Annex 1

of the

National Report of the Czech Republic

under the

Nuclear Safety Convention

1.

Nuclear Power Plant Dukovany

1.1 Reactor Unit Scheme

NPP Dukovany reactor unit scheme is shown on Fig. 1-1. Following main components are marked out:

PRIMARY CIRCUIT

1. Reactor
2. Steam generator
3. Pressuriser
4. Spent-fuel storage pool
5. Refueling pit
6. Refueling machine
7. Main circulation pump
8. Bubbling tower
9. Air-conditioning system
10. Ventilation stack
11. Main crane

SECONDAY CIRCUIT

12. High-pressure turbine stage
13. Low-pressure turbine stage
14. Generator
15. Condenser
16. Separator-reheater
17. Regenerative heaters
18. Feedwater tank with degasifier
19. Steam piping into turbine
20. Cooling circulation circuit piping
21. Insulated cables for generator power outlet
22. High-voltage transformer 400 kV
23. House transformer 6 kV
24. Manipulation crane

1.2

Main parameters

Number of reactor unit	4
Reactor Type	Pressurised water rector VVER 440/213

Unit parameters

Nominal heat output	1375 MWt
Brutto electrical output	440 Mwe
Netto electrical output	388 Mwe
Self consumption	52 Mwe

Reactor parameters

Reactor height	23,67 m
Pressure vessel diameter	3,542 m
Thickness of cylindrical part	340 mm
Thickness of pressure vessel cladding	9 mm
Pressure vessel weight	215.15 t
Reactor weight	395 t

Reactor core

Number of fuel assemblies	312
Number of fuel elements per assembly	126
Number of control rods	37
Height of active core	2,5 m
Diameter of active core	2,88 m
Fuel enrichment	1,6/2,4/3,6 % U 235
Core loading (UO_2)	42 t
Fuel cycle	four years

Reactor cooling system

Number of cooling loops	6
Inner diameter of main cooling piping	500 mm
Volume of coolant in primary circuit	209 m^3
Primary circuit working pressure	12,25 Mpa
Inlet coolant temperature	cca 267 ^oC
Outlet coolant temperature	cca 297 ^oC
Coolant flow	42 000 m^3/hour

Steam-generator

Number per unit	6
Weight	cca 165 t
Steam output	450 t/hour
Outlet steam pressure	4,61 MPa
Outlet steam temperature	260,0 ^{o} C
Diameter	3,21 m
Length	11,80m

Main circulation pump

Number per unit	6
Nominal power consumption	1,6 MW
Pump capacity	cca 7100 m^3/hour
Rotor speed	1500 rounds/min
Weight	cca 48 t

Turbine

Number of high-pressure sections	1
Number of high-pressure sections	2
Nominal rotor speed	3000 rounds/min
Inlet steam temperature	256 ^oC
Inlet steam pressure	4,3 Mpa

Generator

Rated power	220 MW
Output voltage	15,75 kV
Nominal frequency	50 Hz
Cooling media	hydrogen - water

Condenser

Number per turbine	1
Number of pipes per condenser	cca 29 840
Water flow	35 000 m^3/hod
Pipe material	brass alloy

Cooling towers

Number per unit	2
Height	125 m
Diameter in top of the tower	59,49 m
Foot diameter	87,94 m
Wall thickness	0,6-0,15 m
Volume of evaporated steam from one tower	max. 0,15 m^3/s
Water flow (one tower)	cca 10,55 m^3/s

1.3 Modernization projects already performed at NPP Dukovany

A) Projects in framework of ”Back-fitting of NPP Dukovany”

1. Main coolant pump control algorithms modification
2. Steam generator level measurement upgrade
3. Hydrogen recombination system installation within hermetic compartment
4. High-pressure compressors replacement
5. Addition of redundant back-up to the first category power supplies No. 4 system
6. Teledosimetric system installation
7. Grab tank on Skryje stream installation
8. Cooling system installation for the machine hall roof steel structure
9. Stationary fire extinguishing equipment installation for central oil system
10. Unit electrical fire detection system upgrade
11. Stationary halon fire extinguishing system installation for unit electrical equipment

B) Projects in framework of ”Modernization of NPP Dukovany”

1. Installation of electrical fire detection system at water pump station ”Jihlava”
2. Modernization of system for public warning during accidents
3. Construction of interim spent fuel storage facility
4. 0,4 kV switchgears upgrade
5. 32/16/16 MVA transformer back-up installation
6. Data transfer upgrade for Teledosimetric system
7. Fire-proof spraying of important electrical cables
8. Optimalisation of Automated Physical Protection System AKOBOJE
9. Water treatment station modernization
10. Water and Oil cooling system replacement for dieselgenerator I station
11. Condensate treatment system modernization
12. Dieselgenerators electrical system replacement
13. Construction of new telephone switchboard
14. Water and Oil cooling system replacement for dieselgenerator II station
15. TG pumps replacement
16. First category power supplies system No. 4 batteries replacement
17. Control room dieselgerator announciation upgrade
18. SO continuous measurement system installation

2.

Nuclear power plant Temelín

2.1 Reactor Unit Scheme

NPP Temelín reactor unit scheme is shown on Fig. 2-1. Following main components are marked out:

1. Reactor
2. Primary circuit piping
3. Main coolant pump
4. Pressuriser
5. Steam generator
6. Polar Crane
7. Spent-fuel pool
8. Refueling machine
9. Hydro-acummulators
10. Containment
11. Ventilation stack
12. Emergency cooling system
13. Dieselgenerator station
14. Machine hall
15. Feed-water tank
16. Main steam piping
17. High-pressure turbine stage
18. Low-pressure turbine stage
19. Generator
20. Exciter
21. Separator
22. Condenser
23. Heat exchanger
24. Coolant inlet and outlet
25. Pumping station
26. Cooling water pump
27. Cooling tower
28. Generator power output
29. Transformer
30. Power output
31. Destilate reservoir

2.2

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Main parameters

Number of units	2
Reactor Type	PWR VVER 1000-320

Unit parameters

Nominal thermal output	3000 MWt
Brutto electrical output	981 Mwe
Netto electrical output	912 Mwe
Self consumption	69 Mwe

Reactor parameters

Height	10,9 m
Inner diameter	4,5 m
Thickness of cylindrical part	193 mm
Thickness of pressure vessel cladding	7 – 18 mm
Reactor weight	cca 800 t
Pressure vessel weight	322 t

Reactor core

Number of fuel assemblies	163
Number of fuel elements per assembly	312
Number of control rods	61
Height of active core	3,6 m
Diameter of active core	3,1 m
Fuel enrichment	max. 5 % U 235
Core loading (UO_2)	92 t
Fuel cycle	four years

Reactor cooling system

Number of cooling loops	4
Inner diameter of main Cooling piping	850 mm
Volume of coolant in primary circuit	337 m^3
Primary circuit working pressure	15,7 MPa
Inlet coolant temperature	cca 290^o C
Outlet coolant temperature	cca 320^o C
Coolant flow	84 800 m^3/hour

Steam-generator

Number per unit	4
Weight	416 t
Steam output	1470 t/hour
Outlet steam pressure	6,3 Mpa
Outlet steam temperature	278,5^o C
Diameter	4,2 m
Length	14,5 m

Main circulation pump

Number per unit	4
Nominal power consumption	5,1 – 6,8 MW
Pump capacity	cca 21 200 m^3/hod
Rotor speed	1000 rounds/min
Weight	cca 156 t

Containment system

Height of cylindrical part	38 m
Inner diameter of cylindrical part	45 m
Thickness of wall	1,2 m
Thickness of steel cladding	8 mm

Turbine

Number per unit	1
Number of high-pressure section	3
Rotor speed	3000 rounds/min
Weight of high-pressure section	206 t
Weight of low-pressure section	480 t

Generator

Rated power	1000 MW
Efficiency	0,9
Output voltage	24 kV
Nominal frequency	50 Hz
Cooling media	hydrogen - water
Weight	564 t

Condenser

Number per turbine	3
Number of pipes per condenser	cca 32 000
Pipe length	12 m
Pipe material	titan

Cooling tower

Number per unit	2
Height	154,8 m
Diameter in top of the tower	82,6 m
Foot diameter	130,7 m
Wall thickness	0,9 – 0,18 m
Volume of evaporated steam from one tower	max. 0,4 m^3/s
Water flow (one tower)	cca 17,2 m^3/s

2.3 Design changes performed at Temelín NPP

ITEM No.	ITEM	REASON	COMMENT
1	I&C Systems replacement	1,3	With exception of some auxiliary systems
2	Nuclear fuel, control rods (lifetime)	1,3	New nuclear fuel brings significant improvement with respect to nuclear safety, economy and minimization of generated radioactive wastes
3	Radiation monitoring system (RMS)	3,2	Original design of RMS did not fulfil all technical and legislative requirements
4	Primary circuit diagnostic system (TMDS)	4,1	Original design of primary circuit diagnostic system was not completely solved
5	Sipping	2,3	Original (Russian) system did not fulfil all technical and legislative requirements
6	Bitumination system	1	Requirement for minimization of radioactive wastes defined by OSART mission
7	Refueling machine I&C system replacement	3	Replacement of original system by company GANZ for system supplied by company ANSALDO
8	Installation of compact grid in the spent fuel pool	4	New compact grid enables significant increase of spent fuel pool capacity
9	Simulator	1,2	Enables operators training in accordance with requirements
10	Technical support center	1	Post TMI recommendation
11	Electrical equipment replacement (Alterners, rectifiers, etc.)	3	Replacement of original (Russian) electrical equipment ABP (ANN) of safety systems power supplies was initiated to increase its reliability (nuclear safety)
12	Bushing replacement (Škoda+ISTC Company)	3	Installation of new qualified, reliable bushings
13	Replacement of circuit breakers J2UX	3	Initiated by negative operating experience at Bohunice and Dukovany NPP's
14	Replacement of unit transformer bushings (Passoni Villa bushings)	3	Replacement of original (Russian) bushings because of negative operating experience at other Czech power plants
15	Addition of back-up power supply for reactor building No. 2	1	Requirement for separation of power supplies for each unit
16	Addition of back-up dieselgenerator station (DGS) common for both units	1,4	Addition of another back-up emergency power supply source for safety related systems
17	Increase of acubatteries capacity	1	Replacement of original acubatteries because of negative operating experience and with the intent to increase their operational capacity in case of total station blackout
18	Installation of "reserve electrical protections" and introduction of full selectivity in radial electrical networks of 6 kV	4	Protection against short-circuits, problems with grounding, etc.
19	Continuous controls of pressuriser electrical heaters installation	1	The intent is to decrease ageing of primary circuit components
20	Installation of hydrogen recombination system	1	Elimination of hydrogen in containment during accidents
21	Post-accident hydrogen monitoring system	1	Monitoring of hydrogen concentration during and after accident.
22	Replacement of selected valves	3	Replacement of unreliable valves
23	Reconstruction of stabile fire extinguishing system for outdoor power transformers	1	Inclusion of automatic activation; installation of additional barriers; installation of additional nozzles

ITEM No.	ITEM	REASON	COMMENT
24	Introduction of secondary load follow regulation	4	Initiated by technical requirements coming from membership in UCPTE
25	Construction of plant terminal	4	Initiated by technical requirements coming from membership in UCPTE
26	Modification of water treatment systems TVD and TVN	4	Initiated by results of new hydraulic calculations to assure full system functionality in all operating modes
27	Replacement of selected pumps	3	Initiated partly by technical unsuitability of some original equipment and partly by unavailability of original suppliers
28	Modification of containment cesspool system	1	Modifications based on results of tests performed in Russia
29	Containment venting (single failure)	1	Sheathing of first closing valve and corresponding piping under containment
30	Titan condenser pipes installation	4	Increase of pipes design life together with possibility to change to more effective chemistry regime (by increasing pH)
31	Control rod drives replacement	3	Increase of drives design life and reliability by replacing original ones to drives manufactured by ŠKODA
32	Introduction of new chemistry control	4	Initiated to increase life time of important equipment (before others steamgenerator)
33	New safety analysis	1,2	Reworking of safety analysis because of new fuel and I&C system
34	ATWS analyses	1	Reworking of safety analysis with use of up-to-date experience and knowledge
35	PSA level -1 and 2 development project	1	1. level – analysis of the probability of accident with core melting 2. level – analysis of the probability of accident with loose of containment integrity
36	Severe accidents analysis	1	Studies of selected severe (beyond design basis) accidents
37	SW independent verification & validation project (IV&V)	2	Independent verification and validation of safety critical SW
38	Leak Before Break	1	Assessment of primary circuit integrity (prevention against LOCA)
39	EOP development project	4,1	Symptom based emergency procedures development (prevention of accidents)
40	SAMG development project	1,4	Guidelines for liquidation of accidents (logically linked with EOP)- accident mitigation
41	Fire safety, cables, electronic fire detection system	2,4	Replacement of original cabling for fire-poof and fire non-propagating ones; installation of electronic fire detection system manufactured by CERBERUS.
42	Seismic analyses	1	Re-assessment of Temelín design against newly defined seismic loading - 0.1 g; calculation of response spectra for each floor, rep. building; seismic re-qualification
43	Completion of documentation	2	Project for amendment and completion of required documentation related to safety related items, resp. structures
44	ISE project	4,1	Installation of computer based information system
45	Modification of SG inner parts	4	Intent is to increase service life
46	Addition of new SG water level measurement	2	Project assure separations of safety divisions

ITEM No.	ITEM	REASON	COMMENT
47	I&C system for polar crane replacement	3	Replacement of original ROBOTRON system for more reliable one enabling addition of functionality
48	Filtration system for emergency control room	1	Installation of additional filters in ventilation system will enable use of the emergency control room during accidents
49	Modification of main control room venting system	1	Intent is to assure the main control room environment according to standards (temperature, noisiness, ect.)
50	Installation of absorbers GERB	2	Installation of absorbers according to asseismic requirements
51	Addition of drench fire extinguishing system for main coolant pumps	2	Reaction to regulatory body requirements
52	Addition of radioactive waste treatment system for liquid wastes liquidation after accidents	1	Lowering of radioactive wastes volume
53	Addition of system for collection of boric water and system for separation	1	Lowering of radioactive wastes volume
54	Replacement of asbestos sealing	4,2	Replacement with teflon one to increase service life
55	Installation of new heat-exchangers of active engineered safety systems	3	Because of low quality of original heat-exchangers
56	Addition of relief valve to pressuriser system	1	Prevention of false actions of pressuriser safety valves
57	Replacement of steamgenerator steam pipes quick-acting valves	3	Protection of important components
58	Modernization of main circulation pumps	4,1	Required coolant flow through active core
59	Organized depository of high level wastes	2	Change of original radioactive waste depository concept
60	Replacement of freon in cooling systems	2	Reconstruction of cooling station with use of absorber units

Legend : Reason for design change:

1 – recommendation of individual missions and audits (MAAE, NUS Halliburton, TUV, etc.)
2 – requirement coming from regulatory body or/and from new legislation
3 – replacement of components because of low quality of original ones, loss of supplier, ect.
4 – operators own decision