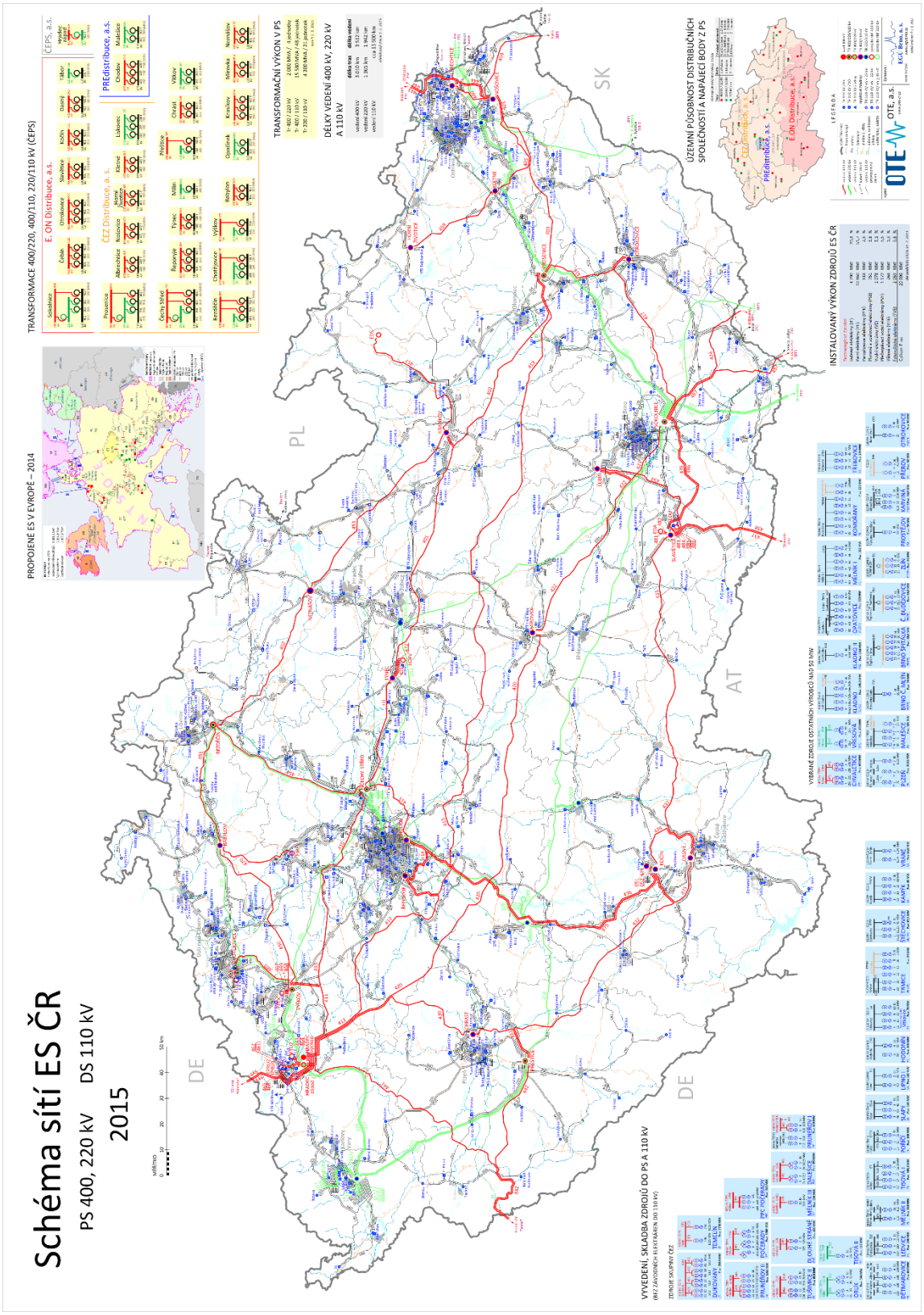
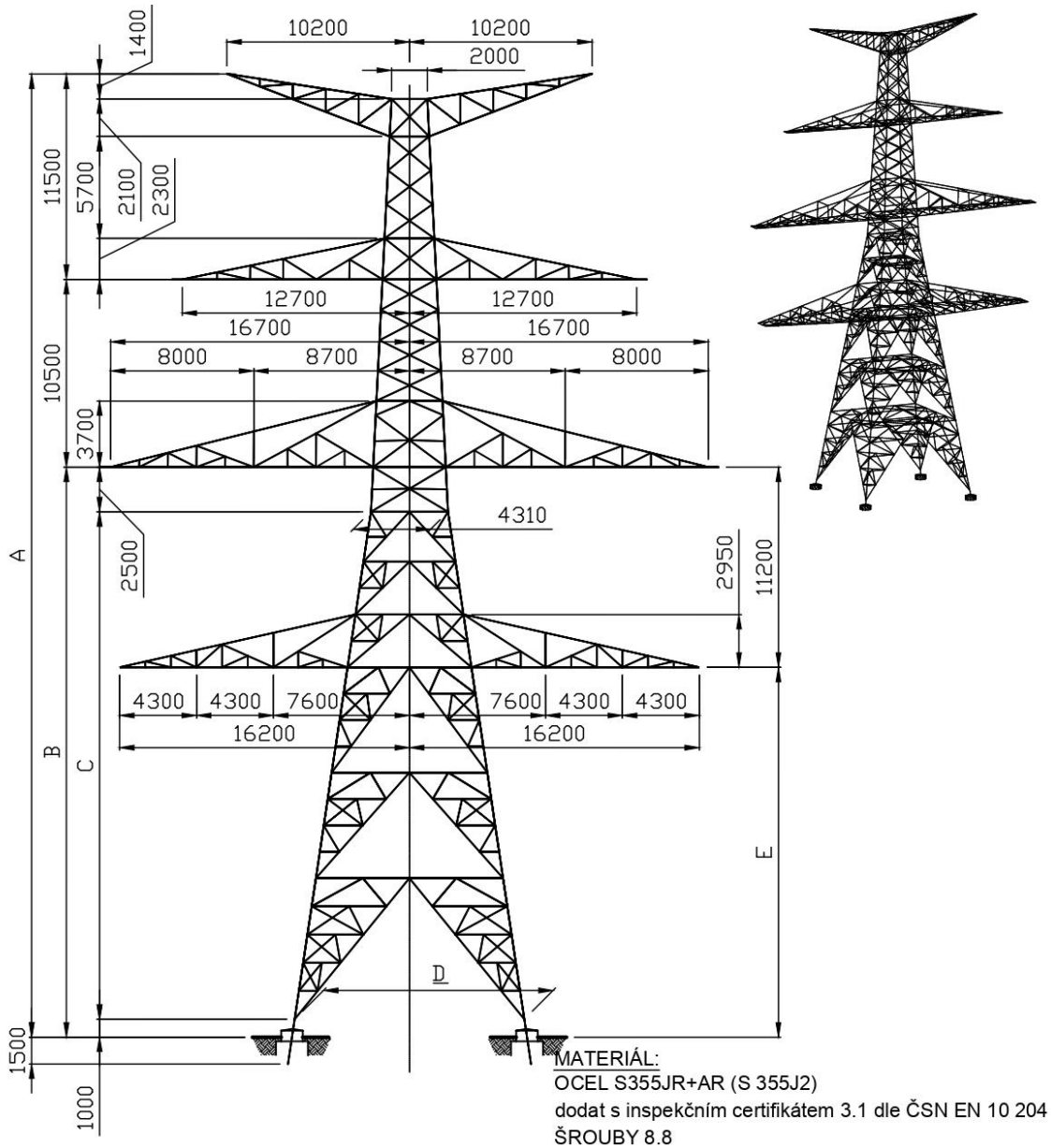
PŘÍLOHY

Příloha A– Schéma elektrizační soustavy České republiky



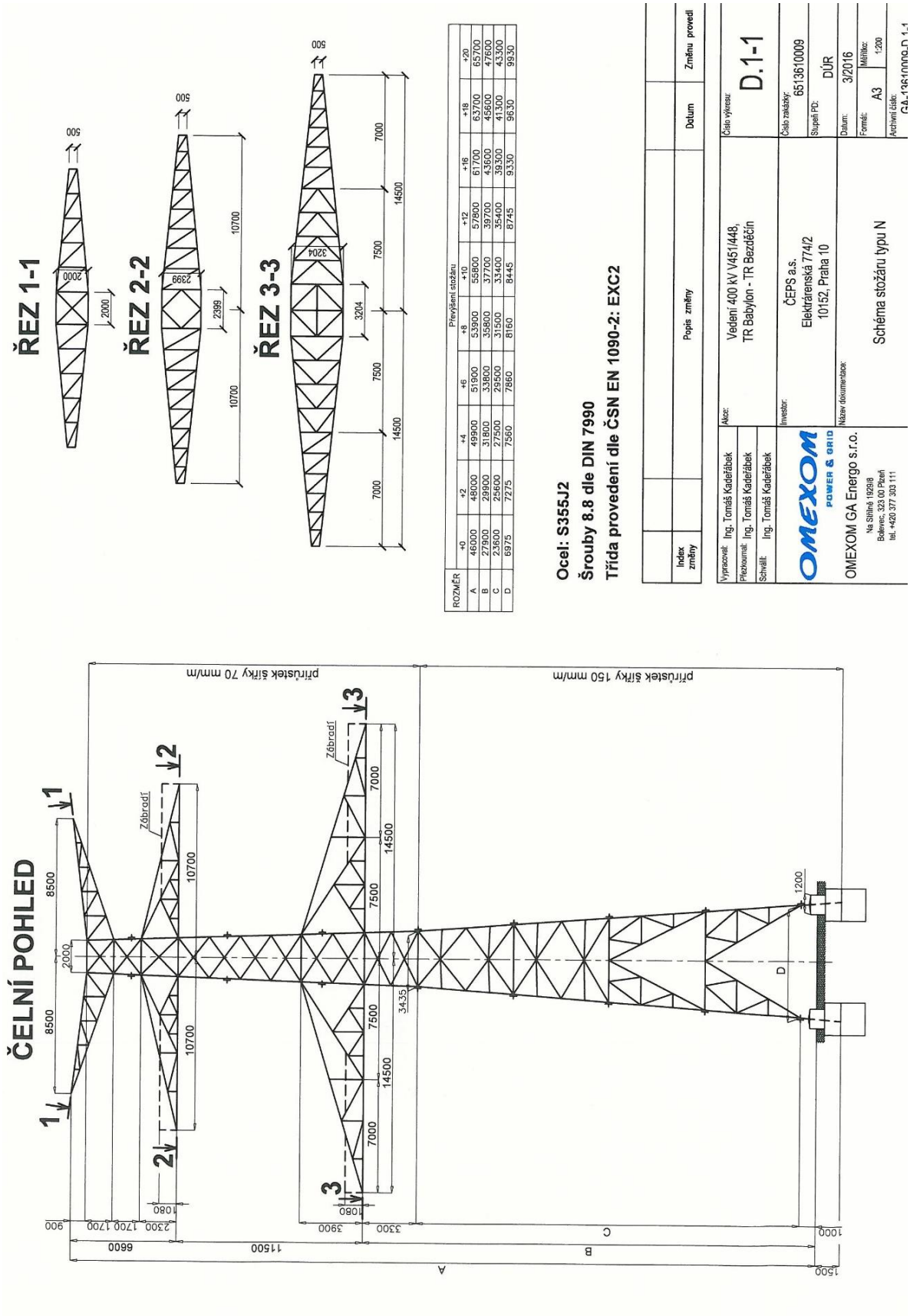
Příloha B – Hlavní rozměry stožáru 2x400 + 2x110 kV typ N – Stožár nosný [2]

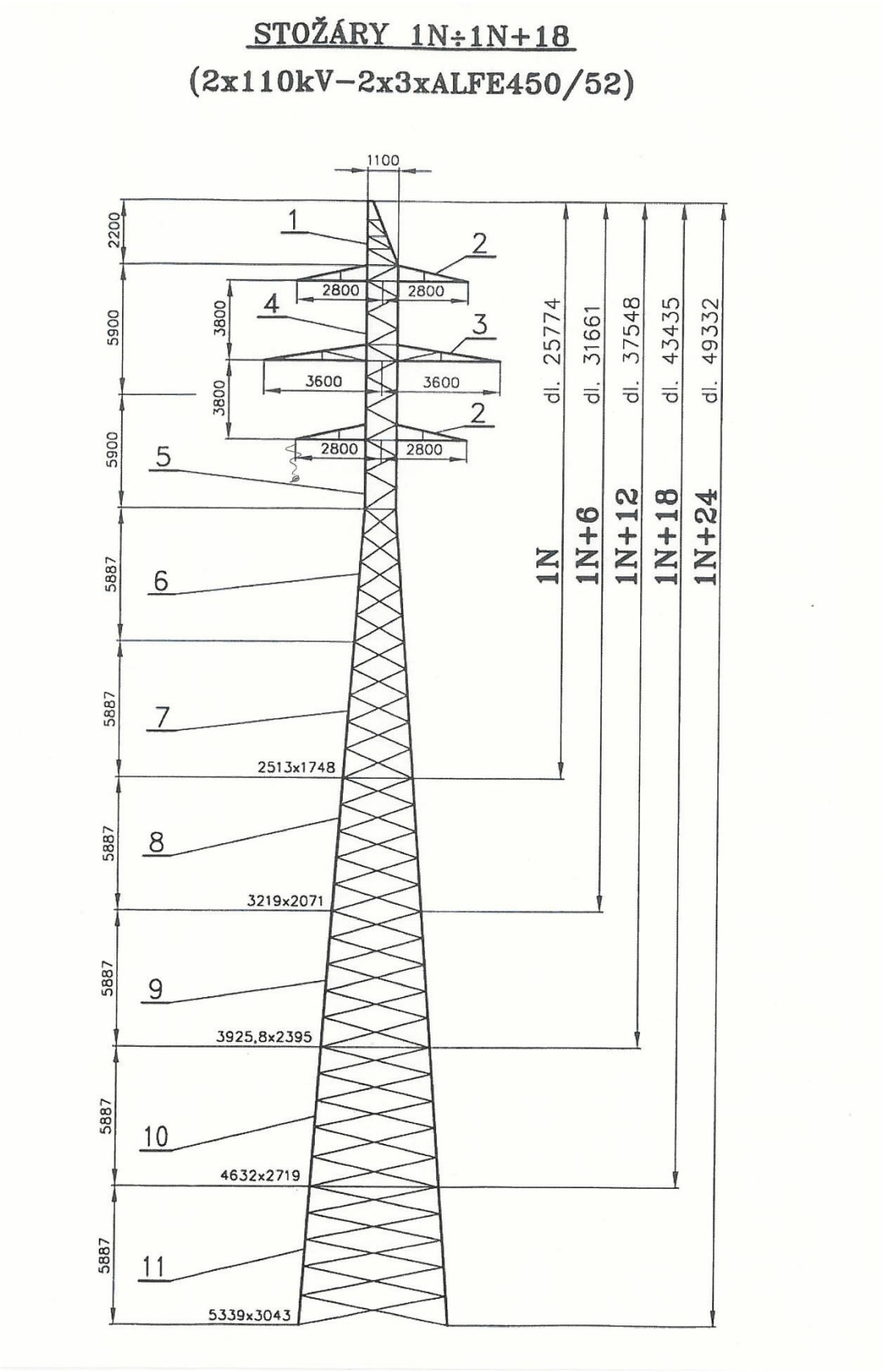


MATERIÁL:
OCEL S355JR+AR (S 355J2)
dodat s inspekčním certifikátem 3.1 dle ČSN EN 10 204
ŠROUBY 8.8

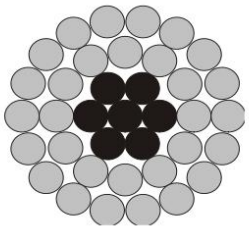
ROZMĚR (m)	PŘEVÝŠENÍ STOŽÁRU (m)						
	-2	0	+2	+4	+6	+8	+10
A	51,9	53,9	55,8	57,8	59,8	61,7	63,7
B	29,9	31,9	33,8	35,8	37,8	39,7	41,7
C	26,4	28,4	30,3	32,3	34,3	36,2	38,2
D	12,23	12,83	13,4	14	14,6	15,17	15,77
E	18,7	20,7	22,6	24,6	26,6	28,5	30,5
ZABRANÁ PLOCHA (m^2)	188,51	205,35	222,01	240,25	259,21	277,89	298,25

Příloha C – Schéma stožárů Dunaj 2 x 400 kV a Soudek 2 x 110 kV [1]




STOŽÁRY 1N÷1N+18
(2x110kV–2x3xALFE450/52)
1100
2200
5900
5900
5887
5887
5887
5887
5887
5887
3800
3800
2800
2800
3600
3600
2800
2800
1
2
3
4
5
2
6
7
8
9
10
11
2513x1748
3219x2071
3925,8x2395
4632x2719
5339x3043
dl. 25774
dl. 31661
dl. 37548
dl. 43435
dl. 49332
1N
1N+6
1N+12
1N+18
1N+24

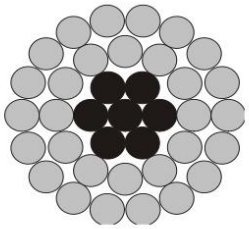
Příloha D – Katalogové listy vodičů 490-AL1/64-ST1A, 679-AL1/86-ST1A a 195-AL4/42-A20SA [2]



M 2 : 1

Typ lana:	490-AL1/64-ST1A		
Fe duše lana (core)	Materiál (Material)	(-)	ST1A
	Počet drátů a konstrukce (Number of wires and design)	(-)	1+6
	Jmenovitý průměr drátu (Nominal diameter of wire)	(mm)	3,40
	Vypočtený průměr (Calculated diametr)	(mm)	10,20
	Matematický průřez (Calculated cross section)	(mm^2)	63,55
	Vypočtená hmotnost (Calculated weight)	($kg \cdot km^{-1}$)	497,0
	Stejnosměrný el. odpor pro 20°C (DC-resistance at 20°C)	($\Omega \cdot km^{-1}$)	3,03674
Al/AA plášť (Al/AA layers)	Materiál (Material)	(-)	AL1
	Počet drátů a konstrukce (Number of wires and design)	(-)	12+18+24
	Jmenovitý průměr drátu (Nominal diameter of wire)	(mm)	3,40
	Matematický průřez (Calculated cross section)	(mm^2)	490,28
	Vypočtená hmotnost (Calculated weight)	($kg \cdot km^{-1}$)	1355,8
	Stejnosměrný el. odpor pro 20°C (DC-resistance at 20°C)	($\Omega \cdot km^{-1}$)	0,05898
Mazivo (Grease)	Mazané pouze jádro (dle EN 50182 přílohy B, obrázek B1a) - Steel core only greased (under EN 50182 Annex B, picture B1a)		
	Vypočtená hmotnost maziva (Weight of grease)	($kg \cdot km^{-1}$)	12,600
Lano (Cable)	Průměr (Total diameter)	(mm)	30,60
	Matematický průřez (Calculated cross section)	(mm^2)	553,83
	Poměr průřezů Al:Fe (Ratio of cross sections)	(-)	7,71
	Jmenovitá hmotnost bez mazadla (Nominal total weight without grease)	($kg \cdot km^{-1}$)	1852,9
	Jmenovitá hmotnost s mazadlem (Nominal total weight including grease)	($kg \cdot km^{-1}$)	1865,5
	Modul pružnosti (Module of elasticity)	(MPa)	67100
	Součinitel teplotní roztažnosti (Coefficient of thermal expansion)	$10^6 \cdot (K^{-1})$	19,4
	Měrná tíha (Specific weight)	($N \cdot m^{-1} \cdot mm^{-2}$)	0,033031
	Matematická pevnost (Rated tensile strength)	(kN)	150,81
	Stejnosměrný el. odpor pro 20°C (DC-resistance at 20°C)	($\Omega \cdot km^{-1}$)	0,05898
	Směr vinutí vnější vrstvy (Direction of outer layer coiling)	-	pravý (Z)
Balení *) (Packaging)	Průměr bubnu / šířka bubnu (Diametr of reel / Overall width of reel)	(mm)	2000 / 1300
	Dodací délka lana (Delivery length of cable)	(m)	2127

*) *běžné rozměry bubnu, použití větších bubnů, je závislé od technického vybavení dodavatele stavby*



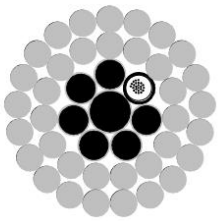
M 2 : 1

Typ lana:	679-AL1/86-ST1A		
Fe duše lana (core)	Materiál (Material)	(-)	ST1A
	Počet drátů a konstrukce (Number of wires and design)	(-)	1+6+12
	Jmenovitý průměr drátu (Nominal diameter of wire)	(mm)	2,40
	Vypočtený průměr (Calculated diametr)	(mm)	12,00
	Matematický průřez (Calculated cross section)	(mm^2)	85,95
	Vypočtená hmotnost (Calculated weight)	($kg \cdot km^{-1}$)	674,0
	Stejnosměrný el. odpor pro 20°C (DC-resistance at 20°C)	($\Omega \cdot km^{-1}$)	2,25140
Al/AA plášť (Al/AA layers)	Materiál (Material)	(-)	AL1
	Počet drátů a konstrukce (Number of wires and design)	(-)	12+18+24
	Jmenovitý průměr drátu (Nominal diameter of wire)	(mm)	4,00
	Matematický průřez (Calculated cross section)	(mm^2)	678,58
	Vypočtená hmotnost (Calculated weight)	($kg \cdot km^{-1}$)	1875,7
	Stejnosměrný el. odpor pro 20°C (DC-resistance at 20°C)	($\Omega \cdot km^{-1}$)	0,04259
Mazivo (Grease)	Mazané pouze jádro (dle EN 50182 přílohy B, obrázek B1a) - Steel core only greased (under EN 50182 Annex B, picture B1a)		
	Vypočtená hmotnost maziva (Weight of grease)	($kg \cdot km^{-1}$)	18,880
Lano (Cable)	Průměr (Total diameter)	(mm)	36,00
	Matematický průřez (Calculated cross section)	(mm^2)	764,54
	Poměr průřezů Al:Fe (Ratio of cross sections)	(-)	7,89
	Jmenovitá hmotnost bez mazadla (Nominal total weight without grease)	($kg \cdot km^{-1}$)	2549,7
	Jmenovitá hmotnost s mazadlem (Nominal total weight including grease)	($kg \cdot km^{-1}$)	2568,6
	Modul pružnosti (Module of elasticity)	(MPa)	69700
	Součinitel teplotní roztažnosti (Coefficient of thermal expansion)	$10^6 \cdot (K^{-1})$	19,5
	Měrná tíha (Specific weight)	($N \cdot m^{-1} \cdot mm^{-2}$)	0,032947
	Matematická pevnost (Rated tensile strength)	(kN)	206,56
	Stejnosměrný el. odpor pro 20°C (DC-resistance at 20°C)	($\Omega \cdot km^{-1}$)	0,04259
	Směr vinutí vnější vrstvy (Direction of outer layer coiling)	-	pravý (Z)
Balení *) (Packaging)	Průměr bubnu / šířka bubnu (Diametr of reel / Overall width of reel)	(mm)	2000 / 1300
	Dodací délka lana (Delivery length of cable)	(m)	1537

*) *běžné rozměry bubnu, použití větších bubnů, je závislé od technického vybavení dodavatele stavby*

Typ lana: 195-AL4/42-A20SA

Cross Section



Design	Center		1	ACS - Wire		4.10	mm
	Layer 1		6	ACS - Wires		3.00	mm
		+	1	Stainless Steel Tube with 24 SMF	2.60 /	3.00	mm
	Layer 2		15	AA - Wires		2.50	mm
	Layer 3		21	AA - Wires		2.50	mm

stranded, core and layer 1 greased
Stranding direction of outer layer: right hand (Z-stranding)

Cable Diameter		20.1	mm
Cable Weight		901	kg/km
Technical Data	according to IEC standards		
Supporting Cross Section		232.3	mm²
Rated Tensile Strength		122.2	kN
Modulus of Elasticity		82.1	kN/mm²
Thermal Elongation Coefficient		18.3	10^{-6}/K
Permissible Maximum Working Stress		220.9	N/mm²
Everyday Stress (16% RTS)		84.2	N/mm²
Ultimate Exceptional Stress		378.7	N/mm²
DC Resistance		0.169	Ω/km
Short Time Current	(1,0s, 20-200°C)	22.4	kA
Short Time Current	(1,0s, 20-160°C)	20.3	kA
Short Time Current (without Steel)	(1,0s, 20-160°C)	18.6	kA
Maximum Permissible Installation Force		36.7	kN
Minimum Bending Radius		302	mm
Normal Delivery Length		4000	m
Temperature Range Installation		-10	to +50°C
Transportation and Operation		-40	to +80°C

Remarks
All Sizes and Values are Nominal Values
Maximum Fibre Capacity per Steel Tube: 36

Příloha E - Výpočet vzájemných vlivů vedení pomoci software.u Wolfram Mathematica
Výpočet impedanční matice, netočivé a zpětné složky napětí

In[125]:=
```
SetDirectory[NotebookDirectory[]];
FileNames["*.out"];
stringToNumbers[str_String] :=
  ToExpression /@ StringSplit[StringReplace[str, "E" → "*10^"], Whitespace];
stringToNumbers[lst_List] := stringToNumbers /@ lst;
stringToNumbers[mm_] := "";
a = ⅇ^(ⅉ*2/3*π) // N;
```

In[131]:=
```
FileNames["*.out"];
dataRaw = Import["modul.out", "CSV"];
iRXmtrxLabel = Position[dataRaw,
    {"              <<<<   SERIES IMPEDANCE  R + J X  (OHMS/KM)  >>>>"}][[1, 1]];
dataRaw[[iRXmtrxLabel]];
iGBmtrxLabel = Position[dataRaw,
    {"              <<<<   SHUNT ADMITTANCE  G + J B  (OHMS/KM)  >>>>"}][[1, 1]];
dataRaw[[iGBmtrxLabel]];
nMtrxRows = (iGBmtrxLabel - iRXmtrxLabel - 5) / 2;

iRmtrxStart = iRXmtrxLabel + 2;
iRmtrxEnd = iRmtrxStart + nMtrxRows - 1;
iXmtrxStart = iRmtrxEnd + 2;
iXmtrxEnd = iXmtrxStart + nMtrxRows - 1;

iGmtrxStart = iGBmtrxLabel + 2;
iGmtrxEnd = iGmtrxStart + nMtrxRows - 1;
iBmtrxStart = iGmtrxEnd + 2;
iBmtrxEnd = iBmtrxStart + nMtrxRows - 1;

Rmtrx = stringToNumbers[dataRaw[[iRmtrxStart ;; iRmtrxEnd]]][[All, 1]];
Xmtrx = stringToNumbers[dataRaw[[iXmtrxStart ;; iXmtrxEnd]]][[All, 1]];
Gmtrx = stringToNumbers[dataRaw[[iGmtrxStart ;; iGmtrxEnd]]][[All, 1]];
Bmtrx = stringToNumbers[dataRaw[[iBmtrxStart ;; iBmtrxEnd]]][[All, 1]];

Zmtrx = Rmtrx + I * Xmtrx;

N[a];
a2 = a * a;
N[a2];
```

In[154]:=
```
Imatrix1 =
 { Iz1, Iz2, 2500 * a2, 2500 * a2, 2500, 2500 * a, 2500, 2500 * a, 0, 0, 0, 0, 0, 0}

Umatrix1 =
 {0, 0, U41b, U42b, U41a, U41c, U42a, U42c, U11a, U11b, U11c, U12a, U12b, U12c}
Soustava1 = Thread[Umatrix1 == Zmtrx.Imatrix1]
Vysledek1 = Solve[Soustava1]
```

Out[154]=
```
{Iz1, Iz2, -1250. - 2165.06 i, -1250. - 2165.06 i, 2500,
 -1250. + 2165.06 i, 2500, -1250. + 2165.06 i, 0, 0, 0, 0, 0, 0}
```

Out[155]=
```
{0, 0, U41b, U42b, U41a, U41c, U42a, U42c, U11a, U11b, U11c, U12a, U12b, U12c}
```

Out[156]=
```
{0 == (146.262 - 63.1465 i) + (0.213714 + 0.723877 i) Iz1 + (0.0446962 + 0.256837 i) Iz2,
 0 == (130.343 - 90.5782 i) + (0.0446962 + 0.256837 i) Iz1 + (0.213714 + 0.723877 i) Iz2,
 U41b == (617.193 - 372.752 i) + (0.0452261 + 0.279096 i) Iz1 + (0.0452038 + 0.238784 i) Iz2,
 U42b == (584.84 - 428.58 i) + (0.0452038 + 0.238784 i) Iz1 + (0.0452261 + 0.279096 i) Iz2,
 U41a == (-14.9275 + 695.44 i) + (0.0457418 + 0.234261 i) Iz1 + (0.0457114 + 0.214686 i) Iz2,
 U41c == (-619.929 - 162.282 i) + (0.045745 + 0.236249 i) Iz1 + (0.0457309 + 0.223999 i) Iz2,
 U42a == (-68.3767 + 622.888 i) + (0.0457309 + 0.223999 i) Iz1 + (0.045745 + 0.236249 i) Iz2,
 U42c == (-656.252 - 244.741 i) + (0.0457114 + 0.214686 i) Iz1 + (0.0457418 + 0.234261 i) Iz2,
 U11a == (-93.1776 + 139.276 i) + (0.0460988 + 0.216832 i) Iz1 + (0.0460695 + 0.204391 i) Iz2,
 U11b == (-120.915 + 113.664 i) + (0.0461003 + 0.217658 i) Iz1 + (0.0460783 + 0.207508 i) Iz2,
 U11c == (-139.292 + 86.4617 i) + (0.0461009 + 0.217776 i) Iz1 + (0.0460861 + 0.210396 i) Iz2,
 U12a == (-141.711 + 82.4218 i) + (0.0460861 + 0.210396 i) Iz1 + (0.0461009 + 0.217776 i) Iz2,
 U12b == (-156.119 + 52.9246 i) + (0.0460783 + 0.207508 i) Iz1 + (0.0461003 + 0.217658 i) Iz2,
 U12c == (-164.476 + 16.1064 i) + (0.0460695 + 0.204391 i) Iz1 + (0.0460988 + 0.216832 i) Iz2}
```

Out[157]=
```
{{Iz1 → 7.11971 + 156.849 i, Iz2 → 69.9601 + 145.506 i,
  U11a → -153.376 + 169.053 i, U11b → -181.696 + 143.667 i, U11c → -200.512 + 116.668 i,
  U12a → -202.846 + 113.092 i, U12b → -216.784 + 83.5646 i, U12c → -224.532 + 46.6648 i,
  U41a → -79.3856 + 725.953 i, U41b → 542.157 - 340.388 i, U41c → -686.052 - 131.1 i,
  U42a → -134.36 + 654.84 i, U42b → 510.263 - 393.684 i, U42c → -720.486 - 212.998 i}}
```

In[158]:=
```
Uabc1l = {U11a /. Vysledek1[[1]], U11b /. Vysledek1[[1]], U11c /. Vysledek1[[1]]};
Amatrix = {{1, a, a2}, {1, a2, a}, {1, 1, 1}};
Amatrix // MatrixForm
U1201l = {U1, U2, U0};
Kombinace1l = Thread[U1201l == 1/3 * (Amatrix.Uabc1l)];
Solve [Kombinace1l]


Uabc1p = {U12a /. Vysledek1[[1]], U12b /. Vysledek1[[1]], U12c /. Vysledek1[[1]]};
Amatrix = {{1, a, a2}, {1, a2, a}, {1, 1, 1}};
Amatrix // MatrixForm;
U1201p = {U1, U2, U0};
Kombinace1p = Thread[U1201p == 1/3 * (Amatrix.Uabc1p)];
Solve [Kombinace1p]
```

Out[160]//MatrixForm=

$$\begin{pmatrix} 1 & -0.5+0.866025\,i & -0.5-0.866025\,i \\ 1 & -0.5-0.866025\,i & -0.5+0.866025\,i \\ 1 & 1 & 1 \end{pmatrix}$$

Out[163]= $\{\{U0 \to -178.528 + 143.129\,i,\ U1 \to 4.78207 + 18.3935\,i,\ U2 \to 20.3696 + 7.53041\,i\}\}$

Out[169]= $\{\{U0 \to -214.721 + 81.1071\,i,\ U1 \to -4.71475 + 18.2291\,i,\ U2 \to 16.5893 + 13.7557\,i\}\}$

In[170]:=
```
Imatrix2 =
 { Iz1, Iz2, 2500 * a, 2500, 2500 * a2, 2500, 2500 * a, 2500 * a2, 0, 0, 0, 0, 0, 0}

Umatrix2 = {0, 0, U41b2, U42b2, U41a2, U41c2,
  U42a2, U42c2, U11a2, U11b2, U11c2, U12a2, U12b2, U12c2}
Soustava2 = Thread[Umatrix2 == Zmtrx.Imatrix2]
Vysledek2 = Solve[Soustava2]
Uabc2l =
  {U11a2 /. Vysledek2[[1]], U11b2 /. Vysledek2[[1]], U11c2 /. Vysledek2[[1]]};
Amatrix = {{1, a, a2}, {1, a2, a}, {1, 1, 1}};
Amatrix // MatrixForm
U1202l = {U12, U22, U02};
Kombinace2l = Thread[U1202l == 1/3 * (Amatrix.Uabc2l)];
Solve [Kombinace2l]


Uabc2p = {U12a2 /. Vysledek2[[1]], U12b2 /. Vysledek2[[1]], U12c2 /. Vysledek2[[1]]};
Amatrix = {{1, a, a2}, {1, a2, a}, {1, 1, 1}};
Amatrix // MatrixForm;
U1202p = {U12, U22, U02};
Kombinace2p = Thread[U1202p == 1/3 * (Amatrix.Uabc2p)];
Solve [Kombinace2p]
```

Out[170]=
```
{Iz1, Iz2, -1250. + 2165.06 i, 2500, -1250. - 2165.06 i,
 2500, -1250. + 2165.06 i, -1250. - 2165.06 i, 0, 0, 0, 0, 0, 0}
```

Out[171]= {0, 0, U41b2, U42b2, U41a2, U41c2, U42a2, U42c2, U11a2, U11b2, U11c2, U12a2, U12b2, U12c2}

Out[172]=
$$\begin{aligned}
&\{0 == (-117.872 - 3.54527\,i) + (0.213714 + 0.723877\,i)\,Iz1 + (0.0446962 + 0.256837\,i)\,Iz2,\\
&\ 0 == (-57.086 + 101.669\,i) + (0.0446962 + 0.256837\,i)\,Iz1 + (0.213714 + 0.723877\,i)\,Iz2,\\
&\ U41b2 == (-665.383 - 283.771\,i) + (0.0452261 + 0.279096\,i)\,Iz1 + (0.0452038 + 0.238784\,i)\,Iz2,\\
&\ U42b2 == (10.1143 + 715.874\,i) + (0.0452038 + 0.238784\,i)\,Iz1 + (0.0452261 + 0.279096\,i)\,Iz2,\\
&\ U41a2 == (540.275 - 320.311\,i) + (0.0457418 + 0.234261\,i)\,Iz1 + (0.0457114 + 0.214686\,i)\,Iz2,\\
&\ U41c2 == (67.6662 + 626.787\,i) + (0.045745 + 0.236249\,i)\,Iz1 + (0.0457309 + 0.223999\,i)\,Iz2,\\
&\ U42a2 == (-559.454 - 289.148\,i) + (0.0457309 + 0.223999\,i)\,Iz1 + (0.045745 + 0.236249\,i)\,Iz2,\\
&\ U42c2 == (497.06 - 395.247\,i) + (0.0457114 + 0.214686\,i)\,Iz1 + (0.0457418 + 0.234261\,i)\,Iz2,\\
&\ U11a2 == (88.9084 + 1.15471\,i) + (0.0460988 + 0.216832\,i)\,Iz1 + (0.0460695 + 0.204391\,i)\,Iz2,\\
&\ U11b2 == (68.1973 + 31.1071\,i) + (0.0461003 + 0.217658\,i)\,Iz1 + (0.0460783 + 0.207508\,i)\,Iz2,\\
&\ U11c2 == (38.1112 + 50.9878\,i) + (0.0461009 + 0.217776\,i)\,Iz1 + (0.0460861 + 0.210396\,i)\,Iz2,\\
&\ U12a2 == (-26.4759 - 60.8733\,i) + (0.0460861 + 0.210396\,i)\,Iz1 + (0.0461009 + 0.217776\,i)\,Iz2,\\
&\ U12b2 == (5.78116 - 77.0091\,i) + (0.0460783 + 0.207508\,i)\,Iz1 + (0.0461003 + 0.217658\,i)\,Iz2,\\
&\ U12c2 == (42.0849 - 79.9892\,i) + (0.0460695 + 0.204391\,i)\,Iz1 + (0.0460988 + 0.216832\,i)\,Iz2\}
\end{aligned}$$

Out[173]=
$$\begin{aligned}
&\{\{Iz1 \to 95.6175 - 117.232\,i,\ Iz2 \to -145.22 - 74.237\,i,\\
&\ U11a2 \to 127.219 - 16.6184\,i,\ U11b2 \to 106.835 + 12.9594\,i,\ U11c2 \to 76.976 + 32.4315\,i,\\
&\ U12a2 \to 12.0681 - 81.2065\,i,\ U12b2 \to 43.9772 - 97.6002\,i,\ U12c2 \to 79.8534 - 100.757\,i,\\
&\ U41a2 \to 581.411 - 337.844\,i,\ U41b2 \to -617.178 - 300.419\,i,\ U41c2 \to 109.724 + 608.089\,i,\\
&\ U42a2 \to -517.926 - 310.795\,i,\ U42b2 \to 56.5811 + 689.519\,i,\ U42c2 \to 537.347 - 417.493\,i\}\}
\end{aligned}$$

Out[176]//MatrixForm=
$$\begin{pmatrix} 1 & -0.5 + 0.866025\,i & -0.5 - 0.866025\,i \\ 1 & -0.5 - 0.866025\,i & -0.5 + 0.866025\,i \\ 1 & 1 & 1 \end{pmatrix}$$

Out[179]=
$$\{\{U02 \to 103.677 + 9.59085\,i,\ U12 \to 17.3922 - 4.48509\,i,\ U22 \to 6.15001 - 21.7241\,i\}\}$$

Out[185]=
$$\{\{U02 \to 45.2996 - 93.188\,i,\ U12 \to -17.5271 - 4.36586\,i,\ U22 \to -15.7044 + 16.3473\,i\}\}$$

In[186]:=
```
Imatrix3 =
 { Iz1, Iz2, 2500, 2500, 2500 * a, 2500 * a2, 2500 * a, 2500 * a2, 0, 0, 0, 0, 0, 0}

Umatrix3 = {0, 0, U41b3, U42b3, U41a3, U41c3,
  U42a3, U42c3, U11a3, U11b3, U11c3, U12a3, U12b3, U12c3}
Soustava3 = Thread[Umatrix3 == Zmtrx.Imatrix3]
Vysledek3 = Solve[Soustava3]
Uabc3l =
  {U11a3 /. Vysledek3[[1]], U11b3 /. Vysledek3[[1]], U11c3 /. Vysledek3[[1]]};
Amatrix = {{1, a, a2}, {1, a2, a}, {1, 1, 1}};
Amatrix // MatrixForm
U1203l = {U13, U23, U03};
Kombinace3l = Thread[U1203l == 1/3 * (Amatrix.Uabc3l)];
Solve [Kombinace3l]


Uabc3p = {U12a3 /. Vysledek3[[1]], U12b3 /. Vysledek3[[1]], U12c3 /. Vysledek3[[1]]};
Amatrix = {{1, a, a2}, {1, a2, a}, {1, 1, 1}};
Amatrix // MatrixForm;
U1203p = {U13, U23, U03};
Kombinace3p = Thread[U1203p == 1/3 * (Amatrix.Uabc3p)];
Solve [Kombinace3p]
```

Out[186]=
$$\{Iz1, Iz2, 2500, 2500, -1250. + 2165.06\,i, -1250. - 2165.06\,i, -1250. + 2165.06\,i, -1250. - 2165.06\,i, 0, 0, 0, 0, 0, 0\}$$

Out[187]= $\{0, 0, U41b3, U42b3, U41a3, U41c3, U42a3, U42c3, U11a3, U11b3, U11c3, U12a3, U12b3, U12c3\}$

Out[188]=
$$\begin{aligned}
&\{0 == (-18.4447 + 158.24\,i) + (0.213714 + 0.723877\,i)\,Iz1 + (0.0446962 + 0.256837\,i)\,Iz2,\\
&0 == (13.2714 + 158.17\,i) + (0.0446962 + 0.256837\,i)\,Iz1 + (0.213714 + 0.723877\,i)\,Iz2,\\
&U41b3 == (14.2159 + 720.88\,i) + (0.0452261 + 0.279096\,i)\,Iz1 + (0.0452038 + 0.238784\,i)\,Iz2,\\
&U42b3 == (78.7413 + 720.777\,i) + (0.0452038 + 0.238784\,i)\,Iz1 + (0.0452261 + 0.279096\,i)\,Iz2,\\
&U41a3 == (-594.805 - 360.647\,i) + (0.0457418 + 0.234261\,i)\,Iz1 + (0.0457114 + 0.214686\,i)\,Iz2,\\
&U41c3 == (450.505 - 455.733\,i) + (0.045745 + 0.236249\,i)\,Iz1 + (0.0457309 + 0.223999\,i)\,Iz2,\\
&U42a3 == (-505.248 - 370.66\,i) + (0.0457309 + 0.223999\,i)\,Iz1 + (0.045745 + 0.236249\,i)\,Iz2,\\
&U42c3 == (540.078 - 445.96\,i) + (0.0457114 + 0.214686\,i)\,Iz1 + (0.0457418 + 0.234261\,i)\,Iz2,\\
&U11a3 == (-74.0281 - 150.332\,i) + (0.0460988 + 0.216832\,i)\,Iz1 + (0.0460695 + 0.204391\,i)\,Iz2,\\
&U11b3 == (-37.9787 - 161.547\,i) + (0.0461003 + 0.217658\,i)\,Iz1 + (0.0460783 + 0.207508\,i)\,Iz2,\\
&U11c3 == (-5.23204 - 163.861\,i) + (0.0461009 + 0.217776\,i)\,Iz1 + (0.0460861 + 0.210396\,i)\,Iz2,\\
&U12a3 ==\\
&\quad (-0.523676 - 163.937\,i) + (0.0460861 + 0.210396\,i)\,Iz1 + (0.0461009 + 0.217776\,i)\,Iz2,\\
&U12b3 == (32.2256 - 161.666\,i) + (0.0460783 + 0.207508\,i)\,Iz1 + (0.0461003 + 0.217658\,i)\,Iz2,\\
&U12c3 == (68.2897 - 150.494\,i) + (0.0460695 + 0.204391\,i)\,Iz1 + (0.0460988 + 0.216832\,i)\,Iz2\}
\end{aligned}$$

Out[189]=
$$\begin{aligned}
&\{\{Iz1 \to -139.395 - 72.2589\,i,\ Iz2 \to -160.992 - 12.1656\,i,\ U11a3 \to -69.7163 - 217.354\,i,\\
&\ U11b3 \to -33.5709 - 229.187\,i,\ U11c3 \to -0.781894 - 231.982\,i,\\
&\ U12a3 \to 3.48263 - 232.216\,i,\ U12b3 \to 36.0229 - 229.523\,i,\ U12c3 \to 71.8532 - 217.783\,i,\\
&\ U41a3 \to -589.001 - 431.726\,i,\ U41b3 \to 23.7062 + 639.716\,i,\ U41c3 \to 456.562 - 528.589\,i,\\
&\ U42a3 \to -499.928 - 443.779\,i,\ U42b3 \to 85.8087 + 638.743\,i,\ U42c3 \to 544.705 - 517.46\,i\}\}
\end{aligned}$$

Out[192]//MatrixForm=
$$\begin{pmatrix} 1 & -0.5 + 0.866025\,i & -0.5 - 0.866025\,i \\ 1 & -0.5 - 0.866025\,i & -0.5 + 0.866025\,i \\ 1 & 1 & 1 \end{pmatrix}$$

Out[195]= $\{\{U03 \to -34.6897 - 226.174\,i,\ U13 \to -18.3203 - 5.05535\,i,\ U23 \to -16.7063 + 13.8754\,i\}\}$

Out[201]= $\{\{U03 \to 37.1196 - 226.507\,i,\ U13 \to -13.4295 - 13.1977\,i,\ U23 \to -20.2074 + 7.48894\,i\}\}$

Úbytky napětí na vedení 2x110 kV pro různé kombinace vedení 2x440 kV + 2x110 kV

1. BAC

B B

A C A C

$$\mathrm{U01L} \rightarrow -178.528 + 143.129j$$

$$|U01L| \rightarrow 228.819 \quad \varphi \rightarrow 2.46581$$

$$\mathrm{U11L} \rightarrow 4.78207 + 18.3935j$$

$$\mathrm{U21L} \rightarrow 20.3696 + 7.53041j$$

$$|U21L| \rightarrow 21.7170 \quad \varphi \rightarrow 0.354106$$

$$U01P \rightarrow -214.721 + 81.1071j$$

$$|U01P| \rightarrow 229.529 \quad \varphi \rightarrow 2.780429$$

$$\mathrm{U11P} \rightarrow -4.71475 + 18.2291j$$

$$\mathrm{U21P} \rightarrow 16.5893 + 13.7557j$$

$$|U21P| \rightarrow 21.5505 \quad \varphi \rightarrow 0.692289$$

2. CBA_ACB

C A

B A C B

$$\mathrm{U02L} \rightarrow 103.67663506004192 + 9.59084906044163j$$

$$|U02L| \rightarrow 104.11930197169633 \quad \varphi \rightarrow 0.0922447997690596$$

$$\mathrm{U12L} \rightarrow 17.392238326798832 - 4.4850867442253035j$$

$$\mathrm{U22L} \rightarrow 6.150011438756437 - 21.724142457747412j$$

$$|U22L| \rightarrow 22.577887550019793 \quad \varphi \rightarrow -1.2949192901608796$$

$$U02P \rightarrow 45.299559614698296 - 93.18799846962122j$$

$$|U02P| \rightarrow 103.6149273032594 \quad \varphi \rightarrow -1.118322842193613$$

$$\mathrm{U12P} \rightarrow -17.52711702039762 - 4.365855220698508j$$

$$\mathrm{U22P} \rightarrow -15.704376716562182 + 16.3473197804007j$$

$$|U22P| \rightarrow 22.6685313167479 \quad \varphi \rightarrow 2.336137615898873$$

3.ACB

A A

C B C B

$$\mathrm{U03L} \rightarrow -34.689721628066266 - 226.17447338592402j$$

$$|U03L| \rightarrow 228.81929376263878 \quad \varphi \rightarrow -1.72298627731782022$$

$$\mathrm{U13L} \rightarrow -18.320265763850887 - 5.055350128344443j$$

$$\mathrm{U23L} \rightarrow -16.70634282522755 + 13.875415229798628j$$

$$|U23L| \rightarrow 21.71702185828802 \quad \varphi \rightarrow 2.4485005895559409$$

$$U03P \rightarrow 37.119589610234016 - 226.50720375902108j$$

$$|U03P| \to 229.52859797324360 \quad \varphi \to -1.40836198667506488$$

$$\mathrm{U13}P \to -13.429513167803131 - 13.19765475560869j$$

$$\mathrm{U23}P \to -20.207444172400244 + 7.488942267602681j$$

$$|U23P| \to 21.550523340934405 \quad \varphi \to 2.7866823255736179$$

4. CBA

C C

B A B A

$$\mathrm{U04L} \to 213.21770045381032 + 83.04505651284617j$$

$$|U04L| \to 228.81929376263838 \quad \varphi \to 0.3714088250753761$$

$$\mathrm{U14L} \to 13.538194518096711 - 13.338140491405094j$$

$$\mathrm{U24L} \to -3.6632906644494008 - 21.40582490587824j$$

$$|U24L| \to 21.71702185828801 \quad \varphi \to -1.7402896152304534$$

$$\mathrm{U04P} \to 177.6011977903728 + 145.40010946002613j$$

$$|U04P| \to 229.5285979732432 \quad \varphi \to 0.6860331157181322$$

$$\mathrm{U14P} \to 18.14426087263523 - 5.031472185970879j$$

$$\mathrm{U24P} \to 3.618107834981136 - 21.244631132655776j$$

$$|U24P| \to 21.550523340934413 \quad \varphi \to -1.40210787921277433$$

5. ACB_CBA

A C

C B B A

$$\mathrm{U05L} \to 74.85134376570231 - 152.72026593351953j$$

$$|U05L| \to 170.07705103962812 \quad \varphi \to -1.115083452313213$$

$$\mathrm{U15L} \to -22.174309572553145 - 13.908403875524243j$$

$$\mathrm{U25L} \to -26.51964492843337 + 14.193732781667885j$$

$$|U25L| \to 30.07912261698428 \quad \varphi \to 2.6501708905243674$$

$$\mathrm{U05P} \to 169.42122778590877 + 12.080904170626265j$$

$$|U05P| \to 169.85140761873197 \ \varphi \to 0.071186419463373139$$

$$\mathrm{U15P} \to 22.241864725229654 - 13.863271720880977j$$

$$\mathrm{U25P} \to -0.8849596208569276 - 30.10300864545389j$$

$$|U25P| \to 30.11601373088442 \quad \varphi \to -1.6001855758391335$$

6. ACB_BAC

A B

C B A C

$$\mathrm{U06L} \to -43.53239859981662 - 94.58202427110578j$$

$$|U06L| \to 104.1193019716967 \quad \varphi \to -2.002150302624137$$

$$\mathrm{U16L} \rightarrow -12.580318222075366 - 12.819576847568394j$$

$$\mathrm{U26L} \rightarrow -21.888664963219558 + 5.536005089345686j$$

$$|U26L| \rightarrow 22.577887550019749 \quad \varphi \rightarrow 2.8938709146255136$$

$$\mathrm{U06P} \rightarrow -103.35295380986668 + 7.363429828234001j$$

$$|U06P| \rightarrow 103.61492730325955 \quad \varphi \rightarrow 3.07046736259278063$$

$$\mathrm{U16P} \rightarrow 4.98261697982902 + 17.36185620511626j$$

$$\mathrm{U26P} \rightarrow 22.00938257189602 + 5.42672929694333j$$

$$|U26P| \rightarrow 22.66853131674797 \quad \varphi \rightarrow 0.241742513505676$$

7. BAC_ACB

B A

A C C B

$$\mathrm{U07L} \rightarrow -169.6853018539944 + 11.536967758259337j$$

$$|U07L| \rightarrow 170.0770510396282 \quad \varphi \rightarrow 3.07370675247317926$$

$$\mathrm{U17L} \rightarrow -0.9578762960213159 + 26.15771733897361j$$

$$\mathrm{U27L} \rightarrow 25.551955627669116 + 15.86981981653243j$$

$$|U27L| \rightarrow 30.07912261698431 \quad \varphi \rightarrow 0.5557757881311683$$

$$\mathrm{U07P} \rightarrow -74.24824398050677 - 152.76353928826032j$$

$$|U07P| \rightarrow 169.85140761873219 \quad \varphi \rightarrow -2.0232086829298224$$

$$\mathrm{U17P} \rightarrow -23.126877852464336 - 12.33038401914547j$$

$$\mathrm{U27P} \rightarrow -25.62749040687719 + 15.817901835712377j$$

$$|U27P| \rightarrow 30.11601373088436 \quad \varphi \rightarrow 2.5886046289472607$$

8. BAC_CBA

B C

A C B A

$$\mathrm{U08L} \rightarrow -60.144236460225954 + 84.9911752106639j$$

$$|U08L| \rightarrow 104.119301971697 \; \varphi \rightarrow 2.186639902162258$$

$$\mathrm{U18L} \rightarrow -4.811920104723488 + 17.304663591793748j$$

$$\mathrm{U28L} \rightarrow 15.738653524463162 + 16.188137368401684j$$

$$|U28L| \rightarrow 22.577887550019814 \quad \varphi \rightarrow 0.7994758122323162$$

$$\mathrm{U08P} \rightarrow 58.05339419516781 + 85.82456864138699j$$

$$|U08P| \rightarrow 103.6149273032592 \quad \varphi \rightarrow 0.9760722601995859$$

$$\mathrm{U18P} \rightarrow 12.544500040568625 - 12.9960009844178j$$

$$\mathrm{U28P} \rightarrow -6.3050058553338975 - 21.77404907734408j$$

$$|U28P| \rightarrow 22.66853131674797 \; \varphi \rightarrow -1.8526525888875236$$

9. CBA_BAC

C B

B A A C

$$\mathrm{U09L} \rightarrow 94.8339580882916 + 141.18329817525984j$$

$$|U09L| \rightarrow 170.077051039628 \quad \varphi \rightarrow 0.979311650079984$$

$$\mathrm{U19L} \rightarrow 23.13218586857461 - 12.249313463449244j$$

$$\mathrm{U29L} \rightarrow 0.9676893007642775 - 30.063552598200182j$$

$$|U29L| \rightarrow 30.079122616984069 \quad \varphi \rightarrow -1.53861931426202520$$

$$\mathrm{U09P} \rightarrow -95.17298380540245 + 140.6826351176337j$$

$$|U09P| \rightarrow 169.8514076187320 \quad \varphi \rightarrow 2.165581521856571$$

$$\mathrm{U19P} \rightarrow 0.8850131272346762 + 26.193655740026475j$$

$$\mathrm{U29P} \rightarrow 26.51245002773398 + 14.285106809741507j$$

$$|U29P| \rightarrow 30.11601373088435 \quad \varphi \rightarrow 0.4942095265540673$$

Úbytky napětí na vedení 2x110 kV pro provedení 2x400 kV a 2x110 kV na samostatných stožárech

B B

A C A C

$$U0L \rightarrow -107.69148091691785 - 3.7738675971632025j$$

$$|U0L| \rightarrow 107.757585063510 \quad \varphi \rightarrow -3.10656366254139$$

$$\mathrm{U1L} \rightarrow 14.859042810003945 - 1.0044565305276667j$$

$$\mathrm{U2L} \rightarrow 8.56278228945378 - 5.485740432189734j$$

$$|U2L| \rightarrow 10.169296368281561 \quad \varphi \rightarrow -0.5697736785014846$$

$$\mathrm{U0P} \rightarrow -81.75256635888731 + 3.3975774461394046j$$

$$|U0P| \rightarrow 81.82313632932184 \quad \varphi \rightarrow 3.100057279796684 6$$

$$\mathrm{U1P} \rightarrow 8.260704232230022 + 1.4441817584245626j$$

$$\mathrm{U2P} \rightarrow 5.348210585182618 - 6.2682575715243445j$$

$$|U2P| \rightarrow 8.239806396174103 \quad \varphi \rightarrow -0.8644351288170468$$