

## REFERENCE LIST

**Experience of the Nova Industrial specialists referring to the elaboration of specifically procedures, technical assistance and coordination of the workings for on-site refurbishing of large power transformers and shunt reactors**

**CUSTOMER: CNTEE TRANSELECTRICA SA - Bucuresti Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 104951/1982	400 kV Domnesti Substation	1990	14,34	600
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 119547/1986	400 kV Gura Ialomitei Substation	1993	12,03	700
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 99821/1979	400 kV Pelicanu Substation	1994	11,075	650
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 106796/1982	400 kV Pelicanu Substation	1994	11,48	700
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 119548/1986	400 kV Domnesti Substation	1996	39,11	2200
Autotransformer, Main Unit, 400/400/160 MVA 400/231/22 kV, No. 113082/1983	400 kV Bucuresti Sud Substation	2001	32,14	558
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 105791/1981	220 kV Teleajen Substation	1993	18,565	760
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 93200/1973	220 kV Ghizdaru Substation	1996	51,02	1200
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 22286/1968	220 kV Brazi Vest Substation	1997	21,895	1200
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 74396/1970	220 kV Fundeni Substation	1997	59,760	1850
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 83913/1972	220 kV Fundeni Substation	1998	41,275	1450

Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 95731/1986	220 kV Turnu Magurele Substation	2000	21,970	1950
Autotransformer 200/200/60 MVA 225/123±8x1,66%/10,5 kV No. 109260/1983	220 kV Fundeni Substation	2001	23,770	720

**CUSTOMER: CNTEE TRANSELECTRICA SA - Bacau Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 101393/1979	400 kV Gutinas Substation	1996	34,21	1600
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 57424/1967	220 kV Focsani Substation	1996	50,60	2450
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 114785/1984	220 kV Munteni Substation	1996	35,36	2600

**CUSTOMER: CNTEE TRANSELECTRICA SA - Cluj Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 114543/1985	400 kV Cluj Est Substation	1996	19,265	2600
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 96340/1975	220 kV Floresti Substation	1993	89,5	1715
Autotransformer 100/100/30 MVA 231 ± 12x1,25%/121/10,5 kV No. 76421/1971	220 kV Tihau Substation	1993	47,73	1400
Autotransformer 100/100/30 MVA 231 ± 12x1,25%/121/10,5 kV No. 101717/1980	220 kV Vetis Substation	1996	50,60	2450

**CUSTOMER: CNTEE TRANSELECTRICA SA - Constanta Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 101717/1980	400 kV Tulcea Vest Substation	1991	11,35	680
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 104951/1981	400 kV Tulcea Vest Substation	1992	13,78	650
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 104127/1981	400 kV Tulcea Vest Substation	1992	15,6	1000
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 102769/1981	400 kV Constanta Nord Substation	1992	8,19	650
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 101932/1980	400 kV Smardan Substation	1995	14,31	1300
Transformer 250/250/80 MVA 400±8x1.56%/121/20kV No. 99882/1979	400 kV Smardan Substation	1995	18,96	2250
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 95430/1974	220 kV Filesti Substation	1996	24,39	1460
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 93199/1973	220 kV Lacul Sarat Substation	1997	78,545	2070

**CUSTOMER: CNTEE TRANSELECTRICA SA - Craiova Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Autotransformer, Main Unit, 133/133/53 MVA, 400/√3/231/√3/22 kV, No. 80522/1970	400 kV Portile de Fier Substation	1993	2,68	1400
Autotransformer, Main Unit, 133/133/53 MVA, 400/√3/231/√3/22 kV, No. 80523/1970	400 kV Portile de Fier Substation	1993	4,345	700

Autotransformer, Main Unit, 133/133/53 MVA, 400/ $\sqrt{3}$ /231/ $\sqrt{3}$ /22 kV No. 79566/1970	400 kV Portile de Fier Substation	1993	4,15	1400
Regulating special transformer 40,5 MVA $\pm 10 \times 2,985/22$ kV No. 985657/1970	400 kV Portile de Fier Substation	1993	It was not measured	Specifically drying process; the transformer tank do not resist to high vacuum
Autotransformer, Main Unit, 133/133/53 MVA, 400/ $\sqrt{3}$ /231/ $\sqrt{3}$ /22 kV, No. 79565/1970	400 kV Portile de Fier Substation	1994	9,42	420
Autotransformer, Main Unit, 133/133/53 MVA, 400/ $\sqrt{3}$ /231/ $\sqrt{3}$ /22 kV, No. 78698/1970	400 kV Portile de Fier Substation	1994	7,13	510
Autotransformer, Main Unit, 133/133/53 MVA, 400/ $\sqrt{3}$ /231/ $\sqrt{3}$ /22 kV, No. 80524/1970	400 kV Portile de Fier Substation	1994	5,875	400
Autotransformer, Main Unit, 133/133/53 MVA 400/ $\sqrt{3}$ /231/ $\sqrt{3}$ /22 kV, No. 78697/1970	400 kV Portile de Fier Substation	1995	9,865	200
Regulating special transformer 40,5 MVA $\pm 10 \times 2,985/22$ kV No. 985656/1970	400 kV Portile de Fier Substation	1995	20,85	Specifically drying process; the transformer tank do not resist to high vacuum
Autotransformer 200/200/60 MVA 231 $\pm 12 \times 1,25\%/121/10,5$ kV No. 101716/1980	220 kV Calafat Substation	1993	21,86	1200
Autotransformer 200/200/60 MVA 231 $\pm 12 \times 1,25\%/121/10,5$ kV No. 50483/1976	220 kV Urechesti Substation	1993	67,7	1700
Autotransformer 200/200/60 MVA 231 $\pm 12 \times 1,25\%/121/10,5$ kV No. 97062/1977	220 kV Cetate Substation	1996	58,08	2100
Shunt reactor 20 MVAr 25/ $\sqrt{3}$ kV No. 995656/71	400 kV Portile de Fier Substation	1994	3,65	Specifically drying process; the reactor tank do not resist to high vacuum
Shunt reactor 20 MVAr 25/ $\sqrt{3}$ kV No. 995655/71	400 kV Portile de Fier Substation	1994	3,53	Specifically drying process; the reactor tank do not resist to high vacuum
Shunt reactor 20 MVAr 25/ $\sqrt{3}$ kV No. 995658/71	400 kV Portile de Fier Substation	1994	4,81	Specifically drying process; the reactor tank do not resist to high vacuum
Shunt reactor 20 MVAr 25/ $\sqrt{3}$ kV No. 995666/71	400 kV Portile de Fier Substation	1994	3,81	Specifically drying process; the reactor tank do not resist to high vacuum
Shunt reactor 20 MVAr 25/ $\sqrt{3}$ kV No. 995668/71	400 kV Portile de Fier Substation	1994	1,555	Specifically drying process; the reactor tank do not resist to high vacuum
Shunt reactor 20 MVAr 25/ $\sqrt{3}$ kV No. 995669/71	400 kV Portile de Fier Substation	1994	5,73	Specifically drying process; the reactor tank do not resist to high vacuum

**CUSTOMER: CNTEE TRANSELECTRICA SA - Pitesti Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Autotransformer, Main Unit, 400/400/160 MVA 400/231/22 kV, No. 82213/1980	400 kV Slatina Substation	1994	7,5	1200
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 101715/1980	220 kV Gradiste Substation	1992	67,695	2032
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 52701/1967	220 kV Aref Substation	1997	37,34	1550
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 69013/1969	220 kV Pitesti Sud Substation	2003	25,95	1990

**CUSTOMER: CNTEE TRANSELECTRICA SA - Sibiu Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Transformer 250/250/80 MVA 400±8x1.56%/121/20 kV No. 107781/1983	400 kV Darste Substation	1992	59,25	1280
Transformer 250/250/80 MVA 400±8x1.56%/121/20 kV No. 107782/1983	400 kV Brasov Substation	1996	25,82	1900
Transformer 250/250/80 MVA 400±8x1.56%/121/20 kV No. 114542/1985	400 kV Brasov Substation	2001	32,62	1400
Autotransformer Main Unit 400/400/160 MVA 400/231/22 kV, No. 88152/1980	400 kV Sibiu Sud Substation	1994	13,49	1100
Regulating special transformer (a+t) 400/60 MVA ± [12 x 34,65/12] / 22 kV No. 95701/74	400 kV Sibiu Sud Substation	2003	26,992	950

Regulating special transformer (a+t) 400/60 MVA $\pm [12 \times 34,65/12] / 22\text{kV}$ No. 85766/72	400 kV Sibiu Sud Substation	2003	17,473	343
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 97061/1976	220 kV Alba Iulia Substation	1997	37,745	950
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 95431/1974	400 kV Sibiu Sud Substation	1997	37,48	984
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 41666/1965	400 kV Sibiu Sud Substation	1999	54,4	2400
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 106794/1982	220 kV Alba Iulia Substation	2000	37,03	1500
Autotransformer 66,6/66,6/21 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 1173722/1966	400 kV Iernut Substation	2003	36,635	357,915

**CUSTOMER: CNTEE TRANSELECTRICA SA - Timisoara Subsidiary**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 65999/1969	220 kV Timisoara Substation	1994	27,28	1700
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 88554/1973	220 kV Timisoara Substation	1995	19,05	2400
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 95385/1974	220 kV Arad Substation	1996	44,32	2100
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 71903/1970	220 kV Resita Substation	1997	47,0	1530
Autotransformer 200/200/60 MVA $231 \pm 12 \times 1,25\% / 121/10,5 \text{ kV}$ No. 95730/1974	220 kV Resita Substation	1997	55,11	1250

**CUSTOMER: SC TERMOELECTRICA SA – Borzesti Thermoelectric Power Plant**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Step-up Transformer 250 MVA 242/15,75 kV No. 675455/1970	Borzesti	1997	22,165	900

**CUSTOMER: SC TERMOELECTRICA SA – Brazi Thermoelectric Power Plant**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Step-up Transformer 240 MVA 242/15,75 kV No. 933529/1972 (drying after on-site reparing - it has changed a failed winding )	Brazi	1992	393,58	It was not measured
Step-up Transformer 160 MVA 116/10,5 kV No. 94660/1973	Brazi	1994	30,28	900
Step-up Transformer 160 MVA 116/10,5 kV No. 88568/1973	Brazi	1996	30,22	1120

**CUSTOMER: SC TERMOELECTRICA SA – Bucuresti Vest Thermoelectric Power Plant**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Step-up Transformer 170 MVA 116/13,8kV No. 94662/1974	Bucuresti Vest	1998	16,81	950

**USTOMER: SC HIDROELECTRICA SA – Lotru Hydroelectric Power Plant**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Step-up Transformer 190 MVA 242/15,75 kV No. 94397/1975	Lotru Ciunget	1991	29,5	It was not measured

**CUSTOMER: SC HIDROELECTRICA SA – Clabucet Hydroelectric Power Plant**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Step-up Transformer 80 MVA 121/10,5 kV No. 104243/1980	Clabucet	2002	14,370	232

**CUSTOMER: SC RETRASIB SA SIBIU**

Description	Site	Year of on-site refurbishing	Total water and aged oil extracted from insulation [liters]	
			Water	Aged oil
Autotransformer Main Unit 400/400/160 MVA 400/231/22 kV, No. 95700/1974	Sibiu	1997	30,68	1450
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 59557/1968	Sibiu	1989	11,565	It was not measured
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 69013/1969	Sibiu	1994	28,50	2250
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 42145/1966	Sibiu	1995	51,43	1300
Autotransformer 200/200/60 MVA 231 ± 12x1,25%/121/10,5 kV No. 77808/1971 (drying after reparing - it has changed a failed winding )	Sibiu	1996	395,95	2100





Photo 1



Photo 2

Photo 1, 2 The insulation drying of 250/250/80 MVA  $400\pm 8 \times 1.56\%$ /121/20kV transformer no. 114542/1985, in 400 kV Brasov-Romania substation



Photo 3: The insulation drying of (a+t) 400/60 MVA  $\pm$  [12 x 34,65/12] / 22kV regulating special transformer no. 85766/72, in 400 kV Sibiu-Romania substation



Photo 4. The insulation drying of 200/200/60 MVA  $231\pm 8x1.56\%$ /121/20kV autotransformer no. 95731/1986, in 220 kV Turnu Magurele-Romania substation





Photo 5: The control of active part of 66,6/66,6/21 MVA  $231 \pm 12 \times 1,25\% / 121 / 10,5$  kV autotransformer, no. 1173722/1966, in untanking tower, before insulation drying in 400 kV Iernut-Romania substation



Foto 5 Entering of the Nova Industrial specialist inner of the 417/417/80 MVA  $750 / \sqrt{3} / 400 / \sqrt{3} / 15,75$  kV autotransformer tank, no. 128702/1986, to control and direct the activity of 525 kV failed bushing raising and its changing with a new one, in 750 kV Isaccea-Romania substation.



Foto 6 The control of 525 kV bushing raising from inner of the autotransformer tank

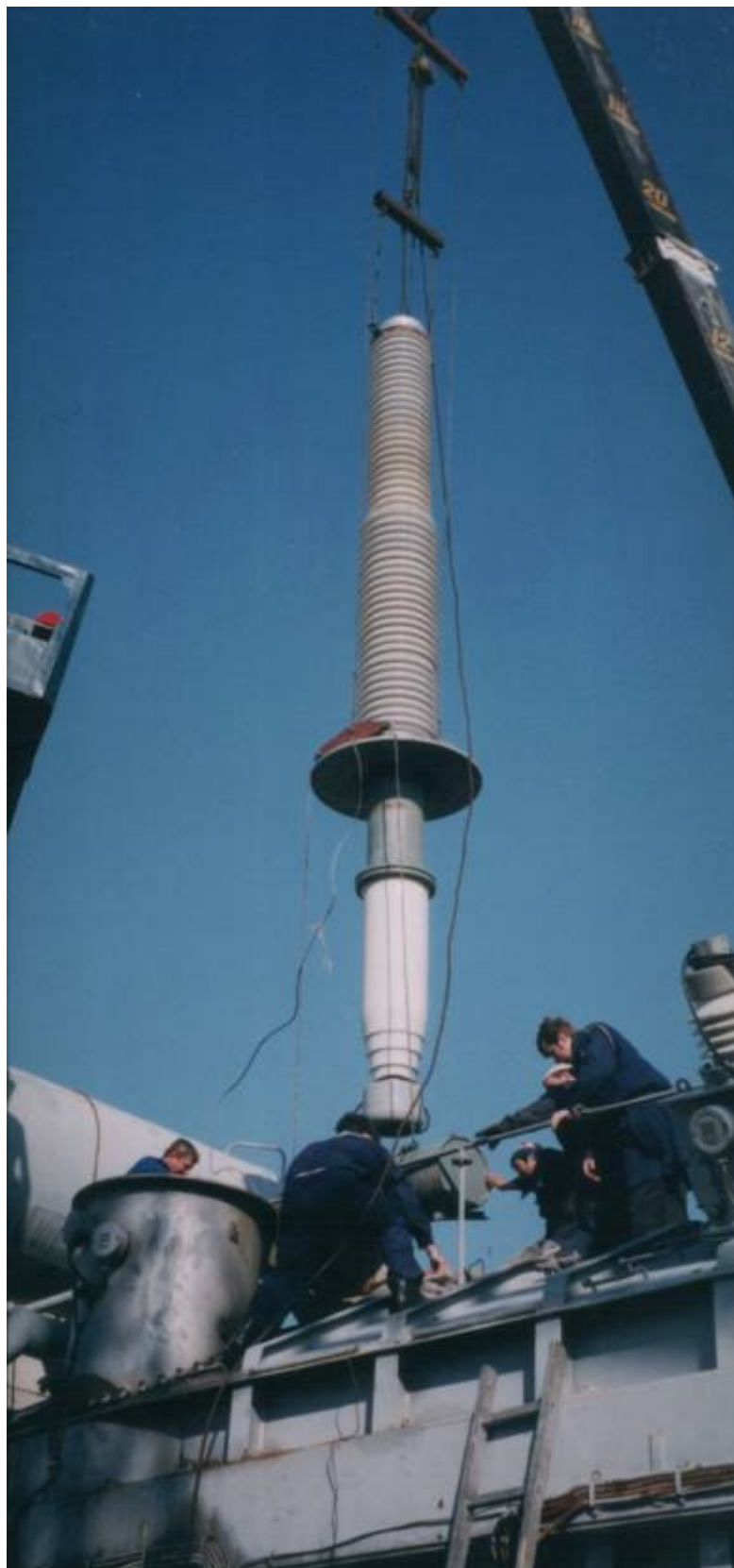


Foto 7 Changing of a 525 kV failed bushing at 417/417/80 MVA  $750/\sqrt{3}/400/\sqrt{3}/15,75$  kV autotransformer, no. 128702/1986, from 750 kV Isaccea-Romania substation