

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 |

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|---|--|------|--------|------|
| 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

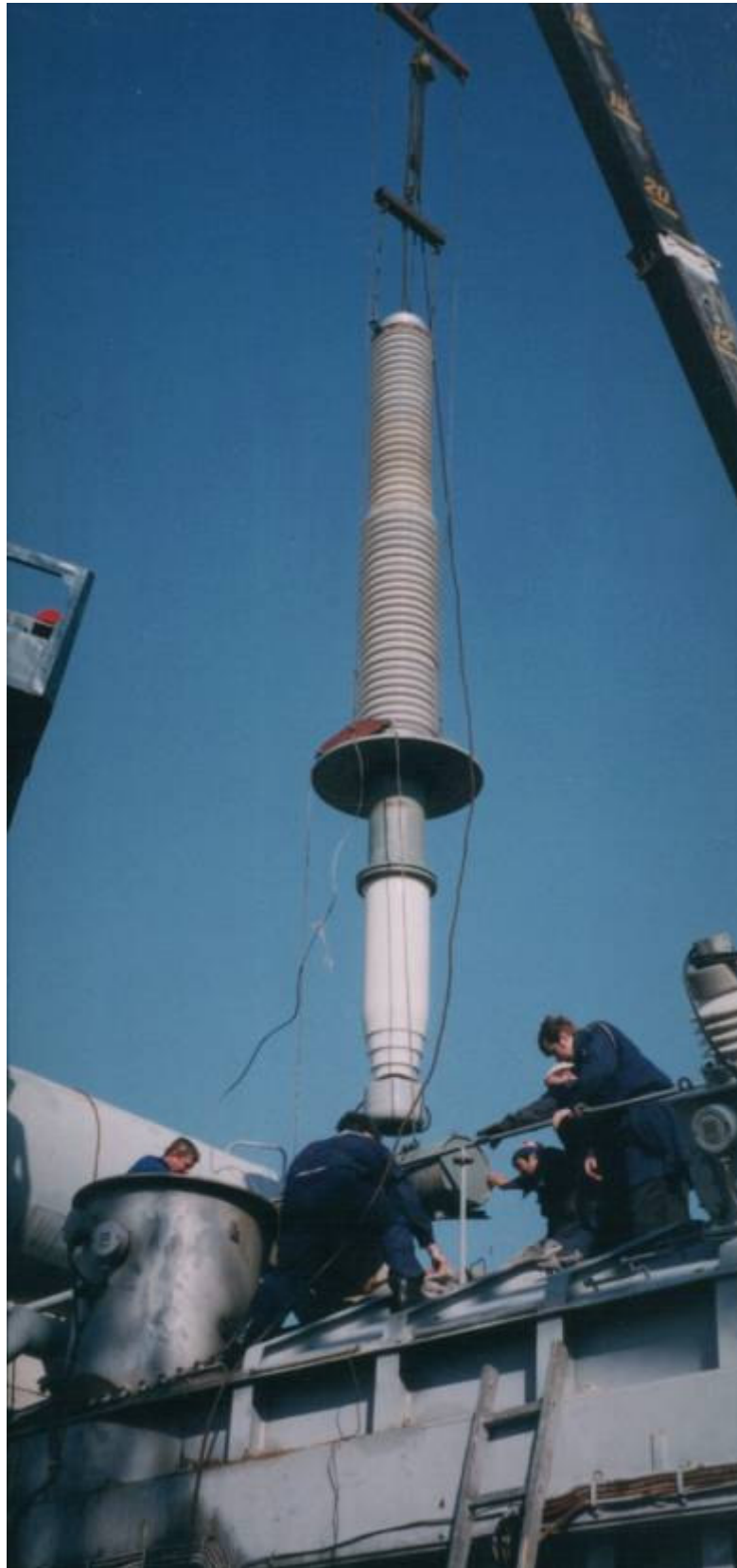


Foto 7 Changing of a 525 kV failed bushing at 417/417/80 MVA $750/\sqrt{3}/400/\sqrt{3}/15,75$ kV autotransformer, no. 128702/1986, from 750 kV Isaccea-Romania substation