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Main Characteristics of Nuclear Power Plants in the European Union and Candidate Countries

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Main Characteristics of Nuclear Power Plants in the European Union and Candidate Countries

Report for the European Commission
Contract: ENV.C.2/ETU/2000/0020

Prepared by a Consortium led by AEA Technology plc

incorporating

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EXECUTIVE SUMMARY

The European Commision (EC) requested a review of Community activities in the field of harmonisation of nuclear safety standards, under Contract ENV.C.2/ETU/2000/0020 [1] entitled:

25 Years of Community Activities towards Harmonisation of Nuclear Safety Criteria and Requirements - Achievements and Prospects.

with the specification:

To advise the EC on future challenges and opportunities in terms of enhanced co-operation in the area of nuclear safety and harmonisation of safety requirements and practices in an enlarged European Union.

Part of this activity was to provide a summary of the plant characteristics of the operating civil nuclear power plants in the EU Member and Candidate Countries. The present report provides these data in three formats, as specified in the contract:

1. A reference table which lists the main characteristics of nuclear power-producing reactors operating in the European Union (EU) and Candidate Countries, as at 31 December 1999. Also included, for the sake of completeness, are data for reactors in the former Soviet Union, such as Russia and the Ukraine. The format adopted follows that in the annual International Atomic Energy Agency (IAEA) reference data report 'Nuclear Power Reactors of the World', from which much of the information was taken;
2. A summary table indicating totals by reactor type covering Western and Eastern Europe separately, again from IAEA sources, giving number of plant, total generating capacity and total years in operation. A list of the abbreviations for different reactor types is also provided;
3. A set of detailed data sheets giving main plant characteristics for different reactor types ordered by country. These data sheets cover reactors in EU Member and Candidate Countries only.

Details are provided on the origin of the data where these are available, so that further information may be obtained if desired and where permitted by commercial and/or proprietary considerations.

Table of Contents

1. Introduction

The European Commision (EC) requested a review of Community activities in the field of harmonisation of nuclear safety standards, under Contract ENV.C.2/ETU/2000/0020 [1] entitled:

25 Years of Community Activities towards Harmonisation of Nuclear Safety Criteria and Requirements - Achievements and Prospects.

with the specification:

To advise the EC on future challenges and opportunities in terms of enhanced co-operation in the area of nuclear safety and harmonisation of safety requirements and practices in an enlarged European Union.

This main part of the work is reported in [2]. A supplementary part of this activity was to provide a summary of the plant characteristics of the operating civil nuclear power plants in the EU Member and Candidate Countries. The present report provides these data in Annex 1. The section following comments on the nature of the data and the formats employed, explaining the methodology used. Finally, some concluding remarks are provided.

2. Summary of Plant Data

The data are provided in Annex 1 in three formats:

1. A reference table, section A1.1, which lists the main characteristics of nuclear power-producing reactors operating in the European Union (EU) and Candidate Countries, as at 31 December 1999. Also included, for the sake of completeness, are data for reactors in the former Soviet Union, such as Russia and the Ukraine. The format adopted follows that in the International Atomic Energy Agency (IAEA) reference data report [3], from which much of the information was taken. This reference report is updated annually; the issue quoted (April 2000) was the latest available at the time of writing. Cross-reference is made to the data sheets in section A1.3 below where more detailed data are available;
2. A summary table, section A1.2, indicating totals by reactor type covering Western and Eastern Europe separately, giving number of plant, total generating capacity and total years in operation [4]. A list of the abbreviations for different reactor types is also provided;
3. A set of detailed data sheets, section A1.3, giving main plant characteristics for different reactor types ordered by country, as indicated in section A1.1. These data sheets cover reactors in EU Member and Candidate Countries only. Schematic diagrams for the reactors are provided where available. Each data sheet also indicates plants of similar type to avoid unnecessary repetition of information.

The reference tables and detailed data sheets follow the format specified in the contract. References are provided in each section showing the origin of the data where available. In some cases data are not available because of proprietary or other reasons.

3. Concluding Remarks

A compendium of plant data for power reactors in EU Member and Candidate Countries has been provided, according to the contract specification. Reference should be made to the documentation listed for further information if required.

References

[1] European Commission, Contract ENV.C.2/ETU/2000/0020, 2000.
[2] Lillington J N et al., 25 Years of Community Activities towards Harmonisation of Nuclear Safety Criteria and Requirements- Achievements and Prospects, AEAT/R/PSEG/0404, 2001.
[3] IAEA, Nuclear Power Reactors of the World, IAEA Reference Data Series no 2, April 2000.
[4] IAEA, Nuclear Technology Review 2000, GC(44)9, 14 August 2000.

ANNEX 1: Compendium of Plant Data

A1.1 LIST OF OPERATING POWER REACTORS BY COUNTRY

(See A1.2 for abbreviations of reactor type and Representative Plant in A1.3 for Technical Details)

Nuclear Power Plants in the European Union and Candidate Countries

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
BELGIUM	Doel - 1	PWR/West	Electrabel	392.5	1969	1974	84.0	Data provided
	Doel - 2	PWR/West	Electrabel	392.5	1969	1975	78.0	Doel 1
	Doel - 3	PWR/West	Electrabel	(900) 1006	1975	1982	84.0	Data provided
	Doel - 4	PWR/West	Electrabel	1003	1977	1985	80.0	Data provided
	Tihange - 1	PWR/Fram	Electrabel	(870) 962	1970	1975	81.0	Data provided
	Tihange - 2	PWR/West	Electrabel	(900) 967	1975	1982	86.0	Doel 3
	Tihange - 3	PWR/West	Electrabel	1006	1977	1985	86.0	Doel 4
BRITAIN	Bradwell - 1	GCR/TNPG	BNFL/Magnox	123	1957	1962	57.0 *	Data provided
	Bradwell - 2	GCR/TNPG	BNFL/Magnox	123	1957	1962	57.0 *	Data provided
	Calder Hall - 1	GCR/UKAEA	BNFL/Magnox	50	1953	1956	72.0 *	Data provided
	Calder Hall - 2	GCR/UKAEA	BNFL/Magnox	50	1953	1957	72.0 *	Data provided
	Calder Hall – 3	GCR/UKAEA	BNFL/Magnox	50	1953	1958	72.0 *	Data provided
	Calder Hall – 4	GCR/UKAEA	BNFL/Magnox	50	1953	1959	72.0 *	Data provided
	Chapelcross –1	GCR/UKAEA	BNFL/Magnox	47	1955	1959	80.0 *	Data provided
	Chapelcross – 2	GCR/UKAEA	BNFL/Magnox	47	1955	1959	80.0 *	Data provided
	Chapelcross – 3	GCR/UKAEA	BNFL/Magnox	47	1955	1959	80.0 *	Data provided
	Chapelcross –4	GCR/UKAEA	BNFL/Magnox	47	1955	1960	80.0 *	Data provided
	Dungeness A-1	GCR/TNPG	BNFL/Magnox	220	1960	1965	66.0 *	Data provided
	Dungeness A-2	GCR/TNPG	BNFL/Magnox	220	1960	1965	66.0 *	Data provided
	Dungeness B-1	AGR/APC	BE	555	1965	1985	46.0 *	Data provided
	Dungeness B-2	AGR/APC	BE	555	1965	1983	35.0	Data provided
	Hartlepool-1	AGR/NNC	BE	605	1968	1983	63.0	Data provided

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
	Hartlepool - 2	AGR/NNC	BE	605	1968	1984	70.0	Data provided
	Heysham A-1	AGR/NNC	BE	575	1970	1983	69.0	Data provided
	Heysham A-2	AGR/NNC	BE	575	1970	1984	72.0	Data provided
	Heysham B-1	AGR/NNC	BE	625	1980	1988	53.0	Data provided
	Heysham B-2	AGR/NNC	BE	625	1980	1988	57.0	Data provided
	Hinkley Pt A-1	GCR/GEC	BNFL/Magnox	235	1957	1965	66.0 *	Data provided
	Hinkley Pt A-2	GCR/GEC	BNFL/Magnox	235	1957	1965	66.0 *	Data provided
	Hinkley Pt B-1	AGR/TNPG	BE	610	1967	1976	74.0	Data provided
	Hinkley Pt B-2	AGR/TNGP	BE	610	1967	1976	69.0	Data provided
	Hunterston B-1	AGR/TNGP	BE	597	1967	1976	64.0	Data provided
	Hunterston B-2	AGR/TNGP	BE	597	1967	1977	64.0	Data provided
	Oldbury - 1	GCR/TNGP	BNFL/Magnox	212	1962	1967	79.0 *	Data provided
	Oldbury - 2	GCR/TNGP	BNFL/Magnox	212	1962	1968	79.0 *	Data provided
	Sizewell A-1	GCR/EE.BW.TW	BNFL/Magnox	210	1961	1966	70.0 *	Data provided
	Sizewell A-2	GCR/EE.BW.TW	BNFL/Magnox	210	1961	1966	70.0 *	Data provided
	Sizewell B	PWR/West	BE	1188	1986	1995	n/a	Data provided
	Torness - 1	AGR/NNC	BE	605	1980	1988	55.0	Data provided
	Torness - 2	AGR/NNC	BE	605	1980	1989	58.0	Data provided
	Wylfa - 1	GCR/EE.BW.TW	BNFL/Magnox	475	1963	1971	71.0 *	Data provided
	Wylfa - 2	GCR/EE.BW.TW	BNFL/Magnox	475	1963	1971	71.0 *	Data provided
BULGARIA	Kozloduy - 1	VVER-440/230/AE	NEC	408	1970	1974	59.0	Data provided
	Kozloduy - 2	VVER-440/230/AE	NEC	408	1970	1975	65.0	Data provided
	Kozloduy - 3	VVER-440/230/AE	NEC	408	1973	1980	67.0	Data provided
	Kozloduy - 4	VVER-440/230/AE	NEC	408	1973	1982	69.0	Data provided
	Kozloduy - 5	VVER-1000/AE	NEC	953	1980	1987	42.0	Temelin 1-2
	Kozloduy - 6	VVER-1000/AE	NEC	953	1984	1991	54.0	Temelin 1-2

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
CZECH REPUBLIC	Dukovany - 1	VVER-440/213/AE	EDU	412	1978	1985	80.0	Data provided
	Dukovany - 2	VVER-440/213/AE	EDU	412	1978	1986	82.0	Data provided
	Dukovany - 3	VVER-440/213/AE	EDU	412	1978	1986	81.0	Data provided
	Dukovany - 4	VVER-440/213/AE	EDU	412	1978	1987	80.0	Data provided
	Temelin – 1	VVER-1000/AE	EDU	912	1984	1998	-	Data provided
	Temelin – 2	VVER–1000/AE	EDU	912	1985	2000	-	Data provided
FINLAND	Loviisa - 1	VVER-440/AE	Fortum	488	1971	1977	84.0	Data provided
	Loviisa - 2	VVER-440/AE	Fortum	488	1972	1980	87.0	Loviisa - 1
	Olkiluoto - 1	BWR/Asea-Atom	TVO	840	1974	1978	90.0	Data provided
	Olkiluoto - 2	BWR/Asea-Atom	TVO	840	1975	1980	92.0	Olkiluoto – 1
FRANCE [5]	Belleville - 1	PWR/Fram	EDF	1310	1980	1987	67.0	REP-1300
	Belleville - 2	PWR/Fram	EDF	1310	1980	1988	64.0	REP-1300
	Blayais – 1	PWR/Fram	EDF	910	1977	1981	71.0	REP-900
	Blayais – 2	PWR/Fram	EDF	910	1977	1982	75.0	REP-900
	Blayais – 3	PWR/Fram	EDF	910	1978	1983	74.0	REP-900
	Blayais – 4	PWR/Fram	EDF	910	1978	1983	74.0	REP-900
	Bugey – 2	PWR/Fram	EDF	910	1972	1978	63.0	REP-900
	Bugey – 3	PWR/Fram	EDF	910	1973	1978	63.0	REP-900
	Bugey – 4	PWR/Fram	EDF	880	1974	1979	63.0	REP-900
	Bugey – 5	PWR/Fram	EDF	880	1974	1979	67.0	REP-900
	Cattenom - 1	PWR/Fram	EDF	1300	1979	1986	62.0	REP-1300
	Cattenom - 2	PWR/Fram	EDF	1300	1980	1987	68.0	REP-1300
	Cattenom - 3	PWR/Fram	EDF	1300	1982	1990	73.0	REP-1300
	Cattenom - 4	PWR/Fram	EDF	1300	1983	1991	76.0	REP-1300
	Chinon - B1	PWR/Fram	EDF	905	1977	1982	73.0	REP-900
	Chinon - B2	PWR/Fram	EDF	905	1977	1983	72.0	REP-900
	Chinon - B3	PWR/Fram	EDF	905	1980	1986	70.0	REP-900

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
	Chinon - B4	PWR/Fram	EDF	905	1981	1987	75.0	REP-900
	Chooz - B1	PWR/Fram	EDF	1455	1984	1996	n/a	N4
	Chooz - B2	PWR/Fram	EDF	1455	1985	1997	76.0	N4
	Civaux - 1	PWR/Fram	EDF	1450	1988	1997	68.0	N4
	Civaux - 2	PWR/Fram	EDF	1450	1991	1999	n/a	N4
	Cruas - 1	PWR/Fram	EDF	915	1978	1983	70.0	REP-900
	Cruas - 2	PWR/Fram	EDF	915	1978	1984	71.0	REP-900
	Cruas - 3	PWR/Fram	EDF	915	1979	1984	71.0	REP-900
	Cruas - 4	PWR/Fram	EDF	915	1979	1984	70.0	REP-900
	Dampierre - 1	PWR/Fram	EDF	890	1975	1980	69.0	REP-900
	Dampierre - 2	PWR/Fram	EDF	890	1975	1980	67.0	REP-900
	Dampierre - 3	PWR/Fram	EDF	890	1975	1981	71.0	REP-900
	Dampierre - 4	PWR/Fram	EDF	890	1975	1981	69.0	REP-900
	Fessenheim - 1	PWR/Fram	EDF	880	1971	1977	67.0	REP-900
	Fessenheim - 2	PWR/Fram	EDF	880	1972	1977	69.0	REP-900
	Flamanville - 1	PWR/Fram	EDF	1330	1979	1985	65.0	REP-1300
	Flamanville - 2	PWR/Fram	EDF	1330	1980	1986	65.0	REP-1300
	Golfech - 1	PWR/Fram	EDF	1310	1982	1990	72.0	REP-1300
	Golfech - 2	PWR/Fram	EDF	1310	1984	1993	72.0	REP-1300
	Gravelines - B1	PWR/Fram	EDF	910	1975	1980	67.0	REP-900
	Gravelines - B2	PWR/Fram	EDF	910	1975	1980	72.0	REP-900
	Gravelines - B3	PWR/Fram	EDF	910	1975	1980	73.0	REP-900
	Gravelines - B4	PWR/Fram	EDF	910	1976	1981	73.0	REP-900
	Gravelines - C5	PWR/Fram	EDF	910	1979	1984	73.0	REP-900
	Gravelines - C6	PWR/Fram	EDF	910	1979	1985	73.0	REP-900
	Nogent - 1	PWR/Fram	EDF	1310	1981	1987	64.0	REP-1300
	Nogent - 2	PWR/Fram	EDF	1310	1982	1988	71.0	REP-1300
	Paluel - 1	PWR/Fram	EDF	1330	1977	1984	67.0	REP-1300
	Paluel - 2	PWR/Fram	EDF	1330	1978	1984	65.0	REP-1300
	Paluel - 3	PWR/Fram	EDF	1330	1979	1985	67.0	REP-1300

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
	Paluel - 4	PWR/Fram	EDF	1330	1980	1986	68.0	REP-1300
	Penly - 1	PWR/Fram	EDF	1330	1982	1990	73.0	REP-1300
	Penly - 2	PWR/Fram	EDF	1330	1984	1992	74.0	REP-1300
	Phenix	FBR/CEA	CEA/EDF	233	1968	1973	45.0	n/a
	St Alban/ St Maurice - 1	PWR/Fram	EDF	1335	1979	1985	61.0	REP-1300
	St Alban/ St Maurice - 2	PWR/Fram	EDF	1335	1979	1986	59.0	REP-1300
	St Laurent-des-Eaux B1	PWR/Fram	EDF	915	1976	1981	68.0	REP-900
	St Laurent-des-Eaux B2	PWR/Fram	EDF	915	1976	1981	69.0	REP-900
	Tricastin - 1	PWR/Fram	EDF	915	1974	1980	69.0	REP-900
	Tricastin - 2	PWR/Fram	EDF	915	1974	1980	71.0	REP-900
	Tricastin - 3	PWR/Fram	EDF	915	1975	1981	75.0	REP-900
	Tricastin - 4	PWR/Fram	EDF	915	1975	1981	72.0	REP-900
GERMANY	Biblis A	PWR/KWU	RWE	1167	1970	1974	67.0	Data provided
	Biblis B	PWR/KWU	RWE	1240	1972	1976	66.0	Biblis A
	Brokdorf	PWR/KWU	KBR	1370	1976	1986	85.0	Biblis A
	Brunsbuettel	BWR/KWU	KKB	771	1970	1976	53.0	Data provided
	Emsland	PWR/KWU	KLE	1290	1982	1988	92.0	Biblis A
	Grafenrheinfeld	PWR/KWU	BAG	1275	1975	1981	84.0	Biblis A
	Grohnde	PWR/KWU	KWG	1360	1976	1984	90.0	Biblis A
	Gundremmingen-B	BWR/KWU	KRB	1284	1976	1984	78.0	Data provided
	Gundremmingen-C	BWR/KWU	KRB	1288	1976	1984	76.0	Gundremmingen-B
	Isar - 1	BWR/KWU	KKI	870	1972	1977	74.0	Brunsbuettel
	Isar - 2	PWR/KWU	KKI	1365	1982	1988	85.0	Biblis A
	Kruemmel	BWR/KWU	KKK	1260	1974	1983	74.0	Gundremmingen-B
	Muelheim-	PWR/B&W	RWE		1975			Data provided

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
	Kaerlich							
	Neckarwestheim-1	PWR/KWU	GKN	785	1972	1976	78.0	Data provided
	Neckarwestheim-2	PWR/KWU	GRN	1269	1982	1989	92.0	Biblis A
	Obrigheim	PWR/KWU	KWO	340	1965	1968	77.0	Data provided
	Phillippsburg - 1	BWR/KWU	KKP	890	1970	1979	74.0	Brunsbuettel
	Philippsburg - 2	PWR/KWU	KKP	1358	1977	1984	89.0	Biblis A
	Stade	PWR/KWU	KKS	640	1967	1972	82.0	Data provided
	Unterweser	PWR/KWU	KKU	1285	1972	1978	80.0	Biblis A
HUNGARY	Paks - 1	VVER-440/213/AE	PAKS RT	433	1974	1982	84.1 [7]	Data provided
	Paks - 2	VVER-440/213/AE	PAKS RT	433	1974	1984	85.6 [7]	Data provided
	Paks - 3	VVER-440/213/AE	PAKS RT	433	1979	1986	86.4 [7]	Data provided
	Paks - 4	VVER-440/213/AE	PAKS RT	433	1979	1987	87.3 [7]	Data provided
LITHUANIA	Ignalina - 1	LWGR/AE	INAP	1185	1977	1983	52.0	Data provided
	Ignalina - 2	LWGR/AE	INAP	1185	1978	1987	59.0	Data provided
NETHER-LANDS	Borssele - 1	PWR/KWU	EPZ	447	1969	1973	79.0	Data provided
ROMANIA	Cernavoda - 1	PHWR/AAC	SNN	646	1982	1996	85.0	Data provided
SLOVAKIA	Bohunice - 1	VVER-440/230/AE	EBO	408	1974	1978	72.0	Data provided
	Bohumice - 2	VVER-440/230/Ae	EBO	408	1974	1980	73.0	Data provided
	Bohunice - 3	VVER-440/213/AE	EBO	408	1976	1984	76.0	Data provided
	Bohunice - 4	VVER-440/213/AE	EBO	408	1976	1985	78.0	Data provided
	Mochovce-1	VVER-440/213/AE	EMO	408	1981	1988	70.0	Data provided
	Mochovce-2	VVER-440/213/AE	EMO	408	1981	1999	n/a	Data provided
SLOVENIA	Krsko	PWR/West	NEK	632	1975	1981	77.0	Data provided

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
SPAIN	Almaraz – 1	PWR/West	CNAT (ENDESA 36%, IBERDROLA 53%, UFG 11%)	943	1973	1981	81.0	Data provided
	Almaraz - 2	PWR/West	CNAT (ENDESA 36%, IBERDROLA 53%, UFG 11%)	953	1973	1983	85.0	Data provided
	Ascó - 1	PWR/West	ANA-V II (ENDESA 100%)	943	1974	1983	81.0	Data provided
	Ascó - 2	PWR/West	ANA-V II (ENDESA 85%, IBERDROLA 15%)	936	1975	1985	84.0	Data provided
	Cofrentes	BWR/GE	IBERDROLA (100%)	955	1975	1984	87.0	Data provided
	Santa Mariá de Garoña	BWR/GE	NUCLENOR (IBERDROLA 50%, ENDESA 50%)	440	1966	1971	71.0	Data provided
	José Cabrera (Zorita)	PWR/West	UFG (100%)	153	1964	1968	66.0	Data provided
	Trillo	PWR/KWU	CNAT (UFG 34.5%, IBERDROLA 48%, HC 15.5%, NUCLENOR 2%)	1000	1979	1988	78.0	Data provided
	Vandellós - 2	PWR/West	ANA-V II (ENDESA 72%, IBERDROLA 28%)	966	1981	1987	84.0	Data provided

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
SWEDEN [6]	Barsebäck 2	BWR/Asea-Atom	BKAB	615	1972	1977	76.0	Sim. Oskarshamn 2
	Forsmark 1	BWR/Asea-Atom	FKA	1006	1971	1980	80.0	Sim. Forsmark 3
	Forsmark 2	BWR/Asea-Atom	FKA	1006	1975	1981	79.0	Sim. Forsmark 3
	Forsmark 3	BWR/Asea-Atom	FKA	1200	1978	1985	83.0	Data provided
	Oskarshamn 1	BWR/Asea-Atom	OKG	165	1966	1972	60.0	Sim. Oskarshamn 2
	Oskarshamn 2	BWR/Asea-Atom	OKG	630	1969	1974	74.0	Data provided
	Oskarshamn 3	BWR/Asea-Atom	OKG	1200	1980	1985	83.0	Sim. Forsmark 3
	Ringhals 1	BWR/Asea-Atom	RAB	860	1968	1976	65.0	Sim. Oskarshamn 2
	Ringhals 2	PWR/West	RAB	910	1969	1974	62.0	Data provided
	Ringhals 3	PWR/West	RAB	960	1972	1981	67.0	Data provided
	Ringhals 4	PWR/West	RAB	960	1973	1982	75.0	Data provided

Nuclear Power Plants in the Former Soviet Union (and Switzerland)

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
ARMENIA	Metsamor - 2	VVER/AEP	JSC	376	1975	1980	53.0	n/a
KAZAKH-STAN	BN - 350 Aktau	FBR/CATEP	CATEP	135	1964	1973		n/a
RUSSIA	Balakovo - 1	VVER-1000/AE	REA	950	1980	1985	50.0	n/a
	Balakovo - 2	VVER-1000/AE	REA	950	1981	1987	51.0	n/a
	Balakovo - 3	VVER-1000/AE	REA	950	1982	1988	56.0	n/a
	Balakovo - 4	VVER-1000/AE	REA	950	1984	1993	58.0	n/a
	Beloyarsky- 3	FBR/AEP	REA	560	1969	1980	72.0	n/a
	Bilibino - 1	LWGR/AE	REA	11	1970	1974	64.0	n/a
	Bilibino - 2	LWGR/AE	REA	11	1970	1974	64.0	n/a
	Bilibino - 3	LWGR/AE	REA	11	1970	1975	66.0	n/a
	Bilibino - 4	LWGR/AE	REA	11	1970	1976	66.0	n/a
	Kalinin - 1	VVER-1000/AE	REA	950	1977	1984	66.0	n/a
	Kalinin - 2	VVER-1000/AE	REA	950	1982	1986	66.0	n/a
	Kola - 1	VVER-440/230/AE	REA	411	1970	1973	67.0	n/a
	Kola - 2	VVER-440/230/AE	REA	411	1973	1974	67.0	n/a
	Kola - 3	VVER-440/213/AE	REA	411	1977	1981	73.0	n/a
	Kola - 4	VVER-440/213/AE	REA	411	1976	1984	73.0	n/a
	Kursk - 1	LWGR/AE	REA	925	1972	1976	58.0	n/a
	Kursk - 2	LWGR/AE	REA	925	1973	1979	61.0	n/a
	Kursk - 3	LWGR/AE	REA	925	1978	1983	71.0	n/a
	Kursk - 4	LWGR/AE	REA	925	1981	1985	76.0	n/a
	Leningrad - 1	LWGR/AE	REA	925	1970	1973	66.0	n/a
	Leningrad - 2	LWGR/AE	REA	925	1970	1975	67.0	n/a
	Leningrad - 3	LWGR/AE	REA	925	1973	1979	68.0	n/a
	Leningrad - 4	LWGR/AE	REA	925	1975	1981	76.0	n/a

Country [1]	Name [1]	Reactor type/ Designer [1], [2], [4]	Owner/ operator [1[, [2], [4]	Net electric output (MW) [3]	Start of construc-tion [2], [4]	Start of operation [3], [4]	Lifetime load factor to 1998 (%) [4]	Represent-ative plant
	Novovoronezh - 3	VVER-440/230/AE	REA	385	1967	1971	71.0	n/a
	Novovoronezh - 4	VVER-440/230/AE	REA	385	1967	1972	77.0	n/a
	Novovoronezh - 5	VVER-1000/AE	REA	950	1974	1980	59.0	n/a
	Smolensk - 1	LWGR/AE	REA	925	1975	1982	71.0	n/a
	Smolensk - 2	LWGR/AE	REA	925	1976	1985	74.0	n/a
	Smolensk - 3	LWGR/AE	REA	925	1984	1990	72.0	
SWITZER-LAND	Beznau - 1	PWR/West	NOK	365	1965	1969	80.0	n/a
	Beznau - 2	PWR/West	NOK	357	1968	1971	86.0	n/a
	Goesgen	PWR/KWU	KKG	970	1973	1979	86.0	n/a
	Leibstadt	BWR/GE	KKL	1030	1974	1984	84.0	n/a
	Muehleberg	BWR/GE	BKW	355	1967	1971	85.0	n/a
UKRAINE	Chernobyl - 3	LWGR/AE	NNEGC	925	1976	1981	62.0	n/a
	Khmelnitski - 1	VVER-1000/AE	MAEP	950	1981	1987	68.0	n/a
	Rovno - 1	VVER-440/213/AE	Goskomat	361	1976	1980	85.0	n/a
	Rovno - 2	VVER-440/213/AE	Goskomat	384	1977	1981	78.0	n/a
	Rovno - 3	VVER-1000/AE	MAEP	950	1981	1986	69.0	n/a
	South Ukraine - 1	VVER-1000/AE	MAEP	950	1977	1983	65.0	n/a
	South Ukraine - 2	VVER-1000/AE	MAEP	950	1979	1985	57.0	n/a
	South Ukraine - 3	VVER-1000/AE	MAEP	950	1985	1989	69.0	n/a
	Zaporozhye - 1	VVER-1000/AE	MAEP	950	1980	1984	54.0	n/a
	Zaporozhye - 2	VVER-1000/AE	MAEP	950	1981	1985	58.0	n/a
	Zaporozhye - 3	VVER-1000/AE	MAEP	950	1982	1987	62.0	n/a
	Zaporozhye - 4	VVER-1000/AE	MAEP	950	1981	1987	67.0	n/a
	Zaporozhye - 5	VVER-1000/AE	MAEP	950	1985	1989	68.0	n/a
	Zaporozhye - 6	VVER-1000/AE	MAEP	950	1986	1995	75.0	n/a

* Cumulative load factors for multiple unit stations calculated over whole station
n/a Not available or not known
The UK GCR stations are of the Magnox type, gas-cooled reactor with uranium metal fuel and Magnox magnesium alloy cladding

References for A1.1

[1] Nucleonics Week, Vol 41, No 6, February 10, 2000.
[2] Operating Experience with Nuclear Power Stations in EU Member States in 1994, International Atomic Energy Agency, Vienna, 1994.
[3] Nuclear Power Plants Worldwide, European Nuclear Society, 1998.
[4] Nuclear Power Reactors of the World, IAEA Reference Data Series no 2, April 2000.
[5] Mómento sur le'energie – Edition 1998 – CEA.
[6] Sweden's First National Report under the Convention on Nuclear Safety, Swedish Implementation of the Obligations of the Convention, Ds 1998:54
[7] Hozer Z, AEKI Budapest, private communication to Lillington J, AEA Technology, 2001

A1.2 SUMMARY OF OPERATING NUCLEAR POWER PLANTS

A1.2.1 Number of Reactors in Operation by Region and Type

Region	Type	No.	Total MW(e)	Years in Operation
Eastern Europe				
	FBR	1	560	45
	LWGR	18	13514	424
	PHWR	1	650	3
	PWR	1	632	18
	VVER	47	29953	772
	Total	***68***	***45309***	***1262***
Western Europe				
	AGR	14	8380	250
	BWR	20	17699	564
	FBR	1	233	86
	GCR	20	3400	1094
	PWR	93	95406	1642
	VVER	2	976	97
	Total	***150***	***126094***	***3733***

A1.2.2 List of Abbreviations for Reactor Types

Abbreviation	Reactor Type
AGR	Advanced Gas-cooled Reactor
BWR	Boiling Water Reactor
FBR	Fast Breeder Reactor
GCR	Gas Cooled Reactor
LWGR	Light Water Gas-cooled Reactor
PHWR	Pressurized Heavy Water Reactor
PWR	Pressurized Water Reactor
VVER (WWER)	Water-cooled Water-moderated Energy Reactor

A1.2.3 List of Abbreviations for Reactor Designers

Abbreviation	Reactor Designer
AE	Atomenergo Export (R)
AEP	Atomenergyoprojekt (R)
ANA	Association Nuclear ASCO (S)
APC	Atomic Power Construction (GB)
Asea-Atom	Now ABB Atom (SW)
BE	British Energy (GB)
BKW	Bernische Kraftweke (CH)
B&W	Babcock & Wilcox (US)
CEA	Commissariat a ‘’Energie Atomique (F)
EdF	Electricite de France (F)

Abbreviation	Reactor Designer
EE.BW.TW	English Electric – Babcock Wilcox – Taylor Woodrow Construction
ERZ	Electricas Reunidas de Zaragoza (S)
FKA	Forsmark Kraftgrupp (SW)
Fram	Framatome (F)
GE	General Electric (US)
GEC	General Electric (GB)
KKB	Kernkraftwerk Brunsbuttel (G)
KKG	Kernkraftwerk Grohnde (G)
KKI	Kernkraftwerk Isar (G)
KKK	Kernkraftwerk Kruemmel (G)
KKL	Kernkraftwerk Liebstadt (G)
KKP	Kernkraftwerk Philippsburg (G)
KKS	Kernkraftwerk Stade (G)
KLE	Kernkraftwerk Lippe-Ems (G)
KRB	Kernkraftwerk RWE-Bayernwerk (G)
KWD	Kernkraftwerk Obrigheim (G)
KWG	Kernkraftwerk Graben (G)
KWU	Kraftwerk Union (G)
MAEP	Ministry of Atomic Energy and Industry Minatomenergoprom (R)
NEC	National Electric Company (BU)
NEK	Nuklearna Elektrama Krsko (SL)
NNC	National Nuclear Corporation (GB)
OKG	Oskarshamnverkets Kraftgrupp (SW)
RWE	RWE Energie (G)
TNPG	The Nuclear Power Group (GB)
TVO	Teillisuuden Voima Oy (FIN)
UKAEA	United Kingdom Atomic Energy Authority (GB)
West	Westinghouse Electric (US)

Reference for A1.2

IAEA, Nuclear Technology Review 2000, GC(44)9, 14 August 2000.

A1.3 MAIN CHARACTERISTICS OF TYPICAL REACTOR TYPES

This section presents the main characteristics of nuclear plant in the EU, ordered by country:

- Belgium
- Britain
- Czech Republic
- Finland
- France
- Hungary
- Netherlands
- Slovakia
- Spain
- Sweden

In these tables, n/a, a blank or a '-' indicates the data are not available or not applicable.

NB. Technical data are only provided for the different types of NPPs. Table A.1 lists all the NPPs and their connection with the NPPs for which technical data are given.

A1.3.1 BELGIUM

TECHNICAL DATA FOR DOEL 1 & 2

List of plants of this type: Doel 1 & 2

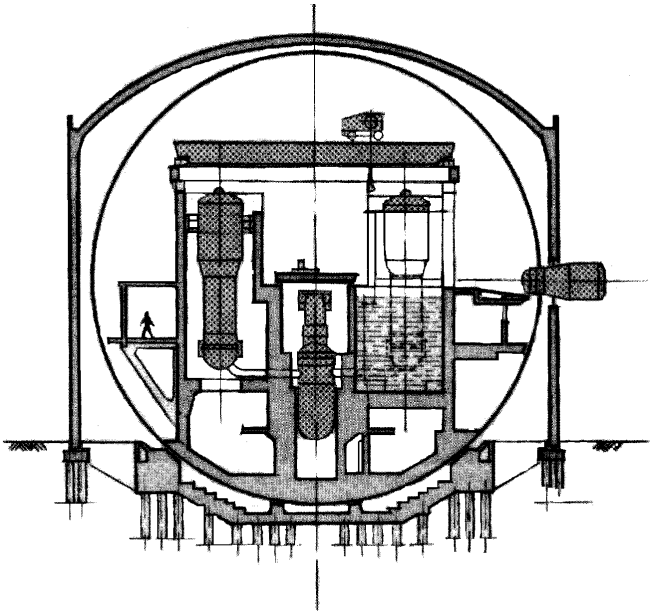


Figure 1: Standard Data twin units Doel 1 and Doel 2

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse design)	1
Nominal Electrical output	MW	392.5	1,3,4
Nominal thermal Power	MW	1192	1,3,4
Coolant type		H_2O	1
Volume of coolant (of liquid water in LWR)	m^3	-	-
Volume of primary circuit	m^3	-	-
Moderator type		H_2O	1
Fuel type (oxide/metal)		UO_2	3
Typical fuel enrichment	% mass	3.6	3
Fuel cladding		Zircaloy 4	4
Number of fuel elements		121 (179 fuel rods each)	3,4
Mass of U in core	tonnes	31.738	3
Control rod type		Ag-In-Cd	4
Number of control rods		21 for quick-response reactivity control and 12 for shutdown. 16 fingers per rod	3,4
Secondary shutdown systems		-	
Pressure vessel material		-	
Pressure vessel diameter	m	3.327 (internal)	3
Pressure vessel height	m	10.600 (internal, including head)	3
Pressure vessel wall thickness	m	0.180	3
Pressure vessel weight	tonnes	160	3

Data	Units	Value	Ref.
Coolant pressure	MPa	15.51	4
Coolant temperature at reactor inlet	°C	283.8	4
Coolant temperature at reactor outlet	°C	316.7	4
Number of primary circuit loops		2	1
Number of primary coolant pumps		2	1
Primary coolant flowrate	m^3/s	4.54 (per loop)	4
Number of steam generators		2	1
Steam generator/exch. area		Vertical U-tubes/ 4,130 m^2	3
Number of turbines		1 (1 high- and 2 low-press. sect.)	3
Steam pressure at turbine inlet	MPa	6.02	4
Steam temperature at turbine inlet	°C	279	3
Steam flowrate at turbine inlet	kg/s	667	1,3
Feedwater temperature (water station outlet)	°C	225	4
Feedwater flow	kg/s	333 per SG at 4.2 MPa	3
Auxiliary feedwater system SRFS		Motor driven pump	3
Number of SRFS		2 systems	3
Duty of SRFS		-	
Capacity of SRFSs		4 x 50%	1
Number of high pressure injection systems (HPIS)		1, common for both units, with 4 pumps (50% cap.)	4
Duty of HPIS	kg/s	-	
Operating pressure of HPIS	MPa	-	
Capacity of HPIS		-	
Number of accumulators		2 per unit	4
Duty of accumulators	kg	-	
Capacity of accumulator		-	
Set-point of accumulators	MPa	-	
Number of low pressure injection systems (LPIS)		1 per unit with 2 exchangers fed from 3 pumps (3 x 50% cap.)	4
Duty of LPIS		-	
Capacity of LPIS	kg	(2 injection lines of 100%)	4
Operating pressure of LPIS	MPa	-	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		4 diesels shared by both reactors	3,4
Duty of generators		2065 kVA at 6.3 kV	3
Capacity of generators		100% of duty defined above	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	-	
Number and capacity of (at lift pressure) secondary system relief	(m^3/s at X MPa and	One per SG	4

Data	Units	Value	Ref.
valves	Y°C)		
Containment building type		Steel, 0.024 m thick, primary containment (sphere with intern diam. 46 m). Prestressed concrete, 1.0 m thick, secondary containment (cylinder with intern diam. 48 m)	1
Containment design pressure	MPa	0.39	1
Containment free volume	m^3	-	
Containment sprays – capacity	kg/s	Borated water, one system for both reactors with four, 50% pumps.	4
Containment heat removal		Containment spray system/ventilators (four, 50% capacity fans and cooling batteries)	4
Containment venting		No, filtered exhaust from annular space.	-
Containment hydrogen management system		Autocatalytic hydrogen recombiners. Manually activated post-accident containment hydrogen control system.	- 4

First and second ten-yearly overhaul/safety review took place in 1984 and 1994.

NSSS suppliers: Acec, Cockerill (Westinghouse licence)

References

[1] Smissaerts, G.: Technische en ekonomische beschouwingen bij het kernpark te Doel, Ingenieurstijdingen, 35 (1986) no.1, pp.23.
[2] EBES, Doel Nuclear Power Plant, Units 3 and 4, 1979
[3] Elektriciteit uit kernenergie – kerncentrale Doel, Electrbel n.v., 1991.
[4] Kingdom of Belgium, National Report of the Nuclear Safety Convention, 1998.

BELGIUM

TECHNICAL DATA FOR DOEL 3

List of plants of this type: Doel 3, Tihange 2

For scheme, see Doel 4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR, Westinghouse	1
Nominal Electrical output	MW	1006	4
Nominal thermal Power	MW	3054	4
Coolant type		H_2O	1
Volume of coolant (of liquid water in LWR	m^3	-	
Volume of primary circuit		-	
Moderator type		H_2O	1
Fuel type (oxide/metal)		MOX (7.7% PuO_2 , 37 elements)	4
Typical fuel enrichment	% mass	3.25	2,3
Fuel cladding		Zircaloy 4	4
Number of fuel elements		157 (264 rods each), 37 MOX	2,3,4
Mass of U in core	tonnes	72.4555	2,3
Control rod type		Ag-In-Cd alloy	
Number of control rods		32 quick response assemblies and 16 shutdown control assemblies (24 fingers per assembly)	2,3,4
Secondary shutdown systems		3 x 100% emergency boration system (2 x 100% systems at Tihange 2).	4
Pressure vessel material		-	5
Pressure vessel diameter	m	3.998	2,3
Pressure vessel height	m	12.018 (internal, including head)	2,3
Pressure vessel wall thickness	m	0.205	2,3
Pressure vessel weight	tonnes	331 (without mechanisms)	2,3
Coolant pressure	MPa	15.5	1,2,3
Coolant temperature at reactor inlet	°C	282.3	4
Coolant temperature at reactor outlet	°C	324	4
Number of primary circuit loops		3	1,3
Number of primary coolant pumps		3	1,3
Primary coolant flowrate	m^3/s	5.89 per loop	4
Number of steam generators		3 (Incoloy 800 tubes)	1,4
Steam generator/exch. area		Vertical U-tubes/ 4,751 m^2	2,3
Number of turbines		1 (1 high- and 3 low-press. sect.)	2
Steam pressure at turbine inlet	MPa	5.8	4
Steam temperature at turbine inlet	°C	268	1,2,3
Steam flowrate at turbine inlet	kg/s	1690	4

Data	Units	Value	Ref.
Feedwater temperature (at SG)	°C	225	4
Feedwater flow	kg/s	562	4
Type of safety related feedwater systems (SRFS)		2 turbine driven (50% each), 1 motor driven, in standby (50%)	2,3
Number of SRFS		3	2,3
Duty of SRFS		-	-
Capacity of SRFSs		-	-
Number of high pressure injection systems (HPIS)		3 (one per loop)	2
Duty of HPIS	kg/s	-	
Operating pressure of HPIS	MPa	-	
Capacity of HPIS		-	
Number of accumulators		3 (one per loop)	2
Duty of accumulators	kg	-	
Capacity of accumulator		-	
Set-point of accumulators	MPa	-	
Number of low pressure injection systems (LPIS)		3 (one per loop)	2
Duty of LPIS		-	
Capacity of LPIS	kg	-	
Operating pressure of LPIS	MPa	-	
Reactor shut-down cooling pump		3 (one per loop)	2
Number and type of back-up generators on-site		3 (+1 reserve also for Doel 4) diesels and 3 diesels in bunker (common for Doel 3 and Doel 4)	3
Duty of generators		3 (+1) 6.6 kV (5167 kVA) and 3 of 6.6 kV (2300 kVA)	3, 4
Capacity of generators		100% of duty defined above	2
Number of battery systems		4 plus 2	2
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	3	4
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	-	
Containment building type		Cylinder plus dome shape. Pre-stressed concrete primary containment, thickness 0.85 m with 6 mm steel liner. Internal diameter is 42.56 m). A concrete secondary containment, thickness 1.2 m. Internal diameter of 50 m.	1
Containment design pressure	MPa	0.45 (0.403 test pressure2)	1

Data	Units	Value	Ref.
Containment free volume	m^3	-	
Containment sprays – capacity	kg/s	3 systems with 50% pumps	4
Containment heat removal		Spraying borated water 5 and 6 cooling systems with 50% fans and cooling batteries.	4
Containment venting		No, filtered exhaust from annular space only	4
Containment hydrogen management system		Autocatalytic hydrogen recombiners and manual activated post-accidental monitor and recombiner system	4

NSSS suppliers: FRAMACEDO (Framatome, Acec, Cockerill) 2

Reference

[1] Smissaerts, G.: Technische en ekonomische beschouwingen bij het kernpark te Doel, Ingenieurstijdingen, 35 (1986) no.1, pp.23.
[2] EBES, Doel Nuclear Power Plant, Units 3 and 4, 1979
[3] Elektriciteit uit kernenergie – kerncentrale Doel, Electrabel n.v., 1991.
[4] Kingdom of Belgium, National Report of the Nuclear Safety Convention, 1998.
[5] Tihange has no additional cooling system, however sprayed water will be accumulated and be reused after cooling across a heat exchanger (3 x 50% capacity), see 4.

BELGIUM

TECHNICAL DATA FOR DOEL 4

List of plants of this type: Doel-4, Tihange 3

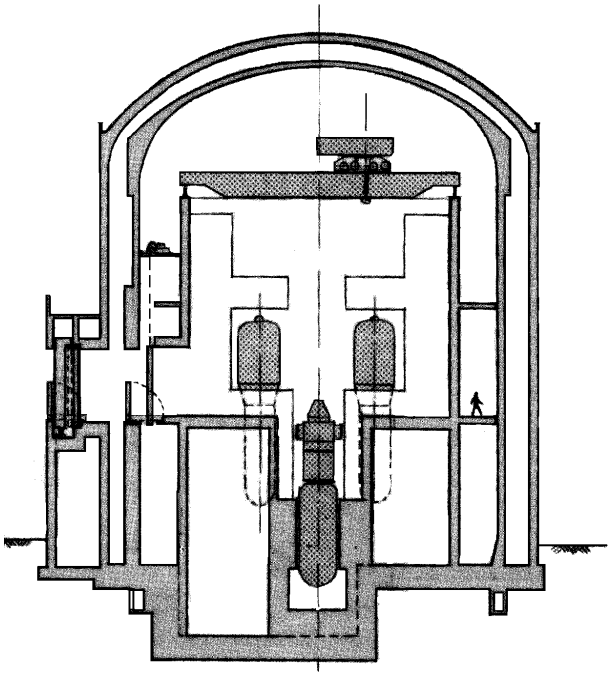


Figure 1: Schematic diagram of Doel 4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR, Westinghouse	1
Nominal Electrical output	MW	1003	1,2,3
Nominal thermal Power	MW	3000	1,2,3
Coolant type		H_2O	1
Volume of coolant (of liquid water in LWR	m^3	-	
Volume of primary circuit		-	
Moderator type		H_2O	1
Fuel type (oxide/metal)		UO_2	2
Typical fuel enrichment	% mass	3.23	2
Fuel cladding		Zircaloy 4	4
Number of fuel elements		157 (264 rods each)	2,3
Mass of U in core	tonnes	82.529	2,3
Control rod type		Ag-In-Cd alloy + B_4C	4
Number of control rods		28 assemblies for quick-response reactivity control 24 assemblies for shutdown, 24 fingers per assembly	4 2,3
Emergency shutdown systems		Two, 100% trains	4

Data	Units	Value	Ref.
Pressure vessel material		SA533/SA508	5
Pressure vessel diameter	m	3.990 (inside)	2,3
Pressure vessel height	m	13.5 (inside, with vessel head)	2,3
Pressure vessel wall thickness	m	0.200	2,3
Pressure vessel weight	tonnes	334 (plus head, without mechanisms)	2,3
Coolant pressure	MPa	15.5	1,2,3, 4
Coolant temperature at reactor inlet	°C	293.6	4
Coolant temperature at reactor outlet	°C	331.8	4
Number of primary circuit loops		3	1
Number of primary coolant pumps		3	1
Primary coolant flowrate	m^3/s	6.40 per loop	4
Number of steam generators		3 (inconel 690 tubes)	4
Steam generator/ exch. area		Vertical U-tubes/ 6,340 m^2	2,3
Number of turbines		1 (1 high- and 2 low-press. sect.)	2,3,4
Steam pressure at turbine inlet	MPa	7.6	4
Steam temperature at turbine inlet	°C	288.5	1,2,3
Steam flowrate at turbine inlet	kg/s	1667	1,2,3
Feedwater temperature (at water station outlet)	°C	224	4
Feedwater flow	kg/s	556 at 6.46 MPa	4
Type of safety related feedwater systems (SRFS)		In case of Tihange 3: Additonal supply by 3 independent pumps drawing groundwater. Also 3 independent pumps drawing water from the river	4
Number of SRFS		3	4
Duty of SRFS		-	2,3
Capacity of SRFSs		3 x 50% of duty defined above	2,3
Number of high pressure injection systems (HPIS)		3 (one per loop)	2,4
Duty of HPIS	kg/s	-	
Operating pressure of HPIS	MPa	-	
Capacity of HPIS		-	
Number of accumulators		3 (one per loop)	2,4
Duty of accumulators	kg	-	
Capacity of accumulator		-	
Set-point of accumulators	MPa	-	
Number of low pressure injection systems (LPIS)		3 (one per loop)	2,4
Duty of LPIS		-	
Capacity of LPIS	kg	-	
Operating pressure of LPIS	MPa	-	
Reactor shut-down cooling pump		3 (one per loop)	2
Number and type of back-up generators on-site		3 (+1 reserve also for Doel 3) diesels and 3 diesels in bunker (common for Doel 3 and Doel 4)	3

Data	Units	Value	Ref.
Duty of generators		3 (+1) 6.6 kV (5167 kVA) and 3 of 6.6 kV (2300 kVA)	3
Capacity of generators		100% of duty defined above)	2
Number of battery systems		4 plus 2	2
Duties of battery systems		-	
Capacity of systems			
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	-	
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	-	
Containment building type		Cylinder plus dome shape. Pre-stressed concrete primary containment, thickness 0.90 m with 6 mm steel liner. Internal diameter is 42.56 m). A concrete secondary containment, thickness 1.2 m. Internal diameter of 50 m.	1
Containment design pressure	MPa	0.468 (0.425 test 2)	1
Containment free volume	m^3		
Containment sprays - capacity	kg/s		
Containment heat removal		Spraying borated water and 6 cooling systems with 50% fans and cooling batteries.	
Containment venting		No, filtered exhaust from annular space only	
Containment hydrogen management system		Autocatalytic hydrogen recombiners and manual activated post-accidental monitor and recombiner system	

NSSS suppliers: ACECOWEN (Westinghouse, Acec, Cockerill) 2

Reference

[1] Smissaerts, G.: Technische en ekonomische beschouwingen bij het kernpark te Doel, Ingenieurstijdingen, 35 (1986) no.1, pp.23.
[2] EBES, Doel Nuclear Power Plant, Units 3 and 4, 1979.
[3] Elektriciteit uit kernenergie – kerncentrale Doel, Electrbel n.v., 1991.
[4] Kingdom of Belgium, National Report of the Nuclear Safety Convention, 1998.
[5] World Nuclear Industry Handbook, 1997.

BELGIUM

TECHNICAL DATA FOR TIHANGE 1

List of plants of this type: Tihange 1

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR, Framatome	2,3
Nominal Electrical output	MW	962	3,4
Nominal thermal Power	MW	2873	3
Coolant type		H_2O	2
Volume of coolant (of liquid water in LWR	m^3	-	
Volume of primary circuit		-	
Moderator type		H_2O	
Fuel type (oxide/metal)		UO_2	3
Typical fuel enrichment	% mass	4.5	3
Fuel cladding		Zircaloy 4	3
Number of fuel elements		157 (204 rods each)	3
Mass of U in core	tonnes		
Control rod type		Ag-In-Cd	3
Number of control rods		32 assemblies for quick-response reactivity control and 16 assemblies for shutdown.	3
Secondary shutdown systems		Boric acid injection.	
Pressure vessel material		-	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	-	
Coolant pressure	MPa	15.5	3
Coolant temperature at reactor inlet	°C	283.4	3
Coolant temperature at reactor outlet	°C	321.9	3
Number of primary circuit loops		3	3
Number of primary coolant pumps		3	3
Primary coolant flowrate	m^3/s	5.87 per loop	3
Number of steam generators		3, Inconel-690 tubes	3
Type of steam generator		Vertical U-tubes	3
Number of turbines		Two, 518 MW each	3
Steam pressure at SG outlet	MPa	6.2	3
Steam temperature at turbine inlet	°C	-	
Steam flowrate at turbine inlet	kg/s	-	
Feedwater temperature (at water station outlet)	°C	223.5	3
Feedwater flow		527 kg/s	3

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		Motor driven	
Number of SRFS		3	3
Duty of SRFS		-	
Capacity of SRFSs		-	
Number of high pressure injection systems (HPIS)		One, with 3 pumps of 100% capacity (one is in reserve)	3
Duty of HPIS	kg/s	-	
Operating pressure of HPIS	MPa	-	
Capacity of HPIS		-	
Number of accumulators		3 x 50%	3
Duty of accumulators	kg	-	
Capacity of accumulator		50%	
Set-point of accumulators	MPa	-	
Number of low pressure injection systems (LPIS)		One, with 3 pumps of 100% capacity	3
Duty of LPIS		-	
Capacity of LPIS	kg	Supply tank 1650 m^3	3
Operating pressure of LPIS	MPa	-	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		2 diesels and 1 diesel to all Tihange units.(one diesel in emergency installation)	3
Duty of generators		6 kV busses	3
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	-	
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	-	
Containment building type		Cylinder plus dome shape. Pre-stressed concrete primary containment.	3
Containment design pressure	MPa	0.4	1
Containment free volume	m^3	-	
Containment sprays – capacity	kg/s	Six 50% pumps (two direct, two for recirculation and two for back-up)	3
Containment heat removal		Containment spray (borated water)	3
Containment venting		Exhaust of filtered air from annular space	3
Containment hydrogen management system		Autocatalytic hydrogen recombiners and post-accident monitor and recombiner system	3

Each safety system has two independent trains with 100% capacity each.

NSSS suppliers: (Acec, Cockerill, Creusot, Framatome, Westinghouse) 4

Power-increase and steam generator replacement took place in 1995.

Reference

[1] EBES, Doel Nuclear Power Plant, Units 3 and 4, 1979
[2] Elektriciteit uit kernenergie – kerncentrale Doel, Electrbel n.v., 1991.
[3] Kingdom of Belgium, National Report of the Nuclear Safety Convention, 1998.
[4] International Nuclear Center Database, www.insc.anl.gov/-- (2001)

A1.3.2 BRITAIN

TECHNICAL DATA FOR BRADWELL – 1 & 2

List of plants of this type: Bradwell – 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1
Nominal Electrical output	MW	129	1
Nominal thermal Power	MW	490	1
Coolant type		CO_2	1
Volume of coolant (of liquid water in LWR	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1
Fuel type (oxide/metal)		U	1
Typical fuel enrichment	% mass	Nat	1
Fuel cladding		Magnox	1
Number of fuel assemblies/rods per assembly		20512/8 per channel	1
Mass of U in core	tonnes	239	1
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		Boron bead injection	
Pressure vessel material		Steel	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	0.076 (Reactor Vessel)	1
Coolant pressure	MPa	10.34 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	170	1
Coolant temperature at reactor outlet	°C	360	1
Number of primary circuit loops		6	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	8850 ton/pr	1
Number of steam generators		6	1
Type of steam generator		-	
Number of turbines		6	1
Steam pressure at turbine inlet	MPa	422 kg/cm^2g	1
Steam temperature at turbine inlet	°C	355	1
Steam flowrate at turbine inlet	kg/s	131.5 ton/br	1
Type of safety related feedwater systems (SRFS)		N/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		N/a	
Number of accumulators		N/a	
Number of low pressure injection systems (LPIS)		N/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		N/a	
Number and capacity of (at lift pressure) secondary system relief valves		N/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	N/a	
Containment heat removal		-	
Containment venting		None	
Containment hydrogen management system		N/a	

Reference

[1] Confirmed by the operator of nuclear plant

BRITAIN

TECHNICAL DATA FOR CALDER HALL – 1, 2, 3 & 4

List of plants of this type: Calder Hall – 1, 2, 3 & 4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1,2,3,4
Nominal Electrical output	MW	60	1,2,3,4
Nominal thermal Power	MW	268	1,2,3,4
Coolant type		CO_2	1,2,3,4
Volume of coolant (of liquid water in LWR	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1,2,3,4
Fuel type (oxide/metal)		U	1,2,3,4
Typical fuel enrichment	% mass	Nat	1,2,3,4
Fuel cladding		Magnox	1,2,3,4
Number of fuel assemblies/rods per assembly		10,000/6 per channel	1,2,3,4
Mass of U in core	tonnes	110-115	1,2,3,4
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		Boron bead injection	
Pressure vessel material		Steel	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	0.051 (Reactor Vessel)	1,2,3,4
Coolant pressure	MPa	8 kg/cm^2 g	1,2,3,4
Coolant temperature at reactor inlet	°C	150	1,2,3,4
Coolant temperature at reactor outlet	°C	345	1,2,3,4
Number of primary circuit loops		4	1,2,3,4
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	4800 ton/br	1,2,3,4
Number of steam generators		4	1,2,3,4
Type of steam generator		-	
Number of turbines		2	1,2,3,4
Steam pressure at turbine inlet	MPa	15.5 kg/cm^2g	1,2,3,4
Steam temperature at turbine inlet	°C	325	1,2,3,4
Steam flowrate at turbine inlet	kg/s	124 ton/br	1,2,3,4
Type of safety related feedwater systems (SRFS)		N/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		N/a	
Number of accumulators		N/a	
Number of low pressure injection systems (LPIS)		N/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1,2,3,4
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		N/a	
Number and capacity of (at lift pressure) secondary system relief valves		N/a	
Containment building type		Reactor Building	1,2,3,4
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	N/a	
Containment heat removal		-	
Containment venting		None	
Containment hydrogen management system		N/a	

References

[1] IAEA publications
   a) Power reactors in EU Member States 1974, 1980, 1981
   b) Operating experience with nuclear power stations in EU Member States 1970, 1971, 1972, 1973, 1974, 1975, 1977, 1979, 1980, 1981
   c) Directory of nuclear reactors (power reactors) IV, VII, IX, X
[2] Nuclear power plants in the world Jun 1984, Japan Atomic Industrial Forum
[3] World list of nuclear power plants, Nuclear news August 1984
[4] Neue Kernkraftwerke in Europa 1984, atw-report Juni 1984

BRITAIN

TECHNICAL DATA FOR CHAPELCROSS – 1, 2, 3 & 4

List of plants of this type: Chapelcross – 1, 2, 3 & 4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1,2,3,4
Nominal Electrical output	MW	60	1,2,3,4
Nominal thermal Power	MW	265	1,2,3,4
Coolant type		CO_2	1,2,3,4
Volume of coolant (of liquid water in LWR	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1,2,3,4
Fuel type (oxide/metal)		U	1,2,3,4
Typical fuel enrichment	% mass	Nat	1,2,3,4
Fuel cladding		Magnox	1,2,3,4
Number of fuel assemblies/rods per assembly		98000/1	1,2,3,4
Mass of U in core	tonnes	110-115	1,2,3,4
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		Boron bead injection	
Pressure vessel material		Steel	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	0.051 (Reactor Vessel)	1,2,3,4
Coolant pressure	MPa	18 kg/cm^2g	1,2,3,4
Coolant temperature at reactor inlet	°C	150	1,2,3,4
Coolant temperature at reactor outlet	°C	345	1,2,3,4
Number of primary circuit loops		8	1,2,3,4
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	10680 ton/hr	1,2,3,4
Number of steam generators		4	1,2,3,4
Type of steam generator		-	
Number of turbines		8	1,2,3,4
Steam pressure at turbine inlet	MPa	15.5 kg/cm^2g	1,2,3,4
Steam temperature at turbine inlet	°C	329	1,2,3,4
Steam flowrate at turbine inlet	kg/s	126 ton/hr	1,2,3,4
Type of safety related feedwater systems (SRFS)		n/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1,2,3,4
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1,2,3,4
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] IAEA publications
a) Power reactors in EU Member States 1974, 1980, 1981
b) Operating experience with nuclear power stations in EU Member States 1970, 1971, 1972, 1973, 1974, 1975, 1977, 1979, 1980, 1981
c) Directory of nuclear reactors (power reactors) IV, VII, IX, X
[2] Nuclear power plants in the world Jun 1984, Japan Atomic Industrial Forum
[3] World list of nuclear power plants, Nuclear news August 1984
[4] Neue Kernkraftwerke in Europa 1984, atw-report Juni 1984

BRITAIN

TECHNICAL DATA FOR DUNGENESS A 1 & 2

List of plants of this type: Dungeness A 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1
Nominal Electrical output	MW	212	1
Nominal thermal Power	MW	720	1
Coolant type		CO_2	1
Volume of coolant l(of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1
Fuel type (oxide/metal)		U	1
Typical fuel enrichment	% mass	Nat	1
Fuel cladding		Magnox	1
Number of fuel assemblies/rods per assembly		27524 rods/7 per channel	1
Mass of U in core	tonnes	304	1
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		Boron bead injection	
Pressure vessel material		Steel	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	0.102 (Reactor Vessel)	1
Coolant pressure	MPa	19.9 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	220	1
Coolant temperature at reactor outlet	°C	360	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	16900 ton/hr	1
Number of steam generators		4	1
Type of steam generator		-	
Number of turbines		4	1
Steam pressure at turbine inlet	MPa	38.7 kg/cm^2g	
Steam temperature at turbine inlet	°C	345	
Steam flowrate at turbine inlet	kg/s	2448 ton/hr	1
Type of safety related feedwater systems (SRFS)		n/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

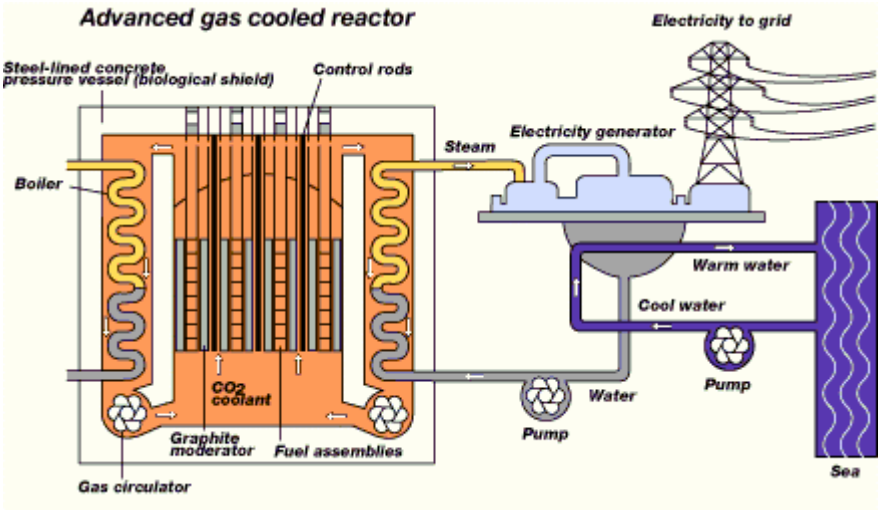
Reference

[1] Confirmed by the operator of nuclear power plant

BRITAIN

TECHNICAL DATA FOR DUNGENESS B 1 & 2

List of plants of this type: Dungeness B 1 & 2



Generic schematic digram of an AGR [2]

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1
Nominal Electrical output	MW	660	1
Nominal thermal Power	MW	1500	1
Coolant type		CO_2	2
Volume of coolant l(of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1
Fuel type (oxide/metal)		UO_2	1
Typical fuel enrichment	% mass	2.4	1
Fuel cladding		SS	1
Number of fuel assemblies/rods per assembly		408/7 elements x 36 pins	1
Mass of U in core	tonnes	121	1
Control rod type		Boron/steel	2
Number of control rods		57 channels	2
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	1
Pressure vessel material		pre-stressed concrete lined with steel	2
Pressure vessel diameter	m	20	2
Pressure vessel height	m	17.7 internal	2
Pressure vessel wall thickness	m	3.8 sidewall/5.9 top & bottom base caps	2

Data	Units	Value	Ref.
Coolant pressure	MPa	34.3 kg/cm^2 g	1
Coolant temperature at reactor inlet	°C	276	1
Coolant temperature at reactor outlet	°C	673	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		4, centrifugal blower, induction motor	2
Primary coolant flowrate	m^3/s	11680 ton/hr	1
Number of steam generators		4	1
Type of steam generator		once-through	2
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	161 kg/cm^2 g	1
Steam temperature at turbine inlet	°C	554	1
Steam flowrate at turbine inlet	kg/s	1551 ton/hr	1
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] Confirmed by the operator of nuclear power plant
[2] http://www.british-energy.co.uk

BRITAIN

TECHNICAL DATA FOR HARTLEPOOL 1 & 2

List of plants of this type: Hartlepool 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1,2,3,4,5
Nominal Electrical output	MW	666	1,2,3,4,5
Nominal thermal Power	MW	1500	1,2,3,4,5
Coolant type		CO_2	1,2,3,4,5
Volume of coolant l(of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1,2,3,4,5
Fuel type (oxide/metal)		UO_2	1,2,3,4,5
Typical fuel enrichment	% mass	2.3	
Fuel cladding		SS	1,2,3,4,5
Number of fuel assemblies/rods per assembly		324/8 elements x 36 pins	1,2,3,4,5
Mass of U in core	tonnes	111	1,2,3,4,5
Control rod type		boron/steel	6
Number of control rods		81 channels	6
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	6
Pressure vessel material		reinforced pre-stressed concrete lined with mild steel	6
Pressure vessel diameter	m	13.1 internal / 25.9 external	6
Pressure vessel height	m	18.3 internal / 29.3 external	6
Pressure vessel wall thickness	m	6.4	6
Coolant pressure	MPa	42.2 kg/cm_2g	1,2,3,4,5
Coolant temperature at reactor inlet	°C	280	1,2,3,4,5
Coolant temperature at reactor outlet	°C	675	1,2,3,4,5
Number of primary circuit loops		8	1,2,3,4,5
Number of primary coolant pumps		8, squirrel cage induction motor	6
Primary coolant flowrate	m^3/s	12860 ton/hr	1,2,3,4,5
Number of steam generators		8	6
Type of steam generator		helically-wound, integrally-finned pod boilers	6
Number of turbines		2	1,2,3,4,5
Steam pressure at turbine inlet	MPa	163 kg/cm^2g	1,2,3,4,5
Steam temperature at turbine inlet	°C	538	1,2,3,4,5
Steam flowrate at turbine inlet	kg/s	1735 (ton/hr)	1,2,3,4,5

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1,2,3,4,5
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] IAEA publications
   a) Power reactors in EU Member States 1974, 1980, 1981
   b) Operating experience with nuclear power stations in EU Member States 1970, 1971, 1972, 1973, 1974, 1975, 1977, 1979, 1980, 1981
   c) Directory of nuclear reactors (power reactors) IV, VII, IX, X
[2] Nuclear power plants in the world Jun 1984, Japan Atomic Industrial Forum
[3] World list of nuclear power plants, Nuclear news August 1984
[4] Neue Kernkraftwerke in Europa 1984, atw-report Juni 1984
[5] Nuclear Engineering International July 1981 Supplement
[6] http://www.british-energy.co.uk

BRITAIN

TECHNICAL DATA FOR HEYSHAM A 1 & 2

List of plants of this type: Heysham A 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1
Nominal Electrical output	MW	666	1
Nominal thermal Power	MW	1500	1
Coolant type		CO_2	1
Volume of coolant l(of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1
Fuel type (oxide/metal)		UO_2	1
Typical fuel enrichment	% mass	2.3	1
Fuel cladding		SS	1
Number of fuel assemblies/rods per assembly		324/8 elements x 36 pins	1
Mass of U in core	tonnes	111	1
Control rod type		boron/steel	2
Number of control rods		81 channels	2
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	1
Pressure vessel material		pre-stressed concrete lined with mild steel	2
Pressure vessel diameter	m	13.1 internal / 25.9 external	2
Pressure vessel height	m	18.3 internal / 29.3 external	2
Pressure vessel wall thickness	m	6.4	2
Coolant pressure	MPa	42.2 kg/cm^2 g	1
Coolant temperature at reactor inlet	°C	287	1
Coolant temperature at reactor outlet	°C	651	1
Number of primary circuit loops		8	1
Number of primary coolant pumps		8, centrifugal with integrated canned motors	2
Primary coolant flowrate	m^3/s	12929 ton/hr	1
Number of steam generators		8	2
Type of steam generator		helically-wound, integrally-finned pod boilers, divided into 4 quadrants	2
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	156 kg/cm^2 g	1
Steam temperature at turbine inlet	°C	538	1
Steam flowrate at turbine inlet	kg/s	1705 ton/hr	1

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] Confirmed by the operator of nuclear power plant
[2] http://www.british-energy.co.uk

BRITAIN

TECHNICAL DATA FOR HEYSHAM B 1 & 2

List of plants of this type: Heysham B 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1
Nominal Electrical output	MW	660	1
Nominal thermal Power	MW	1551	1
Coolant type		CO_2	1
Volume of coolant l(of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1
Fuel type (oxide/metal)		UO_2	1
Typical fuel enrichment	% mass	2.3	
Fuel cladding		SS	1
Number of fuel assemblies/rods per assembly		332/8 elements x 36 pins	1
Mass of U in core	tonnes	113.5	1
Control rod type		boron/steel	2
Number of control rods		89 channels	2
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	1
Pressure vessel material		pre-stressed concrete lined with steel	2
Pressure vessel diameter	m	20.25 internal / 31.8 external	2
Pressure vessel height	m	21.87 internal / 30.8 external	2
Pressure vessel wall thickness	m	5.775	2
Coolant pressure	MPa	43.51 kg/cm^2 g	1
Coolant temperature at reactor inlet	°C	292	1
Coolant temperature at reactor outlet	°C	638	1
Number of primary circuit loops		8	1
Number of primary coolant pumps		8, centrifugal with variable speed via variable frequency controller	2
Primary coolant flowrate	m^3/s	14108 ton/hr	1
Number of steam generators		12	2
Type of steam generator		once-through serpentine plates in rectangular units	2
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	162.8 kg/cm^2 g	1
Steam temperature at turbine inlet	°C	538	1
Steam flowrate at turbine inlet	kg/s	1772 ton/hr	1

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] Confirmed by the operator of nuclear power plant
[2] http://www.british-energy.co.uk

BRITAIN

TECHNICAL DATA FOR HINKLEY POINT A 1 & 2

List of plants of this type: Hinkley Point A 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1
Nominal Electrical output	MW	270	1
Nominal thermal Power	MW	920	1
Coolant type		CO_2	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1
Fuel type (oxide/metal)		U	1
Typical fuel enrichment	% mass	Nat	1
Fuel cladding		Magnox	1
Number of fuel assemblies/rods per assembly		3600/8 per channel	1
Mass of U in core	tonnes	370	1
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		Boron bead injection	
Pressure vessel material		Steel	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	-	
Coolant pressure	MPa	14.1 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	180	1
Coolant temperature at reactor outlet	°C	360	1
Number of primary circuit loops		6	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	2808 ton/hr	1
Number of steam generators		6	1
Type of steam generator		-	
Number of turbines		6	1
Steam pressure at turbine inlet	MPa	44.3 kg/cm^2g	1
Steam temperature at turbine inlet	°C	350	1
Steam flowrate at turbine inlet	kg/s	750 ton/hr	1
Type of safety related feedwater systems (SRFS)		n/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

Reference

[1] Confirmed by the operator of nuclear power plant

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TECHNICAL DATA FOR HINKLEY POINT B 1 & 2

List of plants of this type: Hinkley Point B 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1
Nominal Electrical output	MW	660	1
Nominal thermal Power	MW	1500	1
Coolant type		CO^2	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1
Fuel type (oxide/metal)		UO_2	1
Typical fuel enrichment	% mass	2.55 Replacement	1
Fuel cladding		SS	1
Number of fuel assemblies/rods per assembly		308/8 elements x 36 pins	1
Mass of U in core	tonnes	114.2	1
Control rod type		boron/steel	2
Number of control rods		81 channels	2
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	1
Pressure vessel material		pre-stressed concrete lined with thick mild steel plate	2
Pressure vessel diameter	m	18.9 internal	2
Pressure vessel height	m	19.4 internal	2
Pressure vessel wall thickness	m	5.0	2
Coolant pressure	MPa	42.4 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	292	1
Coolant temperature at reactor outlet	°C	634	1
Number of primary circuit loops		8	1
Number of primary coolant pumps		8, centrifugal with constant electric drive	2
Primary coolant flowrate	m^3/s	13727 ton/hr	1
Number of steam generators		12	1
Type of steam generator		once-through,	2
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	131.7 kg/cm^2g	1
Steam temperature at turbine inlet	°C	498	1
Steam flowrate at turbine inlet	kg/s	1435 ton/hr	1

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] Confirmed by the operator of nuclear power plant
[2] http://www.british-energy.co.uk

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TECHNICAL DATA FOR HUNTERSTON B 1 & 2

List of plants of this type: Hunterston B 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1,2,3,4,5
Nominal Electrical output	MW	660	1,2,3,4,5
Nominal thermal Power	MW	1494	1,2,3,4,5
Coolant type		CO_2	1,2,3,4,5
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1,2,3,4,5
Fuel type (oxide/metal)		UO_2	1,2,3,4,5
Typical fuel enrichment	% mass	2.55 replacement	1,2,3,4,5
Fuel cladding		SS	1,2,3,4,5
Number of fuel assemblies/rods per assembly		308/8 elements x 36 pins	1,2,3,4,5
Mass of U in core	tonnes	114.2	1,2,3,4,5
Control rod type		Boron/steel	6
Number of control rods		81 channels	6
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	1
Pressure vessel material		pre-stressed concrete lined with thick mild steel plate	6
Pressure vessel diameter	m	18.9 internal	6
Pressure vessel height	m	19.4 internal	6
Pressure vessel wall thickness	m	5.0	6
Coolant pressure	MPa	43.2 kg/cm^2g	1,2,3,4,5
Coolant temperature at reactor inlet	°C	292	1,2,3,4,5
Coolant temperature at reactor outlet	°C	648.5	1,2,3,4,5
Number of primary circuit loops		8	1,2,3,4,5
Number of primary coolant pumps		8, centrifugal with constant electric drive	6
Primary coolant flowrate	m^3/s	13060 ton/hr	1,2,3,4,5
Number of steam generators		2	1,2,3,4,5
Type of steam generator		once-through, in 4 quadrants	6
Number of turbines		2	1,2,3,4,5
Steam pressure at turbine inlet	MPa	163 kg/cm^2g	1,2,3,4,5
Steam temperature at turbine inlet	°C	538	1,2,3,4,5
Steam flowrate at turbine inlet	kg/s	1724 ton/hr	1,2,3,4,5

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1,2,3,4,5
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] IAEA Publications
- (a) Power reactors in EU Member States 1974, 1980, 1981
- (b) Operating experience with nuclear power stations in EU Member States 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1979, 1980, 1981
- (c) Directory of nuclear reactors (power reactors) IV, VII, IX, X

[2] Nuclear power plants in the world Jun. 1984, Japan Atomic Industrial Forum
[3] World list of nuclear power plants, Nuclear news August 1984
[4] Neue Kernkraftwerke in Europa 1984, atw-report Juni 1984
[5] Nuclear Engineering International July 1981 Supplement
[6] http://www.british-energy.co.uk

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TECHNICAL DATA FOR OLDBURY 1 & 2

List of plants of this type: Oldbury1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1,2,3,4,5
Nominal Electrical output	MW	218	1,2,3,4,5
Nominal thermal Power	MW	730	1,2,3,4,5
Coolant type		CO_2	1,2,3,4,5
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1,2,3,4,5
Fuel type (oxide/metal)		U	1,2,3,4,5
Typical fuel enrichment	% mass	Nat	1,2,3,4,5
Fuel cladding		Magnox	1,2,3,4,5
Number of fuel assemblies/rods per assembly		26464/8 per channel	1,2,3,4,5
Mass of U in core	tonnes	293	1,2,3,4,5
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		(1) Articulated control rods (2) boron dust	
Pressure vessel material		Concrete	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	-	
Coolant pressure	MPa	24.6 kg/cm^2g	1,2,3,4,5
Coolant temperature at reactor inlet	°C	250	1,2,3,4,5
Coolant temperature at reactor outlet	°C	412	1,2,3,4,5
Number of primary circuit loops		4	1,2,3,4,5
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	18492 ton/hr	1,2,3,4,5
Number of steam generators		4	1,2,3,4,5
Type of steam generator		Once through	
Number of turbines		2	1,2,3,4,5
Steam pressure at turbine inlet	MPa	44.8 kg/cm^2g	1,2,3,4,5
Steam temperature at turbine inlet	°C	390	1,2,3,4,5
Steam flowrate at turbine inlet	kg/s	990.4 ton/hr	1,2,3,4,5

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1,2,3,4,5
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] IAEA Publications
- (a) Power reactors in EU Member States 1974, 1980, 1981
- (b) Operating experience with nuclear power stations in EU Member States 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1979, 1980, 1981
- (c) Directory of nuclear reactors (power reactors) IV, VII, IX, X

[2] Nuclear power plants in the world Jun. 1984, Japan Atomic Industrial Forum
[3] World list of nuclear power plants, Nuclear news August 1984
[4] Neue Kernkraftwerke in Europa 1984, atw-report Juni 1984
[5] Nuclear Engineering International July 1981 Supplement

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TECHNICAL DATA FOR SIZEWELL A 1 & 2

List of plants of this type: Sizewell A 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1
Nominal Electrical output	MW	225	1
Nominal thermal Power	MW	810	1
Coolant type		CO_2	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1
Fuel type (oxide/metal)		U	1
Typical fuel enrichment	% mass	Nat	1
Fuel cladding		Magnox	1
Number of fuel assemblies/rods per assembly		26453 rods/7 per channel	1
Mass of U in core	tonnes	321	1
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		Boron bead injection	
Pressure vessel material		Steel	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	-	
Coolant pressure	MPa	19.6 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	220	1
Coolant temperature at reactor outlet	°C	360	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	18300 ton/hr	1
Number of steam generators		4	1
Type of steam generator		-	
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	44.8 kg/cm^2g	1
Steam temperature at turbine inlet	°C	390	1
Steam flowrate at turbine inlet	kg/s	1250 ton/hr	1
Type of safety related feedwater systems (SRFS)		n/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Reactor Building	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	-	
Containment heat removal		n/a	
Containment venting		none	
Containment hydrogen management system		n/a	

Reference

[1] Confirmed by the operator of nuclear power plant

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TECHNICAL DATA FOR SIZEWELL B

List of plants of this type: Sizewell B

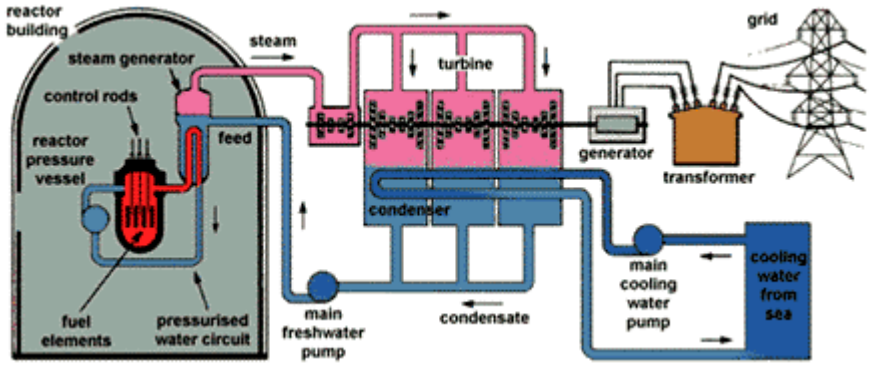

Figure 1: Generic schematic diagram of Sizewell B [3]

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR 4 Loop Westinghouse	1
Nominal Electrical output	MW	1245	1
Nominal thermal Power	MW	3411	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	334.5	3
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.1 (Reload)	1
Fuel cladding		Zircaloy	1
Number of fuel elements		193 assemblies	1
Mass of U in core	tonnes	523.4 kg (UO_2)	2
Control rod type		AIC	1
Number of control rods		53 assemblies, 24 rods/assembly	1
Secondary shutdown systems		Boric acid injection	1
Pressure vessel material		SS	1
Pressure vessel diameter	m	4.39 (internal)	1
Pressure vessel height	m	13.55	1
Pressure vessel wall thickness	m	0.22	1
Coolant pressure	MPa	15.8	1
Coolant temperature at reactor inlet	°C	293.4	1
Coolant temperature at reactor outlet	°C	324.9	1
Number of primary circuit loops		4	1

Data	Units	Value	Ref.
Number of primary coolant pumps		4	1
Primary coolant flowrate	m^3/s	18749 kg/s	1
Number of steam generators		4	1
Type of steam generator		U-tube (Type F)	1
Number of turbines		2	2
Steam pressure at turbine inlet	MPa	6.9	1
Steam temperature at turbine inlet	°C	285	1
Steam flowrate at turbine inlet	kg/s	477 kg/s	1
Type of safety related feedwater systems (SRFS)		1) motor driven, and 2) turbine driven	2
Number of SRFS		4	2
Duty of SRFS		At 11.4 MPa, 135 m^3/hr (motor) At 9.8 MPa, 189 m^3/hr (turbine)	2
Capacity of SRFSs		Eg 4 x 50% of duty defined above	
Number of high pressure injection systems (HPIS)		4	1, 2
Duty of HPIS	kg/s	Delivery commences at 12.5 MPa	2
Operating pressure of HPIS	MPa	1250m (maximum delivery load)	2
Capacity of HPIS		-	
Number of accumulators		4 x 50%	2, 3
Duty of accumulators	kg	Each 57.3 m^3 water: 36.1 m^3	2
Capacity of accumulator		-	
Set-point of accumulators	MPa	4.5 MPa	2
Number of low pressure injection systems (LPIS)		2	1, 2
Duty of LPIS		Delivery commences at 1.7 MPa	2
Capacity of LPIS	kg	-	
Operating pressure of LPIS	MPa	-	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		4 diesel generators	1
Duty of generators		1 is sufficient for duty	1
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	3 relief; 470 kg/s (sat, steam at 17.2 MPa) 2 safety; 52.9 kg/s at 17.2 MPa	2
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	-	
Containment building type		Steel-lined prestressed concrete	1
Containment design pressure	MPa	3.45 bar g	3

Data	Units	Value	Ref.
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	Yes	1
Containment heat removal		Spray, fan coolers	1
Containment venting		-	
Containment hydrogen management system		Recombiners, fan coolers	1

References

[1] B V George, J A Board, The Sizewell B Design Nucl. Energy. 1987, 26 No 3 June, 133-148
[2] A Description of the UK Standard PWR Power Station Design, Editor J R Appleby, Sizewell B Project Management Board, September 1987
[3] http://www.british-energy.co.uk

BRITAIN

TECHNICAL DATA FOR TORNESS 1 & 2

List of plants of this type: Torness 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		AGR	1
Nominal Electrical output	MW	660	1
Nominal thermal Power	MW	1549	1
Coolant type		CO_2	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite blocks	1
Fuel type (oxide/metal)		UO_2	1
Typical fuel enrichment	% mass	2.6 replacement	1
Fuel cladding		SS	1
Number of fuel assemblies/rods per assembly		332/8 elements x 36 pins	1
Mass of U in core	tonnes	113.5	1
Control rod type		Boron/steel	2
Number of control rods		89 channels	2
Secondary shutdown systems		(1) nitrogen injection, (2) boron bead injection	1
Pressure vessel material		pre-stressed concrete lined with steel	2
Pressure vessel diameter	m	20.25 internal / 31.8 external	2
Pressure vessel height	m	21.87 internal / 39.8 external	2
Pressure vessel wall thickness	m	5.775	2
Coolant pressure	MPa	43.51 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	290	1
Coolant temperature at reactor outlet	°C	615	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		8, ce ntrifugal with variable speed via variable frequency converter	2
Primary coolant flowrate	m^3/s	14108 ton/hr	1
Number of steam generators		12	1
Type of steam generator		once-through, serpentine pattern in rectangular units	2
Number of turbines		2	2
Steam pressure at turbine inlet	MPa	162.8 kg/cm^2g	1
Steam temperature at turbine inlet	°C	538	1
Steam flowrate at turbine inlet	kg/s	1805 ton/hr	1

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		n/a	
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Gas turbine	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		Prestressed Concrete	1
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

References

[1] Confirmed by the operator of nuclear power plant
[2] http://www.british-energy.co.uk

BRITAIN

TECHNICAL DATA FOR WYLFA 1 & 2

List of plants of this type: Wylfa 1 & 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		Magnox	1
Nominal Electrical output	MW	495	1
Nominal thermal Power	MW	1650	1
Coolant type		CO_2	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Graphite	1
Fuel type (oxide/metal)		U	1
Typical fuel enrichment	% mass	Nat	1
Fuel cladding		Magnox	1
Number of fuel assemblies/rods per assembly		49248/8 per channel	1
Mass of U in core	tonnes	595.4	1
Control rod type		4%boron/steel bulk rods, others steel	
Number of control rods		-	
Secondary shutdown systems		(1) Articulated control rods (2) boron dust	
Pressure vessel material		Concrete	
Pressure vessel diameter	m	-	
Pressure vessel height	m	-	
Pressure vessel wall thickness	m	-	
Coolant pressure	MPa	28.1 kg/cm^2g	1
Coolant temperature at reactor inlet	°C	247	1
Coolant temperature at reactor outlet	°C	414	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	36948 ton/hr	1
Number of steam generators		4	1
Type of steam generator		Once through	
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	34.5 kg/cm^2g	1
Steam temperature at turbine inlet	°C	330	1
Steam flowrate at turbine inlet	kg/s	1070 ton/hr	1
Type of safety related feedwater systems (SRFS)		n/a	

Data	Units	Value	Ref.
Number of high pressure injection systems (HPIS)		n/a	
Number of accumulators		n/a	
Number of low pressure injection systems (LPIS)		n/a	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves		n/a	
Number and capacity of (at lift pressure) secondary system relief valves		n/a	
Containment building type		-	
Containment design pressure	MPa	-	
Containment free volume	m^3	-	
Containment sprays - capacity	kg/s	n/a	
Containment heat removal		-	
Containment venting		none	
Containment hydrogen management system		n/a	

Reference

[1] Confirmed by the operator of nuclear power plant

A1.3.3 BULGARIA

TECHNICAL DATA FOR KOZLODUY 1-4

List of plants of this type: Kozloduy 1-4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		VVER-440/230	1
Nominal Electrical output	MW	440	1
Nominal thermal Power	MW	1375	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.3 (Reload)	1
Fuel cladding		Zircaloy-Nb	1
Number of fuel elements		349 assemblies	1
Mass of U in core	tonnes	42	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	3.84	1
Pressure vessel height	m	18.8	1
Pressure vessel wall thickness	m	0.20	1
Coolant pressure	MPa	125 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	269.0	1
Coolant temperature at reactor outlet	°C	298.0	1
Number of primary circuit loops		6	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	44500 (ton/hr)	1
Number of steam generators		6	1
Type of steam generator		-	
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	44 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	255	1
Steam flowrate at turbine inlet	kg/s	1320 (ton/hr)	1

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.

A1.3.4 CZECH REPUBLIC

TECHNICAL DATA FOR DUKOVANY 1-4

List of plants of this type: Dukovany 1-4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		VVER-440/213	1
Nominal Electrical output	MW	413	1
Nominal thermal Power	MW	1375	1
Coolant type		Light Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Light Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.5 (Reload)	1
Fuel cladding		Zircaloy-Nb	1
Number of fuel elements		312 x 126	1
Mass of U in core	tonnes	42	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	4.3	1
Pressure vessel height	m	11.8	1
Pressure vessel wall thickness	m	0.140	1
Coolant pressure	MPa	124.7 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	268.0	1
Coolant temperature at reactor outlet	°C	297.0	1
Number of primary circuit loops		6	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	32760 (ton/hr)	1
Number of steam generators		6	1
Type of steam generator		-	
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	44 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	270	1
Steam flowrate at turbine inlet	kg/s	449 (ton/hr)	1
Containment building type		Confinement with bubble condenser tower	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

CZECH REPUBLIC

TECHNICAL DATA FOR TEMELIN 1-2

List of plants of this type: Temelin 1-2

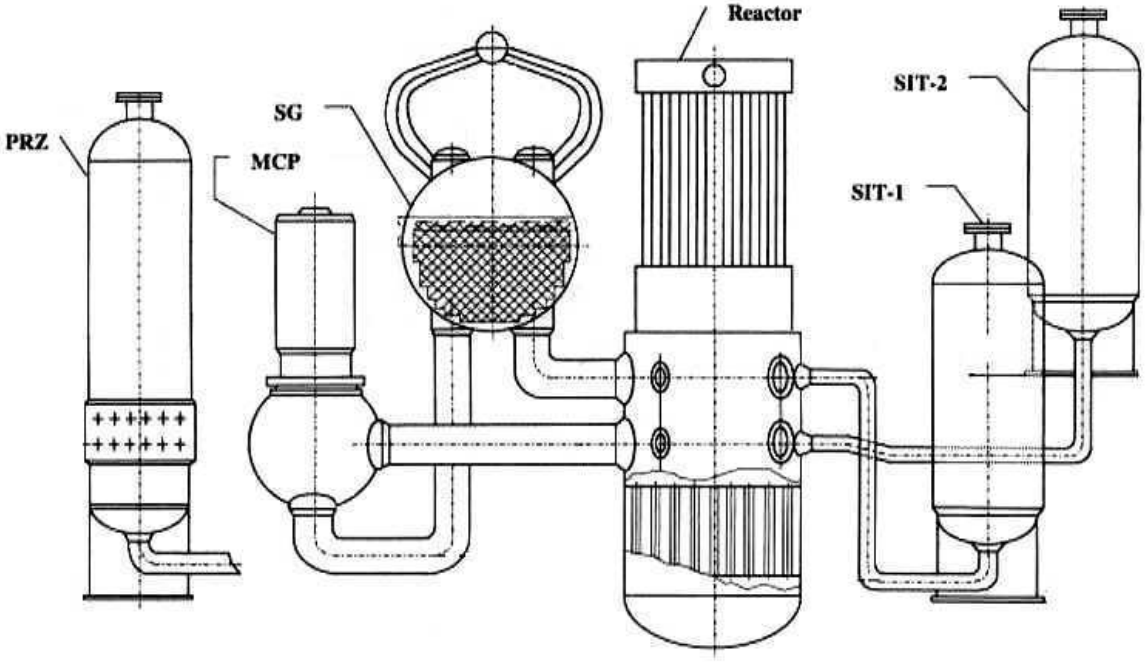

Figure 1: Simple generic diagram for a VVER-1000

Standard Data

Data	Units	Value	Ref.
Reactor type and model	-	WWER-1000/320	1
Nominal electrical output	MW	1000	1
Nominal thermal power	MW	3000	1
Coolant type	-	Demineralised H_2O	1
Volume of coolant in reactor	m^3	100	1
Volume of primary circuit	m^3	337	1
Moderator type	-	Demineralised H_2O	1
Fuel type (oxide/metal)	-	UO_2	1
Typical fuel enrichment (U_{235})	% mass	1.3 - 3.8	1
Fuel cladding		Zr - 4	1
Number of fuel assemblies	-	163	1
Mass of UO2 in core	tonnes	91.755	1
Control rod type		VVANTAGE 6 RCCA, B_4C & Ag-In-Cd	1
Number of control assemblies, burnable absorber	-	61 ZrB_2 and/or Al_2O_3 - B_4C	1
Secondary shutdown systems	-	boric acid	1
Pressure vessel material		15CH2NMFA, near core 15CH2NMFAA	1

Data	Units	Value	Ref.
Pressure vessel diameter (inner/outer)	m	4.570/4.136	1
Pressure vessel height	m	10.9	1
Pressure vessel wall thickness	m	0.1592	1
Coolant pressure	MPa	15.7	1
Coolant temperature at reactor inlet	°C	288.1	1
Coolant temperature at reactor outlet	°C	320.2	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		4	1
Primary coolant flowrate	kg/s	16711 /(effective 16043)	1
Number of steam generators		4	1
Type of steam generator		Horizontal, U-tube	1
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	6	1
Steam temperature at turbine inlet	°C	256	1
Steam flowrate at turbine inlet	kg/s	1462	1
Type of feedwater safety systems (FWSS)		Motor driven	1
Number of FWSS (super emergency feed water system)	-	Redundancy 3x100%	1
Capacity of FWSS (one subsystem)	kg/s	42 at 6.4 MPa, 35 at 6.9 MPa, and 22 at 8.5 MPa	1
Number of high pressure injection systems (HPIS)		Redundancy 3x100%	1
Capacity of HPIS (one subsystem)	m^3/h	(115 - 150) at (10.8 - 9.83) MPa	1
Maximum delivered pressure of HPIS	MPa	11.7	1
Number of accumulators (HA)		4 (2x100% redundancy)	1
Capacity of accumulators (one HA)	m^3	50 / 60	1
Set-point of HA	MPa	5.9	1
Number of low pressure injection systems (LPIS)	-	Redundancy 3x100%	1
Capacity of LPIS (one subsystem)	m^3/h	800/2.26 MPa	1
Maximum delivered pressure of LPIS	MPa	2.5	1
Other decay heat removal systems	-	Residual heat removal system	1
Number and type of back-up generators on-site		8 diesel generators on site,3x100% redundancy per unit, and 2 DGs common	1
Capacity of generators (one subsystem)	MW	6.3	1
Number of battery systems		3x100% per unit + 2x2 per unit	1
Capacity of battery systems (one subsystem)	h	> 1.5, (1440 Ah)	1
Number and capacity (at lift pressure) of primary system relief valves	t/h	1x100%, (lift pressure: 180/16.8 MPa)	1

Data	Units	Value	Ref.
Number and capacity (at lift pressure) of secondary system safety valves	t/h	2x100%, 2x270 (lift pressure: 18.1 and 18.6 MPa)	1
Number and capacity (at lift pressure) of steam generator safety valves (SG SV) - per one SG	t/h	2x800 (lift pressure: 8.2 and 8.5 MPa)	1
Number and capacity of (at lift pressure) steam dump station into atmosphere (SDSA) - per one SG Pipeline	t/h	1x 900 (lift pressure: 7.4 MPa)	1
Containment building type	-	Reinforced concrete , pre-stressed full pressure containment	1
Containment design pressure	kPa	400 overpressure	1
Containment free volume	m^3	60 000	1
Number of containment spray system (SS)	-	Redundancy 3x100%	1
Capacity of SS (one subsystem)	m^3/h	700/1.37 MPa	1
Containment heat removal		Spray system	1
Containment venting		No	1
Containment hydrogen management system		Catalytic recombiners 22 pcs.	1

References

[1] Private Communication.

A1.3.5 FINLAND

TECHNICAL DATA FOR LOVIISA-1

List of plants of this type: Loviisa 1 and 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		VVER-440	1
Nominal Electrical output	MW	488	1
Nominal thermal Power	MW	1500	1
Coolant type		Light water	1
Volume of coolant (primary side)	m^3	204	1
Volume of primary circuit	m^3	216	1
Moderator type		Light water	1
Fuel type (oxide/metal)		Sintered UO_2	1
Typical fuel enrichment	% mass	3.6	2
Fuel cladding		Zr + 1 % Nb	1
Number of fuel elements		313	1
Mass of U in core	tonnes	37.4	1
Control rod type		Boron and stainless steel	1
Number of control rods		37	1
Pressure vessel material		Carbon steel/ stainless steel lined	1
Pressure vessel diameter (int.)	m	3.542	1
Pressure vessel height (int.)	m	13.810	1
Pressure vessel wall thickness	m	0.140 – 0.221	1
Coolant pressure	MPa	12.3	1
Coolant temperature at reactor inlet	°C	265	1
Coolant temperature at reactor outlet	°C	299	1
Number of recirculation loops		6	1
Number of recirculation pumps		6	1
Total core coolant flowrate	kg/s	8500	1
Number of steam generators		6	1
Type of steam generator		horizontal	1
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	4.4	1
Steam temperature at turbine inlet	°C	255	1
Steam flowrate at turbine inlet	kg/s	2 x 414	1
High pressure safety injection system (TJ)		2 trains, 2 parallel pumps/train	1
- nominal capacity	m^3/h	65	1
- nominal head	m	1200	1
Accumulators		2 injecting to upper plenum 2 injecting to downcomer	1
- water volume	m^3	40	1
- pressure	MPa	5.4	1

Data	Units	Value	Ref.
Low pressure safety injection system (TH)		2 trains, 2 parallel pumps/train	1
-	m3/h	396	1
	m	72	1
Small capacity make-up pumps		3 piston pumps	1
- capacity	kg/s	1.7	1
Large capacity make-up pumps		2 pumps	1
- nominal capacity	kg/s	18	1
Large capacity Boron pumps –nominal capacity	 kg/s	2 pumps 18	1
Low capacity Boron pumps –nominal capacity	 kg/s	2 pumps 2,7	1
Boron injection pumps, TB		2 piston pumps	1
- capacity	kg/s	1.7	1
Feedwater pumps		5 pumps	1
- nominal capacity	m^3/h	850	1
- nominal head	m	714	1
Emergency feed water pumps		2 pumps	1
- nominal capacity	kg/s	18	1
- nominal head	m	700	1
Number and type of back-up generators on-site		4 diesel generators	1
Duty of generators	MW	2.8	1
Capacity of generators		2x100% of duty defined above	1
Number of battery systems		2x125V / 2x24V	1
Duties of battery systems	Ah	1600/60 (each type of battery)	1
Capacity of systems		2x100%	1
Primary circuit relief valves		1 valve	1
- capacity	kg/s	1.2 at 13.08 MPa	1
- opening pressure	MPa	13.08	1
Primary circuit safety valves		2 valves	1
- capacity valves 1 and 2	kg/s	36.1 at 13.66 MPa	1
- opening pressure valve 1	MPa	13.74	1
- opening pressure valve 2	MPa	14.36	1
Secondary circuit safety valves		2 valves	1
- capacity valve 1	kg/s	67 at 5.4 MPa	1
- opening pressure valve 1	MPa	5,2	1
- capacity valve 2	kg/s	108 at 5.6 MPa	1
- opening pressure valve 2	MPa	5.6	1
Secondary circuit relief valves		2 valves	1
- capacity	kg/s	67 at 5.4 MPa	1
- opening pressure	MPa	5.2	1
Turbine by-pass valves		4 valves	1
- capacity	kg/s	135 at 5.1 MPa	1
- opening pressure	MPa	47	1
Containment building type		Drywell + pressure suppression torus + secondary containment	1

Data	Units	Value	Ref.
Containment design pressure	MPa	0.43	1
Containment free volume	m^3	3.293	1
Containment sprays - capacity	kg/s	LPCI modes (Drywell spray or torus heat removal), 2x100%	1
Drywell venting		To pressure suppression chamber	1
Containment hydrogen management system		Drywell inertised (N_2) atmosphere	1

References

[1] H. Kantee, H. Lähdesmäki, LO1&2, LOMO, Loviisa Nuclear Power Station Basic Technical Data at uprated 1500 MW Nominal Power, IVO Power Engineering Ltd 1998.
[2] World Nuclear Industry Handbook, 1997.

FINLAND

TECHNICAL DATA FOR OLKILUOTO 1

List of plants of this type: Olkiluoto 1 and 2

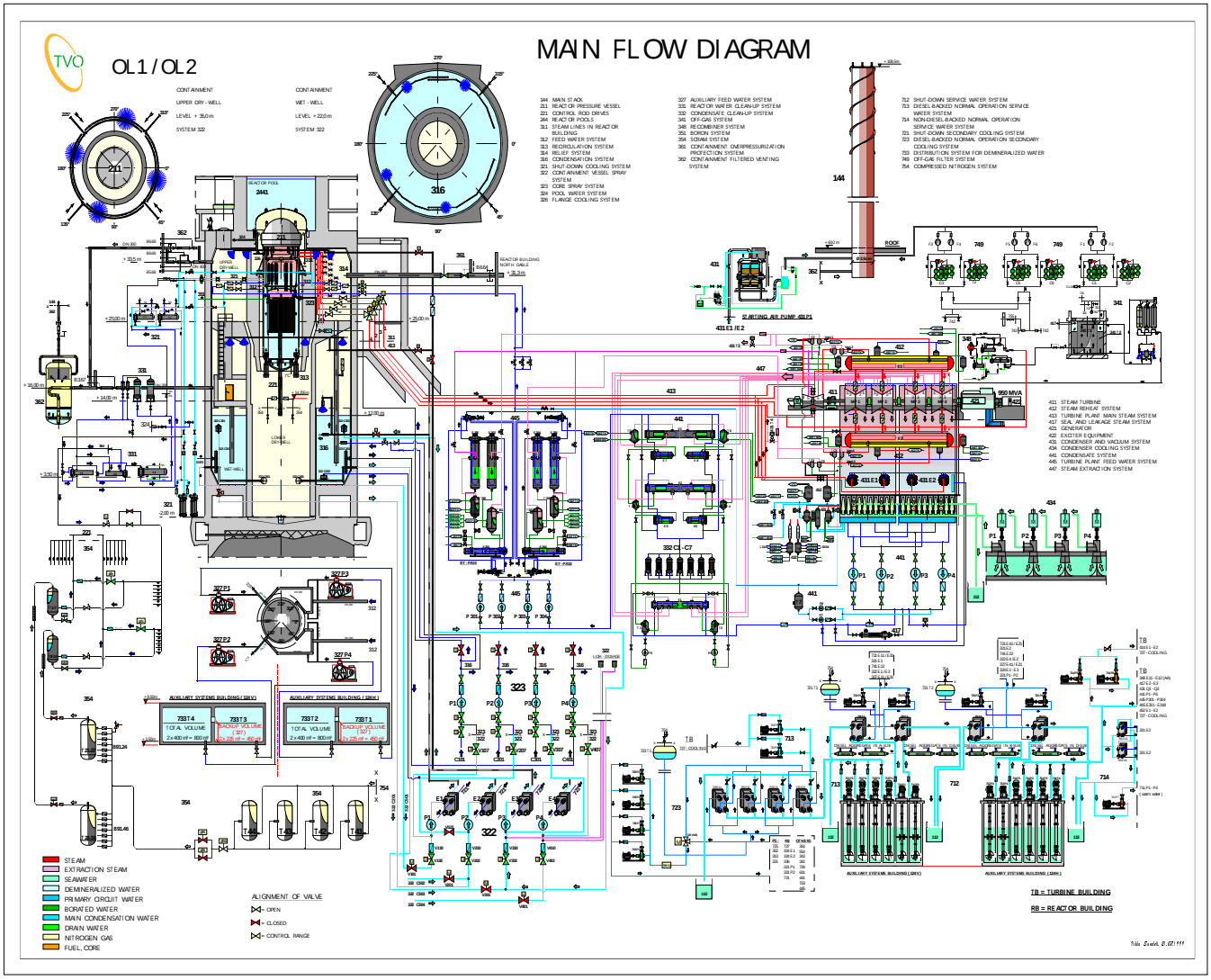

Figure 1: Simple schematic diagram for Olkiluoto 1

Standard Data

Data	Units	Value	Ref.
Reactor type and model		BWR (Asea Atom)	1
Nominal Electrical output	MW	840	1
Nominal thermal Power	MW	2500	1
Coolant type		Light water	1
Volume of coolant (of liquid water in LWR)	m^3	243 in reactor pressure vessel in nominal conditions	1
Volume of primary circuit		414 reactor pressure vessel	1
Moderator type		Light water	1

Data	Units	Value	Ref.
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	3.2 – 3.5 average	1
Fuel cladding		Zircaloy-2 with Zr liner or Fe enhanced liner	1
Number of fuel elements		500	1
Mass of U in core	Tonnes	86-90	1
Control rod type		cruciform control rods, Hf and B_4C absorber	1
Number of control rods		121	1
Pressure vessel material		Carbon steel ASME A533B, A508 Gr2/stainless steel cladding	1
Pressure vessel diameter (int.)	M	5.540	1
Pressure vessel height (int.)	M	20.593	1
Pressure vessel wall thickness	M	0.134, 0.005 cladding	1
Reactor vessel pressure	MPa	7.0	1
Coolant temperature at reactor inlet	°C	185.3	1
Coolant temperature at reactor outlet	°C	286	1
Number of recirculation loops		n/a	1
Number of recirculation pumps		6	1
Total core coolant flow rate	kg/s	7600 – 8360	1
Number of steam generators		n/a	1
Type of steam generator		n/a	1
Number of turbines		1 high and 4 low pressure turbines	1
Steam pressure at turbine inlet	MPa	6.7	1
Steam temperature at turbine inlet	°C	283	1
Steam flowrate at turbine inlet	kg/s	1260	1
Auxiliary feedwater system		4 trains, one piston pump per train	1
- capacity	kg/s	22.5	1
Low pressure safety injection system		4 trains, one pump per train	1
- nominal capacity	m^3/s	0.130	1
- nominal head	M	107	1
Number and type of back-up generators on-site		4 diesel generators, two mobile diesel generator for SAM busbars	1
Duty of generators	MW	1.6 design power (2.0 nominal power) (SAM: 23 kW)	1
Capacity of generators		4x100 % (SAM: 2x100 %) (capacity of each diesel for the demand of the respective sub)	
Number of battery systems		System 665: 4x220 V System 671: 4x440 V System 672: 4x110 V System 673: 2x48 V System 677: 2x24 V System 678: 2x ± 24 V	1

Data	Units	Value	Ref.
		System 679: 2x ± 24 V	
Duties of battery systems	Ah	System 665: 4x216 Ah/10 h System 671: 4x880 Ah/10 h System 672: 4x800 Ah/10 h System 673: 2x420 Ah/10 h System 677: 2x800 Ah/24 h System 678: 2x1050/310 Ah/10h System 679: 2x2000/1300Ah/10 h	1
Capacity of systems		System 665: 4x100 % System 671: 4x100 % System 672: 14x00 % System 673: 2x100 % System 677: 2x100 % System 678: 2x100 % System 679: 2x100 % (capacity of each battery subsystem for the demand of the respective sub)	1
Relief valves		8 valves	1
- nominal capacity	kg/s	70 at 7.0 MPa	1
- opening pressure	MPa	7.4	1
Safety valves		2 + 2 valves	1
- nominal capacity, valve type 1	kg/s	70 at 7.0 MPa	1
- nominal capacity, valve type 2	kg/s	100 at 7.0 MPa	1
- opening pressure	MPa	8.5	1
Fast acting shut-off relief valves		2 valves	1
- nominal capacity	kg/s	54 at 7.0 MPa	1
- opening pressure	MPa	7.4	1
Containment building type		Pressure suppression type, prestressed concrete with embedded steel liner	1
Containment design pressure	MPa	0.47	1
Containment free volume	m^3	7375	1
Containment sprays - capacity	kg/s	4x75 (4x60 all spray directed to drywell)	1
Containment heat removal		Recirculation of condensation pool water without containment spray in normal operation conditions and with containment spray in abnormal conditions	1
Drywell venting		To condensation pool in design basis accidents (Containment overpressure protection and containment filtered venting system in beyond design basis accidents, release to environment)	1
Containment hydrogen management system		Containment inertized with nitrogen during normal operation, active recombiner system	1

References

[1] Final Safety Analysis Report (FSAR)

A1.3.6 FRANCE

TECHNICAL DATA FOR REP 900

List of plants of this type: Blayais-1, Blayais-2, Blayais-4, Bugey-2, Bugey-3, Bugey-4, Bugey-5, Chinon-B1, Chinon-B2, Chinon-B3, Chinon-B4, Cruas-1, Cruas-2, Cruas-3, Cruas-4, Dampierre-1, Dampierre-2, Dampierre-3, Dampierre-4, Fessenheim-1, Fessenheim-2, Gravelienes-1, Gravelines-3, Gravelines-3, Gravelines-4, Gravelines-5, Gravelines-6, St-Laurent-B1, St-Laurent-B2, Tricastin-1, Tricastin-2, Tricastin-3, Tricastin-4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR REP 900	1
Nominal Electrical output	MW	880 to 915 MW	1
Nominal thermal Power	MW	2775 MW	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		280	1
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3,2 %	1
Fuel cladding		Zircaloy	1
Number of fuel elements		157	1
Mass of U in core	tonnes	72,4	1
Control rod type		AIC	1
Number of control rods		48	1
Secondary shutdown systems		Boric acid injection.	1
Pressure vessel material		16MND5	1
Pressure vessel diameter	m	4 (internal)	1
Pressure vessel height	m	12,3	1
Pressure vessel wall thickness	m	0,2	1
Coolant pressure	MPa	15,5 (Tsat=345°C)	1
Coolant temperature at reactor inlet	°C	286°C	1
Coolant temperature at reactor outlet	°C	323°C	1
Number of primary circuit loops		3	1
Number of primary coolant pumps		3	1
Primary coolant flowrate	kg/s	13547 kg/s	1
Number of steam generators		3	1
Type of steam generator		U-tube	1
Number of turbines		1HP, 2 to 3 LP	1
Steam pressure at turbine inlet	MPa	5,5	1
Steam temperature at turbine inlet	°C	270°C	1
Steam flowrate at turbine inlet	kg/s	5460 t/h	1

Data	Units	Value	Ref.
Type of safety related feedwater systems (SRFS)		1) motor driven, and 2) turbine driven	1
Number of SRFS		3	1
Duty of SRFS		At 10 MPa ~150 m3/h	1
Capacity of SRFSs		-	
Number of high pressure injection systems (HPIS)		2	1
Duty of HPIS	kg/s	MPa 17 12 5 m^3/h 50 130 180	1
Operating pressure of HPIS	MPa	-	
Capacity of HPIS		-	
Number of accumulators		3	1
Duty of accumulators	kg	Each: 41 m3; 28,3 m3 water 50°C	1
Capacity of accumulator		-	
Set-point of accumulators	MPa	4,2	1
Number of low pressure injection systems (LPIS)		2	1
Duty of LPIS		MPa 1 0,7 0,3 m^3/h 400 900 1300	1
Capacity of LPIS	kg	-	
Operating pressure of LPIS	MPa	-	
Other decay heat removal systems		Steam generator + AFWS	1
Number and type of back-up generators on-site		diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	1 vapour: 174,2 tons/h at 17,2 MPa water: 370 tonnes/h at 16,2 MPa/340°C	1
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	3; For each: 194 tonnes/h at 7,03 MPa operating at 7,17 MPa	1
Containment building type		Single Prestressed concrete, Lined	1
Containment design pressure	MPa	0,5	1
Containment free volume	m^3	~55.000	1
Containment sprays – capacity	kg/s	Yes	1
Containment heat removal		Spray	1
Containment venting		Sand filters; set point: 0,5 MPa	1
Containment hydrogen management system		Recombiners	1

References

[1] Data supplied by CEA.

FRANCE

TECHNICAL DATA FOR REP 1300

List of plants of this type:, Belleville-1, Belleville-2, Cattenom-1, Cattenom-2, Cattenom-3, Cattenom-4, Flamanville-1, Flamanville-2, Golfech-1, Golfech-2, Nogent-1, Nogent-2, Paluel-1, Paluel-2, Paluel-3, Paluel-4, Penly-1, Penly-2, St Alban-1, St Alban-2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR REP 1300	1
Nominal Electrical output	MW	1300 to 1335 MW	1
Nominal thermal Power	MW	3800 MW	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		400	1
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3,2 %	1
Fuel cladding		Zircaloy	1
Number of fuel elements		193	1
Mass of U in core	tonnes	104	1
Control rod type		AIC/B_4C	1
Number of control rods		56	1
Secondary shutdown systems		boric acid injection.	1
Pressure vessel material		16MND5	1
Pressure vessel diameter	m	4,4 (internal)	1
Pressure vessel height	m	12,9	1
Pressure vessel wall thickness	m	0,22	1
Coolant pressure	MPa	15,5 (Tsat=345°C)	1
Coolant temperature at reactor inlet	°C	293°C	1
Coolant temperature at reactor outlet	°C	328°C	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		4	1
Primary coolant flowrate	m^3/s	18800 kg/s	1
Number of steam generators		4	1
Type of steam generator		U-tube , economiser	1
Number of turbines		1HP, 3 LP	1
Steam pressure at turbine inlet	MPa	6,9	1
Steam temperature at turbine inlet	°C	285°C	1
Steam flowrate at turbine inlet		7760t/h	1
Type of safety related feedwater systems (SRFS)		1) motor driven, and 2) turbine driven	1
Number of SRFS		4	1

Data	Units	Value	Ref.
Duty of SRFS		At 10 MPa ~150 m^3/h	1
Capacity of SRFSs		-	
Number of high pressure injection systems (HPIS)		2	1
Duty of HPIS	kg/s	MPa 12,5 10 6 m^3/h 300 550 800	1
Operating pressure of HPIS	MPa	-	
Capacity of HPIS		-	
Number of accumulators		4	1
Duty of accumulators	kg	Each 47 m3 water: 30 m3	1
Capacity of accumulator		-	
Set-point of accumulators	MPa	4,8 Mpa	1
Number of low pressure injection systems (LPIS)		2	1
Duty of LPIS		MPa 2 1 0,5 m^3/h 300 650 750	1
Capacity of LPIS	kg	-	
Operating pressure of LPIS	MPa	-	
Other decay heat removal systems		-	
Number and type of back-up generators on-site		Diesel	1
Duty of generators		-	
Capacity of generators		-	
Number of battery systems		-	
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	3 (1 relief, 2 safety); For each vapour: 48,4 kg/s at 17,2 MPa Water: 103 kg/s at 16,2 MPa 340°C	1
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	1 per SG, For each: 144,4 kg/s at 8,96 MPa	1
Containment building type		Double, Prestressed concrete, Unlined	1
Containment design pressure	MPa	0,5	1
Containment free volume	m^3	98.000	1
Containment sprays – capacity	kg/s	Yes	1
Containment heat removal		Spray	1
Containment venting		Sand filters; set-point 0,5-0,6 MPa	1
Containment hydrogen management system		Recombiners	1

References

[1] Data supplied by CEA.

FRANCE

TECHNICAL DATA FOR N4

List of plants of this type:, Chooz-B1, Chooz-B2, Civaux-1, Civaux-2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR N4	1
Nominal Electrical output	MW	1516 MW	1
Nominal thermal Power	MW	4270 MW	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.4 %	1
Fuel cladding		Zircaloy	1
Number of fuel elements		205	1
Mass of U in core	tonnes	104	2
Control rod type		AIC	1
Number of control rods		53	1
Secondary shutdown systems		Boric acid injection.	1
Pressure vessel material		16Mn05	1
Pressure vessel diameter	m	4.5 (internal)	1
Pressure vessel height	m	12.6	1
Pressure vessel wall thickness	m	0.225	1
Coolant pressure	MPa	15.5 (Tsat=345°C)	1
Coolant temperature at reactor inlet	°C	292°C	1
Coolant temperature at reactor outlet	°C	330°C	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		4	1
Primary coolant flowrate	m^3/s	69840 (t/h)	1
Number of steam generators		4	2
Type of steam generator		73/19E	1
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	7.0	2
Steam temperature at turbine inlet	°C	285°C	2
Steam flowrate at turbine inlet		-	
Containment building type		Prestressed concrete/steel	1
Containment design pressure	MPa	4.3 bar	1

References

[1] World Nuclear Industry Handbook, 1997.
[2] Directory of Nuclear Power Plants of the World, Japan Nuclear Energy Information Center, 1985.

A1.3.7 GERMANY

TECHNICAL DATA FOR BIBLIS-A

List of plants for this type: Biblis-B, Brokdorf, Emsland, Grafenrheinfeld, Grohnde, Isar-2, Neckar-2, Philippsburg-2, Unterweser

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	1204	1
Nominal thermal Power	MW	3540	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.0 (Reload)	1
Fuel cladding		Zircaloy-4	1
Number of fuel elements		193 assemblies	1
Mass of U in core	Tonnes	102.7 (tu)	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	M	5.0	1
Pressure vessel height	M	13.25	1
Pressure vessel wall thickness	M	0.235	1
Coolant pressure	MPa	151.9 ($kg/cm^s g$)	1
Coolant temperature at reactor inlet	°C	284.7	1
Coolant temperature at reactor outlet	°C	316.0	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	72000 (ton/hr)	1
Number of steam generators		4	1
Type of steam generator		-	
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	50 (bar)	1
Steam temperature at turbine inlet	°C	262.3	1
Steam flowrate at turbine inlet	kg/s	6680 (ton/hr)	1
Containment building type		Steel-lined prestressed concrete	1
Containment design pressure	MPa	4.8 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

GERMANY

TECHNICAL DATA FOR MUELHEIM-KAERLICH

List of plants of this type: Muelheim-Kaerlich

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	1308	1
Nominal thermal Power	MW	3760	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.27 (Reload)	1
Fuel cladding		Zircaloy-4	1
Number of fuel elements		205 assemblies	1
Mass of U in core	tonnes	93.5	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	4.63	1
Pressure vessel height	m	12.9	1
Pressure vessel wall thickness	m	0.2318	1
Coolant pressure	MPa	155 (bar)	1
Coolant temperature at reactor inlet	°C	297.0	1
Coolant temperature at reactor outlet	°C	329.0	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	70400 (ton/hr)	1
Number of steam generators		2	1
Type of steam generator		-	
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	69 (bar)	1
Steam temperature at turbine inlet	°C	313.0	1
Steam flowrate at turbine inlet	kg/s	7280 (ton/hr)	1
Containment building type		Spherical	1
Containment design pressure	MPa	5.7 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

GERMANY

TECHNICAL DATA FOR NECKAR-1

List of plants of this type: Neckar-1

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	855	1
Nominal thermal Power	MW	2497	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.4 (Reload)	1
Fuel cladding		Zircaloy-4	1
Number of fuel elements		177 assemblies	1
Mass of U in core	tonnes	63.1	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	4.36	1
Pressure vessel height	m	10.9	1
Pressure vessel wall thickness	m	0.210	1
Coolant pressure	MPa	158 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	288.0	1
Coolant temperature at reactor outlet	°C	318.0	1
Number of primary circuit loops		3	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	52000 (ton/hr)	1
Number of steam generators		3	1
Type of steam generator		-	
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	58 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	273	1
Steam flowrate at turbine inlet	kg/s	3770 (ton/hr)	1
Containment building type		Spherical steel and concrete	1
Containment design pressure	MPa	4.7 BAR	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

GERMANY

TECHNICAL DATA FOR OBRIGHEIM

List of plants of this type: Obrigheim

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	345	1
Nominal thermal Power	MW	1050	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.2 (Reload)	1
Fuel cladding		Zircaloy-4	1
Number of fuel elements		121 assemblies	1
Mass of U in core	tonnes	34	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	3.3	1
Pressure vessel height	m	9.5	1
Pressure vessel wall thickness	m	0.160	1
Coolant pressure	MPa	147 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	281.0	1
Coolant temperature at reactor outlet	°C	309.0	1
Number of primary circuit loops		2	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	25120 (ton/hr)	1
Number of steam generators		2	1
Type of steam generator		-	
Number of turbines		1	2
Steam pressure at turbine inlet	MPa	53 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	268	1
Steam flowrate at turbine inlet	kg/s	2010 (ton/hr)	1
Containment building type		CS spherical vessel	1
Containment design pressure	MPa	4.05 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

GERMANY

TECHNICAL DATA FOR STADE

List of plants of this type: Stade

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	662	1
Nominal thermal Power	MW	1900	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.2 (Reload)	1
Fuel cladding		Zircaloy-4	1
Number of fuel elements		157 assemblies	1
Mass of U in core	tonnes	56.2	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	4.08	1
Pressure vessel height	m	10.4	1
Pressure vessel wall thickness	m	0.192	1
Coolant pressure	MPa	158 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	288.4	1
Coolant temperature at reactor outlet	°C	316.4	1
Number of primary circuit loops		4	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	44000 (ton/hr)	1
Number of steam generators		4	1
Type of steam generator		-	
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	50 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	265	1
Steam flowrate at turbine inlet	kg/s	3592 (ton/hr)	1
Containment building type		Double containment shell	1
Containment design pressure	MPa	3.85 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

GERMANY

TECHNICAL DATA FOR BRUNSBUETTEL

List of plants of this type: Isar-1, Phillipsburg-1

Standard Data

Data	Units	Value	Ref.
Reactor type and model		BWR	1
Nominal Electrical output	MW	805	1
Nominal thermal Power	MW	2292	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	-	
Fuel cladding		Zircaloy-2	1
Number of fuel elements		532 assemblies	1
Mass of U in core	tonnes	104	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	5.58	1
Pressure vessel height	m	20.7	1
Pressure vessel wall thickness	m	0.136	1
Coolant pressure	MPa	69.6 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	277.0	1
Coolant temperature at reactor outlet	°C	285.4	1
Number of primary circuit loops		8	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	35672 (ton/hr)	1
Number of steam generators		-	
Type of steam generator		-	
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	68.2 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	285.4	1
Steam flowrate at turbine inlet	kg/s	4459 (ton/hr)	1
Containment building type		Pressure suppression spherical	1
Containment design pressure	MPa	4.6 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

GERMANY

TECHNICAL DATA FOR GUNDREMMINGEN-B

List of plants of this type: Gundremmingen-C, Krümmel

Standard Data

Data	Units	Value	Ref.
Reactor type and model		BWR	1
Nominal Electrical output	MW	1310	1
Nominal thermal Power	MW	3840	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.14 (Reload)	
Fuel cladding		Zircaloy-2	1
Number of fuel elements		784 assemblies	1
Mass of U in core	tonnes	138	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	6.62	1
Pressure vessel height	m	22.35	1
Pressure vessel wall thickness	m	0.163	1
Coolant pressure	MPa	70.6 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	280.0	1
Coolant temperature at reactor outlet	°C	287.0	1
Number of primary circuit loops		-	
Number of primary coolant pumps		8	1
Primary coolant flowrate	m^3/s	51480 (ton/hr)	1
Number of steam generators		-	
Type of steam generator		-	
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	67 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	283	1
Steam flowrate at turbine inlet	kg/s	7000 (ton/hr)	1
Containment building type		Steel concrete	1
Containment design pressure	MPa	4.3 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

A1.3.8 HUNGARY

TECHNICAL DATA FOR PAKS 1-4

List of plants of this type: Paks 1-4

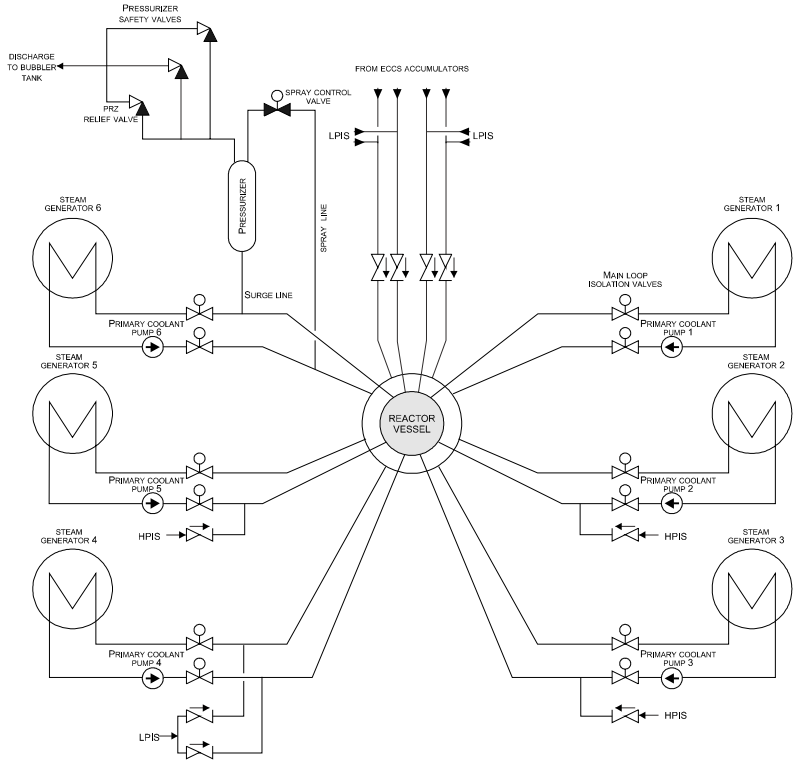

Figure 1: Schematic diagram of primary system for Paks

Standard Data

Data	Units	Value	Ref.
Reactor type and model		VVER-440/213	1
Nominal Electrical output	MW	460	1
Nominal thermal Power	MW	1375	1
Coolant type		light water	1
Volume of coolant (of liquid water in LWR)	m^3	215	1
Volume of primary circuit	m^3	232	1
Moderator type		light water	1
Fuel type (oxide/metal)		oxide	1
Typical fuel enrichment	% mass	3.6	1
Fuel cladding		Zr+1%Nb	1
Number of fuel elements		349 x 126	1
Mass of U in core	tonnes	42	1
Control rod type		control assembly, Fe+2%B	1
Number of control rods		37 x 126	1
Secondary shutdown systems		boric acid injection	1
Pressure vessel material		25CH2MFA + 08CH18N10T	1

Data	Units	Value	Ref.
Pressure vessel diameter	m	3.840	1
Pressure vessel height	m	13.537	1
Pressure vessel wall thickness	m	0.140 + 0.009	1
Coolant pressure	MPa	12.26	1
Coolant temperature at reactor inlet	°C	267	1
Coolant temperature at reactor outlet	°C	297	1
Number of primary circuit loops		6	1
Number of primary coolant pumps		6	1
Primary coolant flowrate	m^3/s	11.28	1
Number of steam generators		6	1
Type of steam generator		horizontal U-tube	1
Number of turbines		2	1
Steam pressure at turbine inlet	MPa	4.46	1
Steam temperature at turbine inlet	°C	256	1
Steam flowrate at turbine inlet	kg/s	375	1
Type of safety related feedwater systems (SRFS)		motor driven	1
Number of SRFS		2 AF + 2 EF	1
Duty of SRFS	kg/s	4 x 18.0	1
Capacity of SRFSs		4 x 100%	1
Number of high pressure injection systems (HPIS)		3	1
Duty of HPIS	kg/s	30	1
Operating pressure of HPIS	MPa	13.0	1
Capacity of HPIS		3 x 100%	1
Number of accumulators		4	1
Duty of accumulators	kg	40000	1
Capacity of accumulator		4 x 50%	1
Set-point of accumulators	MPa	5.8	1
Number of low pressure injection systems (LPIS)		3	1
Duty of LPIS	kg/s	90	1
Capacity of LPIS		3 x 100%	1
Operating pressure of LPIS	MPa	0.8	1
Other decay heat removal systems		RHR via secondary side	1
Number and type of back-up generators on-site		diesel	1
Duty of generators		3 x 2.2 MW	1
Capacity of generators		3 x 100%	1
Number of battery systems		3	1
Duties of battery systems	Ah	3 x 1200	1
Capacity of systems		3 x 100%	1
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C)	1 relief 50 t/h / 14.3 MPa 2 safety 115 t/h / 14.4 MPa	1
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and	2 relief 200 t/h / 5.3 MPa 12 safety 300 t/h / 5.8 MPa	1

Data	Units	Value	Ref.
	Y°C)		
Containment building type		Confinement with bubble condenser tower	1
Containment design pressure	MPa	0.25	1
Containment free volume	m^3	31 700	1
Containment sprays - capacity	kg/s	3 x 170	1
Containment heat removal		Sump recirculation	1
Containment venting		Centrifugal, 1000 m^3/h	1
Containment hydrogen management system		Passive catalytic recombiners	1

References

[1] Data supplied by AEKI, Budapest, Hungary.

A1.3.9 LITHUANIA

TECHNICAL DATA FOR IGNALINA 1 and 2

List of plants of this type: Ignalina 1 and 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		RBMK (LWGR)	1
Nominal Electrical output	MW	1500	1
Nominal thermal Power	MW	4800	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type			
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	2 (Reload)	
Fuel cladding		Zr/Nb	2
Number of fuel elements		1661 channels	1
Mass of U in core	tonnes	189	1
Control rod type		B4C	2
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		Zr/2.5% Nb	2
Pressure vessel diameter	m	0.08	2
Pressure vessel height	m	8.0	2
Pressure vessel wall thickness	m	0.004	2
Coolant pressure	MPa	70 (kg/sq cm)	2
Coolant temperature at reactor inlet	°C	259	2
Coolant temperature at reactor outlet	°C	284	2
Number of primary circuit loops		2	2
Number of primary coolant pumps		8	2
Primary coolant flowrate	m^3/s	29000 (ton/hr)	1
Number of steam generators		-	
Type of steam generator		-	
Number of turbines		2	2
Steam pressure at turbine inlet	MPa	65 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	280.0	1
Steam flowrate at turbine inlet	kg/s	8800 (ton/hr)	1
Containment building type		Localisation	2
Containment design pressure	MPa	0.3 kg/sq cm	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] 1997 World Nuclear Industry Handbook, Nuclear Engineering International.
[3] K. Alemenas, A Kaliatka, E Uspuras, Ignalina RBMK-1400, A Source Book.

A1.3.10 NETHERLANDS

TECHNICAL DATA FOR BORSSELE

List of plants of this type: Borssele

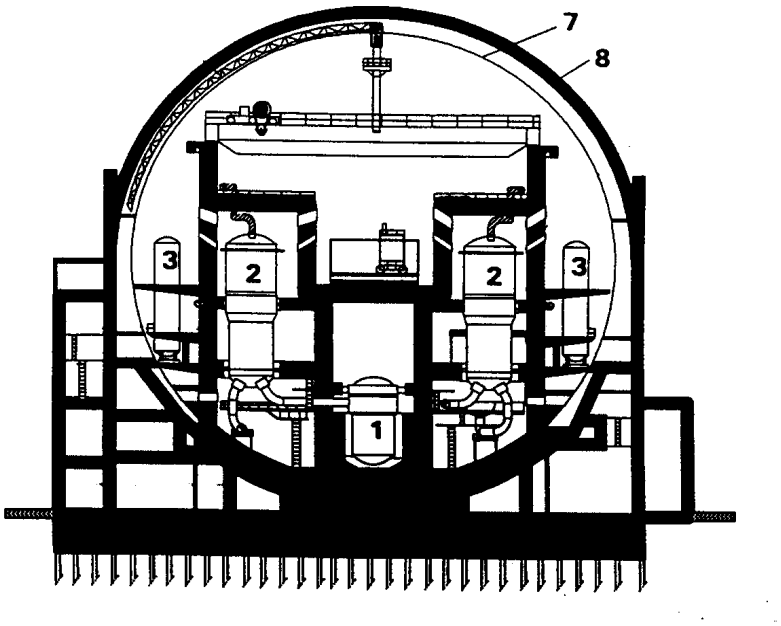

Figure 1: Schematic figure of Borssele

Key
1 Reactor pressure vessel
2 Steam generator
3 Medium-pressure core inundation buffer tank
7 Steel containment
8 Secondary concrete enclosure (shield building)

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR 2 loop Siemens KWU	1
Nominal Electrical output	MW	447	1
Nominal thermal Power	MW	1370	1
Coolant type		H_2O	1
Volume of coolant (of liquid water in LWR)	m^3	137	1
Volume of primary circuit	m^3	166	1
Moderator type		H_2O	1
Fuel type (oxide/metal)		UO_2	1
Typical fuel enrichment	% mass	4	1
Fuel cladding		PCA-2b	1
Number of fuel elements		121	1
Mass of U in core	tonnes	50	1

Data	Units	Value	Ref.
Control rod type		Ag/In/Cd	1
Number of control rods		28	1
Secondary shutdown systems		Boric acid injection	1
Pressure vessel material		22NiMoCr37	1
Pressure vessel diameter	m	3.726	2
Pressure vessel height	m	9.825	2
Pressure vessel wall thickness	m	0.18	1
Coolant pressure	MPa	15.5	1
Coolant temperature at reactor inlet	°C	292.5	1
Coolant temperature at reactor outlet	°C	317.5	1
Number of primary circuit loops		2	1
Number of primary coolant pumps		2	1
Primary coolant flowrate	m^3/s	5 per loop	2
Number of steam generators		2	1
Steam generator/exch. area		Vertical U-tube/ 3,600 m^2	2
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	5.2	1
Steam temperature at turbine inlet	°C	266	1
Steam flowrate at turbine inlet	kg/s	194	1
Type of safety related feedwater systems (SRFS)		2 motor driven, 1 turbine driven	1
Number of SRFS		3	1
Duty of SRFS		32 kg/s / 10 MPa	1
Capacity of SRFSs		3 x 50% of duty defined above	1
Number of high pressure injection systems (HPIS)		2	1
Duty of HPIS	kg/s	-	
Operating pressure of HPIS	MPa	11	1
Capacity of HPIS		4x190m^3/h / 6.5 MPa	1
Number of accumulators		4	1
Duty of accumulators	kg	4 x 21000	1
Capacity of accumulator		-	
Set-point of accumulators	MPa	2.5	1
Number of low pressure injection systems (LPIS)		2	1
Duty of LPIS		-	
Capacity of LPIS	kg	4x465m^3/h / 0.8 MPa	1
Operating pressure of LPIS	MPa	0.9	1
Other decay heat removal systems		2 loop decay heat removal	1
Number and type of back-up generators on-site		Five diesels 3 x 4.343 MW 2 x 0.88 MW	1 2
Duty of generators		-	
Capacity of generators		3x100% 2x100%	1

Data	Units	Value	Ref.
Number of battery systems		2	1
Duties of battery systems		-	
Capacity of systems		-	
Number and capacity (at lift pressure) of primary system relief valves	(m^3/s at X MPa and Y°C	3 x 33.3kg/s at 17.2 MPa	1
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at X MPa and Y°C)	2x2 active, 170kg/s at 8.2MPa 2x10 pasive, 39kg/s at 9.4MPa	1
Containment building type		Steel cont. + concrete outer cont.	1
Containment design pressure	MPa	0.48	1
Containment free volume	m^3	36000	1
Containment sprays - capacity	kg/s	2 x14 at 1.3 MPa	1,2
Containment heat removal		Ventilation coolers + sump water cooling	1
Containment venting		Filtered venting, non-automatic	1
Containment hydrogen management system		Passive recombiners	1

Reference

[1] Safety Report Nuclear Power Plant Borssele (mod doc nr. 063-0000 revision 3, 1997.
[2] Convention on Nuclear Safety, National Report of the Kingdom of the Netherlands, 1998.

A1.3.11 ROMANIA

TECHNICAL DATA FOR CERNAVODA

List of plants of this type: Cernavoda

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	660	1
Nominal thermal Power	MW	-	
Coolant type		D20	2
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		-	
Fuel type (oxide/metal)		Oxide	2
Typical fuel enrichment	% mass		
Fuel cladding		Zircaloy-4	2
Number of fuel elements		37 x 4560	2
Mass of U in core	tonnes	84	2
Control rod type		Cd/H20	2
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		Zr-Nb	2
Pressure vessel diameter	m	0.103	2
Pressure vessel height	m	6.3	2
Pressure vessel wall thickness	m	0.00434	2
Coolant pressure	MPa	107 (kg/sq cm)	2
Coolant temperature at reactor inlet	°C	266	2
Coolant temperature at reactor outlet	°C	310	2
Number of primary circuit loops		2	2
Number of primary coolant pumps		4	2
Primary coolant flowrate	m^3/s	27720 (t/hr)	2
Number of steam generators		-	
Type of steam generator		-	
Number of turbines		1	2
Steam pressure at turbine inlet	MPa	43.51 kg/sq cm	2
Steam temperature at turbine inlet	°C	258	2
Steam flowrate at turbine inlet	kg/s	-	
Containment building type		Pre-stressed concrete	2
Containment design pressure	MPa	1.26 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] 1997 World Nuclear Industry Handbook, Nuclear Engineering International.

A1.3.12 SLOVAKIA

TECHNICAL DATA FOR BOHUNICE V1
(VVER-440/V230)

List of plants of this type: Bohunice V1 Units 1 and 2

Start of construction: 1972 Start of commercial operation: 1980 (Unit 1)
1981 (Unit 2)

Data	Units	Value	Ref.
Reactor type and model	-	VVER-440/230 (PWR)	1, p. 1.2-5
Nominal electrical output	MW	440	
Nominal thermal power	MW	1375	1, p. 1.2-5
Coolant type	-	Demineralised H_2O	1, p. 1.3-23
Volume of coolant in reactor	m^3	93.9	1, p. 15.DB-27
Volume of primary circuit	m^3	252.8	1, 15.DB
Moderator type	-	Demineralised H_2O	1, p. 1.3-23
Fuel type (oxide/metal)	-	Oxide (UO_2)	1, p. 4.3-4
Typical fuel enrichment (U_{235})	%, mass	1.6/2.4/3.6	1, p. 4.3-7
Fuel cladding	-	Zr+1.0% Nb	1, p. 4.2-9
Number of fuel elements	-	312 hexagonal fuel assemblies; assembly contains 126 fuel rods	1, p. 1.2-5
Mass of U in core	tonnes	42	1, p. 1.2-5
Control rod type	-	Hexagonal control assembly with fuel follower	
Number of control rods (assemblies)	-	37 assemblies	1, p. 1.2-5
Secondary shutdown systems	-	Boric acid injection	1, p. 15.DB-73
Pressure vessel material	-	Low alloyed carbon steel with inner stainless steel welds	1, p. 15.DB-10
Pressure vessel diameter (inner/outer)	m	3.56/4.27 (maximum)	1, p. 4.1-4, -15
Pressure vessel height	m	11.8	1, p. 4.1-4
Pressure vessel wall thickness	m	0.15	1, p. 4.1-4
Coolant pressure	MPa	12.26	1, p. 1.2-5
Coolant temperature at reactor inlet	°C	265	1, p. 1.2-5
Coolant temperature at reactor outlet	°C	294	1, p. 1.2-5
Number of primary circuit loops	-	6	1, p. 15.DB-7
Number of primary coolant pumps	-	6	1, p. 1.3-24
Primary coolant flowrate	m^3/s	11.98	1, p. 1.2-5
Number of steam generators	-	6	1, p. 15.DB-35
Type of steam generator	-	Horizontal, type PGV-4E	1, p. 1.3-24
Number of turbines	-	2	1, p. 15.DB-144
Steam pressure at turbine inlet	MPa	4.3	1, p. 1.3-28
Steam temperature at turbine inlet	°C	256	1, p. 1.3-28

Data	Units	Value	Ref.
Steam flowrate at turbine inlet	t/hod	1356	1, p. 1.3-28
Type of feedwater safety systems	-	Motor driven	1, p. 15.DB-134
Number of feedwater safety systems (FWSS)	-	Two independent subsystems; redundancy 2x100%	1, p. 15.DB-143
Capacity of FWSS (one subsystem)	m^3/s	0.014 nominal	1, p. 15.DB-143
Number of high pressure injection systems (HPIS)	-	Two independent subsystems; redundancy 2x100%	1, p. 1.3-31
Capacity of HPIS (one subsystem)	t/hod	Two pumps, each of them 65 nominal and 150 maximum	1, p. 1.3-31
Operating pressure of HPIS	MPa	13.25 max. delivered pressure	1, p. 6.3-14
Number of accumulators	-	None	
Capacity of accumulator	m^3	-	
Set-point of accumulators	MPa	-	
Number of low pressure injection systems (LPIS)	-	Two independent subsystems; redundancy 2x100%	1, p. 15.DB-84
Capacity of LPIS (one subsystem)	t/hod	400 nominal, 820 maximum	1, p. 6.3-14
Operating pressure of LPIS	MPa	3.16 max. delivered pressure	1, p. 6.3-14
Other decay heat removal systems		Spray system	1, p. 6.2-39
Number and type of back-up generators on-site	-	Two independent subsystems; redundancy 2x100%; diesel generators	1, p. 1.3-38
Capacity of diesel generators (one subsystem)	MW	Two DGs for each unit ; each DG 1.6 MW; Second subsystem of Unit 2 has only one DG with 3.1 MW	1, p. 1.3-38 1, p. 6.13-4; -10
Number of battery systems	-	Two independent subsystems; redundancy 2x100%	1, p.1.3-38
Capacity of battery systems	V	240.8	1, p.1.3-38
Number and capacity (at lift pressure) of primary system relief valves	t/hod	One relief valve, 60 (steam) and 338 t/hod (water)	1, p.15.DB-61
Number and capacity (at lift pressure) of primary system safety valves	t/hod	Two safety valves; each of them 108 (steam) and 702 (water)	1, p. 15.DB-61
Number and capacity of (at lift pressure) secondary system safety valves	kg/s	Three safety valves per one SG; each of them 41.7	1, p. 6.8-5
Number and capacity of (at lift pressure) secondary system relief valves	kg/s	One steam dump station into the atmosphere per one SG; each of them 50	1, p. 6.7-5
Containment building type		Multicompartment containment; reinforced concrete with inner hermetic steel liner	1, p. 15.DB-185
Containment design gauge pressure	kPa	60 (overpressure)	1, p. 15.0-39
Containment free volume	m^3	14284.89, including 756 m^3 of water pool	1, p. 15.DB-205
Number of spray systems (SS)	-	Two independent subsystems;	1, p. 6.2-39

Data	Units	Value	Ref.
		redundancy 2x100%	
Capacity of containment SS(one subsystem)	m^3/hod	560 nominal, 648 maximum	1, p. 6.2-47
Containment heat removal	-	Spray system, heat ventilation and air conditioning system	
Containment venting	-	Mitigation measure for beyond design basis accidents	1, p. 1.3-21
Containment hydrogen management system	-	None	

References

[1] Safety Analysis Report for NPP V-1 after gradual reconstruction, 5-BPS-001, REKON, 1999

SLOVAKIA

TECHNICAL DATA FOR BOHUNICE V2
(VVER-440/V213)

List of plants of this type: Bohunice V2 Units 3 and 4
(data are provided for one unit)

Start of construction: 1976 **Start of commercial operation:** **1985 (Unit 3)**
1985 (Unit 4)

Data	Units	Value	Ref.
Reactor type and model	-	VVER-440/213	1, p. 1.2-6
Nominal electrical output	MW	440	1, p. 1.2-8
Nominal thermal Power	MW	1375	1, p. 1.2-8
Coolant type	-	Demineralised H_2O	1, p. 1.2-5
Volume of coolant in reactor	m^3	93.7	2, p. 142
Volume of primary circuit	m^3	240.7	2, p. 142
Moderator type	-	Demineralised H_2O	1, p. 1.2-5
Fuel type (oxide/metal)	-	Oxide (UO_2)	1, p. 1.2-5
Typical fuel enrichment (U_{235})	%, mass	1.6/2.4/3.6	1, p. 4.3-5
Fuel cladding	-	Zr+1% Nb	1, p. 4.2-5
Number of fuel elements	-	312 hexagonal fuel assemblies; assembly contains 126 fuel roods	1, p. 4.3-5
Mass of U in core	tonnes	42	1, p. 4.3-5
Control rod type		Hexagonal control assembly with fuel follower	1, p. 4.6-4
Number of control rods (assemblies)		37 assemblies	1, p. 4.3-5
Secondary shutdown systems		Boric acid injection	
Pressure vessel material		Low alloyed carbon steel with inner stainless steel welds	1, p. 5.3-6
Pressure vessel diameter (inner/outer)	m	3.54/4.27 (maximum)	1, p. 5.3-5
Pressure vessel height	m	11.8	1, p. 5.3-5
Pressure vessel wall thickness	m	0.15	1, p. 5.3-5
Coolant pressure	MPa	12.26	1, p. 1.2-5
Coolant temperature at reactor inlet	°C	267	1, p. 1.2-5
Coolant temperature at outlet from Reactor	°C	297	1, p. 1.2-5
Number of primary circuit loops	-	6	1, p. 1.2-5
Number of primary coolant pumps	-	6	1, p. 1.2-6
Primary coolant flow rate	m^3/s	11.95	1, p. 1.2-5
Number of steam generators	-	6	1, p. 1.2-18
Type of steam generator	-	Horizontal, type PGV-213	1, p. 1.2-18
Number of turbines	-	2	1, p. 1.2-8

Data	Units	Value	Ref.
Steam pressure at turbine inlet	MPa	4.3	1, p. 10.2-5
Steam temperature at turbine inlet	°C	256	1, p. 10.2-5
Steam flow rate at turbine inlet	t/hod	1356	1, p. 10.2-5
Type of feedwater safety systems (FWSS)	-	Motor driven	1, p. 6.8-3
Number of FWSS (super emergency feedwater system)	-	Two independent subsystems; redundancy 2x100%	1, p. 10.4-11
Capacity of FWSS (one subsystem)	t/h	60	1, p. 6.8-3
Number of high pressure injection systems (HPIS)	-	Three independent subsystems; redundancy 3x100%	1, p. 6.3-4
Capacity of HPIS (one subsystem)	m^3/h	65 nominal, 130 maximum	1, p. 1.3-4
Operating pressure of HPIS	MPa	13.0 maximum delivered pressure	1, p. 6.3-4
Number of accumulators	-	Two independent subsystems(four accumulators); redundancy 4x50%	1, p. 6.3-10
Capacity of accumulators (one Accumulator)	m^3	40 nominal, 50 maximum	1, p.6.3-10
Set-point of accumulators	MPa	5.9	1, p. 6.3-10
Number of low pressure injection Systems (LPIS)	-	Three independent subsystems; redundancy 3x100%	1, p. 6.3-6
Capacity of LPIS (one subsystem)	m^3/h	280 nominal, 375 maximum	1, p. 6.3-7
Operating pressure of LPIS	MPa	0.8 maximum delivered pressure	1, p. 6.1-15
Other decay heat removal systems	-	Residual heat removal system	
Number and type of back-up generators on-site		3 diesel generators; three independent subsystems; redundancy 3x100%	1, p. 6.11-4
Capacity of generators (one subsystem)	MW	3.3	1, p. 6.11-6
Number of battery systems		Three independent subsystems; redundancy 3x100%	
Capacity of battery systems	V	220	
Number and capacity (at lift pressure) of primary system relief valves	t/h	One relief valve 5.0 at 13.24 MPa;	1, p. 5.2-16, p. 5.4-87
Number and capacity (at lift pressure) of primary system safety valves	t/h	Two safety valves; 108 at 14.4 MPa	1, p. 5.4-87
Number and capacity of (at lift pressure) secondary system safety valves (SG)	kg/s	Four safety valves per one SG; 41.7 at 5.68 MPa	2, p. 5-2
Containment building type		Multi-compartment containment; reinforced concrete with inner hermetic steel liner and inside steel liner	1, p. 6.2-12
Containment design pressure	kPa	245 maximum	1, p. 6.2-12
Containment free volume	m^3	52400 m^3 without 1345 m^3 of water pool	

Data	Units	Value	Ref.
Number of containment spray system (SS)		Three independent subsystems; redundancy 3x100%	1 6.2-35
Capacity of containment sprays (one subsystem)	$m^{3/}h$	600 nominal, 800 maximum	1, p. 6.2-36
Containment heat removal		Spray system; heat ventilation and air conditioning system	1, p. 6.2-35
Containment venting		None	
Containment hydrogen management System		None	

References

[1] Safety Analysis Report for NPP V-2 Bohunice, Revision 2, December 1996

[2] Database for Safety Analyses of WWER-440 Model V213 NPPs (reference plant Bohunice V2, Slovakia), IAEA, TC/RER/9/004, Vienna, Austria, August 1994

SLOVAKIA

TECHNICAL DATA FOR MOCHOVCE (VVER-440/V213)

List of plants of this type: Mochovce Units 1 and 2
(data are provided for one unit)

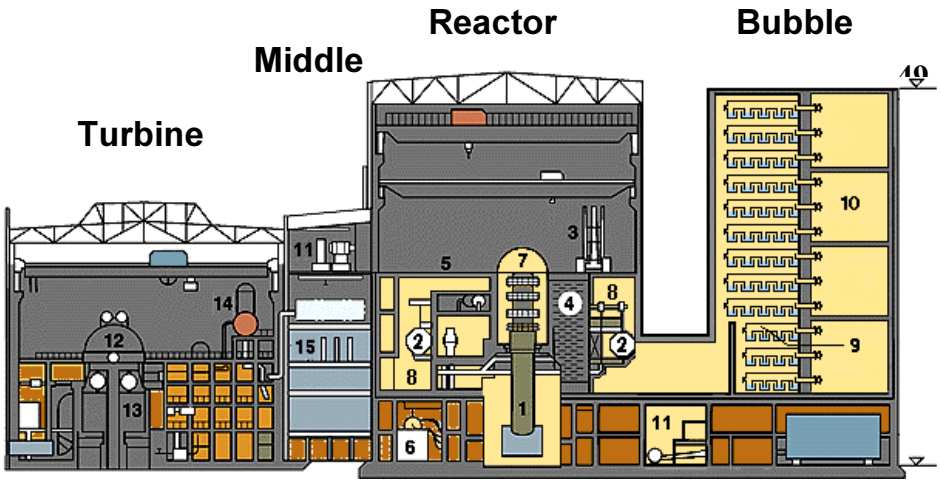

Figure 1: Schematic diagram of VVER440/V213

Key

1. Reactor pressure vessel, 2. Steam generator, 3. Refuelling machine, 4. Spent fuel pit, 5. Reactor hall, 6. Make-up feedwater system, 7. Protective cover, 8. Hermetic compartment system, 9. Bubble condenser trays, 10. Check valves 11. Air traps, 12. Intake air unit, 13. Turbine, 14. Condenser, 15. Feedwater tank with degasifier, 16. Electrical instrumentation and control compartments

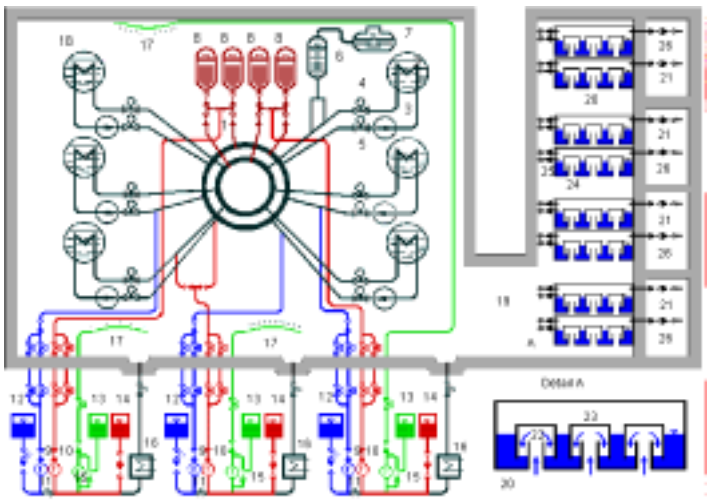

Figure 2: Safety systems of VVER440/V213

Key

1 - Reactor, 2 - Steam generator, 3 - Reactor coolant pump, 4 - Main isolating valve at the hot leg of the loop, 5 - Main isolating valve at the cold leg of the loop, 6 - Pressurizer, 7 - Safety relief tank, 8 - Hydroaccumulators, 9 - HP emergency pump, 10 - LP emergency pump, 11 - Spray system pump, 12 - Reserve tanks of boric acid solution, 13 - Hydrazine hydrate tank, 14 - Reserve tanks of boric acid solution, 15 - Water jet pump, 16 - Heat exchanger, 17 - Sprays, 18 - Hermetic rooms, 19 - Connecting corridor between hermetic rooms and bubble-condenser tower, 20 - Bubble-condenser tower, 21 - Air traps, 22 - Steam entrance into bubble-condenser channels, 23 - Bubble-condenser channel compartment, 24 - Bubble-condenser channel, 25 - Check valves, 26 - Check valves

Start of construction: 1981 **Start of commercial operation:** **1998 (Unit 1)**
1999 (Unit 2)

Data	Units	Value	Ref.
Reactor type and model	-	VVER-440/213 (PWR)	1, p. 1.1-1
Nominal electrical output	MW	440	1, p. 1.1-1
Nominal thermal power	MW	1375	3, p. 1-10
Coolant type	-	Demineralised H_2O	1, p. 1.1-1
Volume of coolant in reactor	m^3	93.7	3. p. 4-8
Volume of primary circuit	m^3	242.0	1
Moderator type	-	Demineralised water	1, p. 1.1-1
Fuel type (oxide/metal)	-	Oxide (UO_2)	1, p. 1.9-9
Typical fuel enrichment (U_{235})	% mass	3.3/3.6/4.0	2., p. 4.3.2-17
Fuel cladding		Zr+1%Nb	1, p. 1.9-10
Number of fuel elements	-	349 hexagonal fuel assemblies; including 37 control assemblies with fuel follower; each assembly contains 126 fuel rods	1, p. 4.1.4.3-1
Mass of U in core	tonnes	42.0	1, p. 4.1.4.3-1
Control rod type		Hexagonal control assemblies with fuel follower	1, chapters 4.6.1 and 4.6.2
Number of control assemblies	-	37 assemblies	1, p. 4.1.4.3-1
Secondary shutdown systems	-	Boric acid injection	
Pressure vessel material		Low alloyed carbon steel with inner stainless steel welds	1, p. 5.3.2-2
Pressure vessel diameter (inner/outer)	m	3.54/4.27	1, p. 4.1.3.1-1
Pressure vessel height	m	11,8	1, p. 5.3.1-1
Pressure vessel wall thickness	m	0.14+0.009	1, p.4.1.3.1-1
Coolant pressure	MPa	12.26	1, p. 1.9-2
Coolant temperature at reactor inlet	°C	267.0 (at full power)	3, p. 1-10
Coolant temperature at outlet from Reactor	°C	296.0 (at full power)	3, p. 1-10
Number of primary circuit loops		6	1, p. 1.2-13
Number of primary coolant pumps		6	1, p. 1.2-13
Primary coolant flowrate	kg/s	8986.8	1, p. 1.9-2
Number of steam generators		6	
Type of steam generator		Horizontal, U- type, PGV-213	1, p.1.2-13
Number of turbines		2	1, p.1.1-1
Steam pressure at turbine inlet	MPa	4.1	1, chapter 10.1
Steam temperature at turbine inlet	°C	252	1, chapter 10.1
Steam flowrate at turbine inlet	kg/s	376	1, chapter 10.1
Type of feedwater safety systems (FWSS)		Motor driven	1, p. 6.8.2-2
Number of FWSS (super emergency feed water system)	-	Three independent subsystems; redundancy 3x100%	1, p. 6.8.2-2
Capacity of FWSS (one	kg/s	16.67 nominal	1, p. 6.8.2-2

Data	Units	Value	Ref.
subsystem)			
Number of high pressure injection Systems (HPIS)		Three independent subsystems; redundancy 3x100%	1, p. 6.3.2-12
Capacity of HPIS (one subsystem)	m^3/h	65 nominal, 150 maximum	1, p. 6.3.2-5
Operating pressure of HPIS	MPa	13.5 max. delivered pressure	1, p. 6.3.2-5
Number of accumulators (HA)		Four HAs; two independent subsystems; redundancy 4x50%	1, p. 6.3.2-2
Capacity of accumulators (one HA)	m^3	40 minimum; 43.5 maximum	1
Set-point of HA	MPa	6.0	1, p. 6.3.2-3
Number of low pressure injection systems (LPIS)	-	Three independent subsystems; redundancy 3x100%	1, p. 6.3.2-12
Capacity of LPIS (one subsystem)	m^3/h	800 nominal	1, p. 6.3.2-8
Operating pressure of LPIS	MPa	2.2 maximum delivered pressure	
Other decay heat removal systems	-	Residual heat removal system, seismically qualified	3, p. 20-6
Number and type of back-up generators on-site		Three DGs; three independent subsystems; redundancy 3x100%	1, p. 1.9-31
Capacity of generators (one subsystem)	MW	2.8	1, p. 1.9-31
Number of battery systems		5; redundancy 3x100%, 220V	1, p. 1.9-31
Capacity of battery systems (one subsystem)	h	3 hours (in special regime can be extended to 6 hours)	1, p. 1.9-29,30
Number and capacity (at lift pressure) of primary system relief valves	kg/s	One relief valve; 15 steam at 13.1 MPa	1, p. 5.4.10.2-12
Number and capacity (at lift pressure) of primary system safety valves	-	Two safety valves; each of them 30 at 15.1 MPa	1, p. 5.4.10.2-12
Number and capacity of (at lift pressure) steam generator safety valves(SG SV)	kg/s	Three SG SV per one SG; each of them 42.8 at 5.66 MPa and 270°C; and 43.6 at 5.77 MPa and 270°C	3. p 13-1
Number and capacity of (at lift pressure) steam dump station into atmosphere (SDSA)	-	Two SDSA per one SG; 58.3 (steam) at 5.2 MPa; 206.7(water) at 5.9 MPa and 275°C	3, p. 13-2
Containment building type	-	Multi-compartment containment; reinforced concrete; inside steel liner and inner hermetic steel liner	1, chapters 6.1 and 6.2
Containment design pressure	kPa	245 (overpressure)	1, p. 1.9-33
Containment free volume	m^3	52400 m^3 without 1345 m^3 of water pool	
Number of containment spray system (SS)	-	Three independent subsystems; redundancy 3x100%	1, p. 6.2-25
Capacity of SS (one subsystem)	t/h	600 nominal ; 800 maximum	3. p. 21-5

Data	Units	Value	Ref.
Containment heat removal		Spray system, heat ventilation and air conditioning system	
Containment venting		None	
Containment hydrogen management system		Hydrogen catalytic recombiners	

References

[1] Pre-Operational Safety Analysis Report for Mochovce NPP, Tech. Archive Mochovce NPP, Revision 1, 1998

[2] Pre-Operational Safety Analysis Report for Mochovce NPP, Tech. Archive Mochovce NPP, Revision 1, Addition 1, U213-TI-1752, GIDROPRESS, 1999 (in Russian)

[3] AA02 - Intermediate Database, EUCOM, Tech. Archive Mochovce NPP, Slovakia, May 1997 (in English)

A1.3.13 SLOVENIA

TECHNICAL DATA FOR KRŠKO

List of plants of this type: Krško

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR	1
Nominal Electrical output	MW	664	1
Nominal thermal Power	MW	1876	1
Coolant type		Water	1
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit		-	
Moderator type		Water	1
Fuel type (oxide/metal)		Oxide	1
Typical fuel enrichment	% mass	3.5 (Reload)	1
Fuel cladding		Zircaloy-4	1
Number of fuel elements		121 assemblies	1
Mass of U in core	tonnes	49.7	1
Control rod type		-	
Number of control rods		-	
Secondary shutdown systems		-	
Pressure vessel material		SS	1
Pressure vessel diameter	m	3.14	1
Pressure vessel height	m	11.9	1
Pressure vessel wall thickness	m	0.168	1
Coolant pressure	MPa	158 (kg/cm^2g)	1
Coolant temperature at reactor inlet	°C	287.5	1
Coolant temperature at reactor outlet	°C	324.3	1
Number of primary circuit loops		2	1
Number of primary coolant pumps		-	
Primary coolant flowrate	m^3/s	32000 (ton/hr)	1
Number of steam generators		2	1
Type of steam generator		-	
Number of turbines		1	1
Steam pressure at turbine inlet	MPa	61.3 (kg/cm^2g)	1
Steam temperature at turbine inlet	°C	275	1
Steam flowrate at turbine inlet	kg/s	3700 (ton/hr)	1
Containment building type		Vertical cylinder with a spherical dome	1
Containment design pressure	MPa	3.24 bar	2

References

[1] Directory of Nuclear Power Plants in the World, H Fujii (editor), 1985, Japan Nuclear Energy Information Centre Co Ltd, Tokyo, Japan.
[2] World Nuclear Industry Handbook, 1997.

A1.3.14 SPAIN

TECHNICAL DATA FOR JOSÉ CABRERA (ZORITA)

List of plants of this type: José Cabrera (Zorita)

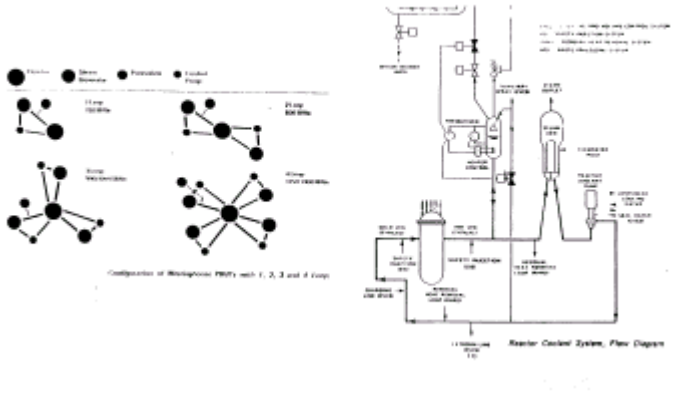

Figure 1: Simple schematic diagram of José Cabrera

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	160	1
Nominal thermal Power	MW	510	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	73.2	3
Volume of primary circuit	m^3	76.0	3
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	2
Typical fuel enrichment	% mass	< 3.6 %	2
Fuel cladding		Zircaloy-4	2
Number of fuel elements		69	1
Mass of U in core	Tonnes	20.8	3
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		17	1
Secondary shutdown systems		boric acid injection	3
Pressure vessel material		Carbon steel/ stainless steel lined	2
Pressure vessel diameter (int.)	M	2.82	3
Pressure vessel height	M	8.74	3
Pressure vessel wall thickness	M	0.2	3
Coolant pressure	MPa	13.8	3
Coolant temperature at reactor inlet	°C	282	3
Coolant temperature at reactor outlet	°C	305	3
Number of primary circuit loops		1	1

Data	Units	Value	Ref.
Number of primary coolant pumps		1	2
Primary coolant flowrate	t/s	3.58	3
Number of steam generators		1	2
Type of steam generator		U-tube	2
Number of turbines		1 high + 1 low pressure	1
Steam pressure at turbine inlet	MPa	4.45	2
Steam temperature at turbine inlet	°C	259	2
Steam flowrate at turbine inlet	kg/s	269	3
Type of safety related feedwater systems (SRFS)		Motor driven + turbine driven	3
Number of SRFS		2 motor driven pumps, 1 turbine driven pump	3
Duty of SRFS	kg/s	6.9 the motor driven pumps and 9.5 the turbine driven pump	3
Capacity of SRFSs		3 x 100%	3
Operating pressure of SIS	MPa	8.5 the motor driven pumps and.8.15 the turbine driven pump	3
Number of safety injection system trains (SIS)		2	3
Duty of SIS (each pump)	kg/s	78.9	3
Operating pressure of SIS	MPa	2.1 (max.9.6)	3
Capacity of SIS		2 x 100%	3
Number of accumulators		1	3
Duty of accumulators	Kg	23,060	3
Capacity of accumulator		1 x 100%	3
Set-point of accumulators	MPa	4.18	3
Number of recirculation system trains (RS)		2	3
Duty of RS (each pump)	kg/s	78.9	3
Capacity of RS		2 x 100%	3
Operating pressure of RS	MPa	0.36	3
Number of jet injection pump trains (JIP)		1	3
Duty of JIP	kg/s	60	3
Capacity of JIP		1 x 100%	3
Operating pressure of JIP	MPa	0.39	3
Number of decay heat removal system trains (DHRS)		2	3
Duty of DHRS (each pump)	kg/s	35.4	3
Capacity of DHRS		2 x 100%	3
Operating pressure of DHRS	MPa	2.5	3
Number and type of back-up generators on-site		1 diesel generator + 3 hydraulic turbine generators	3
Duty of generators		2.2 MW, 3 x 3.75 MW	3
Capacity of generators		1 x 100% + 3 x 100%	3
Number of battery systems		2 x 125V	3
Duties of battery systems	Ah	1200	3

Data	Units	Value	Ref.
Capacity of systems		2 x 100%	3
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 14.5 MPa)	2 x 15.1	3
Number and capacity of (at lift pressure) secondary system relief valves	(kg/s)	2 x 34.7	3
Containment building type		Cylindrical reinforced concrete and concrete slab steel lined and hemispheric steel dome.	3
Containment design pressure	MPa	0.221	2
Containment free volume	m^3	23,360	3
Containment sprays - capacity	kg/s	Dome external spray-0.063 m^3/s	3
Containment heat removal		2 Fan-coils + 2 RS+ 1 JIP	3
Containment venting		No	3
Containment hydrogen management system		Post accident monitoring + mixing system	3

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] FSAR Rev. 11

SPAIN

TECHNICAL DATA FOR SANTA MARÍA DE GAROÑA

List of plants of this type: Santa María De Garoña

Standard Data

Data	Units	Value	Ref.
Reactor type and model		BWR (General Electric)	1
Nominal Electrical output	MW	466	1
Nominal thermal Power	MW	1381	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	n/a	
Volume of primary circuit		n/a	
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	2
Typical fuel enrichment	% mass	2.5 %	3
Fuel cladding		Zircaloy-2	2
Number of fuel elements		400	1
Mass of U in core	Tonnes	70	2
Control rod type		B_4C dust into stainless steel clad	2
Number of control rods		97	1
Secondary shutdown systems		Standby liquid control system.	4
Pressure vessel material		Carbon steel/ stainless steel lined	2
Pressure vessel diameter (int.)	M	4.8	2
Pressure vessel height (int.)	M	19	2
Pressure vessel wall thickness	M	0.125	3
Coolant pressure	MPa	6.86	4
Coolant temperature at reactor inlet	°C	183	2
Coolant temperature at reactor outlet	°C	286	2
Number of recirculation loops		2	1
Number of recirculation pumps		2	2
Total core coolant flowrate	kg/s	6,047	4
Number of steam generators		n/a	
Type of steam generator		n/a	
Number of turbines		1 high and 2 low pressure	1
Steam pressure at turbine inlet	MPa	6.57	2
Steam temperature at turbine inlet	°C	286	2
Steam flowrate at turbine inlet	kg/s	684	2
Type of safety related feedwater systems (SRFS)		n/a	
Number of SRFS		n/a	
Duty of SRFS		n/a	
Capacity of SRFSs		n/a	

Data	Units	Value	Ref.
Number of high pressure core injection systems (HPCI)		1	2
Duty of HPCI	kg/s	189	4
Operating pressure of HPCI	MPa	7.7	4
Capacity of HPCI		1 x 100%	4
Number of accumulators		n/a	
Duty of accumulators	Kg	n/a	
Capacity of accumulator		n/a	
Set-point of accumulators	MPa	n/a	
Number of low pressure core injection trains (LPCI)		2 (2 pumps each train)	4
Duty of LPCI (2 pumps injecting in 2 loops)	kg/s at 0.138 MPa)	9,840	4
Capacity of LPCI pumps		4 x 50%	4
Operating pressure of LPCI	MPa	1.52	4
Number of low pressure core spray trains (LPCS)		2	2
Duty of LPCS	kg/s at 0.82 MPa	158	4
Capacity of LPCS		2 x 100%	4
Operating pressure of LPCS	MPa	2	4
Number of shutdown cooling system trains (SHC)		2	4
Duty of SHC	kg/s	221	4
Capacity of SHC		2 x 100%	4
Operating pressure of SHC	MPa	0.93	4
Number and type of back-up generators on-site		2 diesel generators	2
Duty of generators	MW	2.1	2
Capacity of generators		2x100% of duty defined above	2
Number of battery systems		2 x 125 V / 2 x 24V	4
Duties of battery systems	Ah	1600 / 60 (each type of battery)	4
Capacity of systems		2 x 100%	4
Number and capacity (at lift pressure) of relief valves	(kg/s at 7.27 MPa)	1 x 66,34	4
Number and capacity (at lift pressure) of relief valves	(kg/s at 7.34 MPa)	1 x 66,96	4
Number and capacity (at lift pressure) of relief valves	(kg/s at 7.41 MPa)	1 x 67,58	4
Number and capacity (at lift pressure) of safety/ relief valves	(kg/s at 7.72 MPa)	3 x 108,37	4
Number and capacity of (at lift pressure) secondary system relief valves	(kg/s at x MPa)	n/a	
Containment building type		Drywell + pressure suppression torus + secondary containment	
Containment design pressure	MPa	0.43	4
Containment free volume	m^3	3,293	4

Data	Units	Value	Ref.
Containment sprays - capacity	kg/s	LPCI modes-Drywell spray, 2x100%	4
Containment heat removal		LPCI modes (Drywell spray or torus heat removal),2x100%	4
Drywell venting		To pressure suppression chamber	4
Containment hydrogen management system		Drywell inertised (N_2 atmosphere)	2

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] Nuclear Power Experience
[4] FSAR Rev.16

SPAIN

TECHNICAL DATA FOR ALMARAZ I

List of plants of this type: Almaraz I

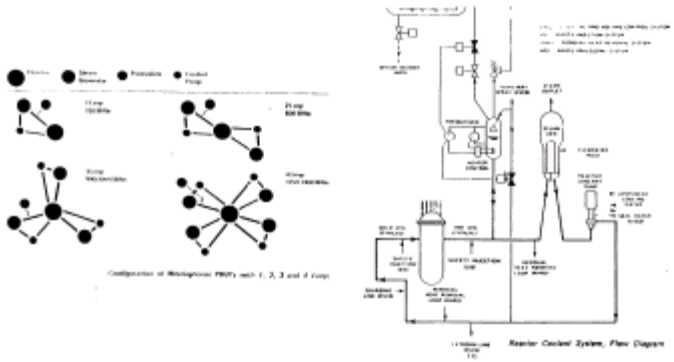

Figure 1: Simple schematic diagram of Almaraz I

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	973.5	1
Nominal thermal Power	MW	2696	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	271	4
Volume of primary circuit	m^3	287.5	4
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	max.3.1 %	2
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	1
Mass of U in core	Tonnes	82.195	2
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		48	1
Secondary shutdown systems		boric acid injection	2
Pressure vessel material		Carbon steel/ stainless steel clad	2
Pressure vessel diameter	m	4	2
Pressure vessel height	m	13	4
Pressure vessel wall thickness	m	0.2	4
Coolant pressure	MPa	15.5	2
Coolant temperature at reactor inlet	°C	292	2
Coolant temperature at reactor outlet	°C	327	2
Number of primary circuit loops		3	1

Data	Units	Value	Ref.
Number of primary coolant pumps		3	2
Primary coolant flowrate	t/s	13.08	2
Number of steam generators		3	2
Type of steam generator		U-tube (Siemens 61W/D3)	2
Number of turbines		3	1
Steam pressure at turbine inlet	MPa	6.87	4
Steam temperature at turbine inlet	°C	284	2
Steam flowrate at turbine inlet	kg/s	1,500	2
Type of safety related feedwater system trains (SRFS)		motor driven/ turbine driven	2
Number of SRFS trains		2 motor driven, 1 turbine driven	2
Duty of SRFS (each pump)	kg/s	28.4 the motor driven and 56.8 the turbine driven pumps	4
Capacity of SRFSs		3 x 100%	4
Number of high pressure injection system trains (HPIS)		2	2
Duty of HPIS (each pump)	kg/s	9.5	4
Operating pressure of HPIS	MPa	19.4	4
Capacity of HPIS		2 x 100%	2
Number of accumulators		3	4
Duty of accumulators	kg	3 x 27,700	4
Capacity of accumulator		3 x 100%	4
Set-point of accumulators	MPa	4.4	4
Number of low pressure injection system trains (LPIS)		2	2
Duty of LPIS (each pump)	kg/s	237	4
Capacity of LPIS		2 x 100%	2
Operating pressure of LPIS	MPa	0.8	4
Number and type of back-up generators on-site		2 diesel generators	2
Duty of generators	kW	4,406	4
Capacity of generators		2 x 100%	2
Number of battery systems		2 x 125V + 1 x 125V	4
Duties of battery systems	Ah	2 x 2360 + 1 x 225	4
Capacity of systems		3 x 100%	4
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 16.3 MPa)	2 x 26.5	4
Number and capacity of (at lift pressure) secondary system relief valves	(kg/s at 7.6 MPa)	3 x 52	4
Containment building type		Steel lined cylindrical reinforced concrete with hemispheric dome.	2
Containment design pressure	MPa	0.446	2
Containment free volume	m^3	59,470	2
Containment sprays - capacity	kg/s	2 x 227	4
Containment heat removal		Containment spray + spray system and LPIS recirculation and heat removal	4

Data	Units	Value	Ref.
Containment venting		No	4
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + purge system	4

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] FSAR Rev. AC11

SPAIN

TECHNICAL DATA FOR ALMARAZ II

List of plants of this type: Almaraz Ii

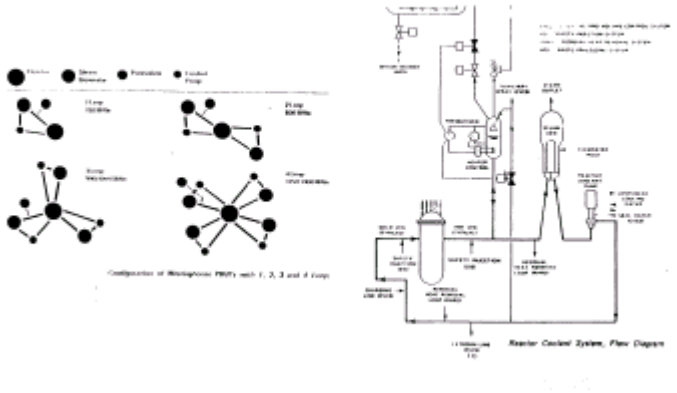

Figure 1: Simple schematic diagram of Almaraz II

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	982.6	1
Nominal thermal Power	MW	2696	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	271	4
Volume of primary circuit	m^3	287.5	4
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	max.3.1 %	2
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	1
Mass of U in core	tonnes	82.195	2
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		48	1
Secondary shutdown systems		boric acid injection	2
Pressure vessel material		Carbon steel/ stainless steel clad	2
Pressure vessel diameter	m	4	2
Pressure vessel height	m	13	4
Pressure vessel wall thickness	m	0.2	4
Coolant pressure	MPa	15.5	2
Coolant temperature at reactor inlet	°C	292	2
Coolant temperature at reactor outlet	°C	327	2

Data	Units	Value	Ref.
Number of primary circuit loops		3	1
Number of primary coolant pumps		3	2
Primary coolant flowrate	t/s	13.08	2
Number of steam generators		3	2
Type of steam generator		U-tube (Siemens 61W/D3)	2
Number of turbines		3	1
Steam pressure at turbine inlet	MPa	6.87	4
Steam temperature at turbine inlet	°C	284	2
Steam flowrate at turbine inlet	kg/s	1,500	2
Type of safety related feedwater system trains (SRFS)		motor driven/ turbine driven	2
Number of SRFS		2 motor driven, 1 turbine driven	2
Duty of SRFS (each pump)	kg/s	28.4 the motor driven and 56.8 the turbine driven pumps	4
Capacity of SRFSs		3 x 100%	4
Number of high pressure injection system trains (HPIS)		2	2
Duty of HPIS (each pump)	kg/s	9.5	4
Operating pressure of HPIS	MPa	19.4	4
Capacity of HPIS		2 x 100%	2
Number of accumulators		3	4
Duty of accumulators	kg	3 x 27,700	4
Capacity of accumulator		3 x 100%	4
Set-point of accumulators	MPa	4.4	4
Number of low pressure injection system trains (LPIS)		2	2
Duty of LPIS (each pump)	kg/s	237	4
Capacity of LPIS		2 x 100%	2
Operating pressure of LPIS	MPa	0.8	4
Number and type of back-up generators on-site		2 diesel generators	2
Duty of generators	kW	4,406	4
Capacity of generators		2 x 100%	2
Number of battery systems		2 x 125V + 1 x 125V	4
Duties of battery systems	Ah	2 x 2360 + 1 x 225	4
Capacity of systems		3 x 100%	4
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 16.3 MPa)	2 x 26.5	4
Number and capacity of (at lift pressure) secondary system relief valves	(kg/s at 7.6 MPa)	3 x 52	4
Containment building type		Steel lined cylindrical reinforced concrete with hemispheric dome.	2
Containment design pressure	MPa	0.446	2
Containment free volume	m^3	59,470	2
Containment sprays - capacity	kg/s	2 x 227	
Containment heat removal		Containment spray + spray system and	4

Data	Units	Value	Ref.
		LPIS recirculation and heat removal	
Containment venting		No	4
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + purge system	4

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] FSAR Rev. AC11

SPAIN

TECHNICAL DATA FOR ASCÓ I

List of plants of this type: Ascó I

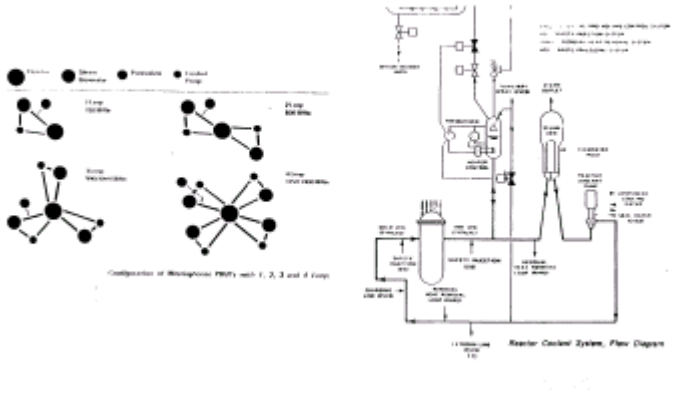

Figure 1: Simple schematic diagram of Ascó I

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	979.1	1
Nominal thermal Power	MW	2696	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	269	4
Volume of primary circuit	m^3	287	4
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	max.3.1 %	3
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	1
Mass of U in core	tonnes	72.5	2
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		48	1
Secondary shutdown systems		boric acid injection	2
Pressure vessel material		Carbon steel/ stainless steel clad	2
Pressure vessel diameter	m	4	2
Pressure vessel height	m	13	3
Pressure vessel wall thickness	m	0.2	4
Coolant pressure	MPa	15.5	4
Coolant temperature at reactor inlet	°C	291	4
Coolant temperature at reactor outlet	°C	326	4
Number of primary circuit loops		3	1

Data	Units	Value	Ref.
Number of primary coolant pumps		3	2
Primary coolant flowrate	t/s	12.7	4
Number of steam generators		3	2
Type of steam generator		U-tube (Siemens 61W/D3)	2
Number of turbines		3	1
Steam pressure at turbine inlet	MPa	6.93	2
Steam temperature at turbine inlet	°C	284	2
Steam flowrate at turbine inlet	kg/s	1,500	2
Type of safety related feedwater systems (SRFS)		motor driven/ turbine driven	2
Number of SRFS		2 motor driven, 1 turbine driven	2
Duty of SRFS	kg/s	26.5 the motor driven and 29 the turbine driven pumps	4
Capacity of SRFSs		3 x 100%	4
Number of high pressure injection system trains (HPIS)		2	2
Duty of HPIS (each pump)	kg/s	9.5	4
Operating pressure of HPIS	MPa	19.3	4
Capacity of HPIS		2 x 100%	2
Number of accumulators		3	4
Duty of accumulators	kg	3 x 41,000	4
Capacity of accumulator		3 x 100%	4
Set-point of accumulators	MPa	4.1	4
Number of low pressure injection systems (LPIS)		2	2
Duty of LPIS	kg/s	237	4
Capacity of LPIS	kg	2 x 100%	2
Operating pressure of LPIS	MPa	1.35	4
Number and type of back-up generators on-site		Diesel generators + SBO diesel generator	2
Duty of generators	MW	2 x 4,500	2
Capacity of generators		2x100% + 1x100% SBO	2
Number of battery systems		2 + 1	4
Duties of battery systems	Ah	2 x 2000 + 1 x 125	4
Capacity of systems		3 x 100%	4
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 16.3 MPa)	2 x 26.5	4
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at 8.1 MPa)	3 x 122	4
Containment building type		Steel lined cylindrical reinforced concrete with hemispheric dome.	2
Containment design pressure	MPa	0.47	2
Containment free volume	m^3	56,900	4
Containment sprays - capacity	kg/s	2x94.6	4
Containment heat removal		2x100% Fan Coils	2

Data	Units	Value	Ref.
Containment venting		No	4
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + purge system	4

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] Nuclear Power Experience
[4] FSAR Rev. 26

SPAIN

TECHNICAL DATA FOR ASCÓ II

List of plants of this type: Ascó Ii

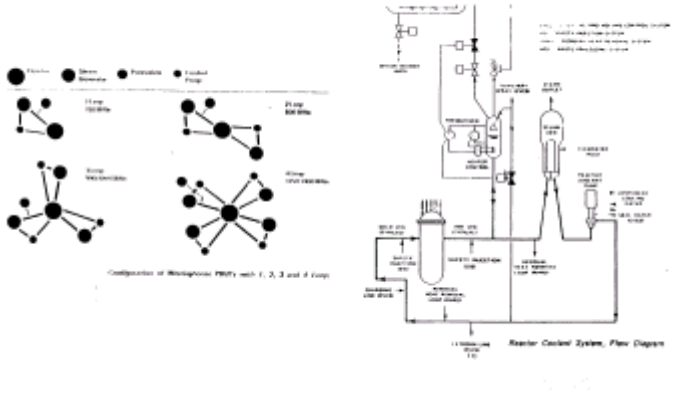

Figure 1: Simple schematic diagram of Ascó Ii

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	1014.8	1
Nominal thermal Power	MW	2900	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	269	4
Volume of primary circuit	m^3	287	4
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	max.3.1 %	3
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	1
Mass of U in core	tonnes	72.5	2
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		48	1
Secondary shutdown systems		boric acid injection.	2
Pressure vessel material		Carbon steel/ stainless steel clad	2
Pressure vessel diameter	m	4	2
Pressure vessel height	m	13	3
Pressure vessel wall thickness	m	0.2	4
Coolant pressure	MPa	15.5	2
Coolant temperature at reactor inlet	°C	291	4
Coolant temperature at reactor outlet	°C	326	2
Number of primary circuit loops		3	1

Data	Units	Value	Ref.
Number of primary coolant pumps		3	2
Primary coolant flowrate	t/s	12.7	4
Number of steam generators		3	2
Type of steam generator		U-tube (Siemens 61W/D3)	2
Number of turbines		3	1
Steam pressure at turbine inlet	MPa	6.93	2
Steam temperature at turbine inlet	°C	284	2
Steam flowrate at turbine inlet	kg/s	1,500	2
Type of safety related feedwater systems (SRFS)		motor driven/ turbine driven	2
Number of SRFS		2 motor driven, 1 turbine driven	2
Duty of SRFS	kg/s	26.4 the motor driven and 28.4 the turbine driven pumps	4
Capacity of SRFSs		3 x 100%	4
Number of high pressure injection systems (HPIS)		2	2
Duty of HPIS	kg/s	9.5	4
Operating pressure of HPIS	MPa	19.3	4
Capacity of HPIS		2 x 100%	2
Number of accumulators		3	4
Duty of accumulators	kg	3 x 41,000	4
Capacity of accumulator		3 x 100%	4
Set-point of accumulators	MPa	4.1	4
Number of low pressure injection systems (LPIS)		2	2
Duty of LPIS	kg/s	237	4
Capacity of LPIS	kg	2 x 100%	2
Operating pressure of LPIS	MPa	1.35	4
Number and type of back-up generators on-site		Diesel generators + SBO diesel generator	2
Duty of generators	MW	2 x 4,500	2
Capacity of generators		2x100% + 1x100% SBO	2
Number of battery systems		2 + 1	4
Duties of battery systems	Ah	2 x 2000 + 1 x 125	4
Capacity of systems		3 x 100%	4
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 16.3 MPa)	2 x 26.5	4
Number and capacity of (at lift pressure) secondary system relief valves	(m^3/s at 8.1 MPa)	3 x 122	4
Containment building type		Steel lined cylindrical reinforced concrete with hemispheric dome.	2
Containment design pressure	MPa	0.47	2
Containment free volume	m^3	56,900	4
Containment sprays - capacity	kg/s	2x94.6	4
Containment heat removal		2x100% Fan Coils	2

Data	Units	Value	Ref.
Containment venting		No	4
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + purge system	4

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] Nuclear Power Experience
[4] FSAR Rev. 26

SPAIN

TECHNICAL DATA FOR COFRENTES

List of plants of this type: Cofrentes

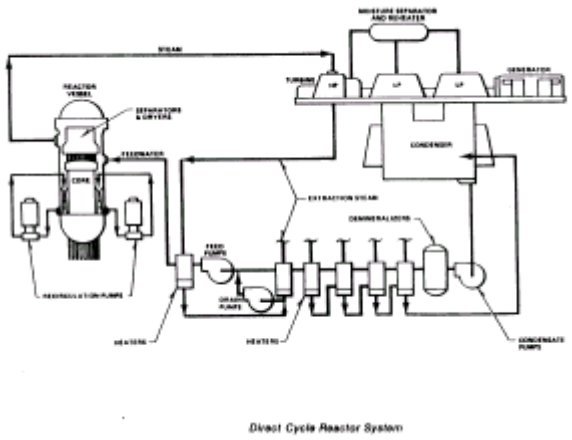

Figure 1: Simple schematic diagram of Cofrentes

Standard Data

Data	Units	Value	Ref.
Reactor type and model		BWR-6 (General Electric)	1
Nominal Electrical output	MW	1025.4	1
Nominal thermal Power	MW	3015	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	n/a	
Volume of primary circuit		n/a	
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	1.9%	4
Fuel cladding		Zircaloy-2	2
Number of fuel elements		624	1
Mass of U in core	tonnes	130	4
Control rod type		B_4C dust in stainless steel clad	3
Number of control rods		145	1
Secondary shutdown systems		Standby liquid control system	4
Pressure vessel material		Carbon steel/ stainless steel clad	2
Pressure vessel diameter	m	5.5	2
Pressure vessel height	m	21	2
Pressure vessel wall thickness	m	0.15	3
Coolant pressure	MPa	7.3	4
Coolant temperature at reactor inlet	°C	216	4
Coolant temperature at reactor outlet	°C	284	4
Number of recirculation loops		2	1

Data	Units	Value	Ref.
Number of recirculation pumps		2	2
Core coolant flowrate	kg/s	10,650	4
Number of steam generators		n/a	
Type of steam generator		n/a	
Number of turbines		3	1
Steam pressure at turbine inlet	MPa	7.14	2
Steam temperature at turbine inlet	°C	284	4
Steam flowrate at turbine inlet	kg/s	1,570	4
Type of safety related feedwater systems (SRFS)		n/a	
Number of SRFS		n/a	
Duty of SRFS		n/a	
Capacity of SRFSs		n/a	
Number of high pressure injection systems (HPCS)		1	2
Duty of HPCS	kg/s	88	4
Operating pressure of HPCS	MPa	7.9	4
Capacity of HPCS		1x100%	4
Number of accumulators		n/a	
Duty of accumulators	kg	n/a	
Capacity of accumulator		n/a	
Set-point of accumulators	MPa	n/a	
Number of low pressure injection system/trains (LPIS)		3xLPCI (RHR mode) + 1xLPCS	2
Duty of LPIS (each train)	kg/s	3x319 + 1x316	4
Capacity of LPIS		3x100% + 1x100%	4
Operating pressure of LPIS	MPa	3x0.15 + 1x0.82	4
Number and type of back-up generators on-site		3 diesel generators	2
Duty of generators		2 x 4,400 + 1 x 2400	4
Capacity of generators		3 x 100%	4
Number of battery systems		2 + 1	4
Duties of battery systems		2 x 2800 + 1 x 100	4
Capacity of systems			
Number and capacity (at lift pressure) of RCPB safety/relief valves	(kg/s at 8.1/8.2/ 8.3 MPa)	7 x 113 + 5 x 114 + 4 x 115	2
Containment building type		Mark III: Concrete drywell + pressure suppression pool + primary self-standing steel containment + secondary reinforced concrete containment	2
Containment design pressure	MPa	0.3 (drywell) + 0.2 (primary containment)	2
Containment free volume	m^3	6,850 (drywell) + 28,850 (primary containment)	4
Containment sprays - capacity	kg/s	primary containment 2 x 240 sprays	2

Data	Units	Value	Ref.
		(RHR mode)	
Containment heat removal		suppression pool heat removal (RHR mode)	2
Containment venting		Yes	4
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + Drywell-Containment mixing system + Hydrogen igniters	4

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] Nuclear Power Experience
[4] FSAR Rev.21

SPAIN

TECHNICAL DATA FOR VANDELLÓS II

List of plants of this type: Vandellós Ii

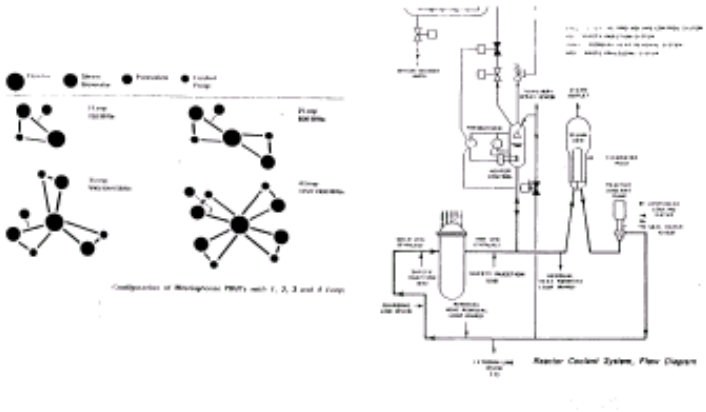

Figure 1: Simple schematic diagram of Vandellós Ii

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	1081.7	1
Nominal thermal Power	MW	2900	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	253.4	4
Volume of primary circuit	m^3	271.8	4
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	max.3.1%	4
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	1
Mass of U in core	tonnes	82,19	4
Control rod type		Ag-In-Cd/B_4C in stainless steel clad	4
Number of control rods		48	1
Secondary shutdown systems		boric acid injection.	2
Pressure vessel material		Carbon steel/ stainless steel clad	2
Pressure vessel diameter	m	4	4
Pressure vessel height	m	13	4
Pressure vessel wall thickness	m	0.2	4
Coolant pressure	MPa	15.5	4
Coolant temperature at reactor inlet	°C	290	4
Coolant temperature at reactor outlet	°C	326	2

Data	Units	Value	Ref.
Number of primary circuit loops		3	1
Number of primary coolant pumps		3	2
Primary coolant flowrate	t/s	13.6	4
Number of steam generators		3	2
Type of steam generator		U-tube (Westinghouse F)	2
Number of turbines		3	1
Steam pressure at turbine inlet	MPa	6.34	4
Steam temperature at turbine inlet	°C	279.2	2
Steam flowrate at turbine inlet	kg/s	1,618	4
Type of safety related feedwater system trains (SRFS)		motor driven/ turbine driven	2
Number of SRFS		2 motor driven, 1 turbine driven	2
Duty of SRFS	kg/s	24 the motor driven and 48 the turbine driven pumps	4
Capacity of SRFSs		3 x 100%	4
Number of high pressure injection system trains (HPIS)		2	2
Duty of HPIS	kg/s	9.5	4
Operating pressure of HPIS	MPa	17.4	4
Capacity of HPIS		2 x 100%	2
Number of accumulators		3	4
Duty of accumulators	kg	28,900	4
Capacity of accumulator		3 x 100%	4
Set-point of accumulators	MPa	4.2	4
Number of low pressure injection system trains (LPIS)		2	2
Duty of LPIS	kg/s	189	4
Capacity of LPIS	kg	2 x 100%	2
Operating pressure of LPIS	MPa	0.9	
Number and type of back-up generators on-site		Diesel generators + SBO diesel generator	2
Duty of generators	MW	2 x 5,760 +1 x 225	4
Capacity of generators		2x100% + 1x100% SBO	2
Number of battery systems		5	2
Duties of battery systems	Ah	2 x 2,600+1 x 520+1x380+1x85	4
Capacity of systems		5 x 100%	4
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 16.2 MPa)	2 x 26.5	4
Number and capacity of (at lift pressure) secondary system relief valves	(kg/s at 8.34 MPa)	3 x 122.21	4
Containment building type		Steel lined cylindrical pre-stressed concrete with hemispheric dome.	2
Containment design pressure	MPa	0.474	4
Containment free volume	m^3	62,863	4
Containment sprays - capacity	kg/s	2 x 221	4
Containment heat removal		2x100% Fan coils	2

Data	Units	Value	Ref.
Containment venting		No	4
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + purge system	4

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] Nuclear Power Experience
[4] FSAR Rev.18

SPAIN

TECHNICAL DATA FOR TRILLO

List of plants of this type: Trillo

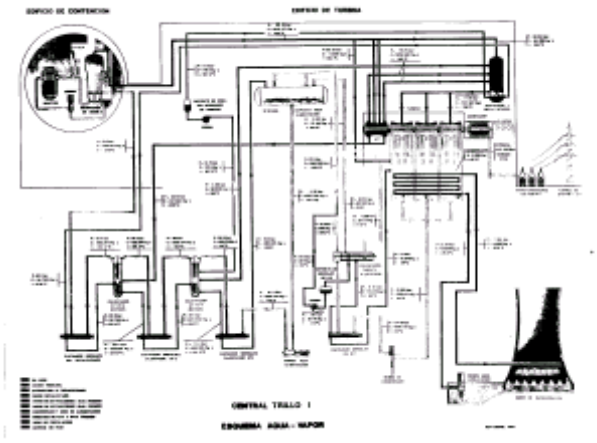

Figure 1: Simple schematic diagram of Trillo

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Siemens)	1
Nominal Electrical output	MW	1066	1
Nominal thermal Power	MW	3010	1
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	300	3
Volume of primary circuit	m^3	318	3
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	max.4%	3
Fuel cladding		Zircaloy-4	2
Number of fuel elements		177	1
Mass of U in core	tonnes	82.8	2
Control rod type		Ag-In-Cd in stainless steel bars	2
Number of control rods		52	1
Secondary shutdown systems		boric acid injection	2
Pressure vessel material		Carbon steel/ stainless steel lined	3
Pressure vessel diameter	m	4.9	3
Pressure vessel height	m	11	3
Pressure vessel wall thickness	m	0.25	3
Coolant pressure	MPa	15.8	3
Coolant temperature at reactor inlet	°C	294	3
Coolant temperature at reactor outlet	°C	326	2

Data	Units	Value	Ref.
Number of primary circuit loops		3	1
Number of primary coolant pumps		3	2
Primary coolant flowrate	t/s	15.8	3
Number of steam generators		3	2
Type of steam generator		U-tube(Siemens)	2
Number of turbines		4	1
Steam pressure at turbine inlet	MPa	6.87	2
Steam temperature at turbine inlet	°C	284	2
Steam flowrate at turbine inlet	kg/s	1650	3
Type of safety related feedwater systems (SRFS)		diesel driven	2
Number of SRFS		4	2
Duty of SRFS	kg/s	33.3	3
Capacity of SRFSs		4 x 50%	2
Number of high pressure injection systems (HPIS)		4	2
Duty of HPIS	kg/s	72	3
Operating pressure of HPIS	MPa	3.6	3
Capacity of HPIS		4 x 50%	2
Number of accumulators		6	3
Duty of accumulators	kg	6 x 34,000	3
Capacity of accumulator		6 x 33.3%	3
Set-point of accumulators	MPa	2.5	3
Number of low pressure injection systems (LPIS)		4	2
Duty of LPIS	kg/s	229	3
Capacity of LPIS	kg	4 x 50%	2
Operating pressure of LPIS	MPa	1	3
Number and type of back-up generators on-site		2x4 diesel generators	2
Duty of generators		4 x 4900 + 4 x 765	3
Capacity of generators		2x4x100%	2
Number of battery systems		2x4	2
Duties of battery systems		4 x 220V +4x3x24V+4x2x24V	2
Capacity of systems	Ah	4 x 2600 + (4x2x2600+4x1100) +(4x2600+1x1100)	3
Number and capacity (at lift pressure) of primary system relief valves	(kg/s at 16.7 MPa)	1 x 40	3
Number and capacity of (at lift pressure) secondary system relief valves	(kg/s at 7.75 MPa)	3 x 550	3
Containment building type		Spherical / steel.	3
Containment design pressure	MPa	0.53	2
Containment free volume	m^3	58,900	3
Containment sprays - capacity	kg/s	n/a	3
Containment heat removal		LPIS-recirculation phase	3

Data	Units	Value	Ref.
Containment venting		No	3
Containment hydrogen management system		Post accident monitoring + H_2 recombiner + mixing	3

References

[1] Spanish Nuclear Power Plants in 1999, UNESA
[2] Las Centrales Nucleares Españolas, 2ª Edición, Consejo de Seguridad Nuclear.
[3] FSAR Rev.15

A1.3.15 SWEDEN

TECHNICAL DATA FOR FORSMARK 3

List of plants of this type: similar to internal pump plants. (Forsmark 1, 2 Oskarshamn 3, OL 1, 2)

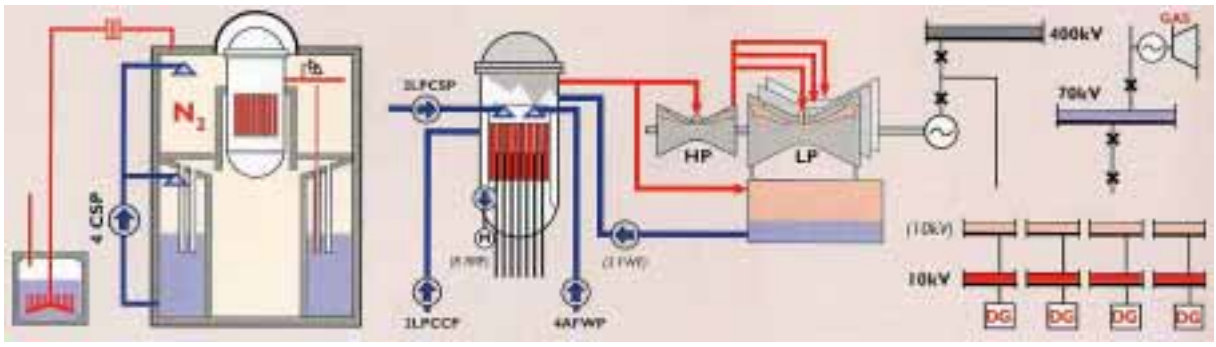

Figure 1: Schematic diagram for Forsmark 3

Standard data

Data	Units	Value	Ref.
Reactor type and model		BWR Internal pump	2
Nominal electrical output	MW	1190	12
Nominal thermal power	MW	3300	9
Coolant type		Boiling water	2
Volume of coolant (of liquid water in LWR)	m^3	293	2
Volume of primary system	m^3	544	2
Moderator type		Water	2
Fuel type		UO_2	*9*
Typical Fuel Enrichment	%mass	3.1	1
Fuel cladding		Zr-2, LK3 with liner	7
Number of fuel bundles		700	2
Mass of U in core	tonnes	126	12
Control rod type		B_4C, Cruciform blades	13
Number of control rods		169	2
Secondary shutdown systems		Electric control rod insertion. Boric acid injection	2
Pressure vessel material		Carbon steel/stainless steel lined	8
Pressure vessel diameter	m	6.4	2
Pressure vessel height	m	20.8	2
Pressure vessel wall thickness	m	0.16	12
Coolant pressure	MPa	7	–
Coolant termperature at inlet to the reactor	°C	278	*11*
Coolant termperature at outlet from the reactor	°C	286	9
Number of primary circuit loops		Not applicable	

Number of primary coolant pumps		8	2
Primary coolant flow rate	kg/s	13080	11
Number of steam generators		Not applicable	
Type of steam generators		Not applicable	
Number of turbines		1 HP, 3 LP	9
Steam pressure at turbine inlet	MPa	6.7	14
Steam temperature at turbine inlet	°C	283	14
Steam flowrate at turbine inlet	kg/s	1780	14
Type of safety related feedwater systems		Auxiliary feedwater system, motor driven.	3
Number of safety related feedwater systems		1	
Duty of safety related feedwater systems	kg/s	4x22.5	3
Capacity of safety related feedwater systems		4x50 % (except for the 80 cm2-break, where 3 of 4 trains are required)	3
Number of High Pressure injection systems (HPIS)		Not applicable	
Duty of HPIS		Not applicable	
Operating pressure of HPIS		Not applicable	
Capacity of HPIS		Not applicable	
Number of accumulators		Not applicable	
Duty of accumulators		Not applicable	
Capacity of accumulators		Not applicable	
Set point of accumulators		Not applicable	
Number of low pressure injection systems(LPIS)		1	4
Duty of LPIS	kg/s	4x(0-350) at (1.2-0) MPa differential pressure between wetwell and RPV	4
Capacity of LPIS	kg/s	4x50 % (2 of the trains to the core spray)	4
Operating pressure of LPIS	MPa	1.3 (start of injection with 0.1 MPa in wetwell)	4
Other decay heat removal systems	kg/s	115	5
Number and type of back-up generators on site		4 diesel generators	20
Duty of generators	kVA	4x3375	21
Capacity of generators		1 diesel generator/sub	
Number of battery systems		System 671 (220V) System 672 (110V) System 673 (±24 V) System 674 (±24 V)	16, 17, 18, 19
Duties of battery systems	Ah/10 h	System 671: 8x969 System 672: 8x252 System 673: <u>Safety</u> +24 V: 8x760 -24 V: 201	16, 17, 18, 19

		Normal operation +24 V: 1290 -24 V: 380 System 674: no information	
Capacity of systems		The batteries are back-up systems. There are no further back up for the batteries.	
Number and capacity of primary system relief valves	kg/s at 7.0 MPa	16x107.6	
Number and capacity of secondary system relef valves		Not Applicable.	
Containment building type		Pressure suppression, prestressed concrete with liner	15
Containment design pressure	MPa	0.6	2
Containment free volume	m^3	11873	2
Containment spray – capacity	kg/s	4x100 kg/s (to wetwell)	2
Containment heat removal	kW/°C	4x244.6 (based on 30 °C in the condesation pool and 17 °C in the sea, i.e. higher pool temperature or lower sea temperature will give conservative results).	2
Containment venting	MPa	0.75	10
Containment hydrogen management system		Inerted containment	2

References

[1] http://www okg se (F3 is similar to the Oskarshamn 3 plant)
[2] Handbok över processamband vid störningar i svenska kokarreaktorer, Internpumpsanläggningar, July 1987
[3] FSAR, System 327, Auxiliary feed water system
[4] FSAR, System 323, Low pressure coolant injection system
[5] FSAR, System 321, Shutdown cooling system
[6] FSAR, System 322, Containment vessel spray system
[7] FSAR, System 263, Replacement Fuel
[8] FSAR, System 211, Reactor pressure vessel
[9] FSAR, Chapter 1, Introduction and general description of the plant
[10] FSAR, System 361, Containment venting
[11] FSAR, System 313, Recirculation system
[12] Broschure: Forsmark
[13] FSAR, System 222, Control rods
[14] FSAR, System 403, Turbine
[15] FSAR, System 141, Containment
[16] FSAR, System 671, DC 220 V
[17] FSAR, System 672, DC 110 V
[18] FSAR, System 673, DC ±24 V
[19] FSAR, System 674, Extra DC ±24 V
[20] Brochure, Forsmarks Kraftstation, Block 3, Forsmark Power Station, Unit 3
[21] FSAR, System 651-654, Diesel generators with auxiliary systems

SWEDEN

TECHNICAL DATA FOR OSKARSHAMN 2

List of plants of this type: similar to external pump plants. (Oskarshamn 1, Barsebäck 2, Ringhals 1)

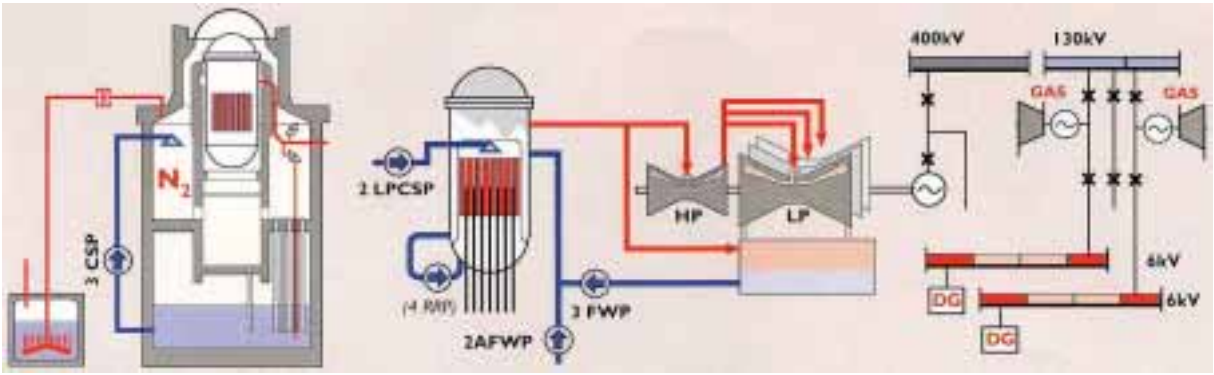

Figure 1: Schematic diagram of Oskarshamn 2

Standard data

Data	Units	Value	Ref.
Reactor type and model		BWR external pump	2
Nominal electrical output	MW	627	1
Nominal thermal power	MW	1800	1
Coolant type		Boiling water	1
Volume of coolant (of liquid water in LWR)	m^3	219	2
Volume of primary system	m^3	374	2
Moderator type		Water	–
Fuel type		UO_2 pellets	3
Typical Fuel Enrichment	%mass	3.1	1
Fuel cladding		Zr-2, LK II	3
Number of fuel bundles		444	1
Mass of U in core	tonnes	82.7	3
Control rod type		B_4C, Cruciform blades	1
Number of control rods		109	1
Secondary shutdown systems		Electric control rod insertion. Boron acid injection	2
Pressure vessel material		Alloy-treated steel/stainless steel lined	4
Pressure vessel diameter	m	5.2	1
Pressure vessel height	m	20	1
Pressure vessel wall thickness	m	0.134	1
Coolant pressure	MPa	7	1
Coolant termperature at inlet to the reactor	°C	274	9
Coolant termperature at outlet from the reactor	°C	286	1

Number of primary circuit loops		4	1
Number of primary coolant pumps		4	1
Primary coolant flow rate	kg/s	7700 (maximum)	1
Number of steam generators		Not applicable	
Type of steam generators		Not applicable	
Number of turbines		1 HP, 2 LP	1
Steam pressure at turbine inlet	MPa	6.75	1
Steam temperature at turbine inlet	°C	283	1
Steam flowrate at turbine inlet	kg/s	900	1
Type of safety related feedwater systems		Ordinary feedwater system, motor driven Auxiliary feedwater system, motor driven	13 14
Number of safety related feedwater systems		2	
Duty of safety related feedwater systems	kg/s	2x455 at 70 bar 2x30 at 80 bar	13 14
Capacity of safety related feedwater systems		2x100 % (as safety system) 2x100 %	13 14
Number of High Pressure injection systems (HPIS)		Not applicable	
Duty of HPIS		Not applicable	
Operating pressure of HPIS		Not applicable	
Capacity of HPIS		Not applicable	
Number of accumulators		Not applicable	
Duty of accumulators		Not applicable	
Capacity of accumulators		Not applicable	
Set point of accumulators		Not applicable	
Number of low pressure core spray (LPCS)		1	2
Duty of LPCS	kg/s at 0.9 MPa	2x170	5
Capacity of LPCS		2x100 %	5
Operating pressure of LPCS	MPa	1.9 (start of injection with 0.1 MPa in wetwell)	5
Other decay heat removal systems	kg/s	2x100	15
Number and type of back-up generators on site		2 diesel generators	6
Duty of generators	kVA	3210 (1614, sub A and 1596, sub B)	6
Capacity of generators		1 diesel generator/sub	6
Number of battery systems		System 675 (110 V) System 676 (48 V) System 677 (24 V) System 678 (24 V)	7
Duties of battery systems	Ah/10 h	System 675: 660+3x345+4x216 System 676: 2x483 System 677: 2x250+2x483 System 678: 2x250	7, 8

Capacity of systems		The batteries are back-up systems. There are no further back-up for the batteries.	
Number and capacity of primary system relief valves	kg/s at 8.7 MPa	13 x 74,7 kg/s	11
Number and capacity of primary system relief valves	kg/s at 8.0 MPa	8 x 68.7 + 2 x 28.4	11
Number and capacity of secondary system relef valves		Not Applicable	
Containment building type		Pressure suppression, prestressed concrete with liner	12
Containment design pressure	MPa	0.5	12
Containment free volume	m^3	9900	2
Containment spray – capacity	kg/s	2x100 kg/s	2
Containment heat removal	kW/°C	2x245 (based on 30 °C in the condesation pool and 17 °C in the sea, i.e. higher pool temperature or lower sea temperature will give conservative results).	16
Containment venting	MPa	0.65	10
Containment hydrogen management system		Inerted containment.	12

References

[1] http://www.okg.se
[2] Handbok över processamband vid störningar i svenska kokarreaktorer, Externpumpsanläggningar, July 1987
[3] SAR, System 263, Fuel
[4] SAR, System 211, Reactor pressure vessel
[5] SAR, System 323, Low pressure coolant injection system
[6] SAR, System 661, Diesel generators
[7] SAR, System 672, Batteries
[8] SAR, System 675, 110 V DC, battery secured
[9] SAR, System 313, Recirculation System
[10] SAR, System 361, Containment Venting to the Atmosphere
[11] SAR, System 314, Relief system
[12] SAR, System 130, Reactor containment
[13] SAR, System 312, Feed water system
[14] SAR, System 327, Auxiliary feed water system
[15] SAR, System 321, Shutdown cooling system
[16] SAR, System 322, Containment vessel spray system

SWEDEN

TECHNICAL DATA FOR RINGHALS 2

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	915	1
Nominal thermal Power	MW	2440	2
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit	m^3	-	
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	3.5%	1
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	2
Mass of U in core	Tonnes	68.2	2
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		53	1
Secondary shutdown systems		boric acid injection	2
Pressure vessel material		SA 533 B	1
Pressure vessel diameter	m	4	1
Pressure vessel height	m	13.3	1
Pressure vessel wall thickness	m	0.2	1
Coolant pressure	MPa	15.4	2
Coolant temperature at reactor inlet	°C	289	2
Coolant temperature at reactor outlet	°C	323	2
Number of primary circuit loops		3	2
Number of primary coolant pumps		3	2
Primary coolant flowrate	kg/s	12,640	2
Number of steam generators		3	2
Type of steam generator		W51	1
Number of turbines		2	2
Steam pressure at turbine inlet	MPa	6.0	2
Steam temperature at turbine inlet	°C	275	2
Steam flowrate at turbine inlet	kg/s	2 x 666.5	2
Type of safety related feedwater system trains (SRFS)		Motor driven/ turbine driven	3
Number of SRFS trains		2 motor driven, 1 turbine driven	3
Duty of SRFS (each pump)	kg/s	20.5 the motor driven and 41.0 the turbine driven pumps	3
Capacity of SRFSs		-	
Number of high pressure injection		2	3

Data	Units	Value	Ref.
system trains (HPIS)			
Duty of HPIS (each pump)	kg/s	35	3
Operating pressure of HPIS	MPa	19.3	3
Capacity of HPIS		-	
Number of accumulators		3	3
Duty of accumulators	kg	26.0 m^3	3
Capacity of accumulator		-	
Set-point of accumulators	MPa	4.8	3
Number of low pressure injection system trains (LPIS)		2	3
Duty of LPIS (each pump)	kg/s	236	3
Capacity of LPIS		-	
Operating pressure of LPIS	MPa	4.1	3
Number and type of back-up generators on-site		4 diesel generators	2
Duty of generators	MVA	3.4	2
Voltage	kV	6.9	2
Containment building type		Cylindrical prestressed concrete dry containment with hemispheric dome	1
Containment design pressure	MPa	0.5	2
Containment free volume	m^3	58,000	2
Containment sprays - capacity	kg/s	-	

References

[1] World Nuclear Industry Handbook, 1997.
[2] Swedish State Power Board, Ringhals 2 Safety Study, June 1983.
[3] B. Pershagen, Light Water Reactor Safety, Pergamon Press, 1989.

SWEDEN

TECHNICAL DATA FOR RINGHALS 3 & 4

Standard Data

Data	Units	Value	Ref.
Reactor type and model		PWR (Westinghouse)	1
Nominal Electrical output	MW	960	1
Nominal thermal Power	MW	2775	2
Coolant type		Light water	2
Volume of coolant (of liquid water in LWR)	m^3	-	
Volume of primary circuit	m^3	-	
Moderator type		Light water	2
Fuel type (oxide/metal)		UO_2 pellets	1
Typical fuel enrichment	% mass	3.7%	1
Fuel cladding		Zircaloy-4	2
Number of fuel elements		157	2
Mass of U in core	Tonnes	72.4	2
Control rod type		Ag-In-Cd into stainless steel clad	2
Number of control rods		53	1
Secondary shutdown systems		Boric acid injection	2
Pressure vessel material		SA 508 CL2	1
Pressure vessel diameter	m	3.99	1
Pressure vessel height	m	12.0	1
Pressure vessel wall thickness	m	0.2	1
Coolant pressure	MPa	15.5	2
Coolant temperature at reactor inlet	°C	284	2
Coolant temperature at reactor outlet	°C	323	2
Number of primary circuit loops		3	2
Number of primary coolant pumps		3	2
Primary coolant flowrate	kg/s	12,860	2
Number of steam generators		3	2
Type of steam generator		1172W103A (Ringhals 3) D3 (Ringhals 4)	1
Number of turbines		2	2
Steam pressure at turbine inlet	MPa	6.0	2
Steam temperature at turbine inlet	°C	275	2
Steam flowrate at turbine inlet	kg/s	2 x 759.7	2
Type of safety related feedwater system trains (SRFS)		motor driven/ turbine driven	3
Number of SRFS trains		2 motor driven, 1 turbine driven	3
Duty of SRFS (each pump)	kg/s	24.0 the motor driven and 48.0 the turbine driven pumps	3
Capacity of SRFSs		-	

Data	Units	Value	Ref.
Number of high pressure injection system trains (HPIS)		2	3
Duty of HPIS (each pump)	kg/s	41	3
Operating pressure of HPIS	MPa	19.3	3
Capacity of HPIS		-	
Number of accumulators		3	3
Duty of accumulators	kg	28.3 m^3	3
Capacity of accumulator		-	
Set-point of accumulators	MPa	4.8	3
Number of low pressure injection system trains (LPIS)		2	3
Duty of LPIS (each pump)	kg/s	238	3
Capacity of LPIS		-	
Operating pressure of LPIS	MPa	4.1	3
Number and type of back-up generators on-site		4 diesel generators	2
Duty of generators	MVA	3.45	2
Voltage	kV	6.9	2
Containment building type		Cylindrical prestressed concrete dry containment with hemispheric dome	1
Containment design pressure	MPa	0.5	2
Containment free volume	m^3	58,000	2
Containment sprays - capacity	kg/s	-	

References

[1] World Nuclear Industry Handbook, 1997.
[2] Swedish State Power Board, Ringhals 2 Safety Study, June 1983.
[3] B. Pershagen, Light Water Reactor Safety, Pergamon Press, 1989.