synchronized with the grid and started commercial operation for the first time in 2016 (cf. **Tab. 1**): China: Changjiang 2 (650 MW, PWR, CGO), Fangchenggang 2 (1086 MW, PWR, CGO), Fuqing 3 (1089 MW, PWR, CGO), Hongyanhe 4 (1119 MW, PWR, CGO), Ningde 4 (1089 MW, PWR, CGO) and USA: Watts Bar 2 (1218 MW, PWR, CGO). Three units reached initial criticality and were synchronized with the grid for the first time in 2016 (cf. Table 1): China: Yangjiang 4 (1086 MW, C); Pakistan: Chasnupp 3 (340 MW, PWR, CG); India: Kudankulam 2 (1000 MW, PWR, CG); Russia: Novovoronezh 2-1 (1115 MW, PWR, CG). One unit reached initial criticality: China: Yangjiang 4 (1086 MW, C). In South Korea one unit which reached initial criticality in 2015 was synchronized with the grid and started commercial operation in 2016: Shin-Kori 3 (1 400 MW, GO).

For the second time since the accidents in Fukushima (Japan) one nuclear power unit, Ikata 3 (890 MW, PWR) resumed operation in 2016 in Japan after a longer shut-down. The units Sendai 1 (PWR, 890 MW) and Sendai 2 (PWR, 890 MW) were connected to the grid in 2015. Further restarts are planned, prepared and applied for at the authorities.

Two nuclear power plant units were definitively permanently shut-down worldwide in 2016. In Russia the unit Novovoronezh 3 (417 MW) was shut-down after 44 years of successful operation. In the USA the unit Fort Calhoun 1 (512 MW) was shut down after 43 year of commercial operation due to economic considerations.

Three new projects started with the first concrete and further build activities. In China two new build projects started with Fangchenggang 4 (1180 MW) and Tianwan 6 (1118 MW), and in Pakistan one additional project started with Kanupp 3 (1100 MW).

In total 58 reactors are under construction worldwide in 15 countries. The total gross capacity of this projects is about 62 GW\*, the net capacity 59 GW.

At the end of last year 2016, 58 plants in 15 countries were under construction, in other words the number was lower compared to the previous year number due to the ten operation starts and three new build projects. The capacity of these projects amounts to about 62 GWe gross and 59 GWe net power output, in other words both about 6 GW lower than a year earlier. Three new nuclear power plant projects were started in 2016: New construction projects are reported from China; two units (Fangchenggang 4 and Tianwan 6), and Pakistan; one project (Kanupp 3). Compared with the millennium change 1999/2000 this means that the number of projects under construction has risen, when 30 nuclear power plants were under construction worldwide.

Active construction projects (numbers in brackets) listed are: Argentina (1), Belarus (2), Brazil (1), China (20), Finland (1), France (1), India (5), Japan (2), Republic of Korea (3), Pakistan (3), Russia (7), Slovak Republic (2), Taiwan (2), the USA (4) and the United Arab Emirates (4).

In addition, there are about 125 nuclear power plant units in 25 countries worldwide that are in an advanced planning stage, others are in the pre-planning phase (status: 31 December 2016).

Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]	
<b>Argentina</b>						
Atucha 1	■	D2O-PWR	357	341	1974	
Embalse	■	Candu	648	600	1983	
Atucha 2	■	D2O-PWR	745	692	2014	
CAREM25	□	PWR	29	25	(2020)	
<b>Armenia</b>						
Metsamor 2	■	VVER-PWR	408	376	1980	
<b>Belarus</b>						
Belarusian 1	□	VVER-PWR	1194	1109	(2019)	
Belarusian 2	□	VVER-PWR	1194	1109	(2021)	
<b>Belgium</b>						
Doel 1	■	PWR	454	433	1975	
Doel 2	■	PWR	454	433	1975	
Doel 3	■	PWR	1056	1006	1982	
Doel 4	■	PWR	1090	1039	1985	
Tihange 1	■	PWR	1009	962	1975	
Tihange 2	■	PWR	1055	1008	1983	
Tihange 3	■	PWR	1094	1046	1985	
<b>Brazil</b>						
Angra 1	■	PWR	640	609	1984	
Angra 2	■	PWR	1350	1275	1999	
Angra 3	□	PWR	1300	1245	(2017)	
<b>Bulgarien</b>						
Kozloduj 5	■	VVER-PWR	1000	953	1987	
Kozloduj 6	■	VVER-PWR	1000	953	1989	
<b>Canada</b>						
Bruce 1	■	Candu	824	772	1977	
Bruce 2	■	Candu	786	734	1977	
Bruce 3	■	Candu	805	730	1977	
Bruce 4	■	Candu	805	750	1979	
Bruce 5	■	Candu	872	817	1985	
Bruce 6	■	Candu	891	822	1984	
Bruce 7	■	Candu	872	817	1986	
Bruce 8	■	Candu	845	817	1987	
Darlington 1	■	Candu	934	878	1993	
Darlington 2	■	Candu	934	878	1990	
Darlington 3	■	Candu	934	878	1993	
Darlington 4	■	Candu	934	878	1993	
Pickering 1	■	Candu	542	515	1971	
Pickering 4	■	Candu	542	515	1973	
Pickering 5	■	Candu	540	516	1983	
Pickering 6	■	Candu	540	516	1984	
Pickering 7	■	Candu	540	516	1985	
Pickering 8	■	Candu	540	516	1986	
Point Lepreau	■	Candu	705	660	1983	
<b>China</b>						
CEFR	■	SNR	25	20	2011	
Changjiang 1	■	PWR	650	610	2015	
Changjiang 2	[1]	■	PWR	650	601	2016
Fangchenggang 1	■	PWR	1080	1000	2015	
Fangchenggang 2	[1]	■	PWR	1088	1000	2016
Fangjiashan 1	■	PWR	1080	1000	2014	
Fangjiashan 2	■	PWR	1080	1000	2014	
Fuqing 1	■	PWR	1087	1000	2014	
Fuqing 2	■	PWR	1087	1000	2015	
Fuqing 3	[1]	■	PWR	1089	1000	2016
Guandong 1	■	PWR	984	944	1993	
Guandong 2	■	PWR	984	944	1994	
Hongyanhe 1	■	PWR	1080	1000	2013	
Hongyanhe 2	■	PWR	1080	1000	2013	
Hongyanhe 3	■	PWR	1080	1000	2014	
Hongyanhe 4	[1]	■	PWR	1119	1000	2016
Lingao 1	■	PWR	990	938	2002	
Lingao 2	■	PWR	990	938	2002	
Lingao II-1	■	PWR	1087	1000	2010	
Lingao II-2	■	PWR	1087	1000	2011	
Ningde 1	■	PWR	1087	1000	2012	
Ningde 2	■	PWR	1080	1000	2014	
Ningde 3	■	PWR	1080	1000	2015	
Ningde 4	[1]	■	PWR	1089	1018	2016
Qinshan 1	■	PWR	310	288	1992	
Qinshan II-1	■	PWR	650	610	2002	
Qinshan II-2	■	PWR	650	610	2004	
Qinshan II-3	■	PWR	642	610	2010	
Qinshan II-4	■	PWR	642	610	2011	
Qinshan III-1	■	Candu	728	665	2002	
Qinshan III-2	■	Candu	728	665	2003	
Tianwan 1	■	VVER-PWR	1060	1000	2005	
Tianwan 2	■	VVER-PWR	1060	1000	2007	
Yangjiang 1	■	PWR	1080	1000	2013	
Yangjiang 2	■	PWR	1080	1000	2015	

Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]	
Yangjiang 3	■	PWR	1080	1000	2015	
Yangjiang 4	■	PWR	1086	1000	2016	
Fangchenggang 3	□	PWR	1080	1000	(2020)	
Fangchenggang 4	[2]	□	PWR	1080	1000	(2022)
Fuqing 4	□	PWR	1087	1000	(2016)	
Fuqing 5	□	PWR	1087	1000	(2020)	
Fuqing 6	□	PWR	1087	1000	(2020)	
Haiyang 1	□	PWR	1180	1100	(2016)	
Haiyang 2	□	PWR	1180	1100	(2016)	
Hongyanhe 5	□	PWR	1080	1000	(2020)	
Hongyanhe 6	□	PWR	1080	1000	(2021)	
Sanmen 1	□	PWR	1180	1100	(2016)	
Sanmen 2	□	PWR	1180	1100	(2016)	
Shidaowan 1	□	HTGR	211	200	(2016)	
Taishan 1	□	PWR	1750	1660	(2017)	
Taishan 2	□	PWR	1750	1660	(2018)	
Tianwan 3	□	VVER-PWR	1060	990	(2017)	
Tianwan 4	□	VVER-PWR	1060	990	(2018)	
Tianwan 5	□	VVER-PWR	1118	1000	(2020)	
Tianwan 6	[2]	□	VVER-PWR	1118	1000	(2022)
Yangjiang 5	□	PWR	1080	1000	(2018)	
Yangjiang 6	□	PWR	1080	1000	(2018)	
<b>Czech Republic</b>						
Dukovany 1	■	VVER-PWR	500	473	1985	
Dukovany 2	■	VVER-PWR	500	473	1986	
Dukovany 3	■	VVER-PWR	500	473	1987	
Dukovany 4	■	VVER-PWR	500	473	1987	
Temelin 1	■	VVER-PWR	1077	1027	1999	
Temelin 2	■	VVER-PWR	1056	1006	2002	
<b>Finland</b>						
Loviisa 1	■	VVER-PWR	520	496	1977	
Loviisa 2	■	VVER-PWR	520	496	1981	
Olkiluoto 1	■	BWR	890	860	1979	
Olkiluoto 2	■	BWR	890	860	1982	
Olkiluoto 3	□	PWR	1600	1510	(2018)	
<b>France</b>						
Belleville 1	■	PWR	1363	1310	1987	
Belleville 2	■	PWR	1363	1310	1988	
Blayais 1	■	PWR	951	910	1981	
Blayais 2	■	PWR	951	910	1982	
Blayais 3	■	PWR	951	910	1983	
Blayais 4	■	PWR	951	910	1983	
Bugey 2	■	PWR	945	910	1978	
Bugey 3	■	PWR	945	910	1978	
Bugey 4	■	PWR	917	880	1979	
Bugey 5	■	PWR	917	880	1979	
Cattenom 1	■	PWR	1362	1300	1986	
Cattenom 2	■	PWR	1362	1300	1987	
Cattenom 3	■	PWR	1362	1300	1990	
Cattenom 4	■	PWR	1362	1300	1991	
Chinon B-1	■	PWR	954	905	1982	
Chinon B-2	■	PWR	954	905	1983	
Chinon B-3	■	PWR	954	905	1986	
Chinon B-4	■	PWR	954	905	1987	
Chooz B-1	■	PWR	1560	1500	1996	
Chooz B-2	■	PWR	1560	1500	1997	
Civaux 1	■	PWR	1561	1495	1997	
Civaux 2	■	PWR	1561	1495	1999	
Cruas Meysse 1	■	PWR	956	915	1983	
Cruas Meysse 2	■	PWR	956	915	1984	
Cruas Meysse 3	■	PWR	956	915	1984	
Cruas Meysse 4	■	PWR	956	915	1984	
Dampierre 1	■	PWR	937	890	1980	
Dampierre 2	■	PWR	937	890	1980	
Dampierre 3	■	PWR	937	890	1981	
Dampierre 4	■	PWR	937	890	1981	
Fessenheim 1	■	PWR	920	880	1977	
Fessenheim 2	■	PWR	920	880	1977	
Flamanville 1	■	PWR	1382	1330	1985	
Flamanville 2	■	PWR	1382	1330	1986	
Golfch 1	■	PWR	1363	1310	1990	
Golfch 2	■	PWR	1363	1310	1993	
Gravelines B-1	■	PWR	951	910	1980	
Gravelines B-2	■	PWR	951	910	1980	
Gravelines B-3	■	PWR	951	910	1980	
Gravelines B-4	■	PWR	951	910	1981	
Gravelines C-5	■	PWR	951	910	1984	
Gravelines C-6	■	PWR	951	910	1985	
Nogent 1	■	PWR	1363	1310	1987	
Nogent 2	■	PWR	1363	1310	1988	
Paluel 1	■	PWR	1382	1330	1984	

Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]
Paluel 2	■	PWR	1382	1330	1984
Paluel 3	■	PWR	1382	1330	1985
Paluel 4	■	PWR	1382	1330	1986
Penly 1	■	PWR	1382	1330	1990
Penly 2	■	PWR	1382	1330	1992
St. Alban 1	■	PWR	1381	1335	1986
St. Alban 2	■	PWR	1381	1335	1987
St. Laurent B-1	■	PWR	956	915	1981
St. Laurent B-2	■	PWR	956	915	1981
Tricastin 1	■	PWR	955	915	1980
Tricastin 2	■	PWR	955	915	1980
Tricastin 3	■	PWR	955	915	1980
Tricastin 4	■	PWR	955	915	1981
Flamanville 3	□	PWR	1600	1510	(2018)
<b>Germany</b>					
Brokdorf	■	PWR	1480	1410	1986
Emsland	■	PWR	1406	1335	1988
Grohnde	■	PWR	1430	1360	1985
Gundremmingen B	■	BWR	1344	1284	1984
Gundremmingen C	■	BWR	1344	1288	1985
Isar 2	■	PWR	1485	1410	1988
Neckarwestheim II	■	PWR	1400	1310	1989
Philippsburg 2	■	PWR	1468	1402	1985
<b>Hungary</b>					
Paks 1	■	VVER-PWR	500	470	1983
Paks 2	■	VVER-PWR	500	473	1984
Paks 3	■	VVER-PWR	500	473	1986
Paks 4	■	VVER-PWR	500	473	1987
<b>India</b>					
Kaiga 1	■	Candu (IND)	220	202	2001
Kaiga 2	■	Candu (IND)	220	202	1999
Kaiga 3	■	Candu (IND)	220	202	2007
Kaiga 4	■	Candu (IND)	220	202	2010
Kakrapar 1	■	Candu (IND)	220	202	1993
Kakrapar 2	■	Candu (IND)	220	202	1995
Kudankulam 1	■	VVER-PWR	1000	917	2013
Kudankulam 2	[1]	VVER-PWR	1000	917	2016
Madras Kalpakkam 1	■	Candu (IND)	220	205	1984
Madras Kalpakkam 2	■	Candu (IND)	220	205	1986
Narora 1	■	Candu (IND)	220	202	1992
Narora 2	■	Candu (IND)	220	202	1991
Rajasthan 1	■	Candu	100	90	1973
Rajasthan 2	■	Candu	200	187	1981
Rajasthan 3	■	Candu (IND)	220	202	1999
Rajasthan 4	■	Candu (IND)	220	202	2000
Rajasthan 5	■	Candu (IND)	220	202	2009
Rajasthan 6	■	Candu (IND)	220	202	2010
Tarapur 1	■	BWR	160	150	1969
Tarapur 2	■	BWR	160	150	1969
Tarapur 3	■	Candu (IND)	540	490	2006
Tarapur 4	■	Candu (IND)	540	490	2005
Kakrapar 3	□	Candu (IND)	700	640	(2016)
Kakrapar 4	□	Candu (IND)	700	640	(2016)
PFBR (Kalpakkam)	□	SNR	500	470	(2016)
Rajasthan 7	□	Candu (IND)	700	630	(2017)
Rajasthan 8	□	Candu (IND)	700	630	(2017)
<b>Iran</b>					
Bushehr 1	■	VVER-PWR	1000	953	2011
<b>Japan</b>					
Fukushima Daini 1	■	BWR	1100	1067	1982
Fukushima Daini 2	■	BWR	1100	1067	1984
Fukushima Daini 3	■	BWR	1100	1067	1985
Fukushima Daini 4	■	BWR	1100	1067	1987
Genkai 2	■	PWR	559	529	1981
Genkai 3	■	PWR	1180	1127	1994
Genkai 4	■	PWR	1180	1127	1997
Hamaoka 3	■	BWR	1100	1056	1987
Hamaoka 4	■	BWR	1137	1092	1993
Hamaoka 5	■	BWR	1267	1216	2004
Higashidori 1	■	BWR	1100	1067	2005
Ikata 2	■	PWR	566	538	1982
Ikata 3	[4]	PWR	890	846	1994
Kashiwazaki Kariwa 1	■	BWR	1100	1067	1985
Kashiwazaki Kariwa 2	■	BWR	1100	1067	1990
Kashiwazaki Kariwa 3	■	BWR	1100	1067	1993
Kashiwazaki Kariwa 4	■	BWR	1100	1067	1994
Kashiwazaki Kariwa 5	■	BWR	1100	1067	1990
Kashiwazaki Kariwa 6	■	BWR	1356	1315	1996
Kashiwazaki Kariwa 7	■	BWR	1356	1315	1997
Mihama 3	■	PWR	826	781	1976
Monju	■	FBR	280	246	1994

Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]
Ohi 1	■	PWR	1175	1120	1979
Ohi 2	■	PWR	1175	1120	1979
Ohi 3	■	PWR	1180	1127	1991
Ohi 4	■	PWR	1180	1127	1993
Onagawa 1	■	BWR	524	496	1984
Onagawa 2	■	BWR	825	796	1995
Onagawa 3	■	BWR	825	798	2002
Sendai 1	■	PWR	890	846	1984
Sendai 2	■	PWR	890	846	1985
Shika 1	■	BWR	540	505	1993
Shika 2	■	BWR	1358	1304	2005
Shimane 2	■	BWR	820	791	1989
Takahama 1	■	PWR	826	780	1974
Takahama 2	■	PWR	826	780	1975
Takahama 3	■	PWR	870	830	1985
Takahama 4	■	PWR	870	830	1985
Tokai 2	■	BWR	1100	1067	1978
Tomari 1	■	PWR	579	550	1989
Tomari 2	■	PWR	579	550	1991
Tomari 3	■	PWR	912	866	2009
Tsuruga 2	■	PWR	1160	1115	1986
Shimane 3	□	BWR	1375	1325	(2018)
Ohma	□	BWR	1385	1325	(2020)
Ikata 1	[6]	✦ PWR	566	538	1977
<b>Korea (Republic)</b>					
Kori 1	■	PWR	603	576	1978
Kori 2	■	PWR	676	639	1983
Kori 3	■	PWR	1042	1003	1985
Kori 4	■	PWR	1041	1001	1986
Shin Kori 1	■	PWR	1048	996	2010
Shin Kori 2	■	PWR	1045	993	2011
Shin Kori 3	[1]	■ PWR	1400	1340	(2016)
Hanul 1	■	PWR	1003	960	1988
Hanul 2	■	PWR	1008	962	1989
Hanul 3	■	PWR	1050	994	1998
Hanul 4	■	PWR	1053	998	1998
Hanul 5	■	PWR	1051	996	2003
Hanul 6	■	PWR	1051	996	2004
Wolsong 1	■	Candu	687	645	1983
Wolsong 2	■	Candu	678	653	1997
Wolsong 3	■	Candu	698	675	1999
Wolsong 4	■	Candu	703	679	1999
Shin Wolsong 1	■	PWR	1043	991	2012
Shin Wolsong 2	■	PWR	1000	960	2015
Hanbit 1	■	PWR	996	953	1986
Hanbit 2	■	PWR	993	945	1987
Hanbit 3	■	PWR	1050	997	1995
Hanbit 4	■	PWR	1049	997	1996
Hanbit 5	■	PWR	1053	997	2001
Hanbit 6	■	PWR	1052	995	2002
Shin Kori 4	□	PWR	1400	1340	(2016)
Shin Hanul 1	□	PWR	1400	1340	(2016)
Shin Hanul 2	□	PWR	1400	1340	(2017)
<b>Mexico</b>					
Laguna Verde 1	■	BWR	820	765	1990
Laguna Verde 2	■	BWR	820	765	1995
<b>Netherlands</b>					
Borssele	■	PWR	515	482	1973
<b>Pakistan</b>					
Kanupp 1	■	Candu	137	909	1972
Chasnupp 1	■	PWR	325	300	2000
Chasnupp 2	■	PWR	325	300	2011
Chasnupp 3	[1]	■ PWR	340	315	2016
Chasnupp 4	□	PWR	340	315	(2017)
Kanupp 2	□	PWR	1100	1014	(2021)
Kanupp 3	[2]	□ PWR	1100	1014	(2022)
<b>Romania</b>					
Cernavoda 1	■	Candu	706	650	1996
Cernavoda 2	■	Candu	706	655	2007
<b>Russia</b>					
Balakovo 1	■	VVER-PWR	1000	953	1986
Balakovo 2	■	VVER-PWR	1000	953	1988
Balakovo 3	■	VVER-PWR	1000	953	1990
Balakovo 4	■	VVER-PWR	1000	953	1993
Beloyarsky 3	■	FBR	600	560	1981
Beloyarsky 4	■	FBR	800	750	2014
Bilibino 1	■	LWGR	12	11	1974
Bilibino 2	■	LWGR	12	11	1975
Bilibino 3	■	LWGR	12	11	1976
Bilibino 4	■	LWGR	12	11	1977
Kalinin 1	■	VVER-PWR	1000	953	1985

Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]
Kalinin 2	■	VVER-PWR	1000	953	1987
Kalinin 3	■	VVER-PWR	1000	953	2004
Kalinin 4	■	VVER-PWR	1000	953	2011
Kola 1	■	VVER-PWR	440	411	1973
Kola 2	■	VVER-PWR	440	411	1975
Kola 3	■	VVER-PWR	440	411	1982
Kola 4	■	VVER-PWR	440	411	1984
Kursk 1	■	LWGR	1000	925	1977
Kursk 2	■	LWGR	1000	925	1979
Kursk 3	■	LWGR	1000	925	1984
Kursk 4	■	LWGR	1000	925	1986
Leningrad 1	■	LWGR	1000	925	1974
Leningrad 2	■	LWGR	1000	925	1976
Leningrad 3	■	LWGR	1000	925	1980
Leningrad 4	■	LWGR	1000	925	1981
Novovoronezh 4	■	VVER-PWR	417	385	1973
Novovoronezh 5	■	VVER-PWR	1000	953	1981
Novovoronezh II-1	[1] ■	VVER-PWR	1000	955	2016
Rostov 1	■	VVER-PWR	1000	953	2001
Rostov 2	■	VVER-PWR	1000	953	2010
Rostov 3	■	VVER-PWR	1085	1011	2014
Smolensk 1	■	LWGR	1000	925	1983
Smolensk 2	■	LWGR	1000	925	1985
Smolensk 3	■	LWGR	1000	925	1990
Akademik Lomonosov I	□	PWR	40	35	(2019)
Akademik Lomonosov I	□	PWR	40	35	(2019)
Baltic 1 (Kaliningrad)	□	VVER-PWR	1170	1080	(2017)
Leningrad II-1	□	VVER-PWR	1170	1085	(2016)
Leningrad II-2	□	VVER-PWR	1170	1085	(2017)
Novovoronezh II-2	□	VVER-PWR	1000	955	(2017)
Rostov 4	□	VVER-PWR	1085	1011	(2016)
Novovoronezh 3	[6] ◇	VVER-PWR	417	385	1972
<b>Slovakia</b>					
Bohunice 3	■	VVER-PWR	505	472	1985
Bohunice 4	■	VVER-PWR	505	472	1985
Mochovce 1	■	VVER-PWR	470	436	1998
Mochovce 2	■	VVER-PWR	470	436	1999
Mochovce 3	□	VVER-PWR	440	408	(2017)
Mochovce 4	□	VVER-PWR	440	408	(2017)
<b>Slovenia</b>					
Krsko	■	PWR	727	696	1983
<b>South Africa</b>					
Koeberg 1	■	PWR	970	930	1984
Koeberg 2	■	PWR	970	930	1985
<b>Spain</b>					
Almaraz 1	■	PWR	1049	1011	1981
Almaraz 2	■	PWR	1044	1006	1983
Ascó 1	■	PWR	1033	995	1984
Ascó 2	■	PWR	1027	997	1985
Cofrentes	■	BWR	1092	1064	1985
Trillo 1	■	PWR	1066	1002	1988
Vandellós 2	■	PWR	1087	1045	1987
Santa María de Garoña	[5] ●	BWR	466	446	1971
<b>Sweden</b>					
Forsmark 1	■	BWR	1022	984	1980
Forsmark 2	■	BWR	1158	1120	1981
Forsmark 3	■	BWR	1212	1170	1985
Oskarshamn 1	■	BWR	492	473	1972
Oskarshamn 2	■	BWR	661	638	1975
Oskarshamn 3	■	BWR	1450	1400	1985
Ringhals 1	■	BWR	910	878	1976
Ringhals 2	■	PWR	847	807	1975
Ringhals 3	■	PWR	1117	1064	1981
Ringhals 4	■	PWR	990	940	1983
<b>Switzerland</b>					
Beznau 1	■	PWR	380	365	1969
Beznau 2	■	PWR	380	365	1972
Gösgen	■	PWR	1060	1010	1979
Leibstadt	■	BWR	1275	1220	1984
Mühleberg	■	BWR	390	373	1973
<b>Taiwan</b>					
Chin Shan 1	■	BWR	636	604	1978
Chin Shan 2	■	BWR	636	604	1979
Kuosheng 1	■	BWR	985	948	1981
Kuosheng 2	■	BWR	985	948	1983
Maanshan 1	■	PWR	951	890	1984
Maanshan 2	■	PWR	951	890	1985
Lungmen 1	□	BWR	1356	1315	(2016)
Lungmen 2	□	BWR	1356	1315	(2017)
<b>United Arab Emirates</b>					
Barakah 1	□	PWR	1400	1340	(2017)

Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]
Barakah 2	□	PWR	1400	1340	(2018)
Barakah 3	□	PWR	1400	1340	(2019)
Barakah 4	□	PWR	1400	1340	(2019)
<b>United Kingdom</b>					
Dungeness B-1	■	AGR	615	520	1985
Dungeness B-2	■	AGR	615	520	1986
Hartlepool-1	■	AGR	655	595	1984
Hartlepool-2	■	AGR	655	585	1985
Heysham I-1	■	AGR	625	585	1984
Heysham I-2	■	AGR	625	575	1985
Heysham II-1	■	AGR	682	595	1988
Heysham II-2	■	AGR	682	595	1989
Hinkley Point B-1	■	AGR	655	610	1976
Hinkley Point B-2	■	AGR	655	610	1977
Hunterston B-1	■	AGR	644	460	1976
Hunterston B-2	■	AGR	644	430	1977
Sizewell B	■	PWR	1250	1191	1995
Torness Point 1	■	AGR	682	595	1988
Torness Point 2	■	AGR	682	595	1989
<b>Ukraine</b>					
Khmelnitski 1	■	VVER-PWR	1000	950	1985
Khmelnitski 2	■	VVER-PWR	1000	950	2004
Rovno 1	■	VVER-PWR	402	363	1981
Rovno 2	■	VVER-PWR	416	377	1982
Rovno 3	■	VVER-PWR	1000	950	1987
Rovno 4	■	VVER-PWR	1000	950	2004
Zaporozhe 1	■	VVER-PWR	1000	950	1985
Zaporozhe 2	■	VVER-PWR	1000	950	1985
Zaporozhe 3	■	VVER-PWR	1000	950	1987
Zaporozhe 4	■	VVER-PWR	1000	950	1988
Zaporozhe 5	■	VVER-PWR	1000	950	1988
Zaporozhe 6	■	VVER-PWR	1000	950	1989
South Ukraine 1	■	VVER-PWR	1000	950	1983
South Ukraine 2	■	VVER-PWR	1000	950	1985
South Ukraine 3	■	VVER-PWR	1000	950	1989
<b>USA</b>					
Arkansas Nuclear One 1	■	PWR	969	903	1974
Arkansas Nuclear One 2	■	PWR	1006	943	1980
Beaver Valley 1	■	PWR	955	923	1976
Beaver Valley 2	■	PWR	957	923	1987
Braidwood 1	■	PWR	1289	1225	1988
Braidwood 2	■	PWR	1289	1225	1988
Browns Ferry 1	■	BWR	1200	1152	1974
Browns Ferry 2	■	BWR	1193	1152	1975
Browns Ferry 3	■	BWR	1232	1190	1977
Brunswick 1	■	BWR	1074	1002	1977
Brunswick 2	■	BWR	1075	1002	1975
Byron 1	■	PWR	1307	1225	1985
Byron 2	■	PWR	1304	1225	1987
Callaway	■	PWR	1316	1236	1985
Calvert Cliffs 1	■	PWR	935	918	1975
Calvert Cliffs 2	■	PWR	939	911	1977
Catawba 1	■	PWR	1286	1205	1985
Catawba 2	■	PWR	1286	1205	1986
Clinton 1	■	BWR	1175	1138	1987
Comanche Peak 1	■	PWR	1283	1215	1990
Comanche Peak 2	■	PWR	1283	1215	1993
Donald Cook 1	■	PWR	1266	1152	1975
Donald Cook 2	■	PWR	1210	1133	1978
Columbia (WNP 2)	■	BWR	1244	1200	1984
Cooper	■	BWR	844	801	1974
Davis Besse 1	■	PWR	971	925	1978
Diablo Canyon 1	■	PWR	1236	1159	1985
Diablo Canyon 2	■	PWR	1246	1164	1985
Dresden 2	■	BWR	1057	1009	1970
Dresden 3	■	BWR	1057	1009	1971
Duane Arnold	■	BWR	737	680	1975
Farley 1	■	PWR	933	888	1977
Farley 2	■	PWR	934	888	1981
Fermi 2	■	BWR	1317	1217	1988
FitzPatrick	■	BWR	918	882	1975
Ginna	■	PWR	713	614	1970
Grand Gulf 1	■	BWR	1516	1440	1985
Hatch 1	■	BWR	891	857	1974
Hatch 2	■	BWR	905	865	1979
Hope Creek 1	■	BWR	1360	1291	1986
Indian Point 2	■	PWR	1348	1299	1974
Indian Point 3	■	PWR	1051	1012	1976
La Salle 1	■	BWR	1242	1170	1984
La Salle 2	■	BWR	1238	1170	1984
Limerick 1	■	BWR	1203	1139	1986



Country Location/ Station name	Status	Reactor type	Capacity gross [MW]	Capacity net [MW]	1st Criticality [Year]	
Limerick 2	■	BWR	1 199	1 139	1990	
McGuire 1	■	PWR	1 358	1 220	1981	
McGuire 2	■	PWR	1 358	1 220	1984	
Millstone 2	■	PWR	946	910	1975	
Millstone 3	■	PWR	1 308	1 253	1986	
Monticello	■	BWR	734	685	1971	
Nine Mile Point 1	■	BWR	671	642	1969	
Nine Mile Point 2	■	BWR	1 302	1 259	1988	
North Anna 1	■	PWR	1 035	980	1978	
North Anna 2	■	PWR	1 033	980	1980	
Oconee 1	■	PWR	955	887	1973	
Oconee 2	■	PWR	955	887	1974	
Oconee 3	■	PWR	961	893	1974	
Oyster Creek	■	BWR	595	550	1969	
Palisades	■	PWR	870	812	1971	
Palo Verde 1	■	PWR	1 528	1 403	1986	
Palo Verde 2	■	PWR	1 524	1 403	1988	
Palo Verde 3	■	PWR	1 524	1 403	1986	
Peach Bottom 2	■	BWR	1 233	1 160	1974	
Peach Bottom 3	■	BWR	1 233	1 160	1974	
Perry 1	■	BWR	1 397	1 312	1987	
Pilgrim	■	BWR	712	670	1972	
Point Beach 1	■	PWR	696	643	1970	
Point Beach 2	■	PWR	696	643	1972	
Prairie Island 1	■	PWR	642	593	1973	
Prairie Island 2	■	PWR	641	593	1974	
Quad Cities 1	■	BWR	1 061	1 009	1973	
Quad Cities 2	■	BWR	1 061	1 009	1973	
RiverBend 1	■	BWR	1 073	1 036	1986	
Robinson 2	■	PWR	855	769	1971	
Salem 1	■	PWR	1 276	1 170	1977	
Salem 2	■	PWR	1 303	1 170	1981	
Seabrook 1	■	PWR	1 330	1 242	1990	
Sequoyah 1	■	PWR	1 259	1 221	1981	
Sequoyah 2	■	PWR	1 279	1 221	1982	
Shearon Harris 1	■	PWR	983	951	1987	
South Texas 1	■	PWR	1 410	1 354	1988	
South Texas 2	■	PWR	1 410	1 354	1989	
St. Lucie 1	■	PWR	1 122	1 080	1976	
St. Lucie 2	■	PWR	1 135	1 080	1983	
Virgil C. Summer	■	PWR	1 071	1 030	1984	
Surry 1	■	PWR	900	848	1972	
Surry 2	■	PWR	900	848	1973	
Susquehanna 1	■	BWR	1 374	1 298	1983	
Susquehanna 2	■	BWR	1 374	1 298	1985	
Three Mile Island 1	■	PWR	1 021	976	1974	
Turkey Point 3	■	PWR	906	877	1972	
Turkey Point 4	■	PWR	800	760	1973	
Vogtle 1	■	PWR	1 223	1 160	1987	
Vogtle 2	■	PWR	1 226	1 160	1989	
Waterford 3	■	PWR	1 250	1 200	1985	
Watts Bar 1	■	PWR	1 370	1 270	1996	
Watts Bar 2	[1]	■	PWR	1 240	1 180	2016
Wolf Creek	■	PWR	1 351	1 268	1984	
Vogtle 3	□	PWR	1 080	1 000	(2019)	
Vogtle 4	□	PWR	1 080	1 000	(2020)	
Virgil C. Summer 2	□	PWR	1 080	1 000	(2020)	
Virgil C. Summer 3	□	PWR	1 080	1 000	(2021)	
Fort Calhoun 1	[6]	◆	PWR	526	502	1973

1) Start of nuclear operation (first criticality), 10 units in 2016 (first criticality: C, first grid connection: G, commercial operation: O): China: Changjiang 2 (650 MW, PWR, CGO), Fangchenggang 2 (1086 MW, PWR, CGO), Fuqing 3 (1089 MW, PWR, CGO), Hongyanhe 4 (1119 MW, PWR, CGO), Ningde 4 (1089 MW, PWR, CGO), Yangjiang 4 (1086 MW, C); Pakistan: Chasnupp 3 (340 MW, PWR, CG); India: Kudankulam 2 (1000 MW, PWR, CG); Russia: Novovoronezh 2-1 (1115 MW, PWR, CG); USA: Watts Bar 2 (1218 MW, PWR, CGO).  
1 unit G&O: Korea: Shin-Kori 3 (1 400 MW, GO)  
2) Start of construction (first concrete), 3 units in 2016: China: Fangchenggang 4 (1 080 MW), Tianwan 6 (1 118 MW); Pakistan: Kanupp 3 (1 100 MW).  
3) Project under construction finally cancelled: none.  
4) Resumed operation: Japan: Ikata 3 (890 MW)  
5) Nuclear power plant in long-term shutdown: none.  
6) Nuclear power plants permanently shutdown in 2016 (2 units): Russia: Novovoronezh (417 MW); USA: Fort Calhoun 1 (526 MW).  
(All capacity data in MWe gross)  
AGR: Advanced Gas-cooled Reactor, Candu: CANada Deuterium Uranium reactor (IND: Indian type), D<sub>2</sub>O-PWR: heavy water moderated, pressurised water reactor, PWR: pressurised water reactor, GGR: gas-graphite reactor, LWGR/GLWR: light water cooled graphite moderated reactor (Russian type RBMK), BWR: boiling water reactor, FBWR: advanced boiling water reactor, FBR: fast breeder reactor

Tab. 1.

Nuclear power plant units worldwide on 31.12.2016 in operation (■), under construction (□), in lay-up operation/long-term shutdown (◆) or permanently shut-down in 2016 (●) [Sources: Operators, IAEA]. All information and data refer to the year 2016. Data have been updated with reference to the sources

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### IAEA project maps groundwater in Africa's Sahel Region

(*iaea*) An IAEA project shows that significant reserves of good quality water are available in Africa's drought-prone Sahel region. Pollution is still limited and has not yet become a serious threat to these vital resources. The findings, compiled in five reports published today, are the result of a four-year Agency effort to help 13 countries use isotopic techniques to assess groundwater origin and quality in five shared aquifers and basins, providing the first broad overview of the region's groundwater supplies.

Scientists from participating countries – Algeria, Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal and Togo – were trained by the Agency to carry out a detailed examination of groundwater using nuclear-based techniques.

The project looked at the aquifers and basins that provide the main source of groundwater to the region's population: the Iullemeden Aquifer System, the Liptako-Gourma-Upper Volta System, and the Senegalo-Mauritanian, Lake Chad and Taoudeni basins.

"This project is a significant achievement given the vast area studied," said IAEA project leader Neil Jarvis. "Inadequate water management practices can increase water scarcity. If countries are to manage growing demands for fresh water, they need to have the tools to understand and map the water resources at their disposal."

The Agency promoted collaboration among national experts and provided equipment and training for technical staff to collect water samples and investigate their origin and composition, using hydro-chemical analyses and mapping techniques.



Using nuclear-derived techniques, scientists from 13 African countries have carried out the first ever regionwide assessment of groundwater in this area of 5 million square kilometres, with the help of the IAEA. Photo: Laura Gil/IAEA

Partner organizations included the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Niger Basin Authority, the Lake Chad Basin Commission, the Volta Basin Authority, the Liptako-Gourma Integrated Development Authority, the Organization for the Development of the Senegal River and the German Federal Institute for Geosciences and Natural Resources.