O’zbekiston respublikasi

Navoiy kon metallurgiya kombinati

# Navoiy davlat konchilik instituti

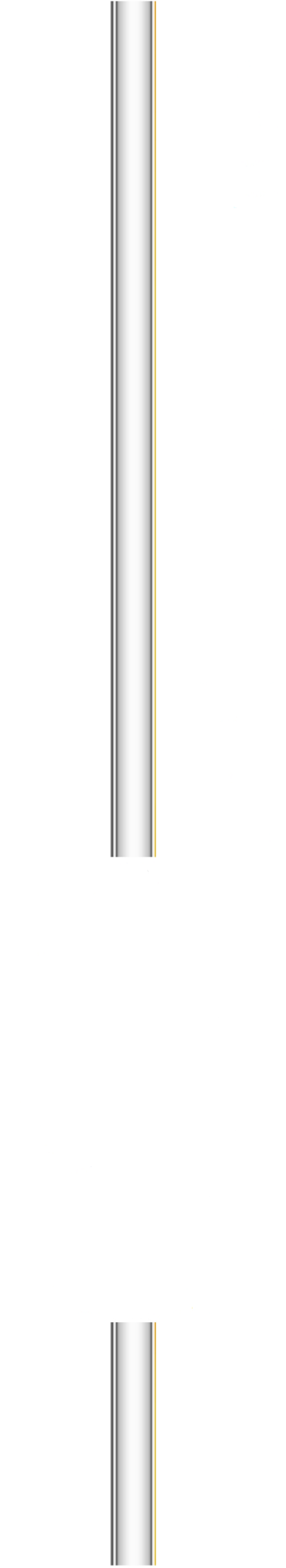
**«Elektr tarmoq va tizimlari»**

**fanidan nazorat ishlari va kurs loyihasini bajarish uchun**

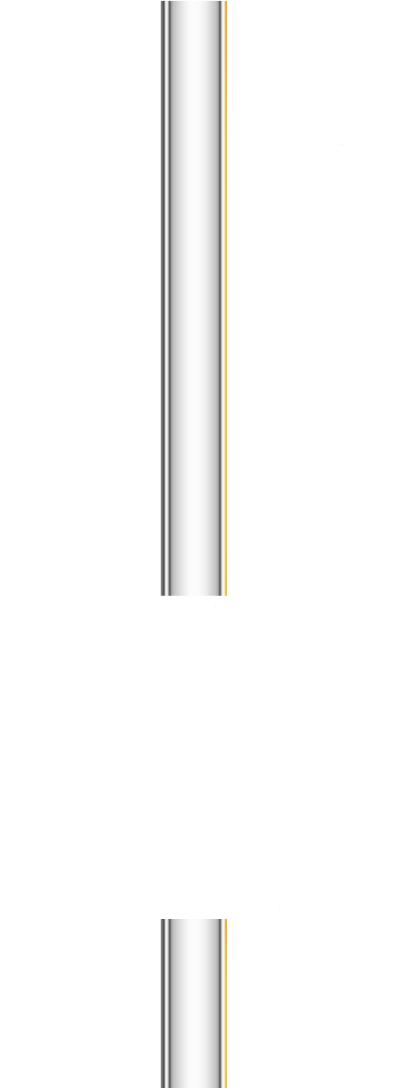
**5310200 «Elektr energetika» (tarmoqlar bo`yicha) ta’lim yo`nalishi talabalari uchun**

##### **USLUBIY QO’LLANMA**

Navoiy- 2016



**O' Q U V - U S L U B I Y K E N G A S H**



Tuzuvchi: dots.Shoymatov B.X

«Elektr tarmoq va tizimlari» fanidan nazorat ishlari va kurs loyihasini bajarish uchun uslubiy qo’llanma. Shoymatov B.X.Navoiy:NDKI,2016 y. 40 b.

Ushbu uslubiy qo’llanma yordamida «Elektr tarmoqlari va tizimlari» fanidan nazorat ishlarini va kurs loyihasini bajarish maqsadida elektr tarmoqlari va tizimlari sohasida sodir bo`ladigan energetikaning eng dolzarb masalalarini yechish, referat shaklida mavzularga javob yozish hamda fanning yakuni sifatida kurs loyihasini bajarishga doir yo`l-yo`riqlar, kerakli qo`shimcha ma'lumotlarga ega bo`ladilar. Mazkur uslubiy qo’llanma 5310200–«Elektroenergetika» (tarmoqlar bo`yicha) ta’lim yo`nalishi talabalari uchun mo`ljallangan.

“Elektr ta'minoti” kafedrasi

Uslubiy ko`rsatma Navoiy davlat konchilik instituti o`quv-uslubiy kengashi qaori bilan chop ettirildi.

Taqrizchilar:

Niyazov U.- Navoiy Azot OAJ

Eshmurodov Z. -NDKI

Saidov F.G`- NDKI

**So`z boshi**

Ushbu uslubiy qo’llanma «Energetika» yo`nalishidagi «Elektr tarmoqlari va tizimlari» fanidan nazorat ishlarini va kurs loyihasini bajarish uchun mo`ljallangan. Ya'ni o`quv rejasiga mos holda elektr tarmoqlari va tizimlari sohasida sodir bo`ladigan energetikaning eng dolzarb masalalarini yechish uchun referat shaklida mavzularga jovob yozish har bir o`quvchining fikr- mulohazasini yanada kengaytirishga yordam beradi. Shuningdek ilmiy-texnik savollarga javob topish bilan birga, tarmoq va tizimlardagi yangi-yangi g`oyalarga duch kelishi, ularni yechish, adabiyotlarga ko`proq yondashish har bir talabaga yordam beradi.

Buni 1-nazorat ishini bajarishda elektr energiyaning sifati haqida, energetik muvozanat sharti haqida, reaktiv quvvatni qoplagichlari, elektr tizimlarining sxemalari haqida bir qator muammolar mujassamlashgan. 2-nazorat ishida esa oddiy bitta iste'molchiga ega bo`lgan tarmoqning texnikaviy va iqtisodiy ko`rsatkichlarini tahlil qilish bilan birga tarmoqdagi elektr o`tkazgichlarni tanlash va ularga qo`yilgan muammolar yechiladi. Uslubiy qo`llanmada bu fanning yakuni sifatida kurs loyihasini bajarishga yo`l-yo`riqlar, kerakli qo`shimcha ma'lumotlarga ega bo`ladilar. Har bir bo`lajak muhandis energetik o`zining nazariyadan olgan bilimlarini amaliyotga tadbiq qilish, muhandislik hisoblashlar bilan yana bir bor «Elektr tarmoq va tizimlar» fanini puxta egallashliklariga sharoit yaratiladi.

Uslubiy qo’llanmaga taqriz bergan Navoiy Azot OAJ Bosh energetik muovini Niyazov U, «Avtomatlashtirilgan boshqaruv va informatika» kafedrasi mudiri dots. Eshmurodov Z. ga minnatdorchilik bildiraman va foydalanuvchilardan fikr- mulohazalarini kutaman.

Muallif.

**1-nazorat ishi**

1- nazorat ishini bajarish uslubiyoti 1-jadvaldagi mavzular bo`yicha 10-15 varaq referat yozish va mavzularga moslashtirgan holda energetikaning yangi yo`nalishlari, qonun va qoidalarni, elektr sxemalarini chizish bilan nazariy bilimini yanada mustahkamlaydilar. By mavzularga reja tuzgan holda adabiyotlardan foydalanib va ravon javoblarni yoritishlari shart.

1-jadval.

|  |  |  |
| --- | --- | --- |
| Variant raqami | shifr | Referat mavzusi |
| 1 | 2 | 3 |
| 1 | 01.51 | Elektr tarmoq va tizimlari haqida umumiy tushuncha.Uning istiqboli |
| 2 | 02.52 | Elektr tarmoqlarining nominal kuchlanishlari. Iste'molchilarning kategoriyalari (toifalari) |
| 3 | 03.53 | Havo liniyalarining konstruktsiyasi,elementlari.Elektr uzatish simlarining turlari. |
| 4 | 04.54 | |  | | --- | | Izolyatorlar va armaturalar haqida tushuncha Havo liniyalari tayanchlarining turi,konstruktsiyasi va qo`llanilishi. | |
| 5 | 05.55 | Elektr uzatish kabellarining konstruktsiyasi, turlari, qo`llanilishi va joylashtirilishi. |
| 6 | 06.56 | Havo liniyalar va kabellarnnng shikastlangan joylarini aniqlash usullari  . |
| 7 | 07.57 | Sim va kabellarning qarshiligi va o`tkazuvchanligini hisoblash."Karona" haqida tushuncha. |
| 8 | 08.58 | Havo liniyalarining aktiv va reaktiv o`tkazuvchanligi |
| 9 | 09.59 | Ikki va uch chulg`amli transformatorlarning qarshiliklari va o`tkazuvchanligini aniqlash. |
| 10 | 10.60 | Quvvatlar haqida tushuncha va ularning kompleks ko`rinishi. |
| 11 | 11.61 | Elektr uzatish liniyalarida kuchlanish isrofi. Bir nechta yuklamali.teng taqsimlangan iste'molchilarining tarqoqlangan tarmoqlarda kuchlanish isrofi. |
| 12 | 12.62 | Transformatorlarda kuchlanish isrofini aniqlash. |
| 13 | 13.63 | Ruxsat etilgan kuchlanish isrofi orqali elektr uzatish simlarining ko`ndalang kesim yuzasini aniqlash. |
| 14 | 14.64 | Bitta va bir nechta yuklamali elektr tarmoqlarida quvvatlar isrofi. |
| 15 | 15.65 | Transformatorlarda quvvat isrofi. |
| 16 | 16.66 | Elektr tarmoqlarida energiya isrofi. Bitta va bir nechta yuklamali tarqoqlangan tarmoqlarda energiya isrofini aniqlash. |
| 17 | 17.67 | Transformatorlarda energiya isrofi. |
| 18 | 18.68 | Elektr tarmoqlarida elektr energiyami uzatish xarajatlarini aniqlash. |
| 19 | 19.69 | Sim va kabel liniyalarining iqtisodiy ko`ndalang kesim yuzasi haqida tushuncha |
| 20 | 20.70 | |  | | --- | | Texnik-iqtisodiy ko`rsatkichlarga asosan elektr tarmoq va tizimlarining eng qulay variantlarni tanlash. | |
| 21 | 21.710 | Elektr tizimida elektr energiyaning asosiy iste'molchilari.Iste'molchilarning aktiv quvvat muvozanati. |
| 22 | *22.72* | Elektr yuklamalarining sutkalik,oylik,yillik grafiklari. |
| 23 | 23.73 | Elektr energiya iste'molchilarining yuklamasini hisoblash haqida tushuncha |
| 24 | 24.74 | |  | | --- | | Rayon elektr tarmoqlarining elektr sxemasi va almashtirish sxemalari. | |
| 25 | 25.75 | Iste'molchilarning keltirilgan xarajitini aniqlash. |

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 3 |
| 26 | 26.76 | Sim va kabellarni issiqlikka chidamliligiga asoslanib tanlash va tekshirish. |
| 27 | 27.77 | Qisqa vaqtli yuklamali iste'molchilarda sim va kabellarning issiqlikka chidamliligi. |
| 28 | 28.78 | Elektr tarmoqlarida sim va kabellarning ko`ndalang kesim yuzasini aniqlash usullari. |
| 29 | 29.79 | Sim va kabellarning ko`ndalang kesim yuzasini ruxsat etilgan kuchlanish isrofiga asoslanib tanlash. |
| 30 | 30.80 | Sim va kabellarni iqtisodiy tok zichligi asosida aniqlash. |
| 31 | 31.81 | Alyumen po`latli (AS) simlarni aniqlash va tanlash. |
| 32 | 32.82 | Saqlagich va avtomatlarni tanlash va ularning turlari. |
| 33 | 33.83 | Radial tarmoqlarni transformatorlarsiz hisoblash. |
| 34 | 34.84 | Radial tarmoqlarni transformatorlar bilan birga hisoblash. |
| 35 | 35.85 | Elektr uzatish liniyalarining o`tkazuvchanlik layoqati. |
| 36 | 36.86 | Elektr uzatish liniyalarining vektor diagrammalari. |
| 37 | 37.87 | Yopiq tarmoqli iste'molchilar haqida umumiy tushuncha va ularni hisoblash |
| 38 | 38.88 | Ikki tomonlama manbali iste'molchilarni hisoblash.Quvvatlar tarqalish nuqtasini aniqlash. |
| 39 | 39.89 | Reaktiv quvvatning qoplagich qurilmasi haqida tushuncha. |
| 40 | 40.90 | Quvvatlar muvozanatlashuvini hisoblash. |
| 41 | 41.91 | Ikki tomonlama iste'molchilarda kuchlanish isrofini aniqlash. |
| 42 | 42.92 | Yopiq murakkab tarmoqlar haqida tushuncha vaularni hisoblash. |
| 43 | 43.93 | Elektr tizimlarida kuchlanish isrofi. |
| 44 | 44.94 | Elektr tarmoq va tizimlarini avtomatik boshqarish usullari. |
| 45 | 45.95 | Nosimmetrik yuklamali tarmoq va tizimlar. |
| 46 | 46.96 | Elektr tizimlaridagi elektr energiya isrofini kamaytirish usullari. |
| 47 | 47.97 | Elektr energiyaning sifati va uni taminlash. |
| 48 | 48.98 | Elektr tizim va tarmoqlarini hisobga olish tadbirlari. |
| 49 | 49.99 | Elektr tizim va tarmoqlaridagi elektr jihozlari. |
| 50 | 50.100 | Elektr tizim va tarmoqlarining hozirgi ahvoli va muammolari |

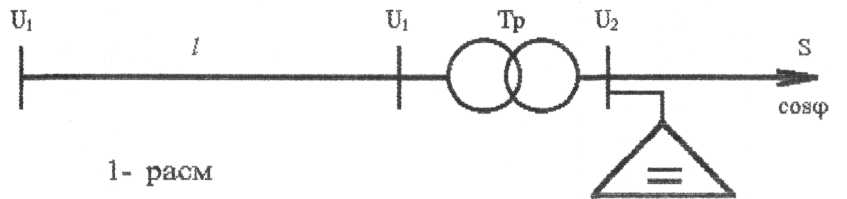
**2-nazorat ishi.**

Ushbu nazorat ishini bajarish uchun elektr tarmoq va tizimlarini bir chiziqli sxemasini chizadilar.Sxema asosida aktiv va reaktiv quvvatlarni hisoblab elektr uzatish liniyalarning simlarini,transformator va reaktiv quvvat qoplagichlarini tanlaydi. Natijada quyidagi hisoblashlarni bajaradilar.

Nazorat ishini bajarish quyidagi tartibda bajariladi, har bir talaba o`zining variantini 2-jadvaldan oladi. Misol :

Berilgan: U1=35 kV ; U2=10,5 kV *; lq15*km;S=1000kVA ;

**cosφ=0.8; Tmax=5000 s; τ=3000 s**



1.Iste'molchining aktiv va reaktiv quvvatini aniqlaymiz. P=Scos**φ**=1000\*0,8=800 [kVt]

Q=Ssin**φ**= 1000\*0,6=600 [kVar]

Bu yerda : sin**φ**=0,6ga teng

cos**φ**=0,8ga teng bo`lganda.

U holda hisobiy to`la quvvat quyidagicha bo`ladi:

S=P+jQ=800+j600=√8002+6002=1000 [ kVA]

Hisobiy to`la quvvatga asoslanib transformator tanlaymiz. Agar ikki transformatorli podstantsiya bo`lsa:

Str=(0,7 ÷ 0,8)S=0,75 \*1000=750 [ kVA];

bitta transformatorli bo`lsa:

Str =S/(0,7÷0,8)= 1000/ 0,75= 1333 [ kVA] ;

Umumiy holda transformatorni tanlash iste'molchilarning toifalariga e'tibor berilishi shart. Yani transformatorning yuklama koeffitsiyentlari quyidagi toifalarga mos kelishi talab qilinadi.

1toifa Kyu=0,6÷0,75

II toifa Kyu=0,7 ÷0,85

III toifa Kyu=0,8÷0,95

Transformatorni tanlashda reaktiv quvvatni qoplash qurilmasini hisobga olinadi. Uning qiymati quyidagicha hisoblanadi:

Qku=P(tg**φest-**tg**φn**) =800(0,75-0,328)=337,6≈338 [ kVar]

Bu yerda tg**φ**est=0,75 cos**φ**est=0,8 ga mos keladi.

cos**φ**n=0,95 tg**φ**n=0,328 ga mos keladi

Hisoblangan reaktiv quvvatni qoplash qurilmasining quvvati (Qku)ga asoslanib adabiyotlardan [8] yoki 8-jadvaldan foydalanib Un=6 [kV] yoki Un=10[kV] ga kondensator qurilmasi tanlaymiz  
Ya'ni, Qku1=330=330 [kVar]

1. Kondensator qurilmasini nazarga olib istemolchining to`la quvvatini hisoblaymiz:

Sx=P+j(Q-Qku1)=800+j(600-330)=800+j270=v8002+2702=845 [kVA]

Kondensator qurilmasini hisobga olgan holda iste’molchining quvvat koeffitsiyentb quyidagicha bo`ladi;

cos**φ** =P / Sx=800 / 845/ 0,95

Ya'ni, quvvat koeffitsiyenti normativga teng yoki katta bo`lishi shart

cos**φ**≥ cos**φ**n = 0,95

Shunday qilib hisobiy to`la quvvatga asoslangan holda 9-jadval yoki [5]adabiyotdan foydalanib, yuqoridagi shartni bajargan holda transformator tanlaymiz. 2xTM-630/10 tipdagi ikki transformatorli pasaytiruvchi podstantsiya tanlaymiz yoki TM-1000/10 tipdagi bitta transformatorli podstantsiya tanlaymiz.

U holda transformatorning yuklama koeffitsenti quyidagicha bo`ladi;  
Kyu=Sx / nSnt=840 / 2\*630=0,67 Kyu=Sx / Snt=840 / 1000=0,84

Tanlangan transformatorlarning 5-jadvaldan pasport qiymatlarini yozib olamiz. Sht=1000[kVA]; Uyuk=35[kV]; Unk=10,5[kV]; ΔPkt=18[kVt];

ΔPxx=3,6 [kVt]; Uk%=6,5%; IX%=1,4%; Rt=8,6[Om];

Xt=49,8 [Om] ; ΔQx= 22,4 [ kVar]

Transformatorning narxi kelishilgan erkin narxda. Transformatordagi aktiv va reaktiv quvvat isroflarini hisoblaymiz:



Bu yerda n=2- transformatorlar soni.

Natijada transformatorning kirish qismidagi aktiv va reaktiv quvvat quyidagicha bo`ladi:

Ptrkir=P+ ΔPtr=800+23,2=823,2 [kVt];

Qtrkir=Q+ΔQtr=600+54,04=654,04[kVar]

U holda to`la quvvat:

Strkir=Ptrkir+jQtpkir=823,2+j654,04[kVA]; Transformatordagi energiya isrofi:

ΔAtr=(1/n)ΔPkt(Sx/Snt)2**τ** +nΔPxxTy=(1/2)\*18\*(840/630)2\*200+2\*3,6\*8760=88592[kVt.s/y]

Bu yerda, **τ**-maksimal isrofgarchilikdagi vaqt

10-jadvaldan va **τ =f(T)** ga bog`liqlik grafikdan olinadi.

Endi elektr uzatish liniyaning simini tanlash uchun*, quyidagi* hisoblashlar bajariladi. Havo liniyasi simining ko`ndalang kesim yuzasini topish va uning turini nominal kuchlanishga mos holda tanlash uchun maksimal ishchi tokini topamiz:



Ishchi toki ikki zanjirli sim bo`lsa ikki baravar kam bo`ladi. Albatta simning ko`ndalang kesim yuzasi va uning turini tanlashda (Imax) maksimal ishchi tokka acoslanib tanlanadi va tanlangan simning ruxsat etilgan tokiga, kuchlanishga bog`liq holda solishtiriladi. Bunda tanlangan sim quyidagi shart asosida tekshiriladi:

Irux ≥ Imax.

Simning ko`ndalang kesim yuzasini tanlash va uning pasport qiymatlari 11-jadvaldan foydalanib qabul qilinadi. Liniyaning aktiv va reaktiv qarshiliklarini hisoblaymiz;

Rl =r0l [Om] ; Xl=X0 *l* [Om];

Zaryadli reaktiv quvvat quyidagicha topiladi:

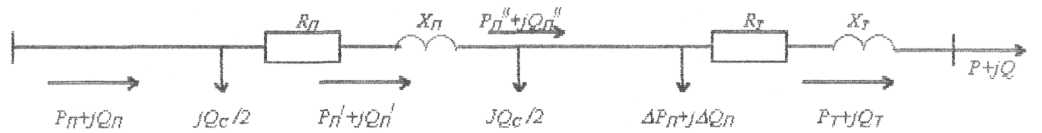
Qs=Ul2b0l [kVar] .

Agarelektr uzatish liniyasi 2 simli bo`lsa, u holda hisoblashlar quyidagi tartibda bajariladi:

Rl=r0 *l/* 2 [Om]; Xl=X0 *l* / 2 [Om] ; Qs=2Ul2b 0 *l* [kVar].

Bu yerda,ro, xo, bo 11-jadvaldan simning turiga mos holda olinadi.

Elektr uzatish liniyasining parametrlarini bilgan holda radial tarmoq va tizimdan oqadigan quvvatni hamda isrofgarchiliklarni quyidagi almashtirish sxemaga asoslanib hisoblashlar bajariladi.



2-rasm

2-rasmdan ko`rinadiki, liniyaning oxiridagi aktiv va reaktiv quvvatlar quyidagilarga teng:

PL11=PT[kVt]; QL11=QT – QS/2 [kVar].

Liniyaning aktiv va reaktiv quvvat isroflarini aniqlaymiz:

ΔPL=(Rl112+QL112)PL/U1H2 [kVt]

ΔQL =(PL112+QT112)XL/U1H2 [kVar]

Liniyadagi isrofni nazarda tutgan holda uning oxiridagi quvvatlar quyidagicha bo`ladi:

PL1=PL11+ΔPL[kVt]; QL1=QL11+ΔQL [kVar]

Natijada liniyaning boshlang`ich qismidagi quvvatni aniqlaymiz.

PL=PL1 [KBT]; QL = QL1 – QC /2 [kVar]

Liniyadagi elektr energiyasining isrofi quyidagicha bo`ladi:

ΔAL= ΔPL **τ** [kVt. S/yil ]

Elektr energiyasining uzatish liniyasiga tanlangan simidagi kuchlanish isrofini aniqlash quyidagi formula bilan tekshiriladi: Ya'ni,

ΔUL=( PL1RL+ QL1XL) /UL [kV]

Kuchlanish isrofi havo liniyalarida ΔUL 5%gacha bo`lishi kerak.

ΔU%= ΔUL 100%/ UL11 ≤5%

Bu yerda UL11-liniyaning oxirgi qismidagi kuchlanish, bu transformatorning yuqori chulg`amiga ulanadigan U1 kuchlanishga mos keladi. U oolda liniyaning boshlang`ich qismidagi kuchlanish;

UL1UL+ ΔUL [kV] bo`ladi.

Liniyaning foydali ish koeffitsiyenti va quvvat koeffitsiyentini aniqlaymiz.

η=PL11 / PL cos **φ**L =PL / SL

bu yerda, SL=PL+jQL [kVA] kompleks ko`rinishi yoki

S=√ PL2+QL2 [kVA]

Elektr tarmoq va tizimining iqtisodiy ko`rsatgichlarini hisoblaymiz. Kapital mablag` yig`indisi quyidagicha aniqlanadi:

ΣK=ΣKp/st+ΣKL [ming so`m]

Bu yerda, ΣKp/st, ΣKL -transformator va liniyalarning narxi (9,11-jadvaldan olinadi). Transformator va liniyalarning amartizatsiyaga ajratilgan mablag`ini hisobga olgan holda elektr tarmog`iga har yili ketadigan xarajatni aniqlaymiz:

ΣG=Gp/st+G L-GΔA [m.so’m]

Bu yerda,

Gp/st= ΣKp/stPa.tr [m.so’m]

G L= ΣKLPa.L [m.so’m]

GΔA=βΔA [m.so’m]

Pa.tr; Pa.L-transformator va liniyalar uchun har yili ajratiladigan umumiy narxiga nisbatan olinadigan amortizatsiya koeffitsiyent.(12-jadval). β-erkin narxda baholanadigan 1kVt\*soat elektr energiyaning narxi. Elektr tarmogi va tizimi uchun keltirilgan xarajat quyidagicha aniqlanadi:

Z=E nΣK+ΔG [m.so’m]

E N=0,12÷0,15 normativ koeffitsiyent.

Agar berilgan nazorat ishini ikki yoki uchdan ortiq variantlarda hisoblanib chiqilsa variantlarni taqqoslash jarayonida Zmin variant eng optimal hisoblanadi.

2-jadval.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | Variant | | S  [kVА] | | cosφ | | U1  [kV] | | U2  [кV| | | *l*  [km] | | Тmax  [soat] | |
| **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | ***7*** | | **8** | |
| 1 | | 01.51 | | 1200 | | 0,8 | | 35 | | 10 | | 12 | | 5000 | |
| *2* | | 02.52 | | 2000 | | 0,85 | | 110 | | 10 | | 20 | | 4000 | |
| 3 | | 03,53 | | 5000 | | 0,84 | | 110 | | 10 | | 15 | | 6000 | |
| 4 | | 04.54 | | 7000 | | 0,80 | | 220 | | 35 | | 15 | | 4500 | |
| 5 | | 05.55 | | 4500 | | 0,9 | | 110 | | 6,3 | | 20 | | 5500 | |
| 6 | | 06.56 | | 8000 | | 0,85 | | 220 | | 35 | | 15 | | 3500 | |
| 7 | | 07.57 | | 1100 | | 0,86 | | 110 | | 10 | | 20 | | 4000 | |
| 8 | | 08.58 | | 4800 | | 0,8 | | 110 | | 10 | | 15 | | 4500 | |
| 9 | | 09.59 | | 9000 | | 0,75 | | 220 | | 35 | | 20 | | 5000 | |
| 10 | | 10.60 | | 1400 | | 0,8 | | 35 | | 63 | | 15 | | 5500 | |
| 11 | | 11.61 | | 4000 | | 0,85 | | 110 | | 10 | | 20 | | 6000 | |
| 112 | | 12.62 | | 9500 | | 0,8 | | 220 | | 35 | | 15 | | 3000 | |
| 13 | | 13.63 | | 8000 | | 0,9 | | 220 | | 35 | | 20 | | 3500 | |
| 14 | | 14.64 | | 6200 | | 0,85 | | 110 | | 10 | | 15 | | 4000 | |
| 15 | | 15.65 | | 10500 | | 0,9 | | 220 | | 35 | | 20 | | 4500 | |
| 16 | | 16.66 | | 1600 | | 0,85 | | 35 | | 6,3 | | 15 | | 5000 | |
| 17 | | 17.67 | | 2400 | | 0,8 | | 35 | | 10 | | 20 | | 5500 | |
| 18 | | 18.68 | | 9200 | | 0,8 | | 110 | | 10 | | 15 | | 6000 | |
| 19 | | 19,69 | | 3600 | | 0,82 | | 35 | | 10 | | 22 | | 4500 | |
| 20 | | 20.70 | | 8500 | | 0,8 | | 110 | | 10 | | 15 | | 3000 | |
| 21 | | 21.71 | | 1600 | | 0,85 | | 35 | | 6,3 | | 20 | | 3500 | |
| 22 | | 22.72 | | 12000 | | 0,86 | | 220 | | 35 | | 15 | | 4000 | |
| 23 | | 23.73 | | 3200 | | 0,9 | | 110 | | 10 | | 15 | | 5000 | |
| 24 | | 24.74 | | 1300 | | 0,85 | | 35 | | 6,3 | | 20 | | 6000 | |
| 25 | | 25,75 | | 1900 | | 0,85 | | 35 | | 10 | | 15 | | 5500 | |
| 26 | | 26.76 | | 2400 | | 0.8 | | 35 | | 10 | | 20 | | 3000 | |
| 27 | | 27.77 | | 6400 | | 0,8 | | 110 | | 10 | | 15 | | 4500 | |
| 28 | | 28,78 | | 12600 | | 0,85 | | 220 | | 35 | | 20 | | 6000 | |
| 29 | | 29.79 | | 10400 | | 0,8 | | 220 | | 35 | | 10 | | 3500 | |
| **1** | | **2** | | **3** | | **4** | | **5** | | **6** | | ***7*** | | **8** | |
| 30 | | 30,80 | | 8600 | | 0,9 | | 110 | | 6,3 | | 20 | | 4000 | |
| 31 | | 31,81 | | 3200 | | 0,85 | | 35 | | 6,3 | | 15 | | 5500 | |
| 32 | | 32,82 | | 1800 | | 0,9 | | 35 | | 10 | | 20 | | 3000 | |
| 33 | | 33.83 | | 2400 | | 0,8 | | 35 | | 10 | | 15 | | 5000 | |
| 34 | | 34.84 | | 7600 | | 0,85 | | 35 | | 10 | | 20 | | 4500 | |
| 35 | | 35.85 | | 8200 | | 0,9 | | 110 | | 6.3 | | 20 | | 4000 | |
| 36 | | 36,86 | | 4200 | | 0,85 | | 110 | | 10 | | 15 | | 6000 | |
| 37 | | 37.87 | | 3400 | | 0.8 | | 35 | | 6.3 | | 20 | | 5500 | |
| 38 | | 38,88 | | 3200 | | 0,8 | | 35 | | 10 | | 15 | | 4500 | |
| 39 | | 39.89 | | 10200 | | 0,85 | | 110 | | 10 | | 20 | | 3500 | |
| 40 | | 40.90 | | 8400 | | 0,8 | | 110 | | 10 | | 15 | | 3000 | |
| 41 | | 41.91 | | 6200 | | 0,9 | | 35 | | 10 | | 20 | | 4500 | |
| 42 | | 4292 | | 8200 | | 0,85 | | 35 | | 6,3 | | 15 | | 6000 | |
| 43 | | 43.93 | | 10400 | | 0,9 | | 35 | | 10 | | 20 | | 5000 | |
| 44 | | 44.94 | | 4600 | | 0,85 | | 35 | | 6,3 | | 15 | | 4000 | |
| 45 | | 45.95 | | 9400 | | 0,9 | | 35 | | 10 | | 20 | | 5500 | |
| 46 | | 46.96 | | 11400 | | 0,8 | | 110 | | 10 | | 15 | | 3500 | |
| 47 | | 47,97 | | 10400 | | 0,75 | | 35 | | 6,3 | | 20 | | 3000 | |
| 48 | | 48,98 | | 4100 | | 0,9 | | 35 | | 10 | | 15 | | 6000 | |
| 49 | | 49.99 | | 16300 | | 0.85 | | 110 | | 10 | | 15 | | 4500 | |
| 50 | | 50.100 | | 1800 | | 0.9 | | 35 | | 6.3 | | 20 | | 5000 | |

**Kurs loyihasini bajarish uslubiyoti**

**l.Kurs loyihasini bajarishdan maqsad.**

"Elektr tarmoq va tizimlari" fanidan kurs loyihasini bajarish asosan yakunlovchi pog`ona bo`lib talabalarning nazariy bilimlarini yanada mustahkamlashga qaratilgan. Bunda quyidagilar alohida e'tiborga loyiqdir;

-Kurs loyihasini loyihalashtirish bilan amaliy bilimlarini mustahkamlaydi;

-Kerakli adabiyotlardan foydalanishni o`rganadilar;

-Texnik-iqtisodiy baholanish va hisoblashlarga e'tiborini kuchaytiradilar;

-Mutaxascislik fanlarga bog`lab muhandislik mashqlarni mustaqil yechish qobiliyatini oshiradilar;

-Bitiruv ishi loyihasi va bitiruv ishi ishlarini bajarishga o`zlarini yana bir bor tayyorlaydilar.

**2.Kurs loyihasining topshirig`i.**

Berilgan rayon uchun elektr energiya bilan taminlanishining qulay variantini ishlab chiqish. Bunda kurs loyihasi quyidagi qiymatlardan iborat:

1.Loyiha rejasi, iste'molchilarning joylashish o`rni bilan birgalikda.

2.Eng yuqori yuklama rejimidagi iste'mol qilayotgan aktiv quvvat (Rn)

3.Eng yuqori foydalanish vaqtiga (**Tmax**) mos keluvchi quvvat koeffitsiyenti (**cosφ**) va iste'molchilarning elektr energiya bilan ta'minlanish ishonchliligini oshirish.

Buning uchun elektr tarmoq sxemasi quyidagi asosiy talablarga javob berishi shart;

1. Elektr energiya bilan ta'minlanishni to`xtovsiz ishonchliligini va sifatini oshirish,

2.Elektr energiya bilan ta'minlanish iqtisodiy jihatdan qulaylik keltirish.

Elektr energiya bilan ta'minlanishing ishonchiiligini oshirish uchun iste'molchilarni 3ta toifaga (kategoriya) ajratiladi. 1-toifali iste'molchilar asosan 100% energiya bilan ta'minlanish kerak, Buning uchun bir-biriga bog`liq bo`lmagan ikki tomonlama energiya manbaidan energiya bilan taminlnanishi ikki simli elektr energiya uzatish liniyalar va ikki transformatorli podstantsiyalyardan foydalanish maqsadga muvofiqdir, 2-toifali istemolchilar esa baland kuchlanishga moslashtirilgan: ishonchliligi yuqori bo`lgan bir simli elektr uzatish liniyalaridan foydalanib yuklama koeffitsiyenti **KYu=0.75** bo`lgan ikki transformatorli podstantsiya yordamida elektr energiya bilan ta'minlanishni e'tiborga olish shart, 3-toifali istemolchilar ko`pincha bir simli liniyalar orqaga uzatiladigan elektr energiyani bir transformatorli podstantsiyalar yordamida ta'minlanadi. Bunda zaxiradagi ikkinchi transformator bir sutkada almashtirilish e'tiborga olinadi. Tanlangan simlar har tomonlama halokat yuz berganda qoniqtira olishligi e'tibordan holi emas.

Elektr tarmoq va tizimini loyihalashtirishda bir necha variantlar sxemalari asosida bir xil yo`nalishdagi hisoblashlar natijasi bilan iqtisodiy ko`rsatkichlari taqqoslanib, eng kam xarajatli variant qabul qilinadi.

### 3.Kurs loyihasining tushuntirish xati va grafik qismini

**rasmiylashtirish tartibi.**

Tushuntirish yozuv xati '"Elektr tarmoq va tizimlari" fanidan tugallangan hisoblashlar natijasida olingan hisobot sifatida quyidagi tartibda bajarilish tavsiya etiladi.

1. Titul varag`i.

2, Loyihaning berilishi va kalendar reja.

3.Kirish.

4.Hisoblashning asosiy qismi.

5.Izoh.

6. Loyihaning bajarishda kerakli adabiyotlar.

Tushuntirish xati 210x297 formatli oq qog`ozga 40-50 varaq yoziladi va loyihaning bo`limlari asosan quyidagi foyizlarni tashkil qiladi;

Quvvatlar muvozanati va kondensator qurilmasini

hisoblash -10% ;

Sxemani tanlash, simning ko`ndalang kesim yuzasini va transformatorni tanlash- 40% ;

Sim va transformatorlarni parametrlarini aniqlash-20%;

Texnik-iqtisodiy hisoblash va variantlarni

taqqoslash -30%.

Kurs loyihasining matni qisqa va texnik jihatidan yorqin yozilgan bo`lib, barcha ketma-ketliklar asosida ko`rsatilgan usul va formulalardan foydalangan holda bajarilishi ma'quldir. Hisoblashdagi formulalar natijasidagi yechimlar bir xil birliklar tizimiga keltirilishi shart

Loyihaning grafik qismi 24 hajmdagi 2ta vatman qog`ozga chizilib loyihachi va kurs loyixaning maslahatchi o`qituvchi qo`l qo`yib tasdiqlangandan keyin himoya qilishga ruxsat etiladi.

**4.Kupc loyihasining titul varag‘i.**

**NAVOIY DAVLAT KONCHILIK INSTITUTI**

**«ENERGO MEXANIKA» FAKULTETI**

**«ELEKTR ENERGETIKASI» KAFEDRASI**

“Tasdiqlayman”

«\_\_\_\_» «\_\_\_\_\_\_\_\_\_\_\_\_\_» 2016 y.

«Elektr energetikasi» kafedrasi mudiri

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**T O P SH I R I Q №\_\_\_\_\_\_**

«Elektr ta’minoti tizimida elektr tarmoqlar» fanidan kurs loyixasi.

Talaba \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Gurux \_\_\_\_\_\_\_\_\_\_

Topshirik berilgan kun «\_\_\_\_» \_\_\_\_\_\_\_\_\_2016 yil

**Loyixa mavzusi: «Rayon elektr tarmoklari»**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| № | **R,** MVt | cosϕ | x | y | **Un,** kV |
| p/st  1  2  3  4  5 |  |  |  |  |  |

U

10

9

8

7

6

5

4

3

2

1

1 2 3 4 5 6 7 8 9 10 X

Loyihalar topshirish davri: Reja \_\_\_\_\_\_\_\_\_\_\_\_Amalda \_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Bosqichlar | | | | | Himoya |
| 1 | 2 | 3 | 4 | 5 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

Rahbar \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**5.Topshiriq bilan tanishish va quvvatlar muvozanatlashuvini hisoblash.**

Elektr tarmoq va tizimlarini loyihalashtirishning asosiy ko’rsatkich-laridan biri berilgan rayonning elektr energiyasi bilan taminlanish tavsifini o’rganishdir. Buning uchun :

-Loyihalashtirilayotgan joyning grafik o`rni;

-Iqlim sharoiti;

-Elektr energiyasi iste'molchilarning tarkibi va tavsifi;

-Elektr energiyasi haqida ma'lumot.

Elektr tarmog`ining loyihalashtirish tizimi va uning to`g`ri sxemasini tanlab olish quvvatlar muvozanatini hisoblash o`ta muhimdir.

**Aktiv quvvat muvozanatini topamiz:**

ΣPG = ΣPyukl +ΔRtar + Rrez [MVt]

Bu yerda, ΣPG -o`rnatilgan generatsiyali quvvat yig`indisi;

ΣPyukl -yuklamadagi quvvat yig`indisi; ΔRtar –tarmoqdagi aktiv quvvat isrofi;

Rrez -rezervdagi aktiv quvvat.

Yuklamaning aktiv quvvat yig`indisi quyidagicha topiladi:

ΣPyukl =P1+ P2 + P3 + P4 + P5  [MVt]

P1+ P2 + P3 + P4 + P5-iste'molchilarning berilgan aktiv quvvati.

Tarmoqdagi aktiv quvvat isrofi quyidagicha;

ΔPtar=(6 ÷ 10)% ΔPyukl [MVt]

Rezervdagi aktiv quvvat esa:

Rrez =10% ΔPyukl [MVt]

Rezervdagi aktiv quvvat xisobiga elektr energiyasi iste'molchilarini energiya bilan ta'minlanishining ishonchliligini oshiradi,

**Reaktiv quvvat muvozanatlashuvi.**

Reaktiv quvvat muvozanatlashuvi bilan rayon elektr tarmoqlarining sxemasini tanlashda qo`shimcha manbaga ega bo`lgan iste'molchilarning elektr energiya bilan ta'minlanishining sifatiga alohida e'tibor qaratiladi. Yani reaktiv quvvatni muvozanatlash uchun kondensator batareyalar yordamida xisoblanib rayon elektr tarmoqlarining texnik iqtisodiy ko`rsatkichlarini yanada yaxshilash o`ta muhimdir.

Buning uchun quyidagi tenglik hisoblanishi talab qilinadi:

ΣQG + ΣQKU = ΣQYUKL + ΔQTR +QREZ [MVar]

Bu yerda, ΣQG -o`rnatilgan generatsiyali reaktiv quvvat yig`indisi;

ΣQKU -kondensator batareya quvvatining yig`indisi;

ΣQYUKL -yuklamaning reaktiv quvvat yig`indisi;

ΔQTR -transformatordagi reaktiv quvvat isrofi,

QREZ -rezervdagi reaktiv quvvat.

Generetsiyalangan reaktiv quvvat yig`indisi berilgan rayon elektr tarmog`idagi aktiv quvvat unga mos kelgan quvvat koeffitsiyenta orqali topiladi:

ΣQG=ΣPyukl tgφ [MVar]

tgφ ning qiymati cosφ orqali topiladi. Yuklamaning reaktiv quvvati quyidagicha;

ΣQyukl=Q1+Q2+Q3+Q4+Q5 [MVar]

Transformatordagi reaktiv quvvat isrofini aniqlash asosiy ko`rsatkichlardan biri bo`lib u quyidagicha topiladi:

ΔQtr=10%ΣSyukl [MVar]

Bu yerda, ΣSyukl -yuklamaning to`la quvvati,

ΣSyukl= ΣPyukl +j ΣQyukl =√ ΣPyukl2+ ΣQyukl2 [ MVA]

Rezervdagi reaktiv quvvat quyidagicha aniqlanadi;

Qrez=10% ΣQyukl [MVar]

Reaktiv quvvatning qoplagichini aniqlash uchun kondensator batareyaning quvvatini hisoblash quyidagi tenglik o`rinlidir:

ΣQku = ΣQyukl +ΣQtr + Qrez -ΣQG [ MVar]

yoki ΣQku=ΣPyukl (tg φest – tg φn)

Bu yerda tgφest = ΣPyukl / ΣSyukl

yoki cos φest = (cosφ1 +cosφ2 +cosφ3 +cosφ4 +cosφ5) / 5

Topilgan quvvat koeffitsiyentiga mos holda **tgφest**  aniqlanadi.

tgφn =0,328cosφn =0,95

ga to`g`ri kelgan holda qabul qilinadi. Natijada hisoblangan kondensator batareyaning quvvati φQku ga qarab 8-jadvaldan kondensator batareya tanlanadi va istemolchining to`la quvvati hisoblanadi.

Syukl= ΣPyukl + j(ΣQyukl - Qku1) [ MVA]

Qku1 -jadvaldan tanlangan kondensator batareyaning quvvati.

Shunday qilib kondensator batareyalar yordamida reaktiv quvvatni qoplash asosan iste'molchiga yaqin joyga o`rnatiladi.Unda reaktiv quvvatni oshirish bilan aktiv quvvat isrofini kamaytiradi va texnik iqtisodiy ko`rsatkichlari elektr energiyaning ta'minlanish sifatini yanada yaxshilaydi.

**6.Elektr tarmoqlar sxemasini tanlash.**

Kurs loyihasini bajarishda elektr tarmoqlarining sxemasini tanlash uchun bir nechta (10-12) variantlar chiziladi, ularning podstantsiyalararo masofalari, ya'ni elektr uzatish liniyalarining uzunliklariga qarab 2ta eng qulay va ishonchliligi yuqori bo`lgan variant tanlab olinadi.Bu ikki variantni texnik iqtisodiy ko`rsatkichlariga qarab taqqoslanadi. Rayon elektr tarmoqlari asosan 3 xil ulanish sxemasiga ega;

1 )Radial (ochiq tarmoqlangan).

2)Halqasimon (yopiq zanjirli sxema).

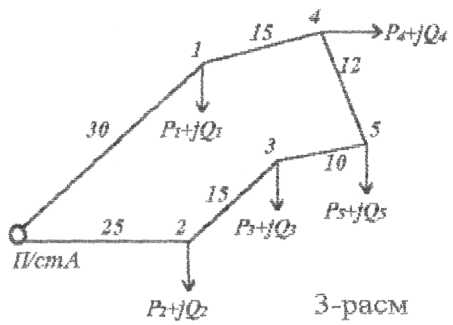
3)Aralash.

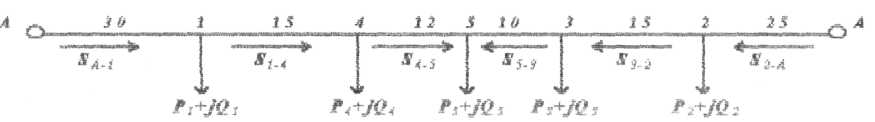
Mazkur ulanish sxemalari istemolchilarning toifalariga qarab, uzatish liniyalarning masofalariga, rezerv quvvatlardan foydalanish va rangli metallarning kam xarajat qilinishlari inobatga olinadi, Shunday qilib tanlanayotgan sxemadan ishonchililik, sifatli va iqtisodiy jihatdan kam xarajatli bo`lishligi, har bir podstantsiyadagi transformatorlarning soni va quvvati, kommutatsion apparatlar muhim o`rin egallashligini talab qilinadi.

10-12 ta konfiguratsiyadan 2 ta optimal variantni tanlab olish loyihachida o`ta muhim qobiliyatni, fikrlashni, oldindan maqsadni ko`ra bilishni talab qiladi. Bunda kurs loyihasining raxbari bilan kelishilgan holda sxema tanlansa maqsadga muvofiq bo`ladi.

**7-Tarmoqda quvvatlar tarqalish nuqtasini aniqlash.**

Shunday qilib quvvatlar tar-qalish nuqtasini aniqlash uchun oddiy halqasimon yopiq zanjirli tarmoqni tahlil qilamiz. Halqa-simon tarmoq ikki tomonlama man-bali iste'molchilar sifatida qara-ladi. Buning uchun. quyidagi tanlan-gan sxemani ko`rib chiqamiz. Bunda bir iste'molchidan ikkinchi iste-molchigacha bo`lgan masofa masshtabida hisoblanadi. Bu halqali tarmoqni ochiq tizimga. aylatiriladi va quv-vatlar yo`nalishi bo`yicha hisoblanadi.





SA-1={(P1+jQ1)30+(P4+jQ4)45+(P5+jQ5)57+(P3+jQ3)67+(P2+jQ2)82}/(Σ*l*=

=107)={(R130+jQ130+P445+jQ445+P557+jQ557+P367+jQ367+P282+jQ282)}/

/107={ΣP+jQ}/107=PA-1+jQA-1 [МVА]

S1-4=SA-1-S1=PA-1+jQA-1-(P1+jQ1) [МVА]

S4-5=S1-4-S4 [МVА]

S5-3=S4-5-S5 [МVА] ammo, agar S4-5<S5 bo`lsa, u holda

hisoblash ikkinchi tomondan hisoblanadi,ya'ni

SA-21={(P2+jQ2)25+(P3+jQ3)40+(P5+jQ5)50+(P4+jQ4)62+(P1+jQ1)77/

/{Σ*l*=107}={ΣP+jΣQ}/107=P1A-2+jQ1A-2 [МVА]

S2-3=S1A-2-S2 [МVА] S3-5=S2-3-S3  [МVА]

Bunday keyingi hisoblash to`xtatiladi, chunki

S5-4 =S3-5 -S5 da S5-4<S5 bo`ladi.

Nihoyat ikkinchi tomon manbadan oqayotgan quvvat yuqoridagi hisoblash shartlarini bajarib quvvatlar tarqalish nuqtasi topildi. Misolda 5-nuqtada har ikki tomonlama quvvatlar oqishi to`xtatiladi.

**8.Elektr tarmoqlarida nominal kuchlanishni tanlash.**

Elektr tarmoq va tizimlarida nominal kuchlanishi tanlash texnik-iqtisodiy ko`rsatkichlar uchun o`ta muhim rol o`ynaydi. Umumiy olganda elektr tarmoqlari orqali quvvatni uzatishda har qanday pog`onali standart kuchlanishni qabul qilishi mumkin. Standart nominal kuchlanishga 6, 10; 35, 110; 220; 330; 500; 750 [kV] kuchlanishlar kiradi. Kurs loyihasini loyihalashda quyidagi ko`rinishda yoki 13-jadvaldan foydalanish tavsiya qilinadi.

2 ÷ 10 [MVt] 50 ÷ 20[km] 35 [kV]

10 ÷ 50[MVt] 150 ÷ 50[km] 110 [kV]

100 ÷ 150[MVt] 300 ÷ 200[km] 220 [kV]

400 ÷ 600[MVt] 500 ÷ 1000 [km] 500 [kV]

Bu ko`rsatkichlar loyihalashtirishda kuchlanish tanlashning yaqinlashuv tavsiyasi hisoblanadi. Kuchlanishni qabul qilish asosan texnik-iqtisodiy hisoblashdan keyin qabul qilinganligi maqsadlidir. Nominal kuchlanishni tanlashda asosiy takliflardan biri havo uzatish liniyalarga optimal simlarni tanlashga rioya qilinadi. Buning uchun. minimal. va maksimal ko`ndalang kesimga ega bo`lgan simlarni kuchlanishlarga mos kelishi karonaga bog`lash muhim vazifadir.

220 kV uchun AS-240 mm2

110 kV uchun AS-70 mm2

35 kV uchun AS-50 mm2  minimal bo`ladi.

Maksimal ko`rsatkichlar quyidagicha;

35 kV uchun AS-95 mm2

110 kV uchun AS-240 mm2

220 kV uchun AS-400 -500 mm2

Kuchlanishni tanlashda taxminiy yaqinlashuv qiymatini quyidagi formula yordamida aniqlanadi:

U=4,34√0,016LP ,[kV];

Bu yerda, *L*-manbadan iste'molchigacha bo`lgan masofa; R-uzatiladigan aktiv quvvat.

Hisoblangan yuklamani va o`nta mos qabul qilingan kuchlanishni quyidagi jadvalga yoziladi:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rasmga binoan tarmoqlararo  qismlar | Masofa  L(km) | Hisoblangan yuklama | | Nominal kuchlanish  U (kV) |
| P+jQ [kVA]  P+jQ [кВА] | S[kVA] |
| А-1  1-2  va h.k |  |  |  |  |

**9-Kuch transformatorini tanlash.**

Kuch transformatorlarini (avtotransformator) tanlash iste'molchilarning manbadan olgan kuchlanishlari texnik-iqtisodiy jihatdan chidamli va ishonchli ta'minlash muhim rol o`ynaydi. Transformatorlarning nominal quvvati Kilovolt-amper yoki Megavolt-amperlarda o`lchanib, istemolchining To`la quvvatiga asoslangan holda tanlanadi. Amaliyotda podstantsiyalarga tanlanayotgan transformatorlar istemol-chilarning toifalariga qarab ikkita yoki bitga qabul qilinadi, yani barcha yuklamalarni normal holatda energiya bilan taminlanishi 40% gacha yuklash, halokat holatda esa 0,7 ÷ 0,75 oraliqlarda qabul qilinadi. Umumiy holda transformatorlarning yuklanish koeffitsiyenti quyidagi taxminiy oraliqlarda tavsiya etiladi.

Agar I toifa bo`lsa Kyu=0,6 ÷0,75 bo`ladi.

II toifa bo`lsa Kyu=0,7 ÷ 0,85 bo`ladi.

III toifa bo`lsa Kyu=0,8 ÷ 0,95 bo`ladi.

Ko`pincha III toifali iste'molchilar uchun quvvati Snt= 6,3 [MVA]gacha keladigan bitta transformatorli podstantsiya tanlanadi. Tanlanayotgan transformatorlar nominal standart kuchlanishlarga. moslashtiriladi.

Kuchlanishlari 220/110/10,5 va 110/35/10,5 bulgan 3 fazali 3 chulg`amli transformatorlar va avtotransformatorlarning quvvati quyidagi foyizlarda yuklantirilishi shart bo`ladi.

Ya'ni,

100/100/100

100/100/66,7

100/66,7/100

100/66,7/66,7

Ikki transformatorli podstantsiyalarga tanlanayotgan transformatorlar quyidagi shartlarga rioya qilinadi. Uning yuklama koeffitsiyentning yuklanish chegarasi 1,4 ya'ni 40% o`ta yuklash qobiliyati inobatga olinadi va uning taxminiy yaqinlashuv quvvati quyidagicha topiladi: Snt ≥ Syukl/1,4 Yuklama koeffitsiyenti esa:

Kyu= Syukl / Snt = 0,7 ÷0,85

Transformator va avtotransformatorlarning kuchlanishga bog`liq holda nominal quvvatlarni tanlash 9-jadvaldan foydalaniladi.

**10.Havo liniyalariga tayanchlar va simning**

**ko`ndalang kesimi yuzasini tanlash.**

Kuchlanishi Un =35 kV va undan yuqori bo`lgan havo liniyalaridaga elektr tarmoqlariga bir simli va ikki simli yog`och, temir va temir betonli tayanchlar qabul qilinadi. Tayanchlar loyihalashtirilayotgan rayonning iqlimiga mos holda tanlanadi.

Temir betonli tayanch yuqori namlikka ega bo`lgan rayonlarda, temir va yog`och tayanchlarning texnik-iqtisodiy ko`rsatgichi ma'qul bo`lmagan joylarga loyihalashtiriladi.

Temirli tayanchlar asosan o`rnatilishi mumkin bo`lgan va kuchlanishi Un=35kV dan yuqori bo`lgan tog`li o`lkalarda o`rnatiladi.

Yog`och tayanchlar esa o`rmon xo`jaligiga tanqis bo`lmagan va namligi kam bo`lgan rayonlarga loyihalashtiriladi.

Shunday qilib tayanchlar yordamida elektr energiyani istemolchilarga yetkazib berish uchun simlarning ko`ndalang kesim yuzasini tanlash quyidagi formuladan foydalaniladi;

Ii=Syukl/√3Un

Bu yerda:

Ii -liniyadagi ishchi tok;

Syukl -yuklamaning to`la quvvati;

Un -liniyadagi nominal kuchlanish.

Ishchi tokning aniqlanishi bilan simning ko`ndalang kesimini tanlaymiz yoki yaqinlashuv formulasi orqali aniqlaymiz:

F = Ii / jik

Bu yerda:

F-simning ko`ndalang kesim yuzasi;

jik –iqtisodiy tok zichligi [ A/mm2]

jik =1,3 ÷1,5 [A/mm2]

Hisoblangan ishchi toki va F = IU/jik shartga asosan 11-jadvaldan simning ko`ndalang kesimi yuzasi tanlanadi. Ikki simli havo liniyasi uchun:



va j=F/2 shart o`rinli

Tanlangan simning ko`ndalang kesim yuzasini har bir tarmoq uchun halokat holatlarda tekshirilib ko`riladi va quyidagi shartlar qanoatlantirilishi kerak:

Ii ≤Irux yoki Itan ≤ Irux

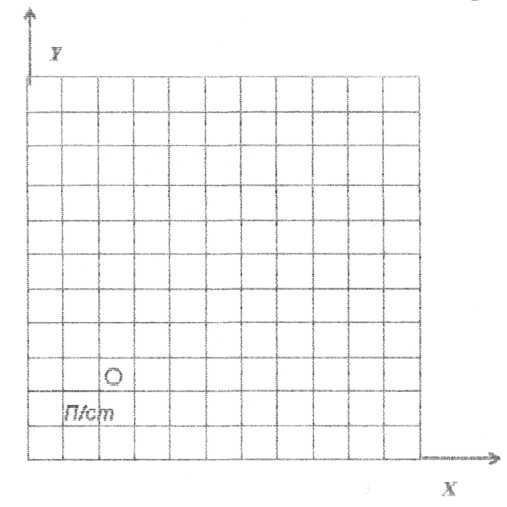
Irux -tanlangan simning ruxsat etilgan toki,

**11.Tarmoqning bir liniyali elektr sxemasi va almashtirish**

**sxemasi.**

Kurs loyihasini hisoblashdan keyin elektr tarmog`ining bir liniyali elektr sxemasi va o`nta mos keluvchi almashtirish sxemasini chizib tahlil qilish o`ta muhim vazifadir.Sxemada GOSTga asoslanib transformator podstantsiyani, havo liniyasi, uning uzunligi, simning turi, ko`ndalang kesim yuzasi ko`rsatiladi. Almashtirish sxemasida elektr tarmog`i parametrlarining hisoblangan qiymatlari ko`rsatiladi.Bu sxemalarni chizish b va 7 rasmdan foydalanish tavsiya etiladi.

**12.Kurs loyihasining variantlari va uni bajarish tartiblari.**



|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| № | | №  Iste'  molchi | | R  MVt | | cosφ | | X | Y | | Toifa% | | | | | | Un  (kV) | | | Tmax  (s) | | masshtab  (km) | |
| I | | II | | III | |  | | |  | |  | |
| **1** | | **2** | | **3** | | **4** | | **5** | **6** | | **7** | | **8** | | **9** | | **10** | | | **11** | | **12** | |
| 1  51 | | P/st | |  | |  | | 2 | 3 | |  | |  | |  | |  | | | 5100 | |  | |
| 1 | | 24 | | 0,75 | | 6 | 5 | | 15 | | 45 | | 40 | | 10 | | |  | |  | |
| 2 | | 10 | | 0,80 | | 6 | 7 | | 20 | | 40 | | 40 | | 10 | | |  | |  | |
| 3 | | 14 | | 0,85 | | 8 | 5 | | - | | 40 | | 45 | | 6 | | |  | |  | |
| 4 | | 16 | | 0,90 | | 9 | 6 | | 15 | | 50 | | 50 | | 10 | | |  | |  | |
| 5 | | 8 | | 0,95 | | 9 | 7 | | 5 | | 50 | | 45 | | 10 | | |  | |  | |
| 2  52 | | p/st | |  | |  | | 9 | 2 | |  | |  | |  | |  | | | 5400 | |  | |
| 1 | | 15 | | 0,90 | | 6 | 5 | | 10 | | 50 | | 40 | | 6 | | |  | |  | |
| 2 | | 9 | | 0,85 | | 8 | 6 | | 15 | | 45 | | 40 | | 6 | | |  | |  | |
| 3 | | 10 | | 0,75 | | 6 | 7 | | 15 | | 35 | | 50 | | 10 | | |  | |  | |
| 4 | | 2 | | 0,95 | | 4 | 7 | | - | | 50 | | 50 | | 10 | | |  | |  | |
| 5 | | 4 | | 0,80 | | 7 | 9 | | 5 | | 40 | | 55 | | 10 | | |  | |  | |
| 3  53 | | p/st | |  | |  | | 9 | 8 | |  | |  | |  | |  | | | 5700 | |  | |
| 1 | | 25 | | 0,75 | | 7 | б | | 20 | | 45 | | 35 | | 10 | | |  | |  | |
| 2 | | 20 | | 0,95 | | 9 | 4 | | 10 | | 35 | | 55 | | 10 | | |  | |  | |
| 3 | | 12 | | 0,90 | | 6 | 2 | | 5 | | 45 | | 50 | | 6 | | |  | |  | |
| 4 | | 8 | | 0,85 | | 7 | 3 | | 15 | | 45 | | 40 | | 10 | | |  | |  | |
| 5 | | 4 | | 0.80 | | 9 | 2 | | 10 | | 40 | | 50 | | 10 | | |  | |  | |
| 4  54 | | p/st | |  | |  | | 2 | 9 | |  | |  | |  | |  | | | 6000 | |  | |
| 1 | | 22 | | 0,80 | | 6 | 7 | | 15 | | 50 | | 35 | | 10 | | |  | |  | |
| 2 | | 25 | | 0,95 | | 8 | 9 | | 5 | | 45 | | 50 | | 6 | | |  | |  | |
| 3 | | 14 | | 0,75 | | 8 | 7 | | 20 | | 40 | | 40 | | 6 | | |  | |  | |
| 4 | | 6 | | 0,80 | | 10 | 8 | | 10 | | 35 | | 55 | | 10 | | |  | |  | |
| 5 | | 8 | | 0,90 | | 9 | 5 | | - | | 50 | | 50 | | 10 | | |  | |  | |
| 5  55 | | p/st | |  | |  | | 1 | 2 | |  | |  | |  | |  | | | 4000 | |  | |
| 1 | | 20 | | 0,75 | | 5 | 5 | | 20 | | 50 | | 30 | | 10 | | |  | |  | |
| 2 | | 12 | | 0,85 | | 7 | 4 | | 15 | | 50 | | 35 | | 6 | | |  | |  | |
| 3 | | 10 | | 0,95 | | 7 | 6 | | 5 | | 35 | | 60 | | 10 | | |  | |  | |
| 4 | | 4 | | 0,90 | | 9 | 6 | | 5 | | 35 | | 60 | | 10 | | |  | |  | |
|  | | 5 | | 6 | | 0,80 | | б | 7 | | 10 | | 40 | | 50 | | 10 | | |  | |  | |
| **1** | | **2** | | **3** | | **4** | **5** | | **6** | | **7** | | **8** | | **9** | | **10** | **11** | | **12** | |
| 6  56 | | p/st | |  | |  | 6 | | 1 | |  | |  | |  | |  | 4300 | |  | |
| 1 | | 20 | | 0,85 | 7 | | 5 | | 15 | | 40 | | 45 | | 10 |  | |  | |
| 2 | | 15 | | 0,75 | 5 | | 6 | | 15 | | 45 | | 40 | | б |  | |  | |
| 3 | | 25 | | 0,90 | 7 | | 7 | | 10 | | 50 | | 40 | | 6 |  | |  | |
| 4 | | 10 | | 0,80 | 4 | | 7 | | 10 | | 50 | | 40 | | 10 |  | |  | |
| 5 | | 5 | | 0,95 | 6 | | 8 | | 5 | | 40 | | 55 | | 10 |  | |  | |
| 7  57 | | p/st | |  | |  | 9 | | 6 | |  | |  | |  | |  | 4600 | |  | |
| 1 | | 18 | | 0,95 | 6 | | б | | 5 | | 50 | | 45 | | 6 |  | |  | |
| 2 | | 24 | | 0,75 | 7 | | 8 | | 15 | | 40 | | 45 | | 10 |  | |  | |
| 3 | | 10 | | 0,90 | 5 | | 8 | | 15 | | 45 | | 40 | | б |  | |  | |
| 4 | | 10 | | 0,90 | 4 | | 7 | | 20 | | 40 | | 40 | | 10 |  | |  | |
| 5 | | 6 | | 0,85 | 3 | | 8 | | 15 | | 40 | | 45 | | 6 |  | |  | |
| 8  58 | | p/st | |  | |  | 9 | | 10 | |  | |  | |  | |  | 5800 | |  | |
| 1 | | 18 | | 0,95 | 6 | | 7 | | 10 | | 40 | | 50 | | 6 |  | |  | |
| 2 | | 9 | | 0,75 | 6 | | 5 | | 20 | | 40 | | 40 | | 10 |  | |  | |
| 3 | | 8 | | 0,90 | 4 | | 6 | | 5 | | 50 | | 45 | | 10 |  | |  | |
| 4 | | 10 | | 0,80 | 5 | | 4 | | 20 | | 35 | | 45 | | 10 |  | |  | |
| 5 | | 2 | | 0,88 | 3 | | 5 | | 15 | | 45 | | 40 | | 10 |  | |  | |
| 9  59 | | p/st | |  | |  | 1 | | 10 | |  | |  | |  | |  | 4600 | |  | |
| 1 | | 20 | | 0,90 | 4 | | 7 | | 10 | | 50 | | 40 | | 10 |  | |  | |
| 2 | | 16 | | 0,85 | 6 | | 7 | | 15 | | 45 | | 40 | | 10 |  | |  | |
| 3 | | 12 | | 0,75 | 3 | | 5 | | 15 | | 35 | | 50 | | 6 |  | |  | |
| 4 | | 10 | | 0,95 | 5 | | 5 | | -- | | 50 | | 50 | | 6 |  | |  | |
| 5 | | 6 | | 0,80 | 6 | | 3 | | 5 | | 40 | | 50 | | б |  | |  | |
| 10  60 | | p/st | |  | |  | 2 | | 2 | |  | |  | |  | |  | 4900 | |  | |
| 1 | | 12 | | 0,75 | 4 | | 5 | | 20 | | 45 | | 35 | | 6 |  | |  | |
| 2 | | 14 | | 0,95 | 6 | | 4 | | 10 | | 35 | | 55 | | 6 |  | |  | |
| 3 | | 16 | | 0,90 | 7 | | 6 | | 5 | | 45 | | 50 | | 10 |  | |  | |
| 4 | | 6 | | 0,80 | 6 | | 7 | | 10 | | 40 | | 50 | | 6 |  | |  | |
| 5 | | 4 | | 0,855 | 9 | | 5 | | 15 | | 45 | | 40 | | 6 |  | |  | |
| 11  61 | | p/st | |  | |  | 9 | | 2 | |  | |  | |  | |  | 5200 | |  | |
| 1 | | 20 | | 0,95 | 8 | | б | | 5 | | 45 | | 50 | | 10 |  | |  | |
| 2 | | 24 | | 0,80 | 7 | | 8 | | 15 | | 50 | | 35 | | 10 |  | |  | |
| 3 | | 16 | | 0,75 | 6 | | 6 | | 20 | | 40 | | 40 | | б |  | |  | |
| 4 | | 8 | | 0,80 | 5 | | 8 | | 10 | | 35 | | 55 | | 10 |  | |  | |
| 5 | | 2 | | 0,90 | 5 | | 5 | | -- | | 50 | | 50 | | 6 |  | |  | |
| 12  62 | | p/st | |  | |  | 9 | | 5 | |  | |  | |  | |  | 5800 | |  | |
| 1 | | 14 | | 0,75 | 6 | | 6 | | 20 | | 50 | | 30 | | 10 |  | |  | |
| 2 | | 18 | | 0,85 | 5 | | 8 | | 15 | | 50 | | 35 | | 6 |  | |  | |
| 3 | | 10 | | 0,95 | 4 | | 6 | | 5 | | 35 | | 60 | | 6 |  | |  | |
| 4 | | 6 | | 0,90 | 3 | | 8 | | 5 | | 35 | | 60 | | 6 |  | |  | |
| 5 | | 2 | | 0,90 | 5 | | 9 | | 10 | | 40 | | 50 | | 6 |  | |  | |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 13  63 | p/st |  |  | 7 | 10 |  |  |  |  | 3900 |  |
| 1 | 25 | 0,85 | 5 | 6 | 15 | 40 | 45 | 10 |  |  |
| 2 | 16 | 0,75 | 3 | б | 15 | 45 | 40 | б |  |  |
| 3 | 20 | 0,90 | 5 | 5 | 10 | 50 | 40 | 6 |  |  |
| 4 | 8 | 0,80 | 7 | 5 | 10 | 50 | 40 | 10 |  |  |
| 5 | 4 | 0,95 | 4 | 4 | 5 | 40 | 55 | 6 |  |  |
| 14  64 | p/st |  |  | 2 | 6 |  |  |  |  | 4100 |  |
| 1 | 14 | 0,95 | б | 5 | 10 | 40 | 50 | 10 |  |  |
| 2 | 12 | 0,75 | 7 | 4 | 20 | 40 | 40 | 6 |  |  |
| 3 | 10 | 0,90 | 8 | 7 | 5 | 50 | 45 | б |  |  |
| 4 | 6 | 0,80 | 9 | 6 | 20 | 35 | 45 | 10 |  |  |
| 5 | 8 | 0,88 | 9 | 4 | 15 | 45 | 40 | 10 |  |  |
| 15  65 | p/st |  |  | 7 | 3 |  |  |  |  | 4400 |  |
| 1 | 20 | 0,80 | 3 | 5 | 20 | 40 | 40 | 10 |  |  |
| 2 | 18 | 0,95 | 5 | б | 5 | 45 | 50 | 10 |  |  |
| 3 | 14 | 0,78 | 5 | 8 | 10 | 50 | 40 | 10 |  |  |
| 4 | б | 0,90 | 3 | 7 | 15 | 40 | 45 | 10 |  |  |
| 5 | 4 | 0,87 | 4 | 9 | — | 45 | 55 | 10 |  |  |
| 16  66 | p/st |  |  | 8 | 3 |  |  |  |  | 4700 |  |
| 1 | 18 | 0,75 | 8 | 7 | 15 | 45 | 40 | 10 |  |  |
| 2 | 25 | 0,90 | 9 | 8 | 10 | 50 | 40 | 10 |  |  |
| 3 | 10 | 0,87 | 16 | 7 | 10 | 50 | 40 | 10 |  |  |
| 4 | 12 | 0,95 | 7 | 9 | -- | 55 | 45 | 6 |  |  |
| 5 | 2 | 0,80 | 5 | 8 | 15 | 40 | 55 | б |  |  |
| 17  67 | p/st |  |  | 7 | 9 |  |  |  |  | 5000 |  |
| 1 | 18 | 0,90 | 7 | 6 | 25 | 50 | 25 | 10 |  |  |
| 2 | 9 | 0,87 | 8 | 4 | 20 | 50 | 30 | б |  |  |
| 3 | 8 | 0,95 | 5 | 5 | -- | 45 | 55 | 6 |  |  |
| 4 | 10 | 0,75 | 5 | 3 | 10 | 40 | 50 | б |  |  |
| 5 | 6 | 0,80 | 6 | 2 | 15 | 35 | 60 | 10 |  |  |
| 18  68 | p/st |  |  | 2 | 7 |  |  |  |  | 5600 |  |
| 1 | 20 | 0,80 | б | 7 | 20 | 50 | 30 | 10 |  |  |
| 2 | 16 | 0,87 | 5 | 5 | 25 | 45 | 30 | 10 |  |  |
| 3 | 14 | 0,90 | 7 | 4 | 5 | 40 | 55 | 6 |  |  |
| 4 | 12 | 0,75 | 8 | 6 | 10 | 45 | 45 | 6 |  |  |
| 5 | 2 | 0,85 | 9 | 5 | 15 | 45 | 40 | 6 |  |  |
| 19  69 | p/st |  |  | 4 | 2 |  |  |  |  | 5900 |  |
| 1 | 24 | 0,87 | 3 | 6 | 25 | 50 | 25 | 10 |  |  |
| 2 | 18 | 0,75 | б | 6 | 20 | 40 | 40 | 10 |  |  |
| 3 | 10 | 0,90 | 5 | 7 | 10 | 50 | 40 | 6 |  |  |
| 4 | 8 | 0,95 | 4 | 9 | — | 50 | 50 | 10 |  |  |
| 5 | 6 | 0,80 | 6 | 9 | 5 | 40 | 55 | 6 |  |  |
| 20  70 | p/st |  |  | 9 | 7 |  |  |  |  | 6200 |  |
| 1 | 20 | 0,75 | 6 | 6 | 25 | 50 | 25 | 10 |  |  |
| 2 | 16 | 0,90 | 4 | 7 | 10 | 50 | 40 | 10 |  |  |
| 3 | 14 | 0,80 | 4 | 6 | 15 | 45 | 40 | 6 |  |  |
| 4 | 12 | 0,87 | 3 | 4 | 15 | 45 | 40 | 6 |  |  |
| 5 | 10 | 0,95 | 5 | 4 | — | 50 | 50 | 10 |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 21  71 | p/st |  |  | 3 | 9 |  |  |  |  | 4500 |  |
| 1 | 16 | 0,85 | 5 | б | 20 | 40 | 40 | 10 |  |  |
| 2 | 24 | 0,90 | 7 | 5 | 10 | 50 | 40 | 10 |  |  |
| 3 | 18 | 0,95 | 4 | 4 | -- | 60 | 40 | 6 |  |  |
| 4 | 9 | 0,78 | 6 | 4 | 25 | 45 | 30 | 10 |  |  |
| 5 | 5 | 0,80 | 5 | 2 | 5 | 50 | 45 | 10 |  |  |
| 22  72 | p/st |  |  | 2 | 4 |  |  |  |  | 4800 |  |
| 1 | 16 | 0,75 | 3 | 8 | 15 | 60 | 25 | 6 |  |  |
| 2 | 10 | 0,80 | 5 | 7 | 5 | 50 | 45 | 10 |  |  |
| 3 | 12 | 0,90 | 5 | 2 | 10 | 40 | 50 | 6 |  |  |
| 4 | 14 | 0,95 | 4 | 10 | — | 60 | 40 | 10 |  |  |
| 5 | 8 | 0,87 | 7 | 9 | 5 | 35 | 60 | 6 |  |  |
| 23  73 | p/st |  |  | 4 | 2 |  |  |  |  | 5100 |  |
| 1 | 20 | 0.80 | б | 5 | 15 | 35 | 50 | 6 |  |  |
| 2 | 25 | 0.75 | 4 | 6 | 10 | 50 | 40 | 6 |  |  |
| 3 | 10 | 0.85 | 8 | 6 | 5 | 45 | 50 | 6 |  |  |
| 4 | 15 | 0.90 | 6 | 7 | — | 40 | 60 | 10 |  |  |
| 5 | 5 | 0.95 | 5 | 8 | 5 | 35 | 60 | б |  |  |
| 24  74 | p/st |  |  | 10 | 4 |  |  |  |  | 5400 |  |
| 1 | 16 | 0.80 | 6 | 5 | 20 | 45 | 35 | 10 |  |  |
| 2 | 12 | 0.75 | 5 | 6 | 15 | 45 | 40 | б |  |  |
| 3 | 10 | 0.95 | 6 | 4 | 5 | 45 | 50 | 6 |  |  |
| 4 | 8 | 0.85 | 4 | 4 | 10 | 40 | 50 | 6 |  |  |
| 5 | 6 | 0.90 | 3 | 5 | -- | 40 | 60 | 6 |  |  |
| 25  75 | p/st |  |  | 8 | 10 |  |  |  |  | 5700 |  |
| 1 | 24 | 0.75 | 7 | 6 | 15 | 45 | 40 | 10 |  |  |
| 2 | 14 | 0.80 | 5 | 6 | 20 | 40 | 40 | 10 |  |  |
| 3 | 16 | 0.85 | 5 | 4 | 15 | 40 | 45 | б |  |  |
| 4 | 8 | 0.90 | 3 | 5 | — | 50 | 50 | 6 |  |  |
| 5 | 2 | 0.95 | 7 | 3 | 5 | 50 | 45 | 10 |  |  |
| 26  76 | p/st |  |  | 1 | 9 |  |  |  |  | 4000 |  |
| 1 | 16 | 0.90 | 3 | 5 | — | 50 | 50 | 10 |  |  |
| 2 | 10 | 0,95 | 5 | б | 10 | 50 | 40 | 6 |  |  |
| 3 | 12 | 0,75 | 3 | 3 | 20 | 35 | 45 | 6 |  |  |
| 4 | 4 | 0,85 | 5 | 4 | 15 | 25 | 60 | 6 |  |  |
| 5 | 2 | 0,80 | 4 | 2 | 10 | 30 | 60 | 6 |  |  |
| 27  77 | p/st |  |  | 7 | 3 |  |  |  |  | 4300 |  |
| 1 | 24 | 0380 | б | 6 | 10 | 45 | 45 | 10 |  |  |
| 2 | 18 | 0,90 | 8 | 7 | 15 | 35 | 50 | 10 |  |  |
| 3 | 9 | 0,75 | 5 | 8 | 15 | 40 | 45 | б |  |  |
| 4 | 12 | 0,85 | 6 | 9 | 10 | 50 | 40 | 6 |  |  |
| 5 | 4 | 0,95 | 8 | 2 | 5 | 25 | 70 | 6 |  |  |
| 28  78 | p/st |  |  | 10 | 2 |  |  |  |  | 4300 |  |
| 1 | 16 | 0,90 | 5 | 4 | 15 | 45 | 40 | 10 |  |  |
| 2 | б | 0,95 | 5 | б | -- | 50 | 50 | 10 |  |  |
| 3 | 2 | 0,75 | 4 | 5 | 20 | 35 | 45 | 10 |  |  |
| 4 | 8 | 0,85 | 7 | 6 | 15 | 25 | 60 | б |  |  |
| 5 | 4 | 0,80 | 3 | 7 | 10 | 30 | 60 | 10 |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 29  79 | p/st |  |  | 4 | 2 |  |  |  |  | 4000 |  |
| 1 | 18 | 0,75 | 5 | 6 | 20 | 35 | 45 | 10 |  |  |
| 2 | 22 | 0,80 | 5 | 5 | 10 | 30 | 60 | б |  |  |
| 3 | 12 | 0,85 | 7 | 6 | 5 | 45 | 50 | 10 |  |  |
| 4 | б | 0,90 | 9 | б | 15 | 25 | 60 | б |  |  |
| 5 | 8 | 0,95 | 8 | 4 | — | 50 | 50 | 10 |  |  |
| 30  80 | p/st |  |  | 3 | 4 |  |  |  |  | 4100 |  |
| 1 | 20 | 0,90 | 3 | 8 | 15 | 45 | 40 | 10 |  |  |
| 2 | 15 | 0,95 | 5 | 8 | -- | 50 | 50 | 10 |  |  |
| 3 | 10 | 0,75 | 7 | 6 | 20 | 35 | 45 | 6 |  |  |
| 4 | 8 | 0,85 | 8 | 8 | 15 | 25 | 60 | 10 |  |  |
| 5 | 2 | 0,80 | 7 | 9 | 10 | 30 | 60 | 10 |  |  |
| 31  81 | p/st |  |  | 3 | 10 |  |  |  |  | 5200 |  |
| 1 | 18 | 0,75 | 5 | 6 | 10 | 45 | 45 | 10 |  |  |
| 2 | 8 | 0,90 | б | 5 | 15 | 35 | 50 | 10 |  |  |
| 3 | 10 | 0,95 | 3 | 5 | 15 | 40 | 45 | 6 |  |  |
| 4 | 12 | 0,85 | 4 | 3 | 10 | 50 | 40 | б |  |  |
| 5 | 5 | 0,80 | 6 | 3 | 5 | 25 | 70 | 6 |  |  |
| 32  82 | p/st |  |  | 10 | 8 |  |  |  |  | 5500 |  |
|  | 18 | 0,80 | 8 | 5 | 20 | 45 | 35 | 10 |  |  |
| 2 | 8 | 0,75 | 6 | 5 | 15 | 45 | 40 | 6 |  |  |
| 3 | 9 | 0,95 | 7 | 3 | — | 40 | 60 | 10 |  |  |
| 4 | 2 | 0,95 | 5 | 4 | 10 | 40 | 50 | 6 |  |  |
| 5 | 5 | 0,90 | 5 | 3 | 5 | 45 | 50 | 10 |  |  |
| 33  83 | p/st |  |  | 4 | 1 |  |  |  |  |  |  |
| 1 | 20 | 0,90 | 3 | 5 | 10 | 50 | 40 | 10 |  |  |
| 2 | 15 | 0,85 | 6 | 5 | 15 | 45 | 40 | 10 |  |  |
| 3 | 12 | 0,75 | 4 | 6 | 15 | 35 | 50 | 6 |  |  |
| 4 | 8 | 0,95 | 3 | 7 | — | 50 | 50 | 10 |  |  |
| 5 | 10 | 0,80 | 5 | 8 | 5 | 40 | 55 | 10 |  |  |
| 34  84 | p/st |  |  | 2 | 8 |  |  |  |  | 6100 |  |
| 1 | 28 | 0,75 | 6 | 7 | 20 | 45 | 35 | 10 |  |  |
| 2 | 10 | 0,95 | 5 | 5 | 10 | 35 | 55 | 6 |  |  |
| 3 | 16 | 0,90 | 7 | 6 | 5 | 45 | 50 | 6 |  |  |
| 4 | 14 | 0,85 | 8 | 7 | 15 | 45 | 40 | 10 |  |  |
| 5 | 6 | 0,80 | 9 | 5 | 10 | 40 | 50 | 6 |  |  |
| 35  85 | p/st |  |  | б | 8 |  |  |  |  | 3800 |  |
| 1 | 15 | 0,80 | 6 | 5 | 15 | 50 | 35 | 10 |  |  |
| 2 | 10 | 0,95 | 4 | 5 | 5 | 45 | 50 | б |  |  |
| 3 | 6 | 0,75 | 6 | 3 | 20 | 40 | 40 | 10 |  |  |
| 4 | 4 | 0,80 | 4 | 3 | 10 | 35 | 55 | 10 |  |  |
| 5 | 8 | 0,90 | 6 | 2 | — | 50 | 50 | 10 |  |  |
| 36  86 | p/st |  |  | 10 | 5 |  |  |  |  | 4100 |  |
| 1 | 25 | 0,75 | 6 | 6 | 20 | 50 | 30 | 10 |  |  |
| 2 | 15 | 0,85 | 7 | 7 | 15 | 50 | 35 | 6 |  |  |
| 3 | 20 | 0,95 | 9 | 8 | 5 | 35 | 60 | 6 |  |  |
| 4 | 10 | 0,90 | 7 | 9 | 5 | 35 | 60 | 10 |  |  |
| 5 | 5 | 0,80 | 5 | 7 | 10 | 40 | 50 | 10 |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 37  87 | p/st |  |  | 7 | 1 |  |  |  |  | 4400 |  |
| 1 | 24 | 0,85 | 4 | 3 | 15 | 40 | 45 | 6 |  |  |
| 2 | 12 | 0,75 | 5 | 5 | 15 | 45 | 40 | 10 |  |  |
| 3 | 18 | 0,90 | 3 | 5 | 10 | 50 | 40 | 6 |  |  |
| 4 | 16 | 0,80 | 2 | 4 | 10 | 50 | 40 | 10 |  |  |
| 5 | 8 | 0,95 | 4 | 6 | 5 | 40 | 55 | 6 |  |  |
| 38  88 | p/st |  |  | 2 | 4 |  |  |  |  | 4700 |  |
| 1 | 20 | 0,95 | 6 | 6 | 5 | 50 | 45 | 6 |  |  |
| 2 | 8 | 0,75 | 5 | 8 | 10 | 45 | 45 | 10 |  |  |
| 3 | 5 | 0,90 | 8 | 5 | 15 | 45 | 40 | 10 |  |  |
| 4 | 2 | 0,80 | 7 | 7 | 20 | 40 | 40 | 10 |  |  |
| 5 | 9 | 0,85 | 9 | 6 | 15 | 40 | 45 | 10 |  |  |
| 39  89 | p/st |  |  | 8 | 10 |  |  |  |  | 5000 |  |
| 1 | 24 | 0,95 | 4 | 8 | 10 | 40 | 50 | б |  |  |
| 2 | 18 | 0,75 | 3 | 6 | 20 | 40 | 40 | 6 |  |  |
| 3 | 10 | 0,90 | 6 | 7 | 5 | 50 | 45 | 10 |  |  |
| 4 | 14 | 0,80 | 5 | 5 | 20 | 35 | 45 | 10 |  |  |
| 5 | 6 | 0,85 | 2 | 5 | 15 | 45 | 40 | 10 |  |  |
| 40  90 | p/st |  |  | 8 | 7 |  |  |  |  | 5300 |  |
| 1 | 12 | 0,85 | 7 | 3 | 15 | 45 | 40 | 6 |  |  |
| 2 | 14 | 0,90 | 6 | 5 | 10 | 50 | 40 | 6 |  |  |
| 3 | 8 | 0,95 | 4 | 4 | 5 | 50 | 45 | 10 |  |  |
| 4 | 5 | 0,75 | 5 | 2 | 15 | 40 | 45 | 6 |  |  |
| 5 | 10 | 0,80 | 4 | 3 | 20 | 35 | 45 | 10 |  |  |
| 41  91 | p/st |  |  | 5 | 2 |  |  |  |  | 5800 |  |
| 1 | 28 | 0,80 | 4 | 5 | 20 | 40 | 40 | 10 |  |  |
| 2 | 12 | 0,90 | 6 | 5 | — | 50 | 40 | 10 |  |  |
| 3 | 10 | 0,75 | 7 | 7 | 10 | 50 | 50 | 10 |  |  |
| 4 | 15 | 0,90 | 5 | 7 | 15 | 40 | 45 | 10 |  |  |
| 5 | 5 | 0,85 | 8 | 6 | — | 45 | 55 | 10 |  |  |
| 42  92 | p/st |  |  | 2 | 8 |  |  |  |  | 5900 |  |
| 1 | 22 | 0,75 | 5 | 5 | 15 | 45 | 40 | 6 |  |  |
| 2 | 16 | 0,90 | 4 | 3 | 10 | 50 | 40 | 10 |  |  |
| 3 | 18 | 0,87 | 7 | 5 | 10 | 50 | 40 | 6 |  |  |
| 4 | 8 | 0,95 | 7 | 3 | — | 45 | 55 | 10 |  |  |
| 5 | 6 | 0,80 | 5 | 2 | 5 | 40 | 55 | 10 |  |  |
| 43  93 | p/st |  |  | 3 | 9 |  |  |  |  | 6200 |  |
| 1 | 14 | 0,90 | 6 | 6 | 25 | 50 | 20 | 10 |  |  |
| 2 | 10 | 0,87 | 8 | 7 | 20 | 50 | 30 | 10 |  |  |
| 3 | 15 | 0,95 | 6 | 4 | -- | 45 | 55 | 10 |  |  |
| 4 | 4 | 0,75 | 8 | 4 | 10 | 40 | 50 | 10 |  |  |
| 5 | 2 | 0,80 | 9 | 6 | 15 | 35 | 50 | 10 |  |  |
| 44  94 | p/st |  |  | 9 | 3 |  |  |  |  | 4200 |  |
| 1 | 16 | 0,80 | 8 | 7 | 20 | 50 | 30 | 6 |  |  |
| 2 | 25 | 0,87 | 6 | 8 | 25 | 45 | 30 | 6 |  |  |
| 3 | 16 | 0,90 | 5 | 6 | 5 | 40 | 55 | 6 |  |  |
| 4 | 8 | 0,75 | 7 | 9 | 10 | 45 | 45 | 6 |  |  |
| 5 | 5 | 0,85 | 9 | 8 | 15 | 40 | 40 | 6 |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| 45  95 | p/st |  |  | 4 | 4 |  |  |  |  | 4500 |  |
| 1 | 9 | 0,87 | 4 | 2 | 25 | 50 | 25 | 6 |  |  |
| 2 | 18 | 0,75 | 7 | 5 | 20 | 40 | 40 | 6 |  |  |
| 3 | 16 | 0,90 | 7 | 7 | 10 | 50 | 40 | 6 |  |  |
| 4 | 2 | 0,95 | 5 | 7 | — | 50 | 50 | 6 |  |  |
| 5 | 6 | 0,80 | 5 | 8 | 5 | 40 | 55 | 6 |  |  |
| 46  96 | p/st |  |  | 2 | 5 |  |  |  |  | 4800 |  |
| 1 | 20 | 0,95 | 5 | 5 | 5 | 50 | 45 | 6 |  |  |
| 2 | 16 | 0,87 | 4 | 3 | 20 | 45 | 35 | 6 |  |  |
| 3 | 25 | 0,80 | 7 | 4 | 15 | 50 | 35 | 10 |  |  |
| 4 | 12 | 0,90 | 6 | 3 | 10 | 40 | 50 | 6 |  |  |
| 5 | 5 | 0,75 | 5 | 2 | 15 | 45 | 40 | 6 |  |  |
| 47  97 | p/st |  |  | 8 | 9 |  |  |  |  | 5100 |  |
| 1 | 15 | 0,75 | 6 | 6 | 25 | 50 | 25 | 10 |  |  |
| 2 | 8 | 0,90 | 4 | 7 | 10 | 50 | 40 | 6 |  |  |
| 3 | 10 | 0,80 | 2 | 6 | 15 | 45 | 40 | 6 |  |  |
| 4 | 14 | 0,87 | 2 | 4 | 15 | 45 | 40 | 6 |  |  |
| 5 | 5 | 0,95 | 6 | 4 | -- | 50 | 50 | 6 |  |  |
| 48  98 | p/st |  |  | 10 | 3 |  |  |  |  | 3800 |  |
| 1 | 12 | 0,80 | 6 | 5 | 40 | 30 | 30 | 10 |  |  |
| 2 | 16 | 0,75 | 5 | 6 | 45 | 40 | 25 | 10 |  |  |
| 3 | 8 | 0,90 | 4 | 4 | 40 | 40 | 20 | 6 |  |  |
| 4 | 10 | 0,85 | 3 | 5 | 50 | 30 | 20 | 10 |  |  |
| 5 | 2 | 0,95 | 3 | 7 | -- | 45 | 25 | 6 |  |  |
| 49  99 | p/st |  |  | 2 | 2 |  |  |  |  | 4200 |  |
| 1 | 12 | 0,75 | 4 | 5 | 20 | 45 | 35 | 6 |  |  |
| 2 | 14 | 0,80 | 7 | 4 | 10 | 35 | 55 | 6 |  |  |
| 3 | 16 | 0,90 | 6 | 7 | 5 | 45 | 50 | 10 |  |  |
| 4 | 8 | 0,85 | 8 | 7 | 10 | 40 | 50 | 10 |  |  |
| 5 | 4 | 0,95 | 9 | 5 | 15 | 45 | 40 | 10 |  |  |
| 50  100 | p/st |  |  | 9 | 5 |  |  |  |  | 3200 |  |
| 1 | 16 | 0,80 | 3 | 7 | 20 | 45 | 35 | 10 |  |  |
| 2 | 12 | 0,75 | 5 | 6 | 15 | 45 | 40 | 6 |  |  |
| 3 | 10 | 0,90 | 6 | 4 | 5 | 40 | 55 | 6 |  |  |
| 4 | 8 | 0,85 | 4 | 4 | 10 | 40 | 40 | 10 |  |  |
| 5 | 2 | 0,95 | 3 | 5 | — | 55 | 45 | 10 |  |  |

**Kurs loyihasini hisoblashda aniq ko`rsatma.**

Kurs loyihasi variant bo`yicha berilgan bo`lsa u quyidagi tartibda bajariladi.

Berilgan P1=20 [MVt]; P2=12[MVt]; P3=10[MVt]; P4=4[MVt]; P5=6[MVt]; cosφ1=0,75; cosφ2=0,85; cosφ3=0,95; cosφ4=0,9; cosφ5=0,8.

**Reaktiv quvvatni aniqlaymiz.**

Q=UIsinφ bu yerda S=UI bo`lsa Q=Ssinφ bo`ladi.

S1=P1/cosφ1=20/0.75=26.7[MVA]; Q1=S1sinφ=26.7\*0.52=17.6[MVar]

bu yerda cosφ=0.75 bo`lganda sinφ=0,52 teng bo`ladi.

Xuddi shuningdek S2=14[MVA]; S3=10.5[MVA]; S4=4.4[MVA]; S5=7.5[MVA]; Q2=7.3[MVAR]; Q3=3.2[MVAR]; Q4=2[MVAR]; Q5=4.5[MVAR].

Hisoblashlardan to`la quvvat quyidagicha bo`ladi:

S1=P1+jQ1=20+j17.6[МВА]; S2=P2+jQ2=12+j7.3[МВА];

S3=P3+jQ3=10+j3.2[МВА]; S4=P4+jQ4=4+j2[МВА];

S5=P5+jQ5=6+j4,5[МВА].

Aktiv va reaktiv quvvatlar muvozanatlashuvini hisoblaymiz:

ΣRG=ΣRyu+ΣPtar+Prez=52+4,2+5,2=61,4 [MVt]

Bu yerda, ΣPYuq =P1+P2+P3+P4+P5=20+12+10+4+6=52 [MVt]

ΣPtar=(6÷10)% ΣPYuq8%/100\*52=4,2 [MVt]

Prez=10%ΣPYuq10% /100\*52=5,2 [MVt]

ΣQG +ΣQku = ΣQyu + ΣQtr +Qrez

Bu yerda, ΣQYuqQ1+Q2+Q3+Q4+Q5=17,6+7,3+3,2+2+4,5=34,6 [MVAR]

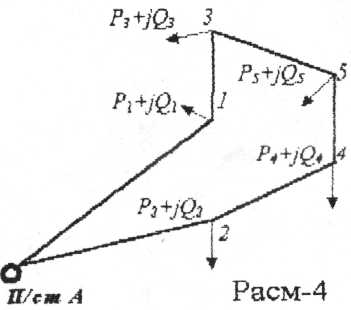
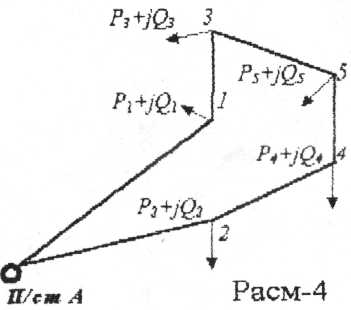


Ya'ni, cosφg=0,84 bo`lganda tgφg=0,64 bo`ladi.

Qku= ΣQyu + ΣQtr + Qyu -ΣQg = 34,6+6,2+3,5-39,2=5,1 [MVar]

39,2+5,1=34,6+6,2+3,5=44,3 [MVar]

ΣQg+ΣQku = ΣQyu + ΣQtr + Qrez

**Quvvatlar tarqalish nuqtasini topamiz.**

Quvvatlar tarqalish nuqtasini topish uchun berilgan iste'molchilarning toifalarini, masofalarini va yuklamalarini nazarda tutib 10-12 ta konfiguratsiyalar chiziladi. Bularning ichidan ikkita eng optimal variant tanlanib hisoblanadi

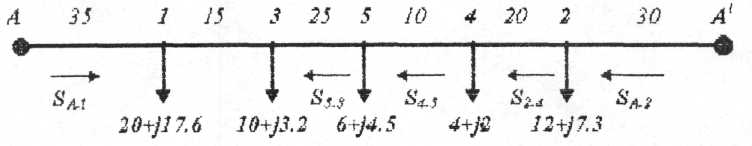
1A-1 =35 km 15-4 = 10 km

l1-3 =15 km l4-2 = 20 km

13-5 = 25 km l2-A = 30 km

Σ1 =135 km

Ushbu tanlangan halqasimon variantli tarmoqni yoyiq holda hisoblaymiz:



SA.1={(20+jl7,6)35+(10+j3,2)50+(6+j4,5)75+(4+j2)85+(12+j7,3)105}/135=

=(3250+j2050)/l35=24,1+j15,2 [MVA]

Birinchi iste'molchidan uchinchi iste'molchigacha oqadigan quvvat:

S1-3=SA.1 =S1 =24,l + j15,2=(20 + j17,6) hisoblash qanoatlantirmasligi uchun SA-2 quvvat hisoblanadi:

SA-2={(12+j7,3)30+(4+j2)50+(6+j4,5)60+(10+j3,2)85+(20+j17,6)100}/135=

=3770+j19,4 [МVА]

S2-4=SA-2-S2=27,9+j19,4-(12+j7,3)=15,9+j12,1 [МVА]

S4-5=S2-4-S4=15,9+j12,1-(4+j2)=11,9+j10,1 [МVА]

S5-3=S4-5-S5=11,9+j10,1-(6+j4,5)=5,9+j5,6 [МVА]

S3-1=S5-3-S3=5,9+j5,6-(10+j3,2)

hisoblash ham qanoatlantirmaydi Shuning uchun quvvatlar tarqalish nuqtasi 1 va 3 iste'molchilarda bo`ladi.

Loyihalashtirilayotgan tarmoq uchun nominal kuchlanish tanlaymiz. 13-jadvaldan foydalanilib quyidagi jadval to`ldiriladi:

4-jadval

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Iste'molchilarning  joylashishi | Hisobiy yuklama  yuklama | | l  (km) | Un  (kV) |
| P+jQ(MVA) | S (MVA) |
| А-1 | 24,1+j15,2 | 28,4 | 35 | 110 |
| А1-2 | 27,9+j19,4 | 34 | 30 | 110 |
| 2-4 | 15,9+j12,1 | 20 | 20 | 110 |
| 4-5 | 11,9+j 10,1 | 15,6 | 10 | 110 |
| 5-3 | 5,9+j5,6 | 8 | 25 | 110 |

Kuch transformatorlarini tanlaymiz

Iste'molchilar uchun kuch transformatorlarini tanlaymiz va ulardagi isrofgarchiliklarni hisoblaymiz

**P/st-1** SYuq =Pl+jQ1=20+j17,6=26,7 [MBA] cosφ=0,75 bo`lganda tgφ=0,88 bo`ladi

Bu yerda cosφ < cosφn= 0.95 bo`lganligi uchun reaktiv quvvatni qoplagichlar, kondensator batareyalar tanlaymiz.

Reaktiv quvvatni qoplagichining quvvatini topamiz:

Qku = P1(tgφ - tgφn)= 20(0,88 – 0,33)=1,1 [MVar]

Topilgan quvvatga mos holda 8-jadvaldan kondensator qoplagichni tanlaymiz:

Qku=22\*500= 110000 [kVar]=11 [MVar]

Qoplagichdan keyingi istemolchining to`la hisobiy quvvati quyidagicha bo`ladi: [MVA]

Uning quvvat koeffitsiyenti: cosφ=P1 /Sx=20/21,4=0,94

Hisoblangan to`la quvvatga mos holda pasaytiruvchi transformator tanlaymiz. Transformatorni tanlashda istemolchining qaysi toyifaga to`g`ri kelishligiga alohida etibor beriladi. 9-jadvaldan uch fazali ikki chulg`amli transformator tanlaymiz. TDN-16000/110 Uning yuklanish koeffitsiyenti quyidagicha

Kyu=Syu /Snt=21,4/2\* 16=0,67

Tanlangan transformatorning pasport ko`rsatkichlarini yozamiz. Snt=16 [MVA]; Uyuk =110 [kV]; Unk=10 [kV], ΔPkt=19 [kVt]; ΔP0=85 [kVt]; I0%=0,7%; Uk%=10,5%; RT=4.38 [Om]; XT=87 [Om];

KT = 63ming so’m. (erkin narxda)

Tanlangan transformatordagi quvvat va energiya isroflarini hisoblaymiz.

ΔPt=1/nΔPk(SyuSnt)2+nΔP0=1/2\*85(21,4/16)2+2\*19=0,11 [MVA]

ΔQt=Uk%S2yu/100Snt+nI0%Snt/100==10,5\*21,42/2\*100\*16+2\*0,7\*16/100=1,5MVar

Energiya isrofi quyidagicha bo`ladi

ΔAt=l/nΔPk(Syu/Snt)2 τ +nΔP0Tyil=

=1/2\*85(21,4/16)22000+2\*19\*8760=485 [MVt .soat/yil]

Bu yerda, Tn b=4000 s; τ =2000 s; Tyil=8760 s 10-jadvaldan olinadi. To`la quvvat isrofi :

ΔSTp=ΔPtr+jΔQtr=0,11+j1,5 [MVt]

Transformator qabul qilinayotgan quvvat isrofni nazarda tutgan holda

ΔSTpkir= Syu +ΔStr=20+\_j17,64+0,11+j 1,5=20,1 +j 19*,*1 [MVt]

Qolgan transformatorlarni tanlash va ularning hisoblashlarini 5-jadval usulida bajariladi .

5-jadval

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P/st  nomi | To`la yuklama | | Tr-ning, turi va  quvvati | Kyu | Snt | ΔPqt | ΔP0 | UK | I0 | R1 | X1 |
|  | MVA | Syu MVA |  |  | МVA | kVt | kVt | % | А | Om | Om |
| p-1  p-2  p-3 p-4  p-5 | 20+j(17,6-10) | 21,4 | 2хТDN-16/110 | 0,67 | 16 | 85 | 19 | 10,5 | 0,7 | 4,4 | 87 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| p/st  nо  mi | K1 | ΔP1 | ΔQ1 | ΔA1 | ΔS1 | S1pxir |
| m\so’m | МVt | MVar | МVts/yil | МVA | МVA |
| p-1 p-2  p-4  p-3  p-5 | 63 | 0,11 | 1.5 | 485 | 0.1+j1.5 | 20.1+j19.1 |
|  | ΣKtr |  |  | ΣAtr |  |  |

Jadvaldagi hisoblashlarga asosan transformatorlarning narxi va ulardagi energiya isroflarining yig`indisi quyidagicha bo`ladi.

ΣKTr =300 m.co’m; ΣΔATr=1855 MVt.s/yil

**Tarmoqlarga simning ko`ndalang kesim yuzasini tanlaymiz**

**va ulardagi isroflarni hisoblaymiz.**

EUY (elektr uzatish yo`li) A-1

Syu=24+j15,2=28,4 [MVA] Iste'molchining ishchi tokini hisoblaymiz:

Ii=Syu/√Un=28,4\* 103 / 110√3 =146 [A]

Ishchi tokiga mos keluvchi simning ko`ndalang kesimi yuzasini 11-jadvaldan tanlaymiz.

Tanlash jarayonida temir-betonli tayanch qabul qilamiz AS-70 Uning kuchlanishi Un=110 [kV]. Ruxsat etilgan toki Irux=265 [A]; Ii<Irux yoki 265 >146 [A] qanoatlantiradi. Tanlangan simning pasport ko`rsatkichlari 11-jadvaldan yozib olinadi.

F=70 mm2; r0=0,43 Om/km; x0=0,4 Om/km; *l=35* km;

Simning 1 km dagi narxi K=12 ming so’m.

Umumiy narxi ΣK=lK=35\*12=420 m so’m.

B0=2.8\*106 sm/km; B =b0\**l2*,8\*106\*35=98\*106 Om/km Kuchlanish icrofini hisoblaymiz:

ΔU=(PR+QX)/`Un=(24\*15.1+15.2\*14)/110=5,2 [ kV]

## Bu yerda R=r0\**lq0*,43\*35=15,l [Om]

X0=x\**l=O*,4\*35= 14 [ Om]

ΔU%=100%ΔU/Un=100%5,2/110=4,7%; ΔU%=4,7%<5%;

Liniyadagi quvvat va energiya icroflarini hisoblaymiz;

STrkir=20,1+j19,1 [MVA]

SL11= STrkir - ΔQs=20,1 +j 19,1 -1,2=20,1 +j19 [MVA]

Bu yerda,

ΔQs=BUn2=98\* 106\*1102 =l,2 [MVar]

Aktiv quvvat icrofi

ΔPL =(R112 + Q112)R/Un2=955[kVt]= 0,96 [MVt],

Reaktiv quvvat icrofi

ΔQL=(P112 + Q112)X/Un2=885 [kVar]=0.89 [MVar]

ΔSL=ΔPL+jΔQL=0,96+j0.89 [MVA] Liniyadagi energiya icrofini hisoblaymiz.

ΔA= ΔPL τ=0.96\*2000=1960 MVt.s/yil

Qolgan liniyalar uchun simni tanlash va ulardagi hisoblashlarni 6-jadval usulida bajariladi.

6-jadval.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EUL | Hisobiy yuklama | | Ii  A | Simning  markasi | Irux  A | r0  Om/km | x0  Om/km | l  km | R  Om | X  Om | Kl  ming/so’m |
|  | P+jQ  МVA | S  МVА |  |
| А-1  АI-1  2-4 4-5  5-3 | 24+j15,2 | 28,4 | 146 | АС-70 | 265 | 0,43 | 0,4 | 35 | 15,1 | 14 | 12 |

davomi

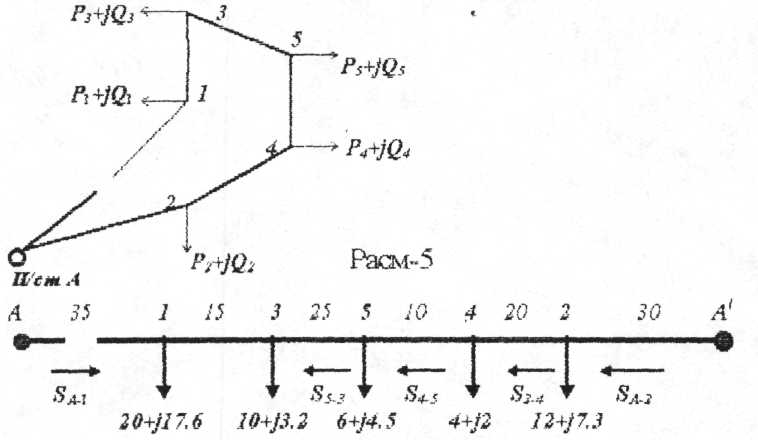
|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EUL | ΣKL | ΔU | | bo | B | ΔQ0 | STrxir | ΔRl | ΔQl | ΔSl | ΔAl |
| M/sum | % | | sm/km | Om/km | MVar | MVA | MVt | MVar | MVA | MVt.s/yil |
| А-1  А'-2 2-4  4-5  5-3 | 420 | 4,7 | | 2,8 | 98 | 12 | 20,l+jl9,l | 0,96 | 0,89 | 0,96+0,89 | 1960 |
|  | ΣК |  |  | |  |  |  |  |  |  | ΣA |

Jadval usulida hisoblashlar natijasiga asosan liniyaning to`liq narxi va ulardagi energiya isrofining yig`indisi quyidagicha buladi:

ΣKL =2112 mln.so’m ΣΔAl =10192 MVt.s/yil

**Tarmoq uchun tanlangan oqimning avariya**

**holatini tekshirish.**

Tanlangan simning halokat holatini tekshirish uchun eng uzoq masofali liniya uzib qo`yiladi, yani quyidagicha tavsiya etiladi.

SA-2={(12+j7,3)30+(4+j2)50+(6+j4,5)60+(10+j3,2)85+(20+j17,6)100}/100=

=(3770+j2621)/100=37,7+j26,2=45,9 [MVA]

Halokat holatidagi ishchi toki: IU=SA-2/√3Un=45,9\*103/100√3=241 A

Ishchi tokining natijasiga qarab AS-70 markali sim tiklanadi.Tanlangan simning ruxsat etilgan toki:

Irux=265 A ; Irux≥Iy yoki 265 ≥241 A

Halokat holatga tanlangan sim, normal holatda shu liniyaga tanlangan simga solishtiriladi. Agar mos kelmasa boshqa standart simni tanlashga to`g`ri keladi.

**Elektr tarmoq v a tizimlarini texnik-iqtisodiy hisoblashlar.**

Tarmoqdagi isrofgarchilikka ketgan sarf:

CΔA=ΣΔAtarC0=4441\*103\*2=8,9 mln.so’m.

Bu yerda, C0=2 so’m (erkin narx) 1 kVt.soat elektr energiyaning narxi.

ΣΔAtar=ΣΔAlep+ΣΔAp/st=1580+2861=4441 MVt.s/yil

ΣΔAlep, ΣΔAp/st- qiymatlari 5,6 –jadvaldan olinadi.

Butun tarmoq uchun sarflar quyidagicha:

ΣCtar=CΔa+Clep + Cp/st=8900+46+32=8,98 mln.so’m

bu yerda, Clep =Pl ΣKL=2,8% 1653=46 ming so’m

Cp/st =Pp/st Σ Kp/st =9,4\*343=:32 ming so’m

Pl, Pp/st -amortizatsiya uchun ajratilgan mablag`,%.12-jadvaldan olinadi.  
ΣKL, ΣKp/st -liniya va p/st larning bahosi. 9,11-jadvaldan olinadi.  
Keltirilgan xarajat: Z=ΣCtar+EnΣKtar=8980+0,15\*1996-9,3 mln.so’m

bu yerda,

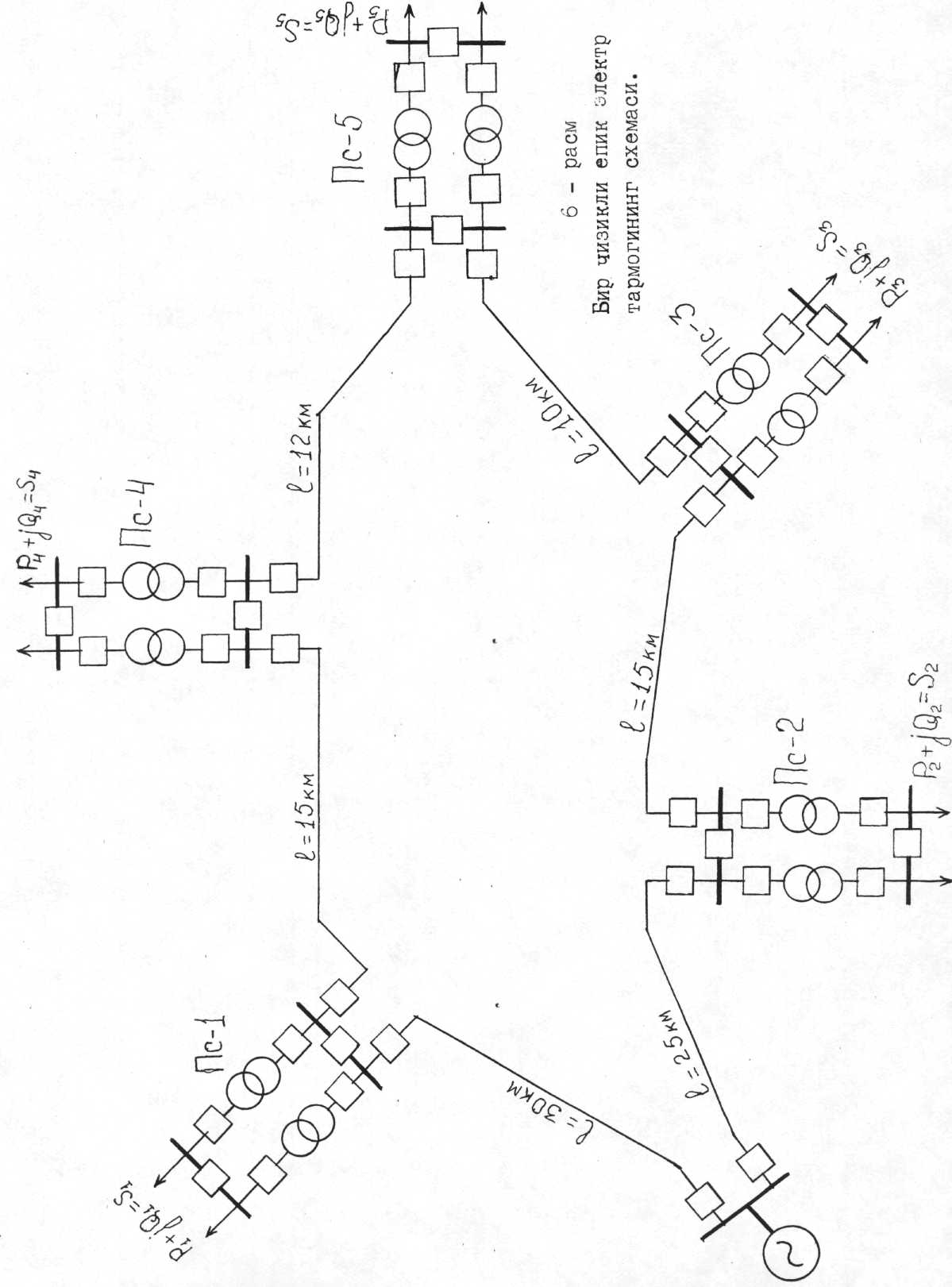
ΣKtar= ΣKL + Σ Kp/st  =1653+343=1,996 mln.so’m

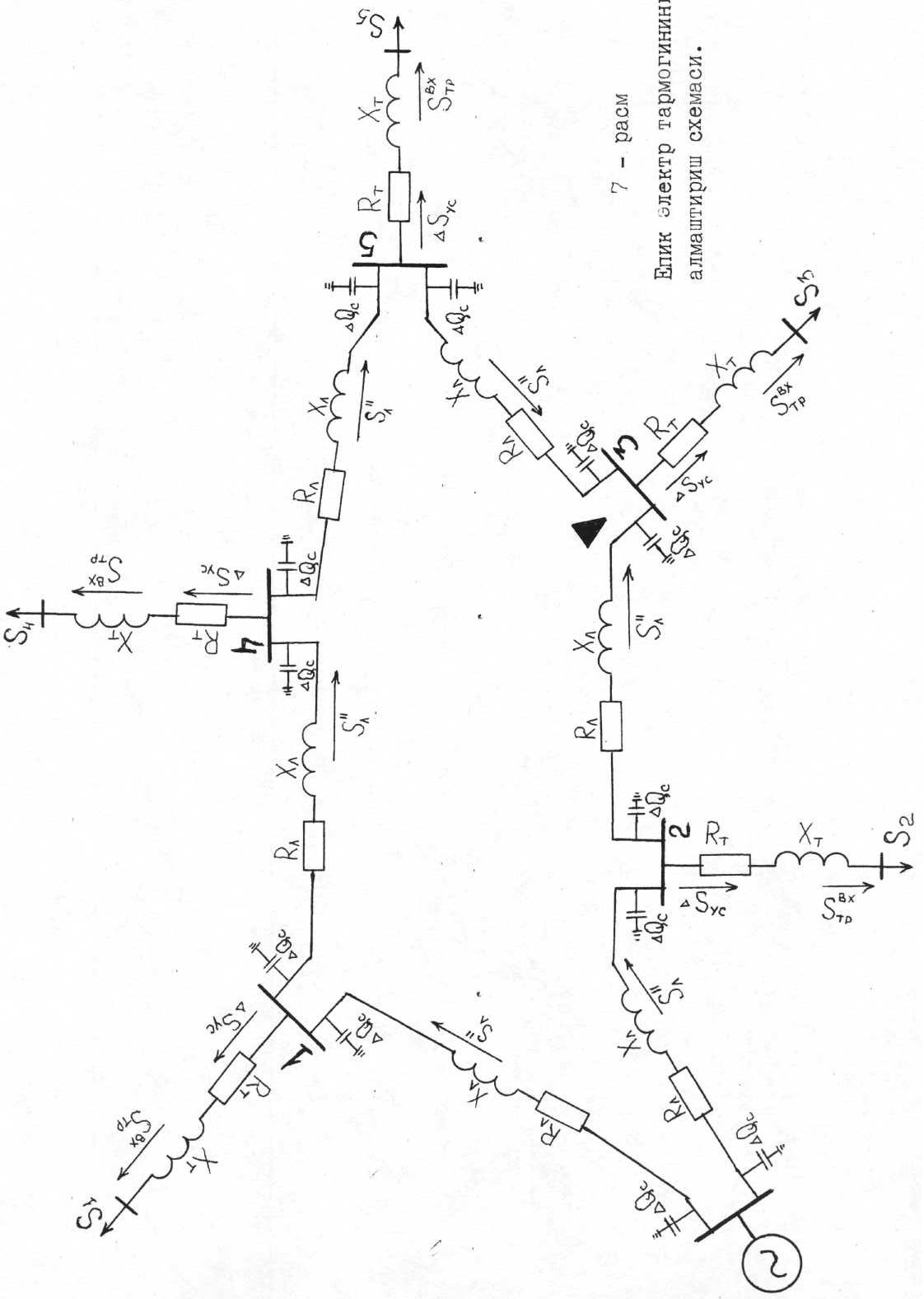
En=0,12—0,15 normativ koeffitsiyent.

Shunday qilib kurs loyihasini loyihashtirishdagi hisoblashlar yuqorida ko`rsatilgan tartibda 2 ta eng optimal variant hisoblanadi va natijada texnik iqtisodiy ko`rsatkichlari 7-jadvalda ko`chiriladi.  
 7-jadval

|  |  |  |
| --- | --- | --- |
|  | I variant | II variant |
| ΣКtar, mln.so’m  ΣΔАtar mvt.soat/yil  ΣUtar mln.so’m  Z mln.so’m |  |  |

7-jadvalga asosan butun loyihaning texnik-iqtisodiy ko`rsatgichlari II variantda bir-biri bilan taqqoslanadi va loyihachi qo`shgan hisoblashlarini sarhisob qilib yakuniy fikrlarini yozadi. Nihoyat qabul qilgan variantlarning bir chiziqli va almashtirish sxemalarini chizadi. Chizma asosida o`z loyihasini himoya qilib fan yuzasidan yakuniy baho oladilar.





**Kurs loyihasini bajarishda qo`shimcha ma'lumotlar**

Kondensator qurilmalari.

8-jadval

|  |  |  |  |
| --- | --- | --- | --- |
| Turi va quvvati  Q (KVar) | Narxi K  (ming.so’m) | Turi va quvvati  Q (kVar) | Narxi K  (ming.so’m) |
| ККU-0,38-1;80 | 1,08 | КК-6-1;330 | 2,16 |
| ККU-0,38-3;160 | 1,92 | КU-6-2;500 | 3,06 |
| ККU-0,З-5;260 | 2,96 | КU-10-1;300 | 2,18 |
| КUN-6-2;420 | 2,22 | КU-10-2;500 | 3,07 |
| КUN-10-2;400 | 2,32 |  |  |

Ikki va uch chulg`amli transformatorlar, avtotransformatorlar.

9-jadval

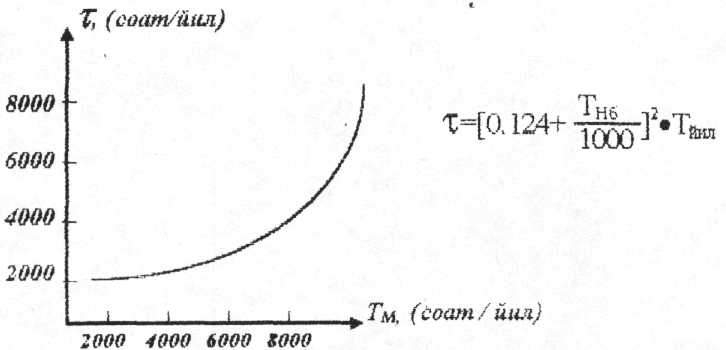
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Turi | Nomi nal  quvva ti  Sn | Nominal kuchlanish Un, kV | | | Quvvat isrofi  P  kVt | | | K.t kuchlanishi  U  % | | | | | | Salt  ish-lash toki | | Nar  xi  K  mln/ sum | |
|  | kVА | Uyu | Uu | Up | ΔРс | ΔРКT | | yu-o’ | | yu-p | | o’-p | | % | |  | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | | | **8** | | **9** | | **10** | | **11** | | **12** | |
| ТМ-25\6-10 | 25 | 6;10 | - | 0.4 | 0.17 | 0.6 | | | - | | 4.5 | | - | | 3.2 | | 0.96 | |
| ТМ-40\6-10 | 40 | 6;10 | - | 0.4 | 0.24 | | 0.88 | - | | 4.5 | | - | | 3.0 | | 1.0 | |
| ТМ-63\6-10 | 63 | 6;10 | - | 0.4 | 0.36 | | 1.28 | - | | 4.5 | | - | | 2.8 | | 1.1 1 | |
| ТМ-100\6-10 | 100 | 6:10 | - | 0.4 | 0.49 | | 1.97 | - | | 4.5 | | - | | 2.6 | | 1.22 | |
| ТМ-160\6-10 | 160 | б;10 | - | 0.4 | 0.73 | | 2.65 | - | | 4.5 | | - | | 2.4 | | 1.54 | |
| ТМ-250\6-10 | 250 | 6,10 | - | 0.4 | 0.94 | | 3.7 | - | | 4.5 | | - | | 2.3 | | 1.93 | |
| ТМ-400\6-10 | 400 | 6;10 | - | 0.4 | 1.2 | | 5.5 | - | | 4.5 | | - | | 2.1 | | 2.7 | |
| ТМ-630\6-10 | 630 | 6;10 | - | 0.4 | 1.56 | | 8.5 | - | | 5.5 | | - | | 2.0 | | 3,6 | |
| LTM-1000\6-10 | 1000 | 6: 10 | - | 0.4 | 2.45 | | 12.2 | - | | 5.5 | |  | | 1.4 | | 4.8 | |
| ТМ-1600\6-10 | 1600 | 6;10 | - | 0.4 | 3.3 | | 18 | - | | 5.5 | | - | | 1.3 | | 6.6 | |
| ТМ-2500\6-10 | 2500 | 6;10 | - | 0.4 | 4.6 | | 25 | - | | 5.5 | |  | | 1.0 | | 8.98 | |
| ТМ-4000\6-10 | 4000 | 6;10 | - | 0.4 | 6.4 | | 33.5 | - | | 6.5 | |  | | 0.9 | | 12.47 | |
| ТМ-6300\6-10 | 6300 | 6;10\_ | - | 0.4 | 9.0 | | 46.5 | - | | 6.5 | | - | | 0.8 | | 16.43 | |
| ТМ-100/3 5 | 100 | 35 | - | 0.4 | 0.46 | | 1.97 | - | | 6.5 | | - | | 2.6 | | 1.87 | |
| ТМ-160/3 5 | 160 | 35 | - | 0.4 | 0.7 | | 2.65 | - | | 6.5 | | - | | 2.4 | | 2.59 | |
| ТМ-250/35 | 250 | 35 | - | 0.4 | 1,0 | | 3.7 | - | | 6.5 | | - | | 2.3 | | 2.93 | |
| ТМ-400/35 ТМ-630/35 | 400 630 | 35 35 | - | 0.4 0.4 | 1.35 1.9 | | 5.5 7.6 | - | | 6.5 6.5 | | - | | 2.1  2.0 | | 3.7  4.99 | |
| ТМ-1000/3 5 | 1000 | 35 | - | 0.4 | 2.75 | | 12.2 | - | | 6.5 | | - | | 1.5 | | 6.87 | |
| ТМ-1600/35 | 1600 | 35 | - | 0.4 | 3.65 | | 18.0 | - | | 6.5 | | - | | 1.4 | | 8.82 | |
| ТМ-2500/35 | 2500\_н | 35 | - | 0.4 | 5.1 | | 25 | - | | 6.5 | | - | | 1.1 | | 11.84 | |
| ТМ-4000/35 | 4000 | 35 | - | 0.4 | 6.7 | | 33.5 | - | | 7.5 | | - | | 1.0 | | 15.48 1 | |
| ТМ-6300/35 | 6300 | 35 | - | 0.4 | 9.4 | | 46.5 | - | | 7.5 | | - | | 0.9 | | 19.62 | |
| ТМН-1000/35 | 1000 | 35 | - | 6,3-11 | 2,75 | | 11,6 | - | | 6,5 | | - | | 1,5 | | 9,5 | |
| ТМН-1600/3 5 | 1600 | 35 | - | 6,3-11 | 3,65 | | 16,5 | - | | 6,5 | | - | | 1,4\_ | | 10,6 | |
| ТМН-2500/35 | 2500 "1 | 35 | - | 6,3-11 | 5.1 | | 23,5 | - | | 6,5 | | - | | 1,1 | | 12,8 | |
| ТМН-4000/35 | 4000 | 35 | - | 6.3-11 | 6,7 | | 33,5 | - | | 7,5 | | - | | 1.0 | | 16,2 | |
| ТМН-6300/35 | 6300 | 35 | - | 6,3-11 | 9,4 | | 46,5 | - | | 7,5 | | - | | 0,9 | | 21 | |
| ТМН-10000/З 5 | 10000 | 35 | - | 6,3-11 | 14,5 | | 65 | - | | 7,5 | | - | | 0,8 | | 28,3 | |

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| ТМН-2500/110 | 2500 | 110 | - | 6,3-11 | 6,5 | 22 | - | 10,5 | - | 1,5 | 29,5 |
| ТМН-4000/110 | 4000 | 115 | - | 6,3-11 | 6,8 | 25 | - | 10,5 | - | 1,6 | 36,8 |
| ТМН-6300/110 | 6300 | 115 | - | 6,3-11 | 17,5 | 50 | - | 10,5 | - | 1,0 | 38,4 |
| ТДН- 10000/110 | 10000 | 115 | - | 6,3-11 | 18 | 60 | - | 10,5 | - | 0,9 | 43,6 |
| ТДН-16000/110 16000 | | 115 | - | 6,3-11 | 26 | 90 | - | 10,5 | - | 0,85 1 | 53 |
| ТРДН-25000/110 |25000 | | l7P | - | 6,3-10,5 | 30 | 120 | - | 10,5 | - | 0,75 | 65 |
| ТРДН-32000/110 | 32000 | 115 | 6,3-10,5 | | 40 | 145 | - | 10,5 | - | 0,7 ! 73,4 | |
| ТРДН-40000/110 | 40000 | 115 | - | 6,3-10,5 | 50 | 160 | - | 10,5 | - | 0,65 | 82,2 |
| ТРДЦН-6З00/110 | 63000 | 115 | - | 6,3-10,5 | 70 | 245 | - | 10,5 | - | 0,6 | 105 |
| ТРДЦН-80000/110 | 80000 | 115 | - | 6,3-10,5 | 85 | 310 | - | 10,5 | - | 0,55 | 118,2 |
| ТРДН-32000/220 | 32000 | ^230 | - | 6,3-10,5 | 53 | 167 | - | 12 | - | 0,9 | 11О |
| ТРДЦН-6З000/220 000/220 | 63000 | 230 | - | 6,3-10,5 | 82 | 300 | - | 12 | - | 0,8 | 153 I |
| ТРДЦН160000/220 | 160000 | 230 | - | 6,3-11 | 167 | 525 | - | 12 | - | 0,6 | 210 |
| ТМТН-6300/35 | 25000 63001 | 35 | 10,5 | 6,3 | 12 | 55 | 7,5 | 7,5 | 16 | 1,2 | 31 |
| ТМТН-6300/110 | 6300 | 115 | 38,5 | 6,6-11 | 17 | 60 | 10,5 | 17 | 6 | 0,85 | 47,5 |
| ТДТН40000/110 | 10000 | 115 | 38,5 | 6,6-11 | 23 | 80 | 10,5 | 17 | 6 | 1,1 | 56,3 |
| ТДТН-16000/110 | 16000 | 115 | 38,5 | 6,6-11 | 26 | 105 | 10,5 | 17 | 6 | 1,05 | 68,2 |
| ТДТН-25000/110 | 25000 | 115 | 38,5 | 6,6-11 | 45 | 145 | 10,5 | 17 | 6 | 1,0 | 75,4 |
| ТДТН-400ОО/110 | 40000 | 115 | 38,5 | 6,6-11 | 63 | 230 | 10,5 | 17 | 6 | 0,9 | 83,7 |
| ТДТН-63000/110 | 63000 | 115 | 38,5 | 6,6-11 | 70 | 310 | 10,5 | 17 | 6 | 0,85 | 107,2 |
| ТДТН-80000/100 | 80000 | 115 | 38,5 | 6,6-11 | 102 | 390 | 10,5 | 17 | 6,5 | 0,8 | 135 ! |
| АТДГН- 32000/220 | 32000 | 230 | 121 | 6,6-38,5 | 30 | 200 | 10,9 | 16 | 10,3 | 0,35 | 210 |
| АТДЦТГН-63000/220 | 63000 | 230 | 121 | 6,3-11-38.5 | 34 | 370 | 12,6 | 18,5 | 13,1 | 0,25 | 280 |
| АТДЦТН-125000/220 | 125000 | 230 | 121 | 6,3-11-38,5 | 85 | 290 | 11 | 31 | 19 | 0,5 | 320 |
| АТДЦТН-200000/220 | 200000 | 230 | 121 | 6,3-11-38.5 | 125 | 430 | 11 | 32 | 20 | 0,5 | 405 |

10-jadval.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Smena | Tv  s | Tm  s | τ  s | |
| cosφ=0.8 | cosφ=1 |
| I | 2000 | 1500÷2000 | 650÷950 | 500÷700 |
| II | 4000 | 2500÷4000 | 1250÷2400 | 950÷2050 |
| III | 6000 | 4500÷6000 | 2900÷4550 | 2500÷4000 |
| To’xtovsiz | 8760 | 6500÷8000 | 5200÷7500 | 4500÷7000 |

Grafik va formula, usulida aniqlash.





10 kV; 35 kV; 110 kV kuchlanish uchun temir-beton tayanchli

A; AS-turdagi simlarning jadvali.

11-jadval.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| AS-turi | Nominal | r0 | 1-km narxi, K m.sum | | |
| Ko’ndalang kesim yuzasi  mm2  alyumin/po’lat | Ruxsat etilgan tok  Irux, А | Оm, km | 10 kV | 35 kV | 110kV |
| 16 | 105 | 1,96 | 2,1 | - | - |
| 25 | 130 | 1-27 | 2,2 | - | - |
| 35/6,2 | 175 | 0,91 | 2,3 | - | - |
| 50,8 | 210 | 0,63 | 2,5 | - | - |
| 70/11 | 265 | 0,45 | - | - | 10,5 |
| 95/16 | 330 | 0,33 | - | 9,4 | 10,8 |
| 120/19 | 380 | 0,27 | - | 10,3 | 11,1 |
| 150/19 | 445 | 0,21 | - | 10,9 | 11,5 |
| 185/24 | 510 | 0,17 | - | - | 12,6 |
| 240/32 | 610 | 0,13 | - | - | 14,0 |
| А-turi  alyumin |  |  |  |  |  |
| 16 | 105 | 1,96 | 2,1 | - |
| 25 | 135 | 1,27 | 2,4 | - |
| 35 | 170 | 0,91 | 2.4 | 3,2 |
| 50 | 215 | 0,63 | 2,4 | 3,3 |
| 70 | 265 | 0.45 | 2,7 | 3,4 |
| 95 | 320 | 033 | 3.1 | 3,6 |

Amartizatsiya koeffitsiyentlari.

12-jadval.

|  |  |  |  |
| --- | --- | --- | --- |
| Tarmoq elementlari nomi | Amartizatsiya  Pa % | Xizmat va  ta'mirlash | Jami  ΣP % |
| Kuchlanish 20 kV gacha bo`l-gan temir va temir-betonli tayanchli havo liniyalari  35 kV dan  220 kVgacha |  |  |  |
|  |  |  |
|  |  |  |
| 3,6 | 0,3 | 3,9 |
| 2,5 | 0,3 | 2,8 |
| Elektrotexnik asbob uskunalar  (transformatorlar)  20kV gacha  220 kV gacha |  |  |  |
|  |  |  |
| 6,4 | 4 | 10,4 |
| 6,4 | 3 | 9,4 |

Kuchlanish tanlash.

13-jadval

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| P+jQ  L | 10 | 20 | 30 | 40 | 50 | 60 |
| 1000 | 35 | 35 | 35 | 35 | 35 | 35 |
| 2000 | 35 | 35 | 35 | 35 | 35 | 110 |
| 3000 | 35 | 35 | 35 | 35 | 110 | 110 |
| 4000 | 35 | 35 | 35 | 110 | 110 | 110 |
| 5000 | 35 | 35 | 110 | 110 | 110 | 110 |
| 6000 | 35 | 110 | 110 | 110 | 110 | 110 |
| 7000 | 35 | 35 | 110 | 110 | 110 | 110 |
| 8000 | 110 | 110 | 110 | 110 | 110 | 110 |
| 9000 | 110 | 110 | 110 | 110 | 110 | 110 |
| 1000 | 110 | 110 | 110 | 110 | 110 | 110 |

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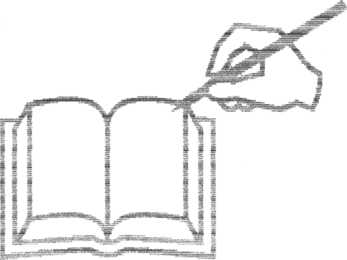
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