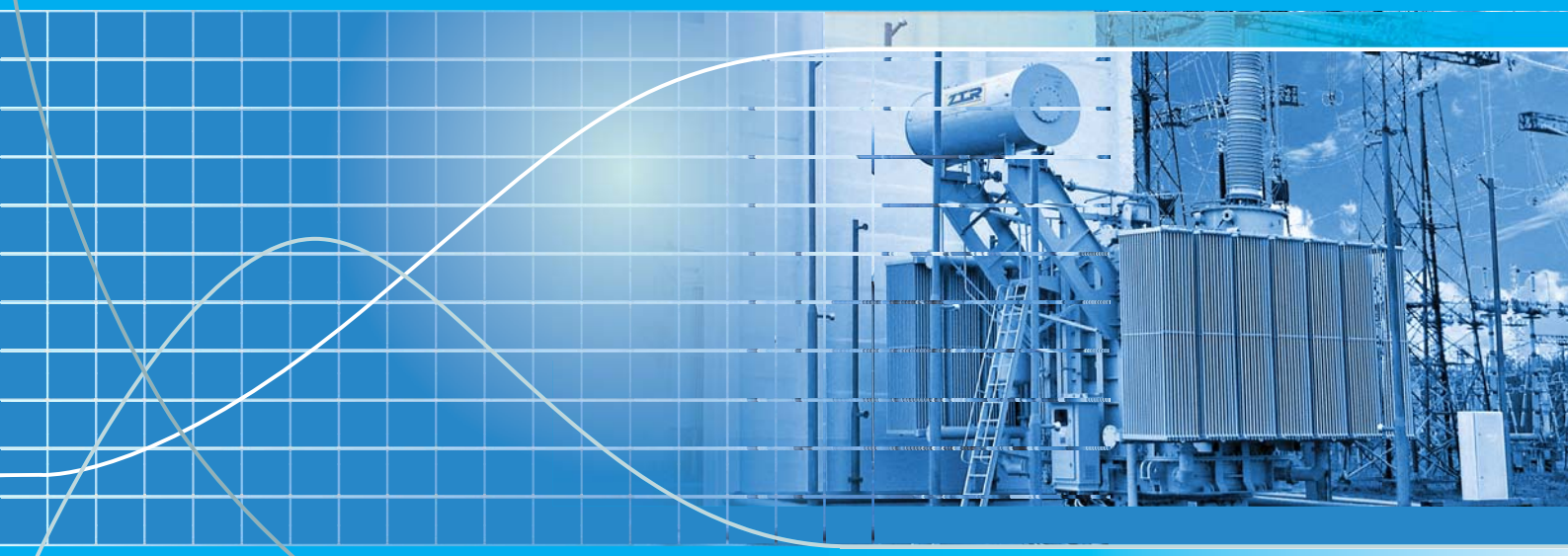


ZTR
ZAPOROZHTRANSFORMATOR

PRODUCT CATALOGUE








- Together we create reliable products, thus ensuring development of power industry of continents.
- By continuous improvement we transform our knowledge, energy and experience of the generations into common success.
- We enjoy what we do and are proud of it.

PRODUCT CATALOGUE

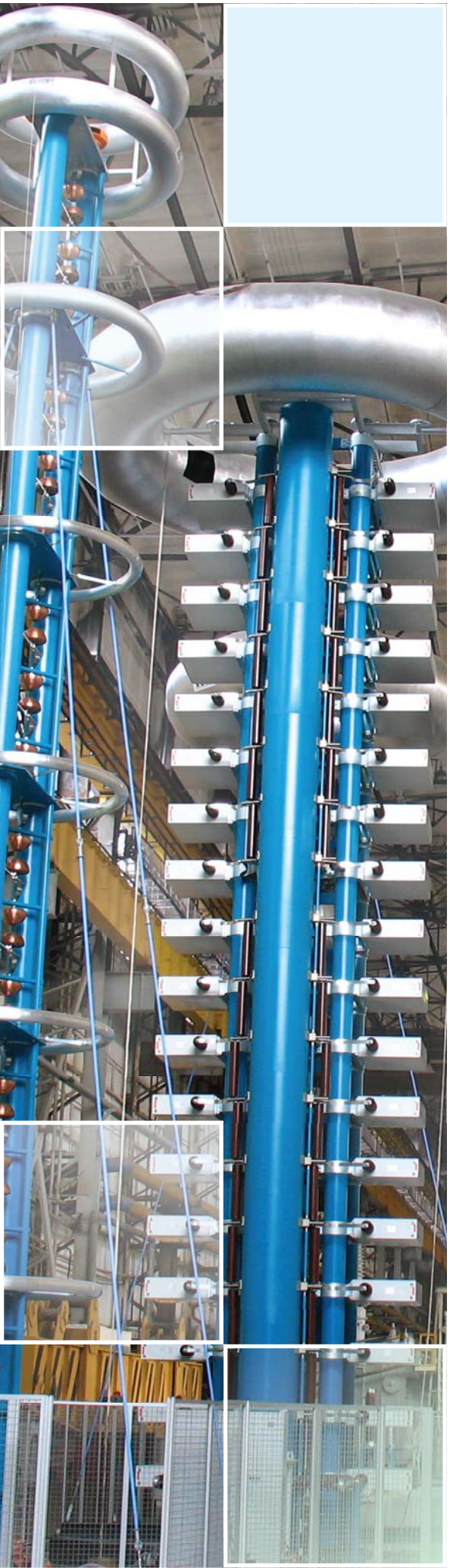
I. POWER TRANSFORMERS 6

1. Generator transformers 6
2. Autotransformers 10
3. Transformers for substations of transmission electric networks 14
4. Auxiliary and standby transformers 20
5. Transformers for DC transmission lines and high-capacity converter substations of tie-lines 22
6. Special transformers
    - 6.1. Transformers for metallurgical enterprises 24
    - 6.2. Transformers for railway substations 24
    - 6.3. Regulating transformers 24
    - 6.4. Furnace transformers 26
    - 6.5. Mine transformer 26

II. ELECTRICAL REACTORS 28

1. Shunt reactors 28
2. Neutral reactors 30

III. CONTROLLABLE SHUNT REACTORS 32

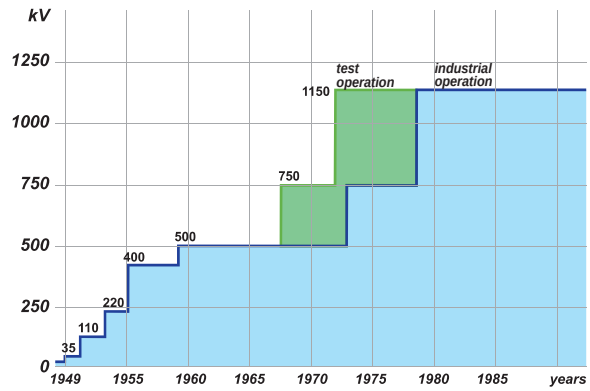


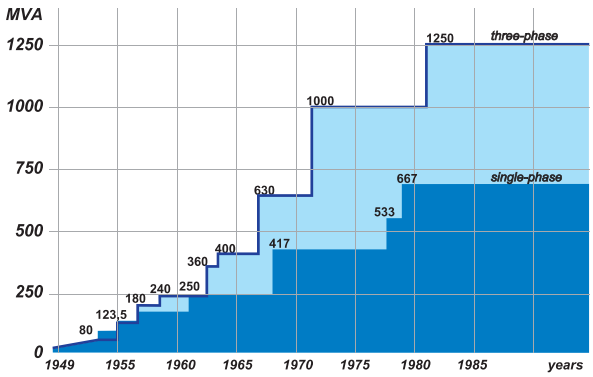
The catalogue introduces the major types of oil immersed power transformers and electrical reactors designed and manufactured by ZTR during more than 66 years under requirements of customers from 86 countries worldwide.

ZTR product range covers oil immersed power transformers, electrical reactors and controllable shunt reactors with power range from 1 MVA to 1250 MVA and voltage classes from 10 kV to 1150 kV inclusive, of different purposes, climatic and seismic conditions.

Up-to-date technology and high-skilled experienced personnel guaranty manufacturing of high quality and reliable equipment.

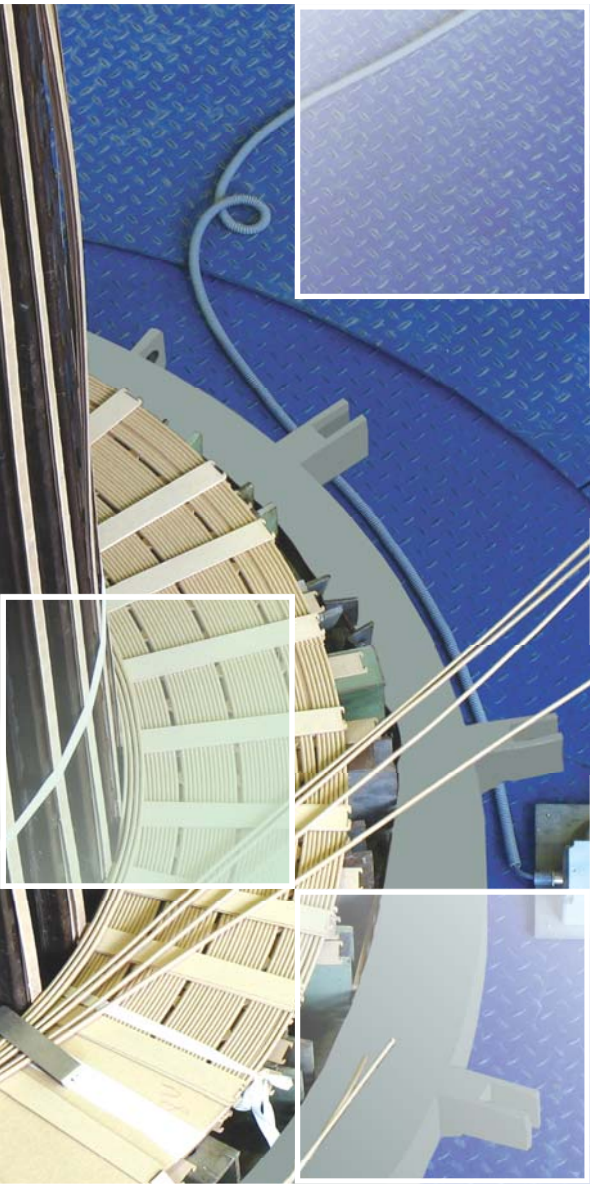
ZTR equipment voltage class and power capacity mastering history





QUALITY MANAGEMENT SYSTEM

- Quality management system of ZTR complies with international ISO 9001:2008 standard.
- Equipment is designed in accordance with the GOST, DSTU, IEC, ANSI, BS, IRAM and other national standards as well as with technical conditions and requirements of customer.
- Due to its high scientific and technical potential, long experience in design and manufacturing of advanced-technology equipment, ZTR is able to fulfil any non-standard requirements of Customers and take orders for transformers and reactors not presented in this catalogue.



ABBREVIATIONS

- **Type of Cooling:**

  ONAN – natural circulation of air and oil;

  ONAF – forced circulation of air and natural circulation of oil;

  OFAF - forced circulation of air and oil with nondirectional oil flow;

  ODWF - forced circulation of water and oil with directional oil flow;

  OFWF - forced circulation of water and oil with nondirectional oil flow;

- **Tap changer type:**
  OLTC – On-Load tap changer;
  OCTC – Off-circuit tap changer;

- **LV split winding –** LV split

I. POWER TRANSFORMERS

1. Generator transformers

Generator transformers manufactured by ZTR are intended for transmission of the power generated by electric power plant to high voltage bus network.

ZTR manufactures one-phase and three-phase generator transformers rated for capacity up to 1250 MVA and voltage up to 750 kV for all types of Power Generation Plants, including Solar and Wind Farms.

Transformers can be produced with split generator windings for simultaneous connection to two and more generators. Transformers can be equipped with in-built on-load or off-circuit tap changers.

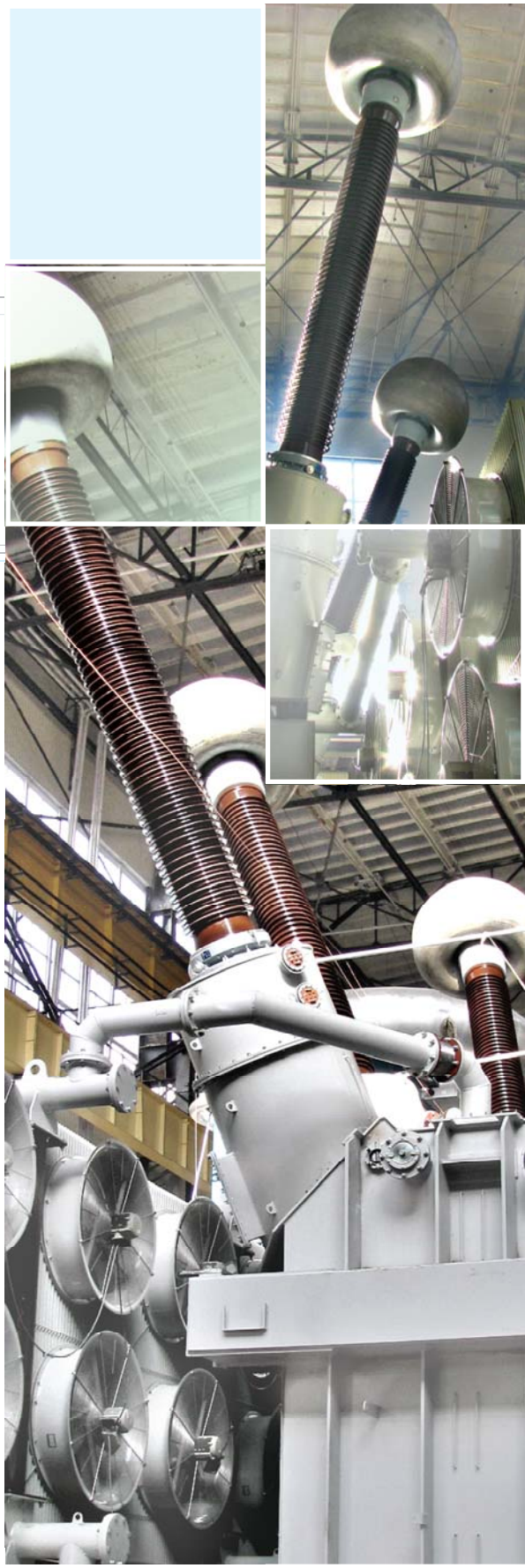


Table 1. Generator transformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
Single phase two-winding transformers							
417 MVA, 750 kV, LV split	750	417	787/√3	20,0; 24,0	YNd11-d11 (in 3-phase group)	OFWF	–
333 MVA, 750 kV	750	333	787/√3	24,0	YNd11 (in 3-phase group)	OFAF	–
533 MVA, 500 kV, LV split	500	533	525/√3	15,75 - 15,75	YNd11-d11 (in 3-phase group)	OFWF	-
334 MVA, 500 kV	500	334	525√3	24	YNd11 (in 3-phase group)	OFAF	-
210 MVA, 500 kV, LV split	500	210	525/√3	15,75	YNd11d11 (in 3-phase group)	OFWF	–
210 MVA, 500 kV, LV split	500	210	525/√3	20 - 20	YNd11-d11 (in 3-phase group)	OFAF	-
135 MVA, 500 kV	500	135	500/√3	15,8	YNd11 (in 3-phase group)	OFWF	OLTC
417 MVA, 420 kV	420	417	420/√3	24,0	YNd11 (in 3-phase group)	OFAF	–
63,3 MVA, 220 kV, LV split	220	63,3	242/√3	10,5	YNd11d11 (in 3-phase group)	OFAF	–
66,667 MVA, 220 kV, LV split	220	66,667	230/√3	11,0	YNd11d11 (in 3-phase group)	ONAF	–
40 MVA, 110 kV	110	40	121	13,8	YNd11 (in 3-phase group)	ONAF	OCTC / -
Three phase two-winding transformers							
1000 MVA, 500 kV	500	1000	525	24	YNd11	ODWF	–
666 MVA, 500 kV	500	666	525	15,75	YNd11	OFWF	–
630 MVA, 500 kV	500	630	525	15,75; 20,0; 24,0	YNd11	OFAF	–
630 MVA, 500 kV	500	630	525	15,75; 20,0; 24,0	YNd11	OFWF	–
520 MVA, 500 kV	500	520	525	20	YNd11	OFAF	-
265 MVA, 500 kV	500	265	525	15,75	YNd11	OFAF	-
400 MVA, 500 kV	500	400	525	15,75; 20,0	YNd11	OFAF	–
400 MVA, 500 kV	500	400	525	15,75; 20,0	YNd11	OFWF	–
320 MVA, 500 kV	500	320	525	15,75	YNd11	OFAF	–
250 MVA, 500 kV	500	250	525	13,8; 15,75; 20,0	YNd11	OFAF	–
250 MVA, 500 kV	500	250	525	13,8; 15,75	YNd11	OFWF	–
780 MVA, 400 kV	400	780	420	27	YNd5	OFWF	OLTC
630 MVA, 400 kV	400	630	420	15,75; 20,0; 24,0	YNd11	OFWF	–
200 MVA, 400kV	400	200	420	15,75	YNd11	ONAF	OLTC
333 MVA, 347 kV	347	333	347	17,0	YNd11	ONAF	OCTC
1250 MVA, 330 kV	330	1250	347	24	YNd11	ODWF	–
1000 MVA, 330 kV	330	1000	347	24	YNd11	ODWF	–
630 MVA, 330 kV	330	630	347	15,75; 20,0; 24,0	YNd11	OFWF	–
430 MVA, 330 kV	330	430	347	15,75	YNd11	OFAF	OCTC
265 MVA, 330 kV	330	265	347	15,75	YNd11	OFAF	-
250 MVA, 330 kV	330	250	347	13,8; 15,75	YNd11	OFAF	–
250 MVA, 330 kV	330	250	347	13,8	YNd11	OFWF	-

Continue **Table 1.** Generator transformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	OLTC
			HV	LV			
215 MVA, 330 kV	330	215	347	13,8	YNd11	OFWF	-
200 MVA, 330 kV	330	200	347	18; 15.75	YNd11	OFAF	-
80 MVA, 330 kV, LV split	330	80	330	10,5-10,5	YNd11-d11	ONAF	OLTC
400 MVA, 245 kV	245	400	245	20	YNd11	OFAF	OLTC
200 MVA, 230 kV	230	200	230	13,8	YNd11	ONAF	OCTC
58 MVA, 230 kV	230	58	230	13,09	Dyn1	ONAF	OCTC
1000 MVA, 220 kV	220	1000	242	24	YNd11	ODWF	–
630 MVA, 220 kV	220	630	242	15,75; 20,0; 24,0	YNd11	OFWF	–
630 MVA, 220 kV	220	630	242	20; 24	YNd11	ODWF	-
520 MVA, 220 kV	220	520	242	20	YNd11	OFAF	OCTC
450 MVA, 220 kV	220	450	242	20	YNd11	OFAF	OCTC
400 MVA, 220 kV	220	400	242	15,75; 20,0	YNd11	OFAF	–
315 MVA, 220 kV	220	315	242	15,75	YNd11	OFAF	-
250 MVA, 220 kV	220	250	242	13,8; 15,75	YNd11	OFAF	–
230 MVA, 220 kV	220	230	230	16,5	YNd11	OFAF	OCTC
200 MVA, 220 kV	220	200	245	15,75	YNd11	OFAF	OLTC
200 MVA, 220 kV	220	200	242	13,8; 15,75	YNd11	OFAF	OCTC
160 MVA, 220 kV	220	160	242	10,5	YNd11	OFAF	OCTC
125 MVA, 220 kV	220	125	242	10,5; 13,8	YNd11	OFAF	OCTC
100 MVA, 220 kV	220	100	230	22,0	YNyn0+d	OFAF	OLTC
90 MVA, 220 kV **	220	90	220	11	YNd1	ONAN	OLTC
80 MVA, 220 kV	220	80	242	6,3-13,8	YNd11	ONAF	OCTC
62,5 MVA, 220 kV	220	62,5	220	15	YNd11	ONAN	OLTC
60 MVA, 220 kV*	220	60	220	15	YNd11	ONAN	OLTC
25 MVA 220 kV	220	25	230	11	YNd11	ONAF	OCTC
61 MVA, 154 kV*	150	61	154	13,8	YNd11	ONAF	OCTC
280 MVA, 150 kV	150	280	165	13,8	YNd11	OFWF	-
130 MVA, 150 kV	150	130	165	10,5	YNd11	OFAF	–

* For Solar Power Plants

** For Geothermal Power Plant

Continue **Table 1.** Generator transformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	OLTC
			HV	LV			
125 MVA, 150 kV	150	125	165	10,5; 13,8	YNd11	OFWF	–
95 MVA, 150 kV	150	95	165	13,8	YNd11	OFAF	–
70 MVA, 150 kV	150	70	165	13,8	YNd11	OFWF	-
10 MVA, 150 kV	150	10	169	6,3	YNd11	OFWF	OCTC
315 MVA, 145/132 kV	145	315	145	132	Dd0	ONAF	OLTC
62,5 MVA, 132 kV	132	62,5	132	15	YNd11	ONAN	OLTC
55,5 MVA, 132 kV	132	56	138,5	11	YNd1	OFWF	OCTC
27,8 MVA, 132 kV	132	28	138,5	11	YNd1	OFWF	OCTC
180 MVA, 121 kV	121	180	121	15,75	YNd11	ONAF	OCTC
400 MVA, 110 kV	110	400	121	20	YNd11	OFAF	–
250 MVA, 110 kV	110	250	121	15,75	YNd11	OFAF	–
230 MVA, 110 kV	110	230	121	16,5	YNd11	OFAF	OCTC
225 MVA, 110 kV	110	225	121	15	YNd11	OFAF	OCTC
200 MVA, 110 kV	110	200	121	13,8; 15,75	YNd11	OFAF	OCTC
200 MVA, 121 kV, LV split	110	200	121	10,5 - 10,5	YNd11-d11	OFAF	OCTC
180 MVA, 110 kV	110	180	121	13,8; 15,0	YNd11	OFAF	OCTC
160 MVA, 110 kV	110	160	121	10,5	YNd11	OFAF	OCTC
125 MVA, 110 kV	110	125	121	10,5; 13,8	YNd11	OFAF	OCTC
90 MVA, 110 kV, LV split	110	90	121	6,3	YNd11d11	ONAF	–
90 MVA, 110 kV, LV split	110	90	121	6,3-6,3	YNd11-d11	ONAF	-
80 MVA, 110 kV	110	80	121	11,0(6,3)	YNd11	OFAF	-
80 MVA, 110 kV	110	80	115	38,5	YNd11	OFAF	OLTC
80 MVA, 110 kV	110	80	121	10,5	YNd11	ONAF	OCTC
63 MVA, 110 kV	110	63	121	10,5	YNd11	ONAF	-
40 MVA, 110 kV	110	40	121	10,5	YNd11	ONAF	OCTC
25 MVA, 110 kV	110	25	121	10,5	YNd11	ONAF	OCTC
32 MVA, 110 kV	110	32	115	10,5	YNd11	ONAF	OCTC
16 MVA, 110 kV	110	16	115	10,5	YNd11	ONAF	OCTC

2. Autotransformers

Autotransformers are intended for interconnection of two high-voltage networks of different voltages, as well as for regulation of power flows in networks and maintenance of required voltage levels in on-load conditions by means of in-built on-load tap changers.

ZTR manufactures autotransformers with capacity up to 800 MVA and voltage up to 1150 kV.

Normally transformers manufactured by Zaporozh–transformator JSC are equipped with delta-connected stabilizing tertiary winding which can be used for power supply to local consumers.

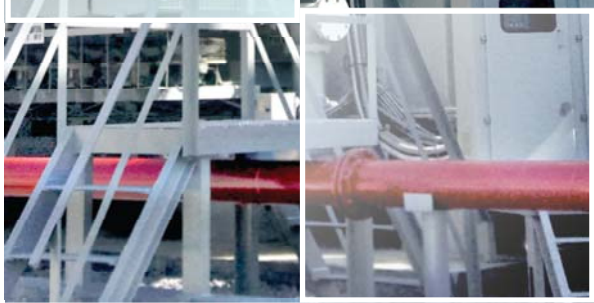


Table 2. Autotransformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV			Vector group	Cooling	Tap Changer
			HV	MV	LV			
Single phase three-winding autotransformers								
667 MVA, 1150/500 kV	1150	667	1150/√3	500/√3	20,0	YNauto0d11 (in 3-phase group)	OFAF	-
500 MVA, 765/400 kV	750	500	500√3	400√3	33	YNauto0d11 (in 3-phase group)	ONAF	OLTC
417 MVA, 750/500 kV	750	417	750/√3	500/√3	10,5	YNauto0d11 (in 3-phase group)	OFAF	OCTC
417 MVA, 750/500 kV	750	417	750/√3	500/√3	10,5;15,75	YNauto0d11 (in 3-phase group)	OFAF	OLTC
333 MVA, 750/330 kV	750	333	750/√3	330/√3	15,75	YNauto0d11 (in 3-phase group)	ONAF	OLTC
333 MVA, 750/330 kV	750	333	750/√3	330/√3	15,75	YNauto0d11 (in 3-phase group)	OFAF	OLTC
333 MVA, 750/330 kV	750	333	750/√3	330/√3	15,75	YNauto0d11 (in 3-phase group)	OFAF	OLTC
267 MVA, 500/220 kV	500	267	500/√3	230/√3	6,3-38,5	YNauto0d11 (in 3-phase group)	OFAF	OLTC
167 MVA, 500/220 kV	500	167	500/√3	230/√3	10,5-38,5	YNauto0d11 (in 3-phase group)	ONAF	OLTC
167 MVA, 500/220 kV	500	167	500/√3	230/√3	10,5-38,5	YNauto0d11 (in 3-phase group)	OFAF	OLTC
167 MVA, 500/330 kV	500	167	500/√3	330/√3	10,5	YNauto0d11 (in 3-phase group)	OFAF	OLTC
150 MVA, 500/220 kV	500	150	500/√3	225/√3	35,0	YNauto0d11 (in 3-phase group)	OFAF	OLTC
135 MVA, 500/110 kV	500	135	500/√3	121/√3	10,5	YNauto0d11 (in 3-phase group)	OFAF	OLTC
250 MVA, 500/220 kV, LV split	500	250	500√3	242√3	11-11	YNauto0d11d11 (in 3-phase group)	OFAF	OLTC
200 MVA, 400/230 kV	400	200	400√3	230√3	24/26,4/33	YNauto0d11 (in 3-phase group)	OFAF	OLTC
267 MVA, 400/231 kV	400	267	400/√3	231/√3	31,5	YNauto0d11 (in 3-phase group)	OFAF	OLTC
120 MVA, 220/110 kV	220	120	242/√3	121/√3	13,8	YNauto0d11d11 (in 3-phase group)	OFAF	OCTC

Continue **Table 2.** Autotransformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV			Vector group	Cooling	Tap Changer
			HV	MV	LV			
Three phase three-winding autotransformers								
500 MVA, 500/220 kV	500	500	500	230	20,0	YNauto0d11	OFAF	OLTC
250 MVA, 500/110 kV	500	250	500	121	6,3-38,5	YNauto0d11	OFAF	OLTC
400 MVA, 400/220 kV	400	400	400	230	20	YNauto0d11	OFAF	OLTC
315 MVA, 400/220 kV	400	315	400	220	33,0	YNauto0d11	OFAF	OLTC
250 MVA, 330/220 kV	330	250	330	230	6,3-38,5	YNauto0d11	OFAF	OLTC
250 MVA, 330/150 kV	330	250	330	158	10,5	YNauto0d11	OFAF	OLTC
250 MVA, 330/110 kV	330	250	330	115	11	YNauto0d11	OFAF	OLTC
240 MVA, 330/220 kV	330	240	330	230	6,6; 38,5	YNa0d11	OFAF	OLTC
200 MVA, 330/110 kV	330	200	330	115	6,56; 10,58; 11; 35; 38,5	YNa0d11	OFAF; ONAN/ ONAF/OFAF	OLTC
200 MVA, 330/110 kV	330	200	330	115	6,3-38,5	YNauto0d11	OFAF	OLTC
200 MVA, 330/110 kV	330	200	330	115	6,3-38,5	YNauto0d11	ONAF	OLTC
150 MVA, 330/110 kV	330	150	330	115	10,5	YNauto0d11	ONAF	OLTC
125 MVA, 330/110 kV	330	125	330	115	6,3-38,5	YNauto0d11	OFAF	OLTC
125 MVA, 330/110 kV	330	125	330	115	6,3-38,5	YNauto0d11	ONAF	OLTC
125 MVA, 330/110 kV	330	125	330	115	10,5	YNa0d11	OFAF; ONAN/ ONAF/OFAF	OLTC
250 MVA, 220/110 kV	220	250	230	121	6,3-38,5	YNauto0d11	OFAF	OLTC
125 MVA, 220/110 kV	220	250	230	121	10,5; 11; 6,3, 38.5	YNa0d11	OFAF; ONAN/ ONAF/OFAF	OLTC
200 MVA, 220/110 kV	220	200	230	121	10,5;11.0; 38,5; 6,3	YNa0d11	OFAF; ONAN/ ONAF/OFAF	OLTC
200 MVA, 220/110 kV	220	200	230	121	6,3-38,5	YNauto0d11	OFAF	OLTC
125 MVA, 220/110 kV	220	125	230	121	6,3; 6,6; 10,5; 11; 38,5	YNa0d11	OFAF; ONAN/ ONAF/OFAF	OLTC
125 MVA, 220/110 kV	220	125	230	121	6,3-38,5	YNauto0d11	ONAF	OLTC
63 MVA, 220/110 kV	220	63	230	121	6,3-38,5	YNauto0d11	ONAF	OLTC
63 MVA, 220/110 kV	220	63	230	121	6,3-38,5	YNauto0d11	OFAF	OLTC
Three phase two-winding								
500 MVA, 500/220 kV	500	500	500	–	230,00	YNauto	OFAF	OLTC


Transener

3. Transformers for substations of transmission and distribution electric networks

Transformers for substations of transmission electric networks are intended for the long-distance transmission of electric power at high voltage providing minimum electric losses in the transmission lines.

Transformers for the substations of distribution electric networks are intended for electric power distribution between power consumers and for voltage decrease to the level of local distribution electric networks including industrial enterprises.

Two- and three-winding transformers of this type as well as transformers with split winding are produced by ZTR. Almost all such transformers are equipped with in-built on-load tap changers.

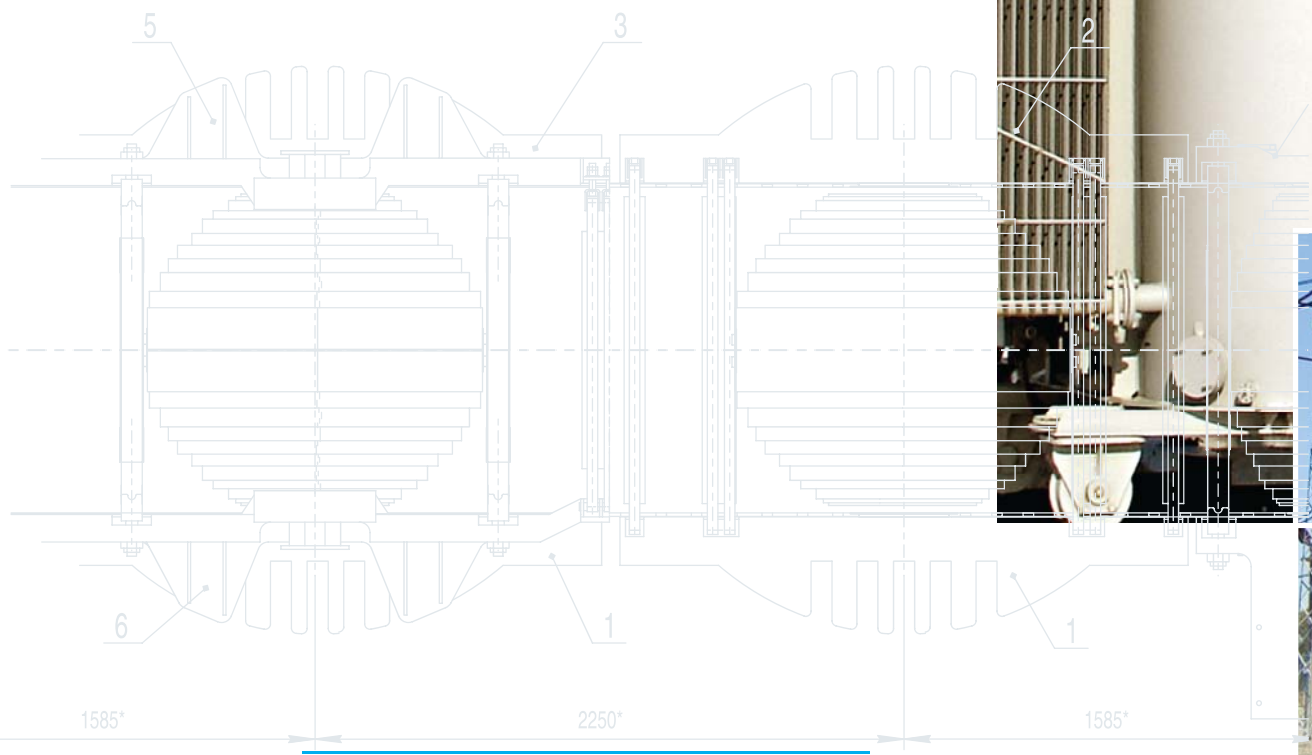


Table 3.1. Transformers for substations of transmission and distribution electric networks

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
Three phase two-winding							
150 MVA, 525 kV	500	150	525	11,5	YNd1	ONAF	OLTC
400 MVA, 500 kV	500	400	500	15,75	YNd11	OFAF	OLTC
250 MVA, 500 kV	500	250	500	15	YNd11	OFAF	OLTC
63 MVA, 330 kV, LV split	330	63	330	6,3-11,0	YNd11d11	OFAF	OLTC
63 MVA, 330 kV, LV split	330	63	330	10,5-10,5	YNd11-d11	ONAF	OLTC
220 MVA, 220 kV	220	220	220	33,0	YNd11	ONAF	OLTC
200 MVA, 220 kV, LV split	220	200	230	10,5-10,5	YNd11-d11	ONAN/ONAF/ OFAF	OLTC
160 MVA, 220 kV, LV split	220	160	230	11,0	YNd11d11	OFAF	OLTC
125 MVA, 220 kV, LV split	220	125	230	10,5-10,5	YNd11-d11	OFAF	OLTC
100 MVA, 220 kV, LV split	220	100	230	10,5-10,5; 11-11; 20-20	YNd11-d11	OFAF; ONAN/ ONAF/OFAF	OLTC
80 MVA, 220 kV, LV split	220	80	230	6,3-11,0	YNd11d11	OFAF	OLTC
63 MVA, 220 kV, LV split	220	63	230	6,3; 10,5	YNd11d11	ONAF	OLTC
63 MVA, 220 kV, LV split	220	63	230	6,3-11,0	YNd11d11	OFAF	OLTC
32 MVA, 220 kV, LV split	220	32	230	6,3; 10,5	YNd11d11	ONAF	OLTC
25 MVA, 220 kV	220	25	230	10,5	YNd11	ONAF	OLTC
5 MVA, 220 kV	220	5	230	10,0	YNd11	ONAN	OLTC
70 MVA, 150 kV	150	70	154	6,3	YNd11	ONAF	OLTC
63 MVA, 150 kV, LV split	150	63	158	6,3-11,0	YNd11d11	ONAF	OLTC
32 MVA, 150 kV, LV split	150	32	158	6,3; 10,5	YNd11d11	ONAF	OLTC
16 MVA, 150 kV	150	16	158	6,6; 11,0	YNd11	ONAF	OLTC
125 MVA, 110 kV, LV split	110	125	115	10,5	YNd11d11	OFAF	OLTC
125 MVA, 110 kV, LV split	110	125	115	10,5-10,5	YNd11-d11	ONAF	OLTC
80 MVA, 110 kV	110	80	115	11,0 6,3	YNd11	ONAF	OLTC
80 MVA, 110 kV, LV split	110	80	115	6,3-11,0	YNd11d11	ONAF	OLTC
80 MVA, 110 kV, LV split	110	80	115	6,3-11,0	YNd11d11	OFAF	OLTC
63 MVA, 110 kV	110	63	115	35,0	YNd11	ONAF	OLTC
63 MVA, 110 kV, LV split	110	63	115	6,3-11,0	YNd11d11	ONAF	OLTC
63 MVA, 110 kV, LV split	110	63	115	6,3-11,0	YNd11d11	OFAF	OLTC
63 MVA, 110 kV, LV split	110	63	115	6,3-11,0	YNd11d11	ONAN	OLTC
40 MVA, 110 kV	110	40	115	6,6	YNd11	ONAF	OLTC
40 MVA, 110 kV, LV split	110	40	115	6,3-11,0	YNd11d11	ONAF	OLTC
40 MVA, 110 kV, LV split	110	40	115	6,3-11,0	YNd11d11	ONAN	OLTC
32 MVA, 110 kV, LV split	110	32	115	6,3; 10,5	YNd11d11	ONAF	OLTC
25 MVA, 110 kV	110	25	115	6,3; 10,5	YNd11	ONAF	OLTC
25 MVA, 110 kV, LV split	110	25	115	6,3-11,0	YNd11d11	ONAF	OLTC

Continue **Table 3.1.** Transformers for substations of transmission and distribution electric networks

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
25 MVA, 110 kV, LV split	110	25	115	11,0 - 11,0; 10,5 - 10,5; 6,6 - 6,6; 6,3 - 6,3	YNd11-d11	ONAF	OLTC
16 MVA, 110 kV, LV split	110	16	115	6,3-6,3	YNd11-d11	ONAF	OLTC
16 MVA, 110 kV	110	16	115	6,6-34,5	YNd11	ONAF	OLTC
10 MVA, 110 kV	110	10	115	6,6-34,5	YNd11	ONAF	OLTC
6,3 MVA, 110 kV	110	6,3	115	6,6; 11,0	YNd11	ONAN	OLTC
4 MVA, 110 kV	110	4 000	115	6,6	YNd11	ONAN	OLTC
2,5 MVA, 110 kV	110	2,5	115	6,6; 11,0	YNd11	ONAN	OLTC
25 MVA, 66 kV	66	25	66	6,6-24	Dyn1	ONAF	OLTC

Description	Vol-tage,kV	Rated apacity, MVA	Rated voltage, kV			Vector group	Cooling	Tap Changer
			HV	MV	LV			
Three phase three-winding								
300 MVA, 500 kV	500	300	500	138	13,8; 34,5	YNyn0d11	ONAF	OLTC
300 MVA, 500 kV	500	300	500	138	13,8; 34,5	YNyn0d11	ONAN/ ONAF/OFAF	OLTC
63 MVA, 220 kV	220	63	230	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
63 MVA, 220 kV	220	63	230	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	OFAF	OLTC (HV) OCTC (MV)
25 MVA, 220 kV	220	25	230	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
63 MVA, 150 kV	150	63	158	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
40 MVA, 150 kV	150	40	158	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
25 MVA, 150 kV	150	25	158	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
80 MVA, 110 kV	110	80	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC
80 MVA, 110 kV	110	80	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	OFAF	OLTC
80 MVA, 110 kV, LV split	110	80	115	-	22,0	YNyn0yn0+d+d	OFAF	OLTC
63 MVA, 110 kV	110	63	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
63 MVA, 110 kV	110	63	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	OFAF	OLTC (HV) OCTC (MV)
40 MVA, 110 kV	110	40	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
32 MVA, 110 kV	110	32	115	38,5	6,6	YNd11-d11	ONAF	OLTC
25 MVA, 110 kV	110	25	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
16 MVA, 110 kV	110	16	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
10 MVA, 110 kV	110	10	115	11,0-38,5	6,6; 11,0	YNyn0d11; YNd11d11	ONAF	OLTC (HV) OCTC (MV)
6,3 MVA, 110 kV	110	6,3	115	39	11; 6,6	YNyn0d11	ONAN	OLTC


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Table 3.2. Transformers for substations of distribution networks up to 35 kV

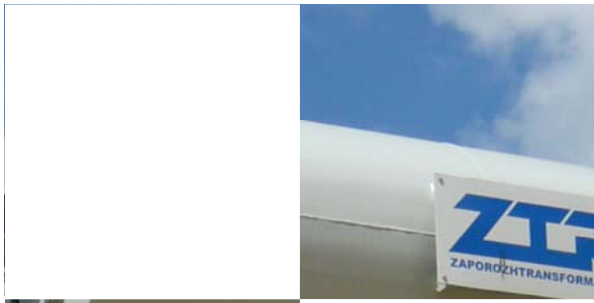
Description	Voltage,kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	TapChanger
			HV	LV			
Three phase two-winding transformers							
25 MVA, 35 kV	35	25	36,75; 15,75	10,5-10,5; 6,3-6,3	YNd11-d11; Dd0-d0	ONAF	OLTC
16 MVA, 35 kV	35	16	36,75	21; 10,5	YNd11	ONAF	OLTC
10 MVA, 35 kV	35	10	36,75	6,3; 11	YNd11	ONAN	OLTC
10 MVA, 35 kV	35	10	36,75	6,3	YNd11	ONAN	OLTC
6,3 MVA, 35 kV	35	6,3	35,0	6,3; 11,0	Yd11	ONAN	OLTC
4 MVA, 35 kV	35	4	20,0; 35,0	0,4-10,5	Yd11	ONAN	OCTC
4 MVA, 35 kV	35	4	35,0	6,3; 11,0	Yd11	ONAN	OLTC
2,5 MVA, 35 kV	35	2,5	20,0; 35,0	0,4-10,5	Yd11	ONAN	OCTC
2,5 MVA, 35 kV	35	2,5	13,8-35,0	6,3; 11,0	Yd11	ONAN	OLTC
1,6 MVA, 35 kV	35	1,6	20,0; 35,0	0,4-10,5	Yyn0; Dyn11; Yd11	ONAN	OCTC
1,6 MVA, 35 kV	35	1,6	13,8-35,0	0,4; 6,3; 11,0	Yyn0; Yd11	ONAN	OLTC
1 MVA, 35 kV	35	1	13,8-35,0	0,4-10,5	Yyn0; Dyn11; Yd11	ONAN	OCTC
1 MVA, 35 kV	35	1	20,0; 35,0	0,4; 6,3; 11,0	Yyn0; Yd11	ONAN	OLTC
100 MVA, 34,5 kV	35	100	34,5	13,8	YNd1	ONAF	–
40 MVA, 33 kV	35	40	33	7	Dyn11	ONAF	OLTC
100 MVA, 23 kV, LV split	24	100	23	11,5 - 11,5	Dyn11-yn11	OFAF	OLTC
6,3 MVA, 20 kV	20	6,3	13,8-20,0	6,3; 11,0	Yd11	ONAN	OLTC
4 MVA, 20 kV	20	4	13,8-20,0	6,3; 11,0	Yd11	ONAN	OLTC
20 MVA, 17 kV	15	20	15,75; 17,0	6,3	Dyn11	ONAF	OLTC
16 MVA, 16 kV	15	16	16	10,5	YNd11	ONAF	OCTC
10 MVA, 10 kV	10	10	10	6,3	Yd11	ONAN	OCTC
6,3 MVA, 10 kV	10	6,3	10,0	6,3	Yd11	ONAN	OLTC
6,3 MVA, 10 kV	10	6,3	10,0	3,15-6,3	Yd11	ONAN	OCTC
4 MVA, 10 kV	10	4	6,0; 10,0	0,4-6,3	Yd11	ONAN	OCTC
2,5 MVA, 10 kV	10	2,5	6,0; 10,0	0,4-6,3	Yd11	ONAN	OCTC
2,5 MVA, 10 kV	10	2,5	6,0; 10,0	3,15; 6,3	Yd11	ONAN	OLTC
1,6 MVA, 10 kV	10	1,6	6,0; 10,0	0,4-6,3	Yyn0; Dyn11; Yd11	ONAN	OCTC
1 MVA, 10 kV	10	1	6,0; 10,0	0,4-6,3	Yyn0; Dyn11; Yd11	ONAN	OCTC
1 MVA, 10 kV	10	1	6,0; 6,3; 10,0; 10,5	0,565	–	ONAN	OCTC
1 MVA, 10 kV	10	1	6,0; 10,0	0,4	Dyn11; Yyn0	ANAN	OCTC
1,6 MVA, 6 kV	6	1,6	6,0	0,4	Dyn11	ANAN	OCTC
1,6 MVA, 10kV	10	1,6	10,0	0,4	YNd11	ONAN	OCTC
0,63 MVA, 6 kV	6	0,63	6,0	0,4	Dyn11	ANAN	OCTC
0,4 MVA, 6 kV	6	0,4	6,0	0,4	Dyn11	ANAN	OCTC

4. Auxiliary and standby transformers

Two types of auxiliary transformers are produced by ZTR: generator transformers to be connected to the power plant generators, and standby transformers to be fed from high-voltage network.

Standby transformers provide power plant with electricity during construction period as well as during operation – in case of emergency shutoff of generators.

As a rule both types of transformers are manufactured with split windings and on-load tap changers.



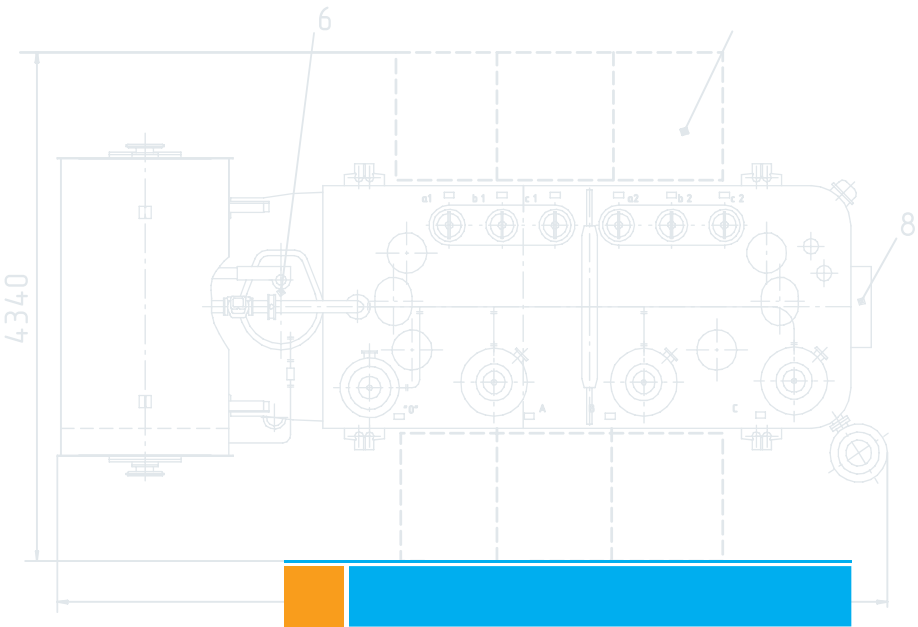


Table 4. Auxiliary and standby transformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
Three phase two-winding transformers							
63 MVA, 330 kV, LV split	330	63	330,0	6,3-11,0	YNd11d11	ONAF	OLTC
63 MVA, 220 kV, LV split	220	63	230,0	6,3-11,0	YNd11d11	ONAF	OLTC
63 MVA, 220 kV, LV split	220	63	230,0	6,3	YNyn0yn0+d	ONAF	OLTC
40 MVA, 220 kV, LV split	220	40	230,0	6,3-11,0	YNd11d11	ONAF	OLTC
32 MVA, 220 kV, LV split	220	32	230	6,3	YNd11-d11	ONAF	OLTC
25 MVA, 220 kV, LV split	220	25	230	6,3-6,3	YNd11-d11	ONAF	OLTC
25 MVA, 110 kV, LV split	110	25	115	6,3 - 6,3	YNd11-d11	ONAF	OLTC
16 MVA, 110 kV	110	16	115	6,3	YNd11	ONAF	OLTC
63 MVA, 35 kV, LV split	35	63	20,0-36,75	6,3; 10,5	YNd11d11; Dd0d0	ONAF	OLTC
40 MVA, 35 kV, LV split	35	40	15,75-36,75	6,3; 10,5	YNd11d11; Dd0d0	ONAF	OLTC
40 MVA, 35 kV, LV split	35	40	20,0	6,3	Dd0d0	ONAF	OCTC
32 MVA, 35 kV, LV split	35	32	15,75-36,75	6,3; 10,5	YNd11d11; Dd0d0	ONAF	OLTC
25 MVA, 35 kV, LV split	35	25	18,0; 20,0; 36,75	6,3	YNd11d11; Dd0d0	ONAF	OLTC
16 MVA, 35 kV	35	16	36,75	6,3; 10,5	YNd11	ONAF	OLTC
10 MVA, 35 kV	35	10	36,75	6,3	YNd11	ONAF	OLTC
80 MVA, 24 kV, LV split	24	80	24	10,5-10,5	YNd11-d11; Dd0-d0	ONAF	OLTC
32 MVA, 20 kV	20	32	20; 15,75	6,3-6,3	Dd0-do	ONAF	OLTC
16 MVA 20 kV	20	16	10,5	6,3	YNd11	ONAF	OLTC
16 MVA, 20 kV	20	16	10,5-18,0	6,3; 10,5	YNy0; Dd0	ONAF	OLTC
25 MVA, 15 kV	15	25	15,0	6,3	Dyn11	ONAF	OLTC
25 MVA, 15 kV, LV split	15	25	10,5; 15,75	6,3	Dd0d0	ONAF	OLTC

5. Transformers for DC transmission lines and high-capacity converter substations of tie-lines

ZTR product range also includes transformers for DC transmission lines and high-capacity converter substations of tie-lines; these transformers are intended for operation together with high-power HV converters (e.g. ± 400 or ± 750 kV), to be used either for rectification of AC or for inverse operation – DC inversion. The specific feature of these transformers is ability to operate at DC high voltage effect as well as at nonsinusoidal currents.

Particular requirement to these transformers is necessity to take into consideration design features of converting substation and choose optimal way of transformers connection to HV converting bridges. ZTR equipment design simplifies this connection a lot and, at the same time, provides its high reliability.

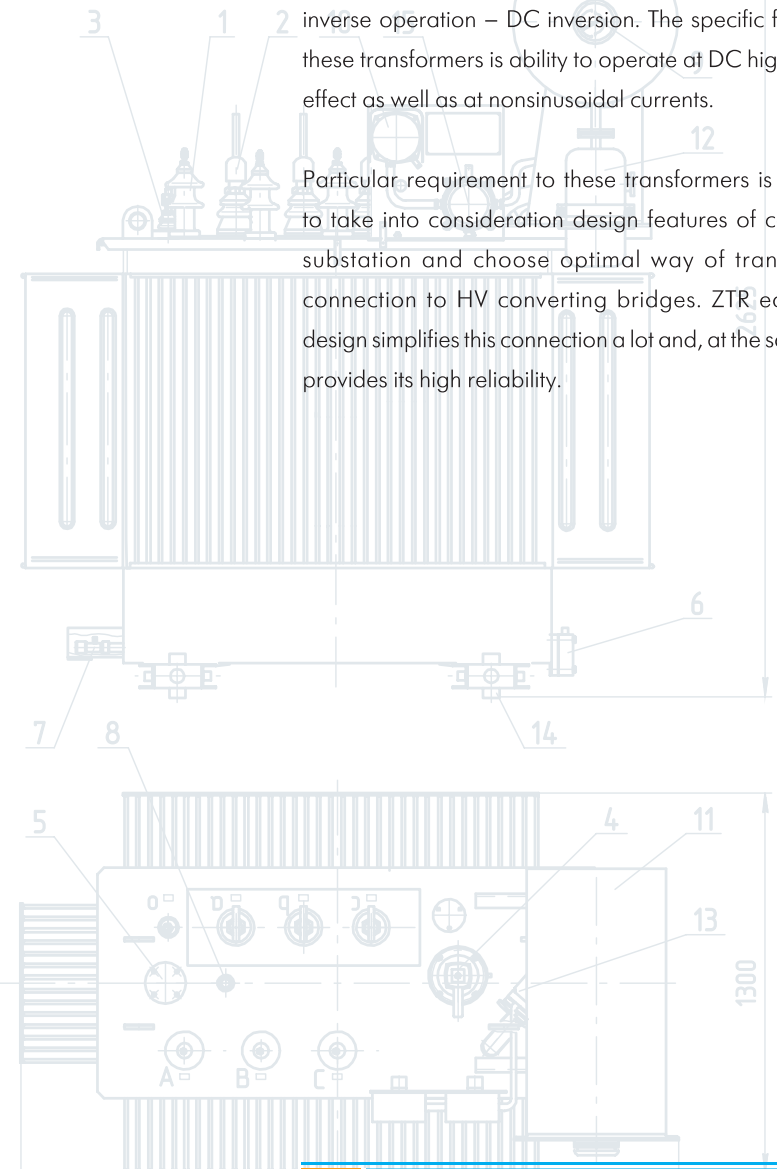


Table 5. Transformers for DC transmission lines and high-capacity converter substations of tie-lines

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
Single phase two-winding transformers							
320 MVA, ±750/500 kV	750	320	525/√3	310√3	YNy11 (in 3-phase group)	OFAF	OLTC
175 MVA, ±750/500 kV	750	175	525/√3	160√3	YNy11 (in 3-phase group)	OFAF	OLTC
320 MVA, ±400/500 kV	500	320	525/√3	310√3	YNy11 (in 3-phase group)	OFAF	OLTC
175 MVA, ±400/500 kV	500	175	525/√3	160√3	YNy11 (in 3-phase group)	OFAF	OLTC
Single phase three-winding transformers							
135 MVA, 400/220 kV	400	135	242/√3	87√3	YNd11 (in 3-phase group)	OFAF	OLTC
135 MVA, 400/110 kV	400	135	400/√3	70√3	YNy0d11 (in 3-phase group)	OFAF	–
135 MVA, 330/110 kV	330	135	330/√3	67√3	YNy0d11 (in 3-phase group)	OFAF	OLTC
Three phase two-winding transformers							
2 MVA, 10 kV	10	2	6,0; 6,3; 10,0;10,5	0,565	–	ONAN	OCTC

6. Special transformers

6.1. Transformers for metallurgical enteprises

Transformers for metallurgical enterprises manufactured by ZTR are intended for voltage decrease in the bus network 110 – 330 kV to the level of metallurgical enterprises network (normally 35 kV) which feeds the transformers to be operated directly for furnace load. The special feature of such transformers is their ability to operate in the conditions of frequent switching on/off and load impacts.

6.2. Transformers for railway substations

Transformers for railway substations manufactured by ZTR are intended for using at substations for voltage decrease in the bus network 110-500 kV to voltage level of overhead contact system (normally 27 kV or 27.5 kV). The enterprises manufactures single-phase or three-phase, two-winding or three-winding transformers of this type. Three-phase three-winding transformers have one secondary winding used for power supply of overhead contact system and another secondary winding used for local public network 6-35 kV.

6.3. Line-regulating & phase-shifting transformers

Line regulating transformers manufactured by ZTR are intended for voltage regulation in the networks 6-35 kV in such cases when required voltage level in this network could not be ensured by only existing in-built-in regulating transformers.

Table 6.1. Transformers for metallurgical enterprises

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
Three phase two-winding transformers							
160 MVA, 220 kV	220	160	230	38,5	YNd11	OFAF	OLTC
100 MVA, 220 kV, LV split	220	100	230	10,5	YNd11d11	OFAF	OCTC
100 MVA, 220 kV	220	100	230	38,5	YNd11	ONAF	OLTC
100 MVA, 220 kV	220	100	230	38,5	YNd11	OFAF	OLTC
100 MVA, 220 kV, LV split	220	100	230	10,5	YNd11d11	OFAF	OLTC
160 MVA, 110 kV	110	160	115	35,0	YNd11	OFAF	OLTC
80 MVA, 110 kV	110	80	115	35,0	YNd11	OFAF	OLTC
80 MVA, 110 kV, LV split	110	80	115	10,5	YNd11d11	OFAF	OLTC
80 MVA, 110 kV, LV split	110	80	115	11,0 - 11,0	YNd11-d11	ONAF	OLTC
63 MVA, 110 kV, LV split	110	63	115	11,0 - 11,0	YNd11-d11	ONAF	OLTC

Table 6.2. Transformers for railway substations

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV			Vector group	Cooling	Tap Changer
			HV	MV	LV			
Single phase three-winding railway transformers								
25 MVA, 110 kV, LV split	110	25	115	11,0	27,5	1/1/1-1-0-0	ONAF	OLTC
Three phase three-winding railway transformers								
40 MVA, 150 kV	150	40	158	38,5	27,5	YNyn0d11	ONAF	OLTC(HV), OCTC(MV)
40 MVA, 110 kV	110	40	115	27,5; 38,5	6,6; 27,5	YNyn0d11; YNd11d11	ONAF	OLTC(HV), OCTC (MV - 38,5кV)
25 MVA, 110 kV	110	25	115	27,5; 38,5	6,6; 27,5	YNyn0d11; YNd11d11	ONAF	OLTC(HV), OCTC (MV - 38,5кV)

Table 6.3. Line-regulating & phase-shifting transformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV		Cooling	Tap Changer
			HV	LV		
Three phase line-regulating transformers						
63 MVA, 35 kV	35	63	38,5	38,5	ONAF	OLTC
63 MVA, 10 kV	10	63	11,0	11,0	ONAF	OLTC
40 MVA, 10	10	40	11,0	11,0	ONAF	OLTC
16000 MVA, 10 kV	10	16	11,0	11,0	ONAN	OLTC
Three phase phase-shifting line-regulating transformers						
400 MVA, 220 kV	220	400	–	–	OFAF	OLTC
16 MVA, 6 kV	6	16	7	7	ONAN	OLTC

6.4. Furnace transformers

Furnace transformers manufactured at «ZTR» are purposed for power supply of the furnaces of different application and design.

The characteristics of these transformers are:

- combination of relatively low secondary voltages (near several hundred volts) and large secondary currents (up to 100 kA);
- the wide range of change of secondary voltages (with a ratio of 3:1 or more);
- Increased switching frequency of OLTCs (tens and hundreds of times a day);
- sharply irregular load curve, accompanied by frequent operational faults (in particular - for electric arc furnace transformers), which entails increased requirements for structural stability of transformers to mechanical impact.

6.5. Mine transformers

Mine transformers manufactured by ZTR are intended for power supply to fixed coal mines and designed for the long-term operation in outdoor electric installations.

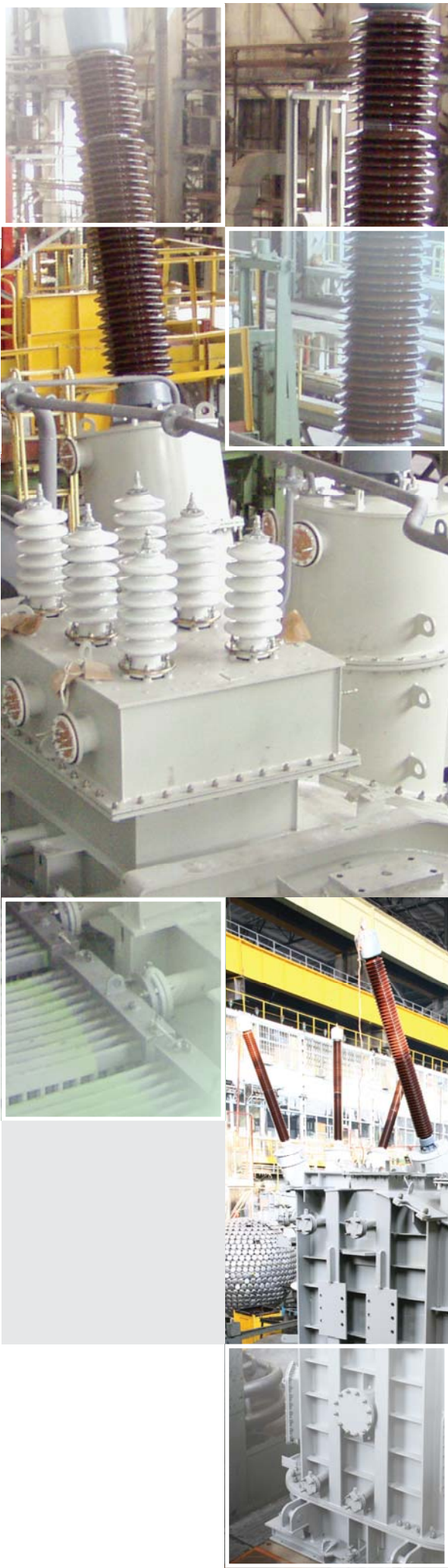


Table 6.4. Furnace transformers

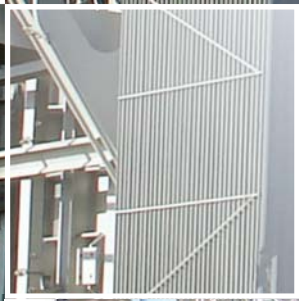
Description	Voltage,kV	Rated capacity, MVA	Rated voltage, kV		Vector group	Cooling	Tap Changer
			HV	LV			
Single phase two-winding transformers							
40 MVA, 150 kV	150	21000	154 / √3	0,141-0,24	1 / 1 - 0	OFAF	OLTC
20 MVA, 35 kV	35	20000	35	0,206-0,6	1 / 1 - 0	OFWF	OLTC
45 MVA, 34,5 kV	34,5	45000	34,5	0,85-2,4	1 / 1 - 0	OFWF	OLTC
9 MVA, 13,8 kV	15	9000	13,8	0,098-0,276	1 / 1 - 0	OFWF	OLTC
16 MVA, 10 kV	10	9200	10	0,088-0,224	1 / 1 - 0	OFWF	OLTC
12,5 MVA, 10 kV	10	9200	10	0,124-0,204	1 / 1 - 0	OFWF	OLTC
16 MVA, 10 kV	10	8500	10	0,11-0,408	1 / 1 - 0	OFAF	OLTC
Three phase two-winding transformers							
160 MVA, 110 kV	110	78000	110	0,075-0,347	Yyn0d11	OFWF	OLTC

Table 6.5. Mine transformers

Description	Voltage, kV	Rated capacity, MVA	Rated voltage, kV			Vector group	Cooling	Tap Changer
			HV	MV	LV			
Three phase three-winding transformers								
40 MVA, 110 kV	110	40	115	6,3	6,6	YNd11d11	ONAF	OLTC(HV)
25 MVA, 110 kV	110	25	115	6,3	6,6	YNd11d11	ONAF	OLTC(HV)
16 MVA, 110 kV	110	16	115	6,3	6,6	YNd11d11	ONAF	OLTC(HV)
10 MVA, 110 kV	110	10	115	6,3	6,6	YNd11d11	ONAF	OLTC(HV)
10 MVA, 35 kV	35	10	36,75	6,3	6,6	YNd11d11	ONAF	OLTC(HV)
Three phase two-winding transformers								
6,3 MVA, 10 kV	10	6,3	6,0	–	6,3	Dd0	ONAN	OCTC
4 MVA, 10 kV	10	4	6,0	–	6,3	Yd11	ONAN	OCTC
2,5 MVA, 10 kV	10	2,5	6,0	–	6,3	Yd11	ONAN	OCTC

II. ELECTRICAL REACTORS

1. Shunt reactors



Shunt reactors manufactured by ZTR are intended for reactive power compensation in the transmission lines rated for voltage 35-800 kV.

Reactors allow increasing transfer capability of the transmission line, reducing electric power losses at its transformation, improving quality of electric power supplied to users. Basic model of shunt reactors has been elaborated considering experience of reactors operated in the power networks within 35 years.

Design with core-type magnetic system with air-gaps core was chosen as a basic model being the most reliable, economical and in compliance with requirements.

Table 7. Shunt reactors

Description	Voltage, kV	Rated capacity, MVA	Rated voltage HV, kV	Current, A	Impedance, Ohm	Vector group	Cooling	Tap Changer
Single phase reactors								
110 MVAr, 765 kV	750	110	765/√3	249,1	1773,4	YN	ONAN	–
80 MVAr, 765 kV	750	80	765/√3	181,1	2438,4	YN	ONAN	–
110 MVAr, 750 kV	750	110	787/√3	242	1877	–	ONAN	–
110 MVAr, 500 kV	500	110	550	346	917	–	ONAN	–
60 MVAr, 500 kV	500	60	525	198	1 531	–	ONAF	–
60 MVAr, 500 kV	500	60	525/√3	198	1531	–	ONAN	–
550 MVAr, 400 kV	400	55	420/√3	227	1069	–	ONAN	–
11 MVAr, 220 kV	220	11	252	76	192	–	ONAN	–
16 MVAr, 35 kV	35	26,667	420/√3	110	2205	–	ONAN	–
Three phase reactors								
128 MVAr, 550 kV	550	128	550	134	2363	YN	ONAN	–
65 MVAr, 550 kV	550	65	550	68	4654	YN	ONAN	–
60 MVAr, 550 kV	550	60	550	63	5042	YN	ONAN	–
100 MVAr, 400 kV	400	100	400	144	1600	YN	OFAF	–
50 MVAr, 400 kV	400	50	400	72	3200	YN	ONAN	–
45 MVAr, 400 kV	400	45	400	65	3556	YN	ONAN	OCTC (400±2x2,5)
100 MVAr, 330 kV	330	100	362	175	1 089	–	ONAB	–
60 MVAr, 330 kV	330	60	362	105	1 815	–	ONAN	–
25 MVAr, 230 kV	230	25	230	63	2116	YN	ONAN	–
75 MVAr, 220 kV	220	75	242	179	781	–	ONAF	–
50 MVAr, 220 kV	220	50	242	131	968	–	ONAN	–
25 MVAr, 220 kV	220	20	230	62,8	2116	YN	ONAN	–
10 MVAr, 220kV	220	10	230	25,1	5290	YN	ONAN	–
50 MVA,r 110 kV	110	50	110	262	242	YN	ONAN	–
20 MVAr, 35 kV	35	20	38,5	300	74	YN	ONAF	–
20 MVAr, 35 kV	35	20	38,5	300	74	YN	ONAN	–
25 MVAr, 20 kV	20	25	20	722	16	YN	ONAN	–

2. Neutral reactors

Neutral reactors manufactured by ZTR are intended for current limiting to the earth in case of breakdown in the transmission line. As a rule, such reactors have no magnetic system, are equipped with electromagnetic shields arranged outside and on the end surfaces of winding. Winding insulation is of oil-barrier type. Cooling system is ONAN.

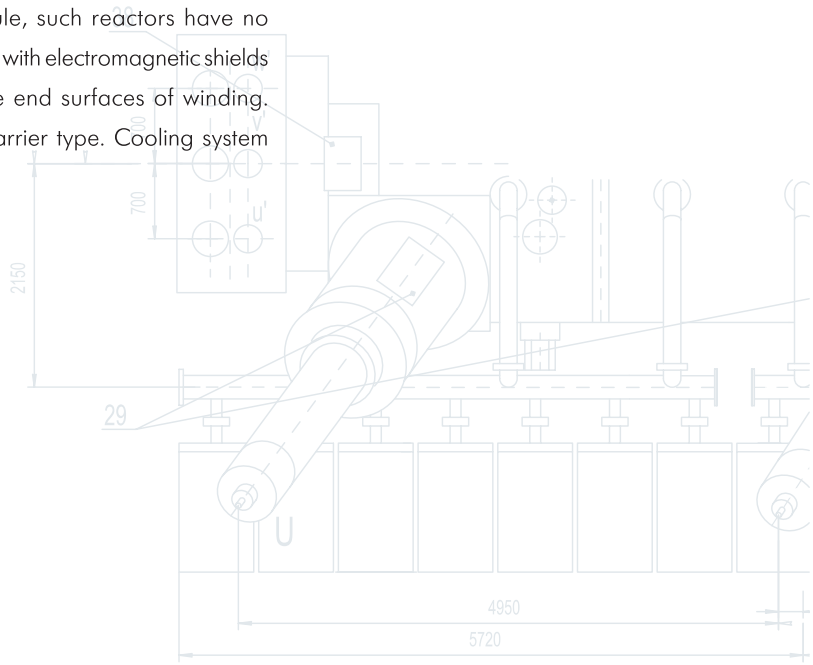


Table 8. Neutral reactors

Description	Voltage, kV	Rated capacity, MVA	Rated voltage HV, kV	Current, A	Impedance, Ohm	Cooling	Tap Changer
Earthing current-limiting reactors							
16 MVAr, 35 kV	35	16	3	20	150	ONAN	–
0,27 MVAr, 35 kV	35	0,270	35/√3	30	300	ONAN	OCTC (300±4x30)
0,51 MVAr, 26 kV	26	0,510	25,6	19 922	1 285	ONAN	–

III. CONTROLLABLE SHUNT REACTORS

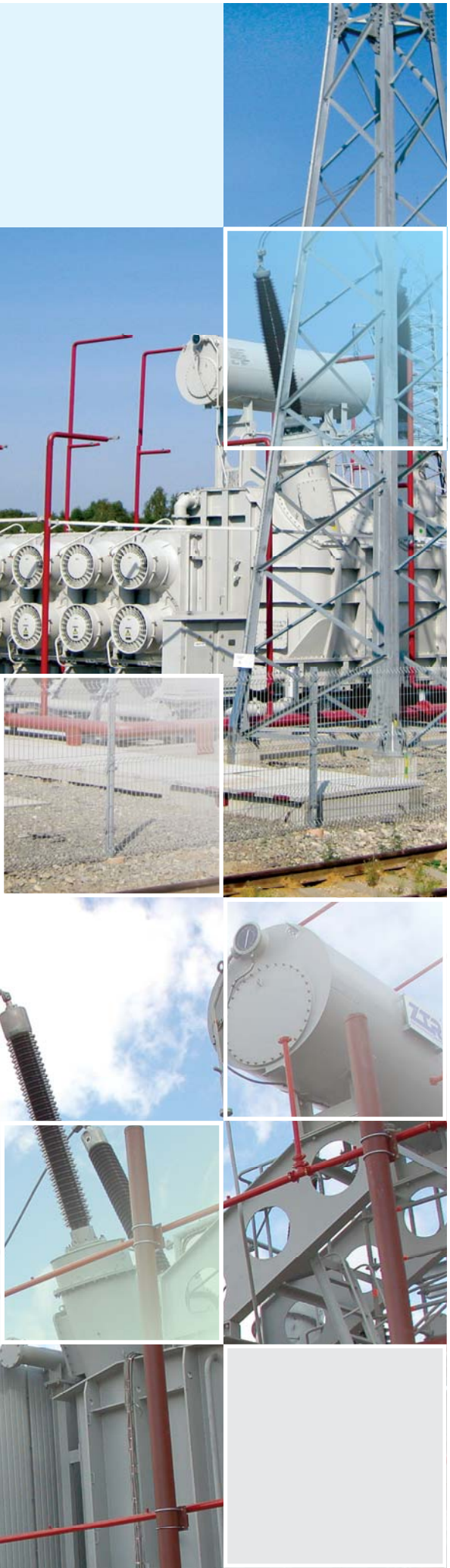
Controllable shunt reactor is a new type of FACTS (Flexible AC Transmission Systems) devices. It is a shunt-type static device with stepless regulation of inductive reactance. Controllable shunt reactors manufactured by ZTR are intended for automatic control over reactive power flows and stabilization of voltage levels that ensure the following:

• Elimination of daily and seasonal voltage oscillations in the electric network.

• Improvement of electric energy quality.

• Optimization and automation of the power network operating modes.

• Decrease losses of electric energy during power transmission and distribution.



• Improvement of operational conditions of electric equipment due to rapid step-down of switchings of non-regulated devices of reactive power compensation.

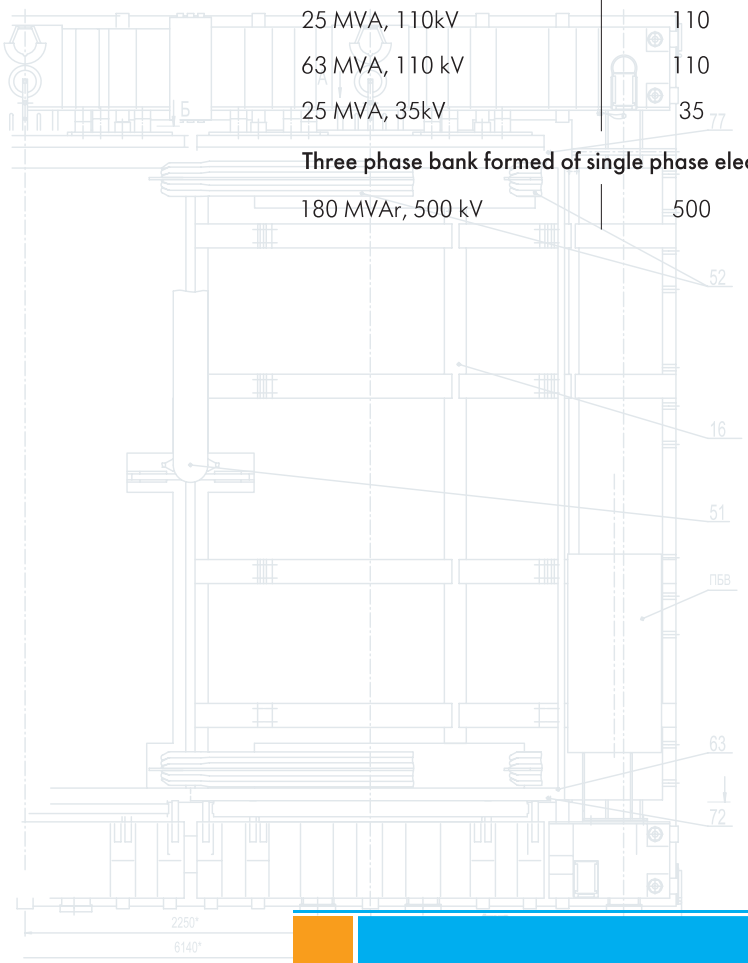
• Increasing transfer capability of transmission lines and ensuring reliable automatic voltage control over voltage levels at power flows which are close to static stability limits.

• Elimination of voltage collapses in case of emergency conditions in the electric network (e.g., emergency power-cut, shutdown of generator, line outages, etc.).

• Providing operation conditions for power plant generators in such reactive power generation range which facilitates the most favorable operational duties.

Table 10. Controllable shunt reactors

Description	Voltage, kV	Rated capacity, MVA	Rated voltage HV, kV	Current, A	Cooling
Three phase bank formed of three phase electromagnetic unit reactors					
180 MVA, 500 kV	500	180	525	198	ONAF
100 MVAr, 400 kV	400	100	420	138	ONAF
180 MVA, 330 kV	330	180	347	300	OFAF/ONAF
100 MVA, 220 kV	220	100	242	239	ONAF
63 MVAr, 220 kV	220	63	242	150	ONAF
60 MVAr, 500 kV	220	60	242	143	ONAF
25 MVA, 220kV	220	25	242	60	ONAF
25 MVA, 110kV	110	25	121	119	ONAF
63 MVA, 110 kV	110	63	121	300	ONAF
25 MVA, 35kV	35	25	38,5	375	ONAF
Three phase bank formed of single phase electromagnetic units reactors					
180 MVAr, 500 kV	500	180	525	198	ONAF



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