TVO

Pocket guide 2009

Olkiluoto,
the centre of
Finnish nuclear
power expertise

Teollisuuden Voima Oyj

Teollisuuden Voima Oyj (TVO) is a public company that was established in 1969 and which produces electricity for its shareholders at cost price. TVO's nuclear power plant produces about one sixth of the electricity used in Finland.

Electricity is generated at the two Olkiluoto nuclear power plant units Olkiluoto 1 and Olkiluoto 2 (OL1 and OL2) at Eurajoki and at the Meri-Pori coal-fired power plant in Pori.

A new unit, Olkiluoto 3 (OL3), is under construction at Olkiluoto. TVO has filed in spring 2008 an application for a decision in principal to construct a fourth nuclear power plant unit at Olkiluoto, in the community of Eurajoki.

The main mission of Teollisuuden Voima Oyj (TVO) is to produce electricity for shareholders safely and economically without carbon dioxide emissions. TVO's vision is to be a world-class nuclear power company that is appreciated by Finnish society. Values of the company are responsibility, transparency, proactivity and continuous improvement.

The Olkiluoto nuclear power plant produced ca. 14.4 TWh electricity in 2008. It was about 16 per cent of all electricity used in Finland.

TVO´s generating capacity consists of the Olkiluoto nuclear power plant units Olkiluoto 1 and Olkiluoto 2 with an electrical output of 860 MW each and the 257 MW share in the Meri-Pori coal-fired power plant.

Company shareholders and holdings Dec. 31, 2008

Holding %

	A-series	B-series	C-series	
Etelä-Pohjanmaan Voima Oy	6.5	6.6	6.5	6.6
Fortum Power and Heat Oy	26.6	25.0	26.6	26.0
Karhu Voima Oy	0.1	0.1	0.1	0.1
Kemira Oyj	1.9	-	1.9	1.1
Oy Mankala Ab	8.1	8.1	8.1	8.1
Pohjolan Voima Oy	56.8	60.2	56.8	58.1

The A series shares entitle the shareholders to the electricity generated by the current plant units, the B series shares to the electricity by the new plant unit OL3, and the C series shares to the electricity generated by the Meri-Pori coal-fired power plant.

Teollisuuden Voima Oyj's important dates

23.1.1969	Teollisuuden Voima Oy was founded by 16 companies.
21.12.1972	The Ministry of Trade and Industry gave principle approval for building a nuclear power plant.
31.5.1973	The Parliament approved TVO´s proposal of acquisition of an area at Olkiluoto.
31.1.1974	The Ministry of Trade and Industry granted construction license for Olkiluoto 1 (OL1) in accordance with the Atomic Energy Act.
1.2.1974	Construction of OL1 unit was started.
12.8.1974	OL1´s foundation stone was laid.
4.8.1975	The Ministry of Trade and Industry granted construction license for Olkiluoto 2 (OL2) in accordance with the Atomic Energy Act.
28.8.1975	Construction of OL2 unit was started.
6.7.1978	The Council of State granted an operation licence for OL1.
2.9.1978	OL1 was connected to the national grid for the first time. The power plant unit achieved full capacity for the first time in January 8, 1979.
1.9.1979	The Council of State granted an operation licence for OL2.
10.10.1979	OL1 was introduced into commercial operation.
18.2.1980	OL2 was connected to the national grid for the first time. The power plant unit achieved full capacity for the first time in November 11, 1980.

Teollisuuden Voima Oyj's important dates

1.7.1982	OL2 was introduced into commercial operation.
17.5.1984	The Council of State granted permission for increased power level for both power plant units.
29.9.1987	Spent fuel was transferred for the first time from the plant to the Interim Storage Facility for Spent Fuel (KPA-Store).
29.3.1988	Agreement on the participation with a 45 per cent share in the Meri-Pori coal-fired power plant project was signed.
15.12.1988	The Council of State granted under the Nuclear Energy Act an operation licence for 10 years for both power plant units.
29.9.1989	Total production of Olkiluoto nuclear power plant reached 100 TWh.
16.3.1990	Training simulator was taken into use at Olkiluoto.
8.5.1992	The first waste transfer to the low and medium-level nuclear waste repository (VLJ) was made.
30.12.1992	Olkiluoto, Konginkangas and Kuhmo were chosen for more detailed site investigations for final disposal site for spent nuclear fuel.
26.9.1993	Meri-Pori coal-fired power plant produced electricity to the national grid for the first time.
1.1.1996	Posiva Oy began its activities.
11.3.1998	Total production of Olkiluoto nuclear power plant reached 200 TWh.
20.8.1998	The Council of State granted a new operation licence for both power plant units and the KPA-Store as well as for the low and medium-level waste interim storages.
1998	Modernization programme of the power plant units, which lasted four years, was completed. After the modernization, the power level rised to 840 MW. It is 18.3 per cent higher than the earlier nominal power level.
30.8.1999	The environmental impact assessment report, i.e. EIA Report, of the environmental impact of a new nuclear power plant unit, which would possibly be built at Olkiluoto, was submitted to the Ministry of Trade and Industry.

Teollisuuden Voima Oyj's important dates

5.12.1999	A certificate based on the ISO 14001 standard was granted to the Olkiluoto nuclear power plant.
15.11.2000	Application for Decision in principle concerning the new nuclear power plant unit was submitted to the Council of State.
21.12.2000	The Council of State gave a positive Decision in principle for Posiva Oy's application for the construction of a final repository of spent nuclear fuel at Olkiluoto, Eurajoki.
18.5.2001	The Finnish Parliament ratified the Decision in principle made by the Council of State supporting Posiva Oy to construct a final repository for spent nuclear fuel at Olkiluoto in Eurajoki.
19.7.2001	The Finnish Environment Institute registered TVO in the EMAS system (Eco Management and Audit Scheme).
24.5.2002	The Finnish Parliament ratified the Decision in principle made 17th January 2002 by the Council of State supporting the construction of a new nuclear power plant unit either at Olkiluoto, Eurajoki or at Hästholmen, Loviisa.
30.9.2002	TVO submitted bid inquiries for the construction of a new nuclear power plant unit.
16.10.2003	Olkiluoto was chosen for the location site for the new power plant unit.
18.12.2003	TVO's Board of Directors decided to invest in the new nuclear power plant unit Olkiluoto 3 (OL3). The Company signed a contract for the construction of a pressurized water reactor plant unit of some 1,600 MW with the consortium comprising AREVA NP (former Framatome ANP) and Siemens.
16.2.2004	The excavation work at the OL3 site was started.
15.11.2004	TVO´s wind power unit at Olkiluoto was inaugurated.
10.12.2004	The festive tarring of the ground of the OL3 site.
11.1.2005	The building permit for OL3 was granted by Eurajoki municipality.
17.2.2005	The Council of State granted the construction licence for the OL3.

Teollisuuden Voima Oyj's important dates

26.4.2005 Total electricity production of OL1 and OL2 reached 300 TWh.

12.8.2005 The actual construction work of OL3 began.

12.9.2005 The OL3 foundation stone was laid.

31.1.2006 Olkiluoto´s new Visitor Center was inaugurated.

1.6.2006 Modernization programme of the Olkiluoto power plant units was completed. After the modernization the nominal power level is 860 MW.

18.10.2006 OL3´s actual casting of concrete began.

31.5.2007 The environmental impact assessment programme (EIA programme) for the fourth nuclear power plant unit to be possibly built at Olkiluoto was submitted to the contact authority, the Ministry of Trade and Industry.

19.11.2007 The Olkiluoto 100 MW gas turbine plant jointly constructed by Fingrid Oyj and Teollisuuden Voima Oy (TVO) was inaugurated.

31.12.2007 TVO has been registered in the trade register as a public company as of 31 December 2007. The official name of the company is Teollisuuden Voima Oyj.

31.12.2007 The Olkiluoto Nuclear Power Plant reached the best production results in its operational history - 14.386 TWh.

25.4.2008 TVO filed to the Council of State an application for a decision in principal to construct a fourth nuclear power plant unit (OL4) at Olkiluoto. Simultaneously Posiva Oy filed an application-in-principal to expand its for spent fuel for OL4.

2.9.2008 The anniversary of 30 years of nuclear energy production at Olkiluoto took place. During the three decades Olkiluoto has produced 350 TWh of electricity.

31.12.2009 The production of electricity of the Olkiluoto nuclear power plant in 2008 was the second highest in the history of the company. The total annual production of the power plant units was 14.380 TWh. The two units produce annually some sixth of the electricity consumed in Finland.

Key figures

	2008	2007
Output of electricity		
Olkiluoto (TWh)	14.380	14.386
Olkiluoto wind power plant GWh	1.6	1.8
Olkiluoto gas turbine plant, GWh	0.5	0.2
Meri-Pori (GWh)	816.9	1,374.3
Turnover (EUR million)	257.3	232.3
Loan portfolio (EUR million)	1,959.5	1,362.3
Investments (EUR million)	588.9	227.2
Funds in the State Nuclear Waste Management Fund (TVO share, EUR million)	1,001.2	927.7
Personnel, December 31	709	676

Production and turnover in 1998-2008

Year	Production, GWh			Turnover
	OL1	OL2	Total	EUR million
1998	6,806	6,629	13,435	257
1999	7,112	7,091	14,203	228
2000	7,043	7,029	14,072	229
2001	7,164	6,988	14,152	219
2002	6,989	7,099	14,088	218
2003	7,118	7,018	14,136	223
2004	7,001	7,072	14,073	217
2005	7,208	6,984	14,192	199
2006	6,956	7,278	14,234	227
2007	7,335	7,051	14,386	232
2008	7,066	7,313	14,380	257

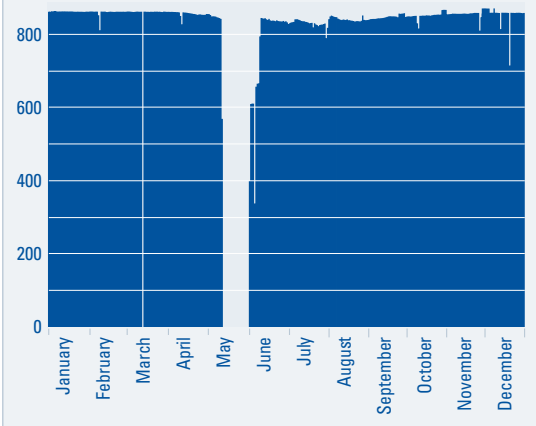
The Olkiluoto Power Plant

The nuclear power plant of Teollisuuden Voima Oyj is located at Olkiluoto, Eurajoki, on the west coast of Finland. The site consists of two nuclear power plant units, Olkiluoto 1 (OL1) and Olkiluoto 2 (OL2). The plant units were delivered by the Swedish AB ASEA-ATOM (nowadays Westinghouse Electric Company).

The third unit, Olkiluoto 3 (OL3), is under construction. It is supplied by consortium AREVA NP (former Framatome ANP) / Siemens.

Olkiluoto 1

Power Production MW, 2008



Electrical output of Olkiluoto 1 and Olkiluoto 2 in 2008

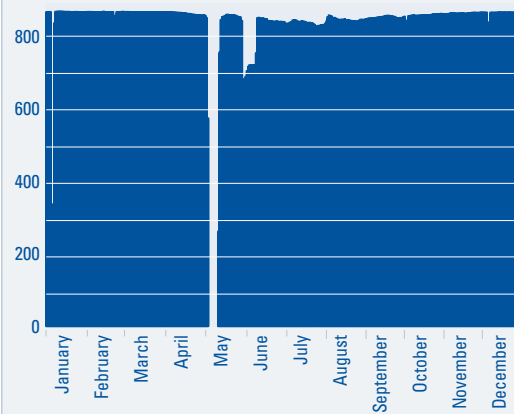
Olkiluoto 1 unit produced 7,066 GWh of electricity and the capacity factor was 93.7 per cent.

Olkiluoto 2 produced 7,314 GWh of electricity and the capacity factor was 96.9 per cent.

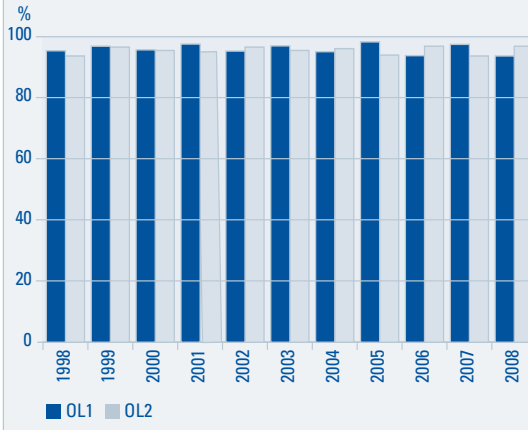
Total production of Olkiluoto nuclear power plant reached 100 TWh on 29.9.1989. Production of 200 TWh was reached on 19.3.1998 and 300 TWh on 26.4.2005. At the end of the year 2008 power plant´s total production was 351 TWh.

Olkiluoto 2

Power Production MW, 2008



Capacity factors of OL1 and OL2 units



Outage lengths and costs of Olkiluoto NPP in 1998-2008

Year	Duration, days		Costs, OL1 + OL2, EUR million
	OL1	OL2	
1998	15	19	27
1999	8	10	9
2000	14	14	18
2001	8	15	13
2002	13	8	15
2003	10	14	15
2004	16	9	14
2005	7	21	15
2006	22	8	15
2007	9	17	12
2008	20	8	14

Technical data of Olkiluoto NPP*

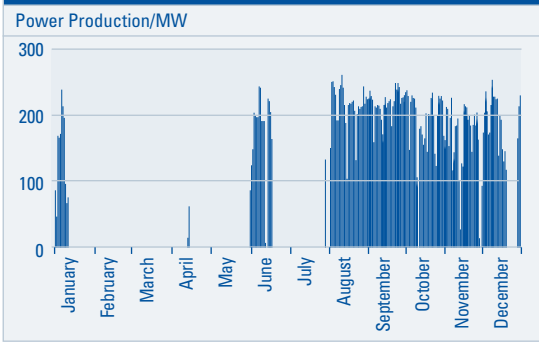
Electric output, net	860 MW
Reactor thermal power	2,500 MW
Number of fuel assemblies	500
Total fuel amount	86-90 tU
Average power density	24-25 kW/kgU
Number of control rods	121
Reactor pressure vessel	
- inner diameter	5,540 mm
- inner height	20,593 mm
Reactor pressure	70 bar
Steam flow	1,260 kg/s
Turbine rated speed	3,000 rpm
Generator, water cooled	
OL1	950 MVA
OL2	905 MVA
Cooling water flow	30 m^3/s
Volume of plant buildings	
OL1	483,000 m^3
OL2	475,000 m^3
Containment	
- design pressure	4.7 bar
- gas volume	7,375 m^3
- water volume	2,700 m^3

* The figures are the same for both plant units, except for those separately defined.

Key figures of Olkiluoto 3

Electric output, net	about 1,600 MWe
Reactor thermal power	4,300 MW
Total effeciency	over 37%
Annual electricity generation	ca. 13 TWh
Reactor pressure	154 bar
Total fuel weight	128 tU
Annual fuel consumption	ca. 32 t
Volume of plant buildings	950,000 m^3
Reactor pressure vessel, height	13 m
Reactor containment building, height	63 m

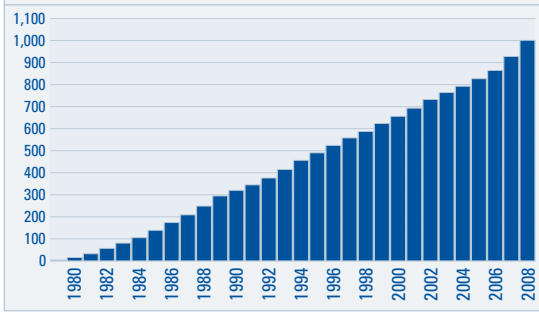
Meri-Pori coal-fired power plant, TVO´s share 2008



Nuclear Waste Management

In order to cover the costs of nuclear waste management, the Company funds the Finnish State Nuclear Waste Management Fund. The Ministry of Employment and Economy confirmed the Company´s end-of-year liability for nuclear waste management at EUR 1,137.6 million and the company target reserve in the State Nuclear Waste Management Fund at EUR 1,001.2 million. Difference is covered with insurance.

Development of Finnish State Nuclear Waste Management Fund



Nuclear power plants in the world in 2008

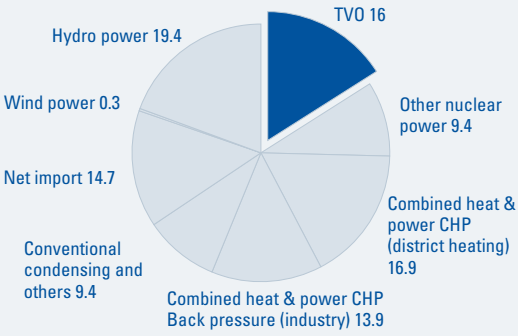
Country	Plant units in operation		Plant units under construction	
	Number	MW (net) total	Number	MW (net) total
Argentina	2	935	1	692
Armenia	1	376	0	0
Belgium	7	5,824	0	0
Brazil	2	1,795	0	0
Bulgaria	2	1,906	2	1,906
Canada	18	12,621	0	0
Czech Republic	6	3,619	0	0
Finland	4	2,696	1	1,600
France	59	63,260	1	1,600
Germany	17	20,470	0	0
Great Britain	19	10,222	0	0
Hungary	4	1,829	0	0
India	17	3,782	6	2,910
Iran	0	0	1	915
Japan	55	47,587	2	2,191
Lithuania	1	1,185	0	0
Mexico	2	1,300	0	0
P. R. China	11	8,438	11	10,120
Pakistan	2	425	1	300
Romania	2	1,300	0	0
Russian Federation	31	21,743	8	5,809
Slovak Republic	4	1,688	0	0
Slovenia	1	666	0	0
South Africa	2	1,800	0	0
South Korea	20	17,466	5	5,180
Spain	8	7,450	0	0
Sweden	10	8,995	0	0
Switzerland	5	3,220	0	0
The Netherlands	1	482	0	0
Ukraine	15	13,107	2	1,900
USA	104	100,582	1	1,165
Taiwan, China	6	4,921	2	2,600
Total	438	371,690	44	38,888

Source: www.iaea.org , January 2009

Electricity in Finland

Electric energy supply in 2008

Total 86.9 TWh %



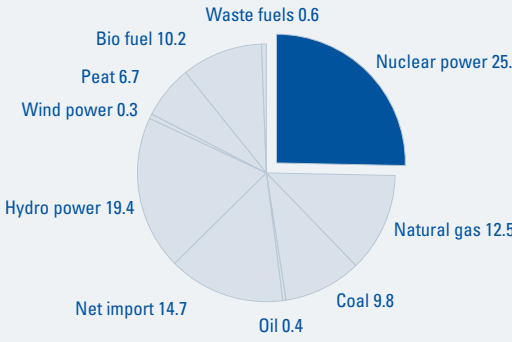
Electric energy supply in Finland 1998–2008, GWh

Year	Hydro power	Wind power	Combined heat & power CHP (industry)	Combined heat & power CHP (district heating)	Conventional condensing	Nuclear power TVO
1998	14,777	23	11,980	13,248	6,320	13,435
1999	12,547	49	12,034	12,810	7,154	14,203
2000	14,453	77	11,740	12,718	6,709	14,072
2001	13,287	71	11,465	14,409	10,529	14,152
2002	10,623	63	12,271	14,902	12,363	14,106
2003	9,455	92	12,707	15,294	20,999	14,154
2004	14,865	120	13,019	15,144	17,193	14,090
2005	13,459	167	11,615	14,572	5,351	14,218
2006	11,313	153	13,064	14,505	17,572	14,267
2007	13,991	188	12,318	14,442	14,377	14,386
2008	16,889	262	12,080	14,660	8,209	14,380

Source: Finnish Energy Industries, TVO

Electric energy supply by sources in 2008

Total 86.9 TWh %



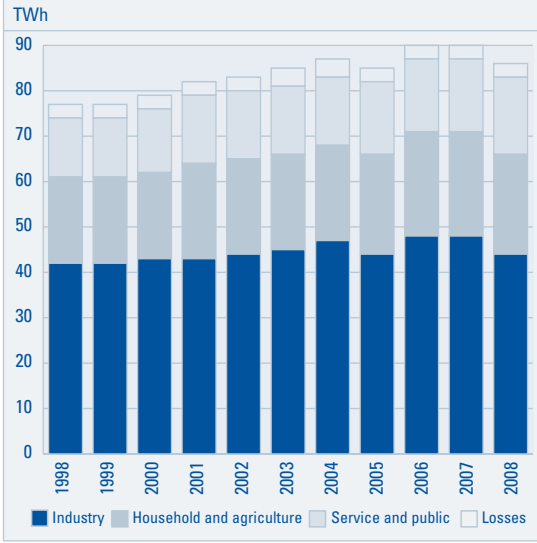
Nuclear power Fortum	Production	+ Net import	- Net export	Total
7,541	67,304	9,582	276	76,610
7,864	66,662	11,356	232	77,786
7,503	67,308	12,206	326	79,188
7,727	71,645	9,959	1,810	81,604
7,337	71,617	13,464	1,539	83,542
7,676	80,377	11,882	7,030	85,229
7,724	82,155	11,667	6,797	87,025
8,115	67,497	17,014	933	84,511
7,737	78,624	11,401	2,716	89,991
8,115	77,817	12,557	2,862	90,374
7,658	74,137	12,768	3,336	86,905

Total electricity consumption 2008

In 2008, the total electricity consumption was 86.9 TWh in Finland. Industry uses a bit over 50% of electricity consumption in Finland. Electricity is needed for instance driving processes and equipment, lightning, heating and communication. Households use electricity mainly for refrigeration devices and heating.

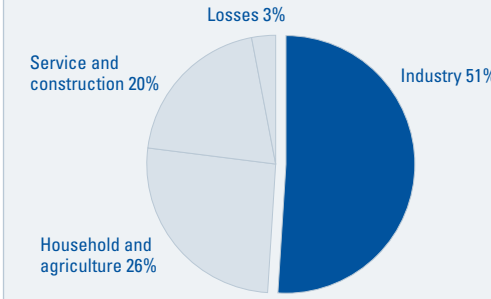
Nuclear energy is, like renewable energy sources hydropower, wood and wind a way to produce electricity with no carbon dioxide emissions, which boost greenhouse effect. Nuclear power is a very competitive way to produce new electricity capacity.

Total consumption of electricity in 1998–2008



Total electricity consumption 2008

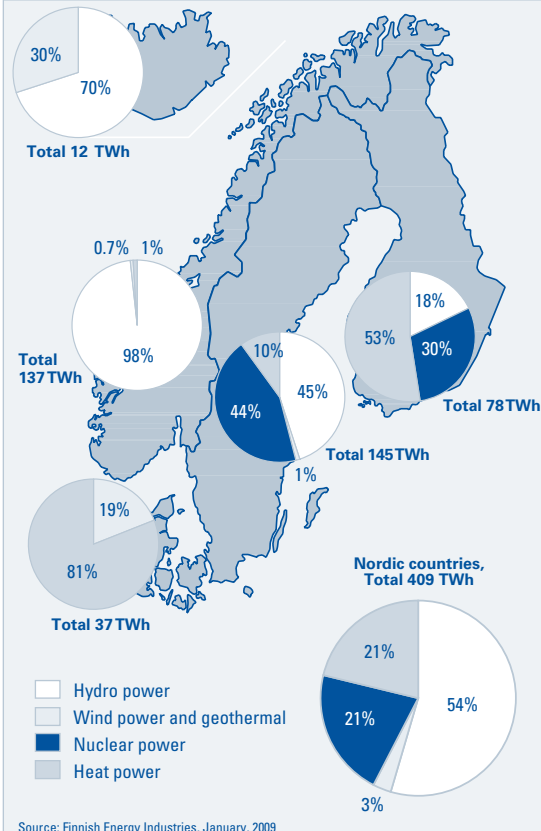
Total 86.9 TWh



The national 400 kV grid of Finland

Electricity in Nordic Countries

Electricity generation in the Nordic Countries 2007 (%)



Source: Finnish Energy Industries, January, 2009

Glossary

ALARA
(As Low As Reasonably Achievable): An internationally used principle regulating the amount of radiation doses at nuclear power plants.

EPR
European Pressurized water Reactor

Euratom
A unit of the EU Commission that supervises nuclear material.

IAEA
International Atomic Energy Agency.

WANO
World Association of Nuclear Operators.

INES
(International Nuclear Event Scale): A seven-level scale used internationally to depict the seriousness of accidents and incidents at nuclear power plants. The lower levels (1-3) depict incidents that have weakened plant safety and the upper levels (4-7) accidents that could cause emissions into the environment that require protective measures against radiation.

Boiling water reactor, BWR
A light-water reactor in which water used as the coolant boils as it passes through the reactor core. The steam generated rotates the turbine.

Pressurized water reactor, PWR

A light-water reactor with such a high reactor pressure that water used as the coolant does not boil in the reactor. The hot water is conducted from the reactor to a steam generator in which the water in the secondary circuit evaporates and the steam is led to rotate the turbine.

Capacity factor

The capacity factor is the energy produced in a year by a power plant as a percentage of the energy it would have produced had it been operating at full capacity for the entire year.

Megawatt, MW

A unit of power. One megawatt equals to 1,000 kilowatts alias 1,000,000 watts.

Gigawatt, GW

A unit of power. One gigawatt equals to one million kilowatts.

Terawatt-hour, TWh

A unit of energy. One terawatt-hour equals to one billion kilowatt hours.

Teollisuuden Voima Oyj
Olkiluoto
FI-27160 EURAJOKI
FINLAND
Tel. +358 2 83 811
Fax +358 2 8381 2109

Teollisuuden Voima Oyj
Töölönkatu 4
FI-00100 HELSINKI
FINLAND
Tel. +358 9 61 801
Fax +358 9 6180 2570

Teollisuuden Voima Oyj
TVO Brussels Office
4 rue de la Presse
BE-1000 BRUSSELS
BELGIUM
Tel. + 32 2 227 1122
Fax + 32 2 218 3141

www.tvo.fi

Eura Print Oy 2/2009/3,000 pcs