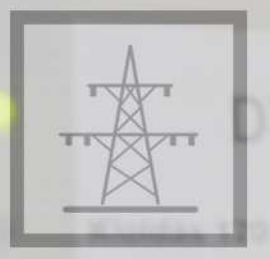
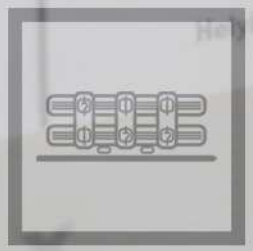
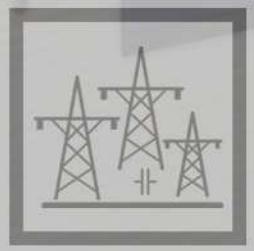
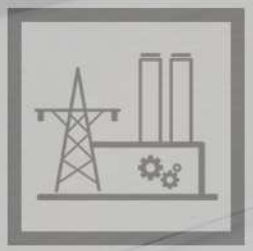
PROTECTA HUNGARY

METODE DE DETECTIE A DEFECTELOR HOMOPOLARE IN RETELE CU NEUTRU COMPENSAT



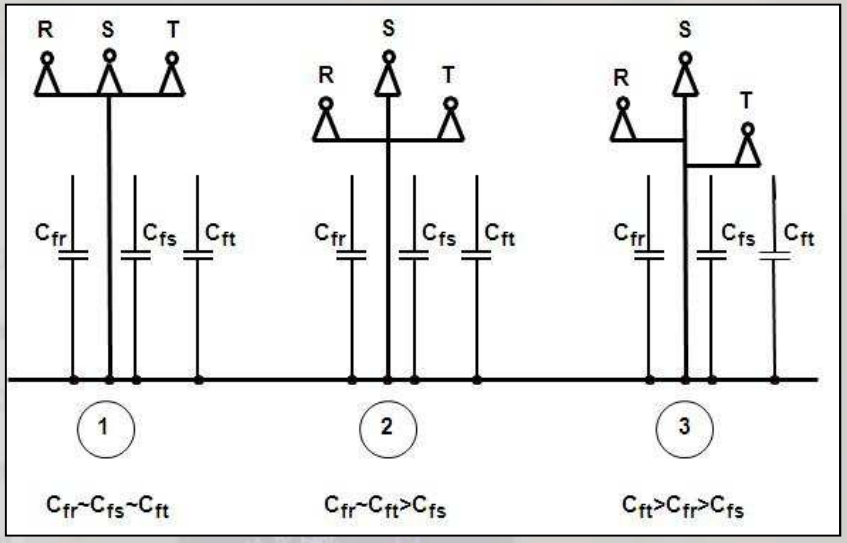
SUMMARY

- Evenimente in timpul functionarii normale a retelei
  - Asimetria in retele compensate
  - Utilizarea controlerului pentru bobina Petersen
- Evenimente in timpul unui singur defect homopolar
  - Prevenirea dezvoltarii in defecte homopolare permanente
  - Principalele tipuri de defecte homopolare
- Diferite metode de detectie a defectelor homopolare
  - Protectia la supracurent homopolar DT
  - Protectia directionata la supracurent homopolar
  - Protectia la defect homopolar temporar
  - Metoda noua: Protectia homopolara cu admitanta

ASIMETRIA IN RETELE CU NEUTRU COMPENSAT

SURSE ALE ASIEMTRIILOR IN RETELE CU NEUTRU COMPENSAT

- Pozitionarea asimetrica a conductorilor



- Structura miezului trafo de putere
- Rezistenta izolatorului
- Elementele asimetrice conectate la retea

CONSECINTE ALE ASIMETRIILOR

- Tensiuni de faza crescute
  - Risc crescut de defect homopolar
- Poate bloca reglarea bobinei Petersen (datorita U_0 marit)
  - Bobina Petersen nu e reglata
  - Curentul homopoplar este crescut
  - Defectul este permanent
  - Riscul de tensiune periculoasa este marit
  - Este necesara declansarea prin protectie

METODE DE SIMETRIZARE

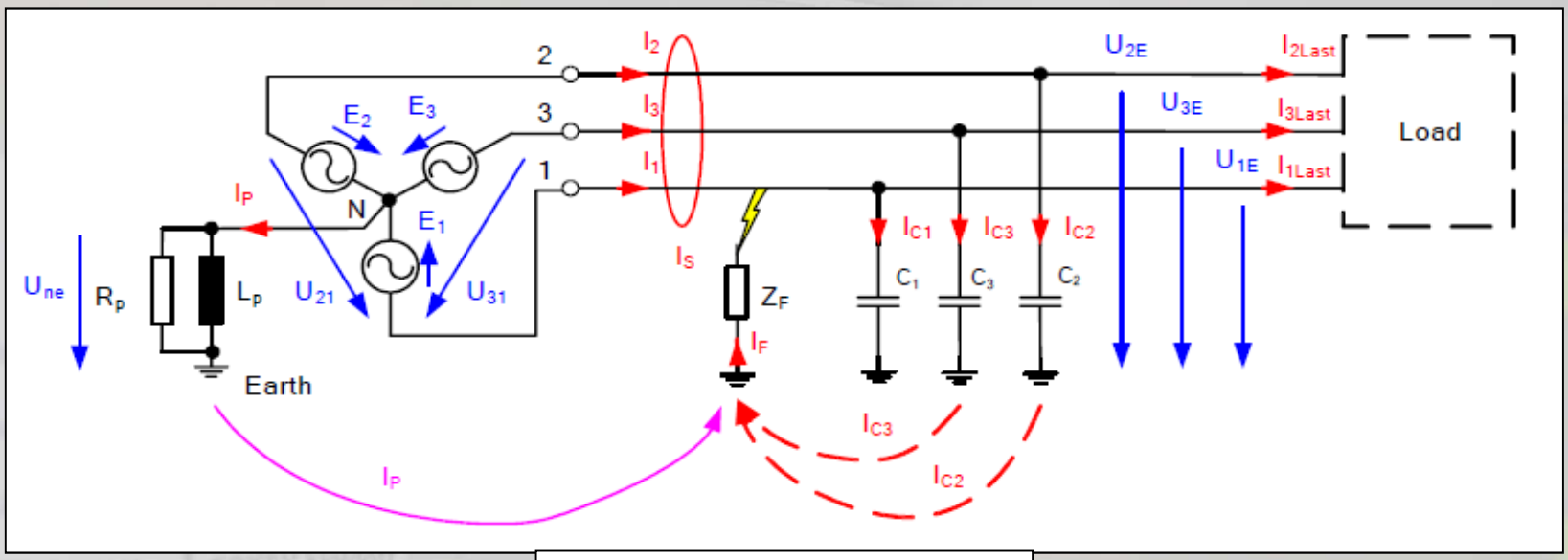
- Transpozitia ciclica a conductorilor de faza
  - Necesita refacerea retelei
  - Montare in mai multe locatii
  - Intrerupere indelungata a furnizarii
- Rezistor de impamantare continuu
  - Mai multe dezavantaje
- Adaugarea capacitorilor de simetrizare
  - Montare doar la postul de transofrmare
  - Costuri reduse
  - Intrerupere scurta a furnizarii

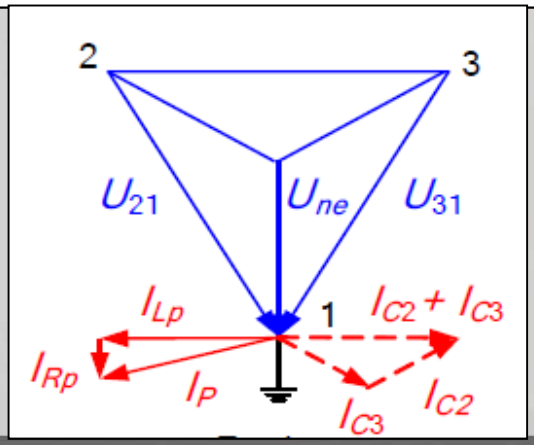




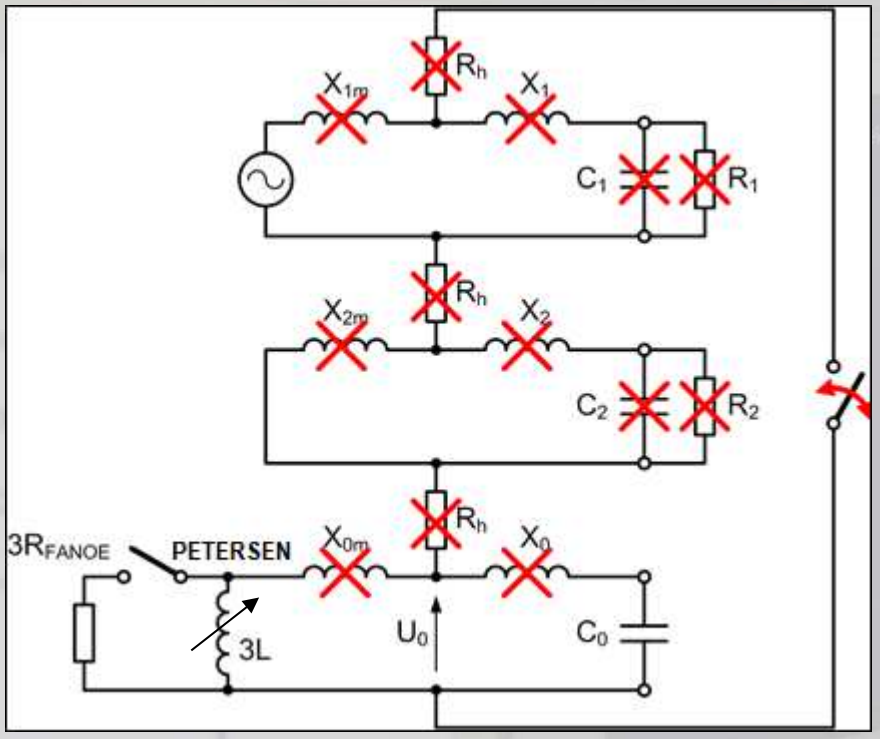
UTILIZAREA CONTROLERULUI BOBINEI PETERSEN

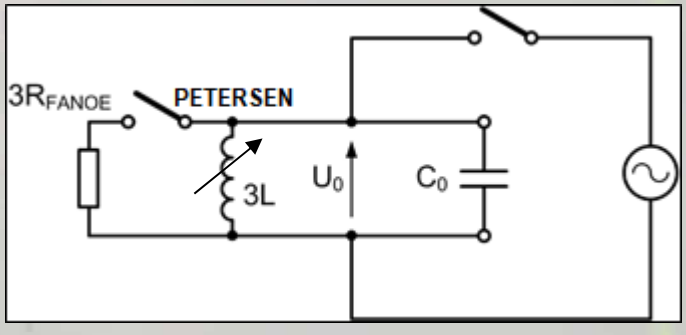
PRINCIPIUL COMPENSARII (BOBINA PETERSEN)





PRINCIPIUL COMPENSARII (BOBINA PETERSEN)





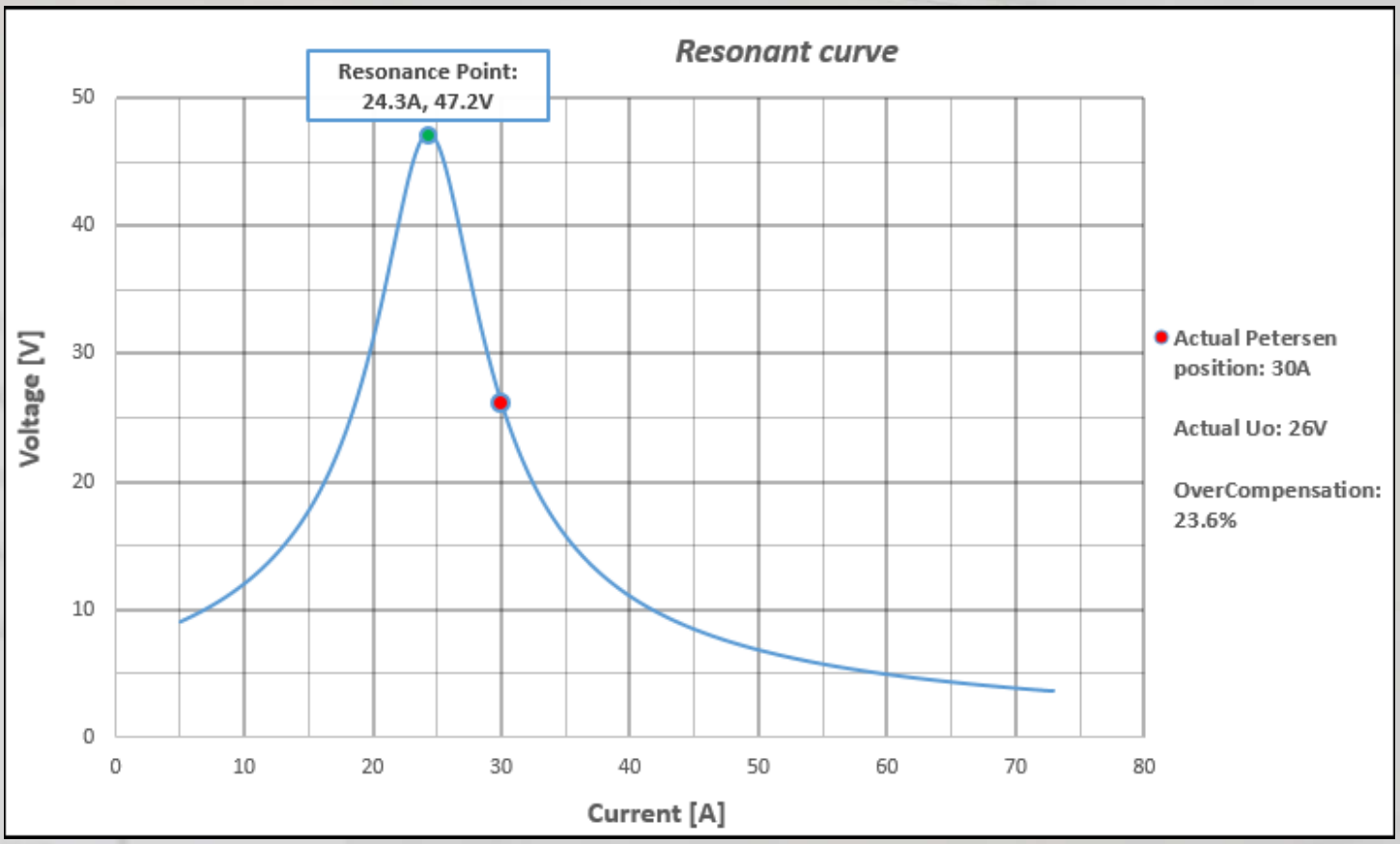
$$Z = \frac{j3\omega L \frac{1}{j\omega Co}}{j3\omega L - j\frac{1}{\omega Co}}$$

AVANTAJELE UTILIZARII CONTROLER BOBINEI PETERSEN

- De ce este importanta utilizarea unui controller automat pentru bobina Petersen?
  - Verificarea nivelului de compensare oricand este necesar
  - Reteaua se schimba permanent: feeder-ele pot fi conectate sau deconectate la campul de bare oricand
  - Capacitatea retelei se poate modifuca oricand, iar bobina Petersen trebuie sa urmeze aceasta modificare a capacitatii
  - Pastreaza intotdeauna bobina Petersen in pozitie reglata



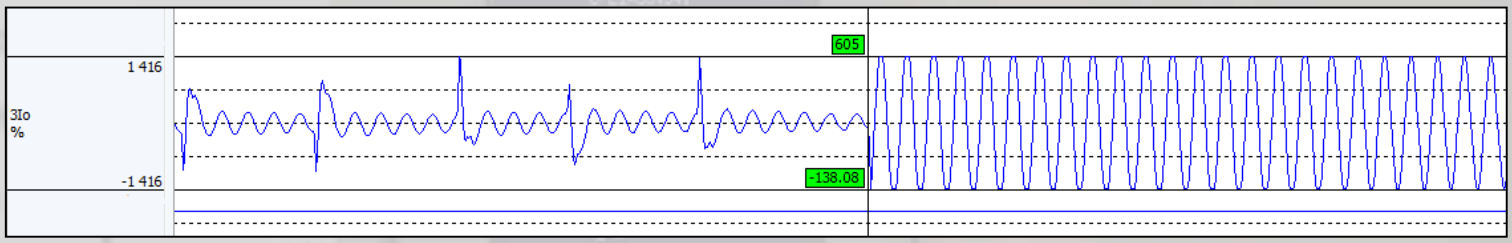
REZULTATE ALE MASURARILOR: CURBA DE REZONANTA



PREVENIREA DEZVOLTARII IN DEFECTE HOMOPOLARE PERMANENTE

CE POATE CRESTE RISCUL DEZVOLTARII DE DEFECTE HOMOPOLARE PERMANENTE

- Utilizarea rezistorului (sunt) de impamantare → creste curentul de defect, astfel ca defectul devine stabil

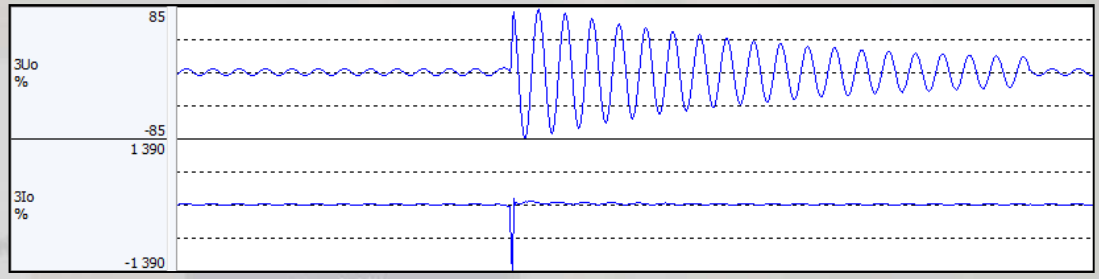


- Bobina Petersen nu este reglata corect → Supra- sau sub- comenpsare mare
- Timp scurt pentru utilizarea doar a bobinei Petersen

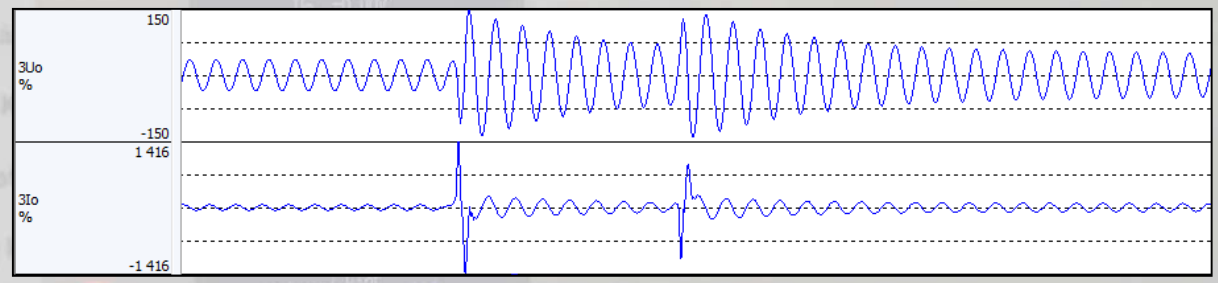
O METODA EFICIENTA DE PREVENTIE

- Bobina Petersen correct reglata

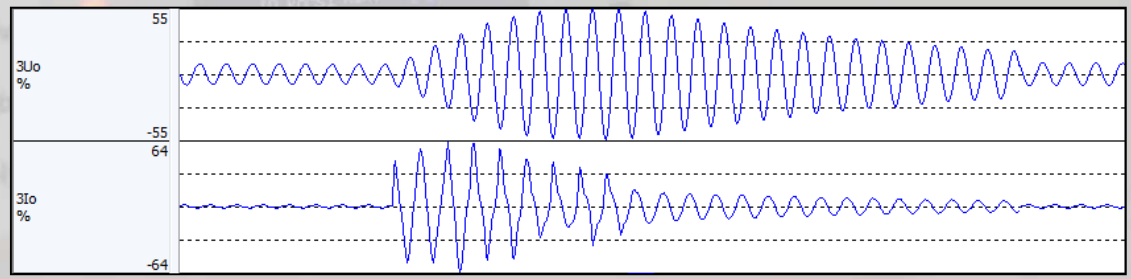
Exemplul 1:



Exemplul 2:

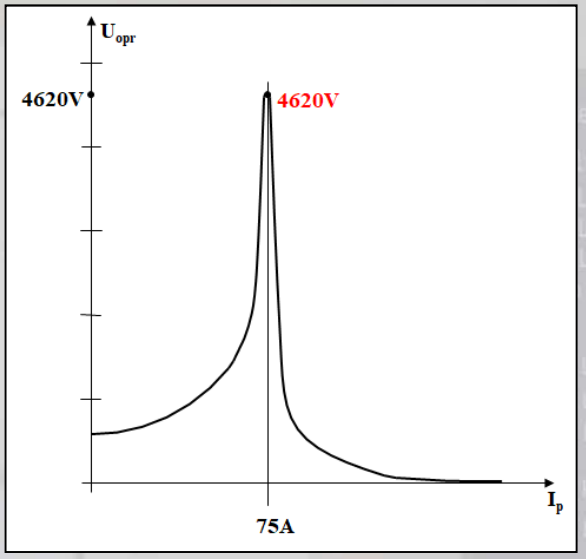


Exemplul 3:



DE CE COMPENSAREA "EXACTA" POATE CAUZA PROBLEME?

- U_0 este relative mare:

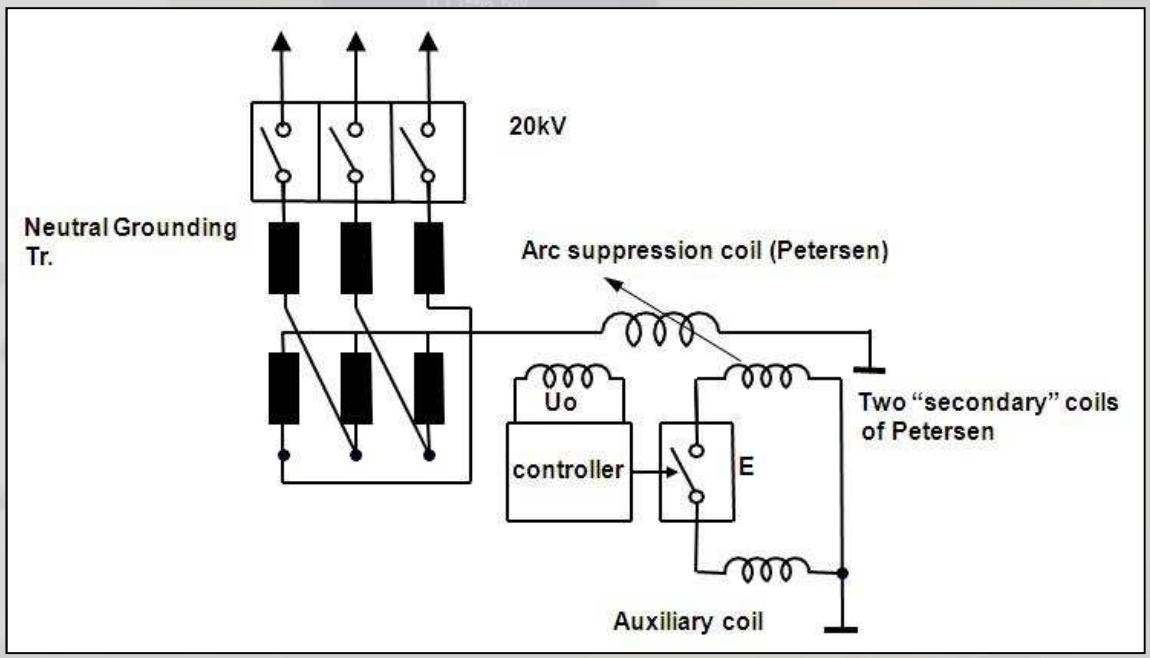


- Tensiuni de faza crescute
- Probleme ale procedurii de reglare a bobinei Petersen

CARE AR PUTEA FI O SOLUTIE OPTIMA? (IDEEA PROTECTA)

- Utilizarea unei inductante de sunt, conectata parallel cu bobina Petersen → in cazul unui defect homopolar, poate fi realizata compensarea “exacta”:

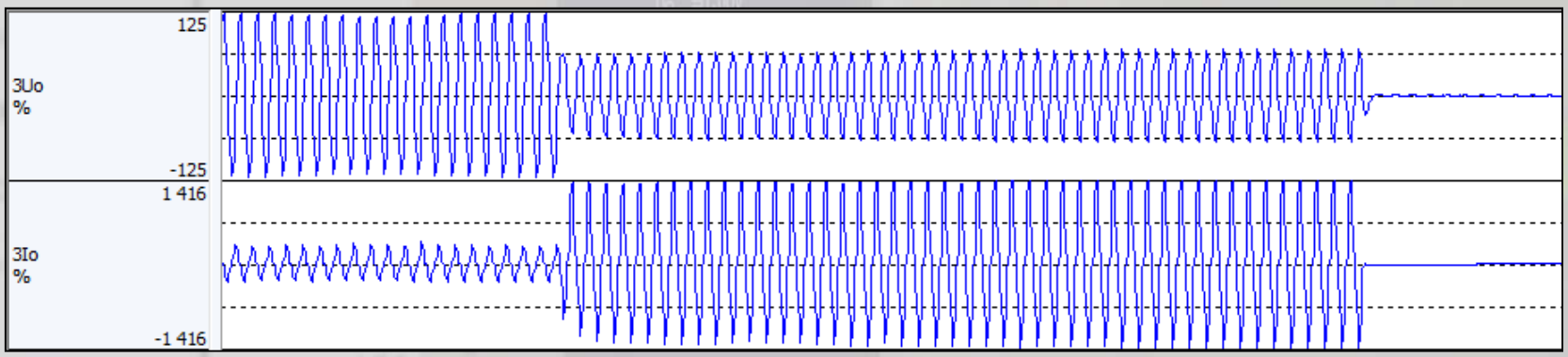
  COMPENSAREA ADAPTIVA



TIPURI PRINCIPALE DE DEFECTE HOMOPOLARE PERMANENTE

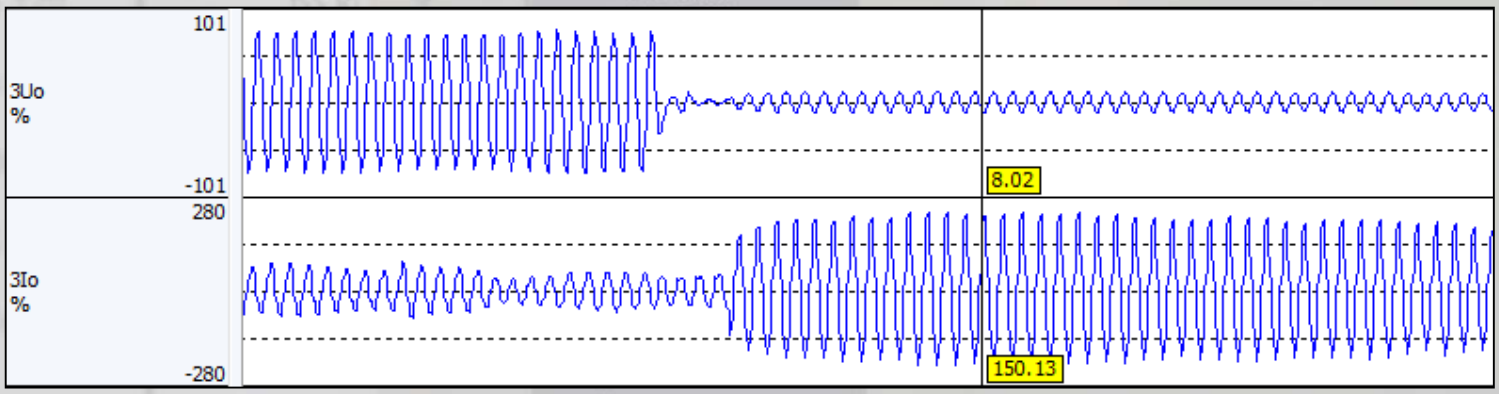
DEFECTE STABILE CU REZISTENTA HOMOPOLARA REDUSA

- Curentul de defect continuu
- Daca rezistenta de impamantare este cuplata, curentul de defect crescut este suficient de mare pentru a fi detectat de functiile de protectie homopolara



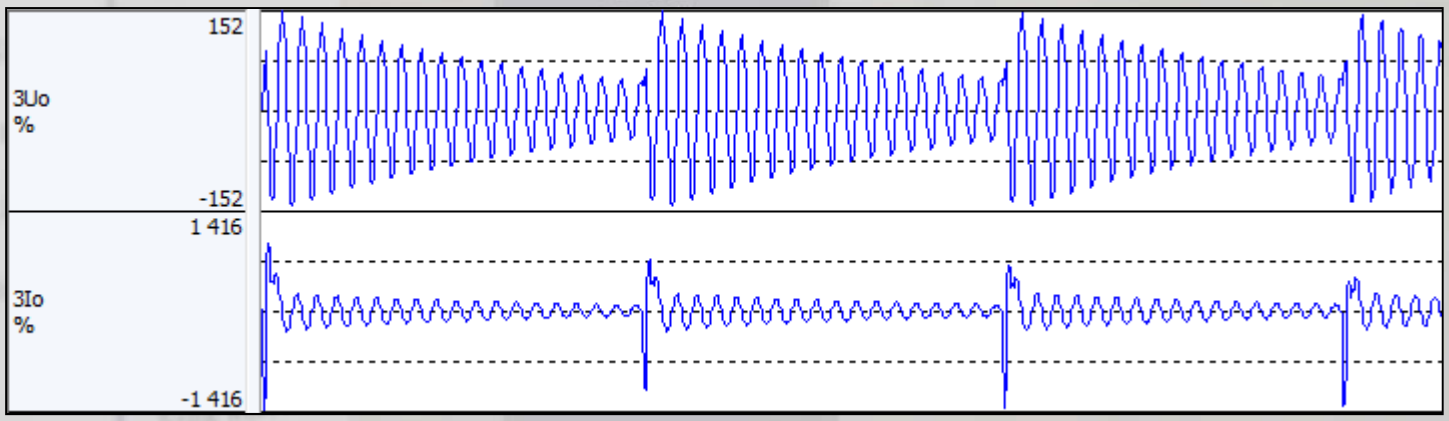
DEFECTE STABILE CU REZISTENTA HOMOPOLARA RIDICATA

- Curentul de defect continuu
- Daca rezistenta de impamantare este cuplata, curentul de defect crescut NU este suficient de mare pentru a fi detectat de functiile de protectie homopolara



DEFECTE HOMOPOLARE INTERMITENTE

- Curentul de defect nu este continuu
- Timpul de defect este de5-10msec, defectul dispare pentru mai multe perioade
- Timpul intre defecte poate fi de 100msec – 500msec

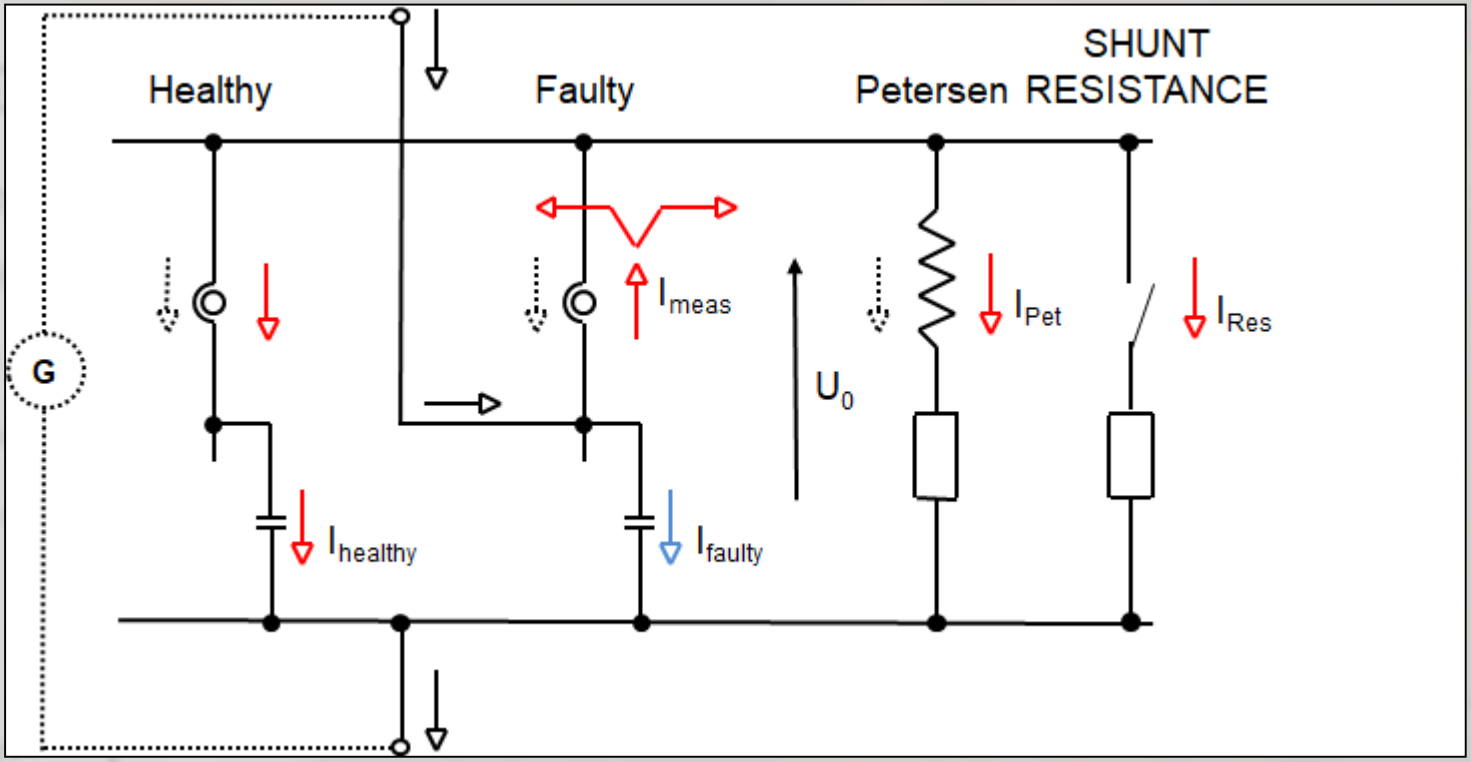


PROTECTIA LA SUPRACURENT REZIDUAL DT



METODA DE CRESTERE A CURENTULUI DE DEFECT

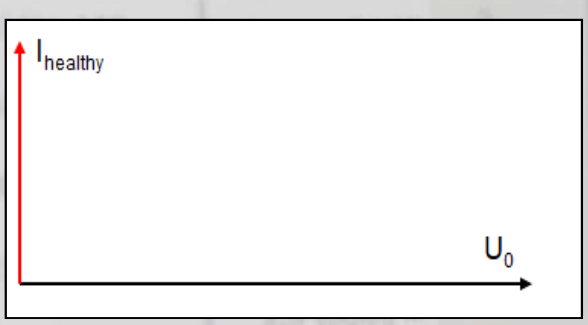
- Componentele retelei simetrice:



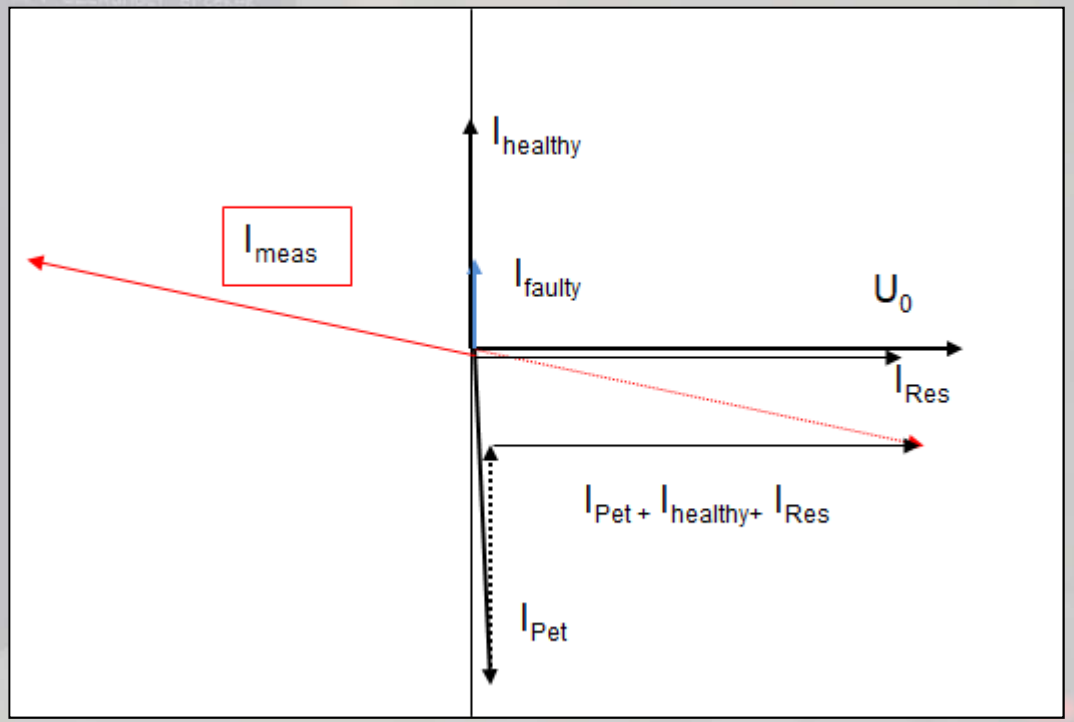
METODA DE CRESTERE A CURENTULUI DE DEFECT

- Curentul si tensiunea homopolara in timpul defectului:

Feeder OK:



Feeder cu defect:



PROTECTIA LA SUPRACURENT HOMOPOLAR DT

- Parametri de setat:
  - Curentul de start (I_{start})
  - Intarzierea (T_{delay})

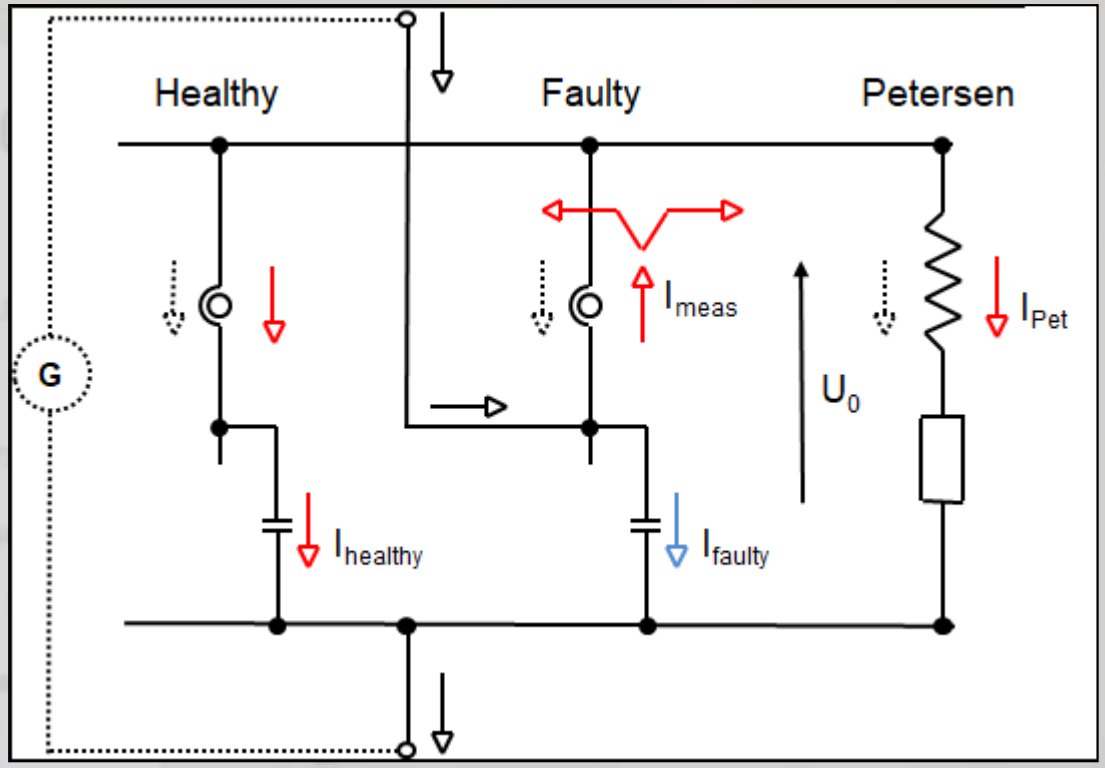
PROTECTIA LA SUPRACURENT HOMOPOLAR DT

- Avantaje
  - Solutie foarte simpla
  - Putini parametri de setat
  - Nu necesita masurarea U_0
- Dezavantaje
  - Mentenanta rezistentei e costisitoare
  - Nu poate detecta defecta cu rezistenta homopolara mare
  - Daca rezistenta este cuplata, posibilitatea eliminarii defectului folosind bobina Petersen este zero
  - Tensiuni periculoase: standardul IEC-50522 nu permite mentinerea curentului de defect pentru mult timp (maximum 100-200ms)

PROTECTIA LA SUPRACURENT HOMOPOLAR DIRECTIONAL

METODA WATTMETRICA

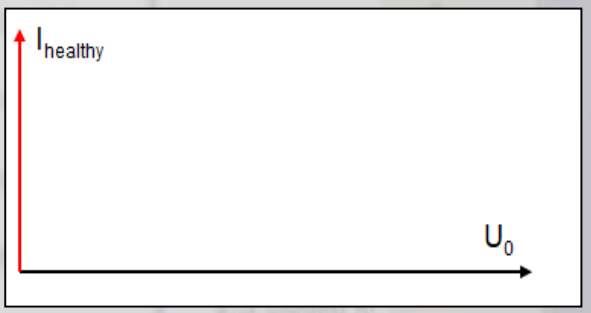
- Componentele retelei simetrice:



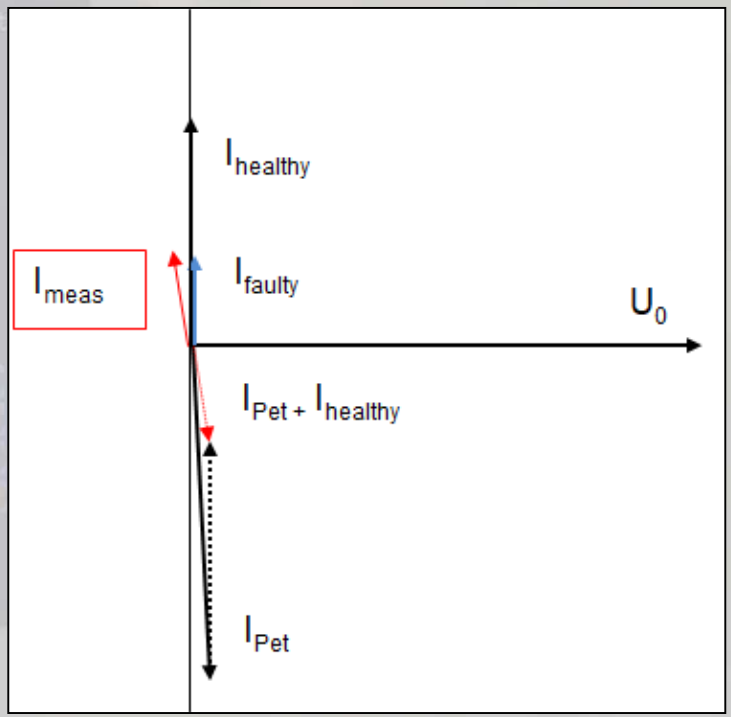
METODA WATTMETRICA

- Tensiune si curentul homopolar in timpul defectului:

Feeder OK:

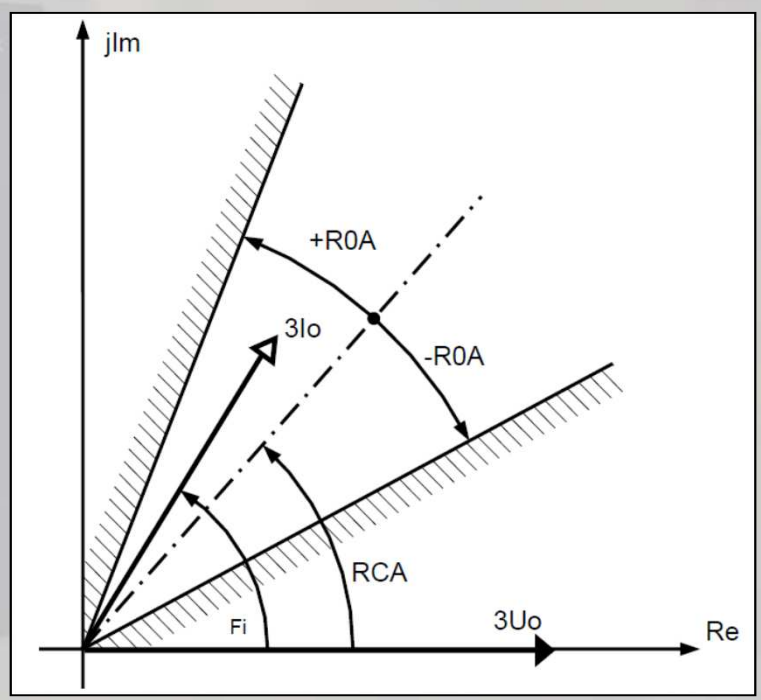


Feeder cu defect:



PROTECTIA LA SUPRACURENT HOMOPOLAR DIRECTIONAL

- Parametri de setat sunt
  - Curentul de start (I_{start})
  - Unghiul characteristic (RCA)
  - Unghiul de operare (ROA)
  - Caracteristica de operare



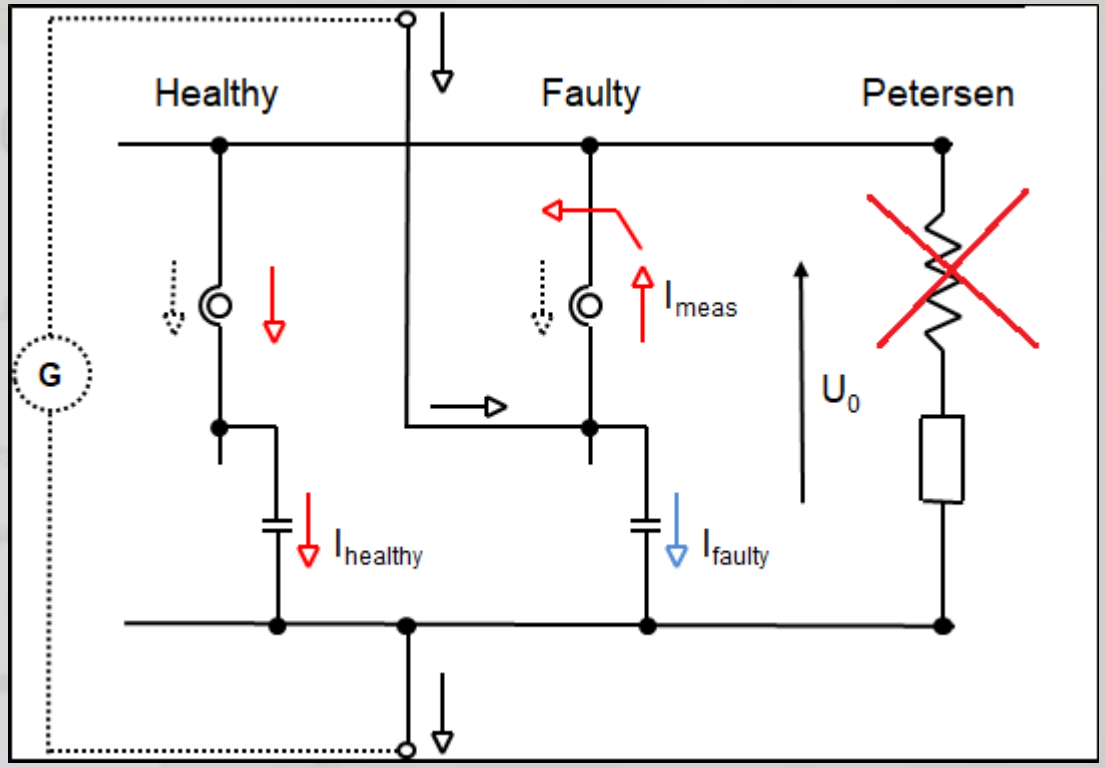
PROTECTIA LA SUPRACURENT HOMOPOLAR DIRECTIONAL

- Avantaje
  - Nu necesita elemente primare sau secundare adaugate
  - Curentul de defect nu este crescut
- Dezavantaje
  - Nu poate detecta defecte intermitente
  - Daca rezistenta bobinei Petersen e prea mica, atunci componenta wattmetrica a curentului de defect este prea mica → e dificil de setat correct caracteristica
  - Necesita masura U_0 voltage

PROTECTIA LA DEFECTE HOMOPOLARE TEMPORARE

METODA TEMPORARA

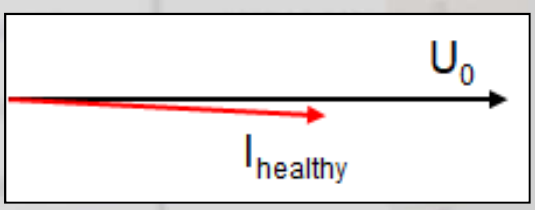
- Componenta retelei simetrice:



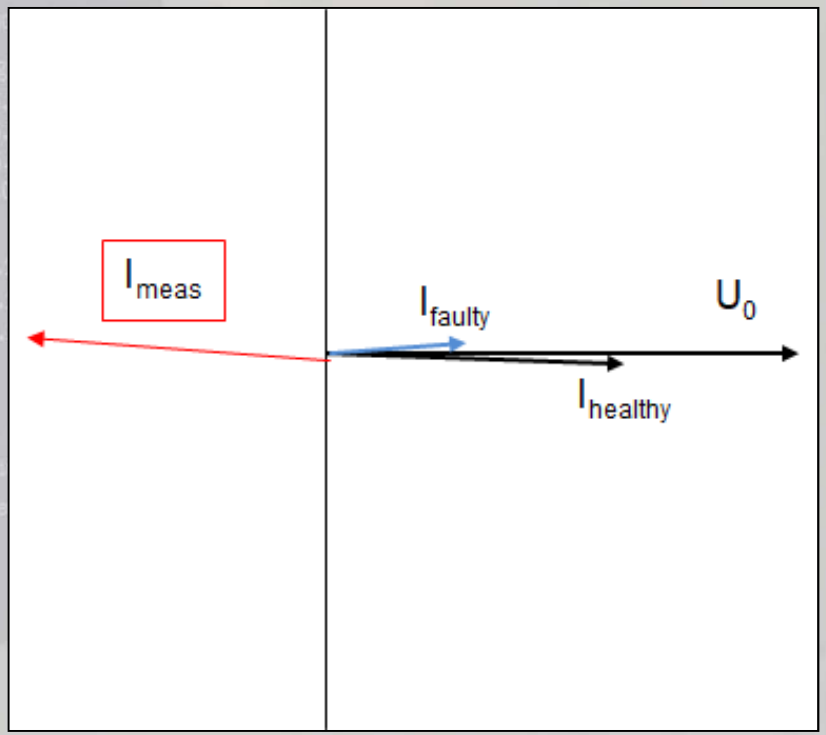
METODA TEMPORARA

- Tensiunea si curentul homopolar in momentul defectului:

Feeder OK:



Feeder cu defect:



METODA TEMPORARA

- Parametri de setat sunt:
  - Tensiunea $U_{0,min}$ si curentul ($I_{0,min}$)
  - Numarul de varfuri contorizate
  - Timpul de reset dupa ultimul varf contorizat (T_{reset})

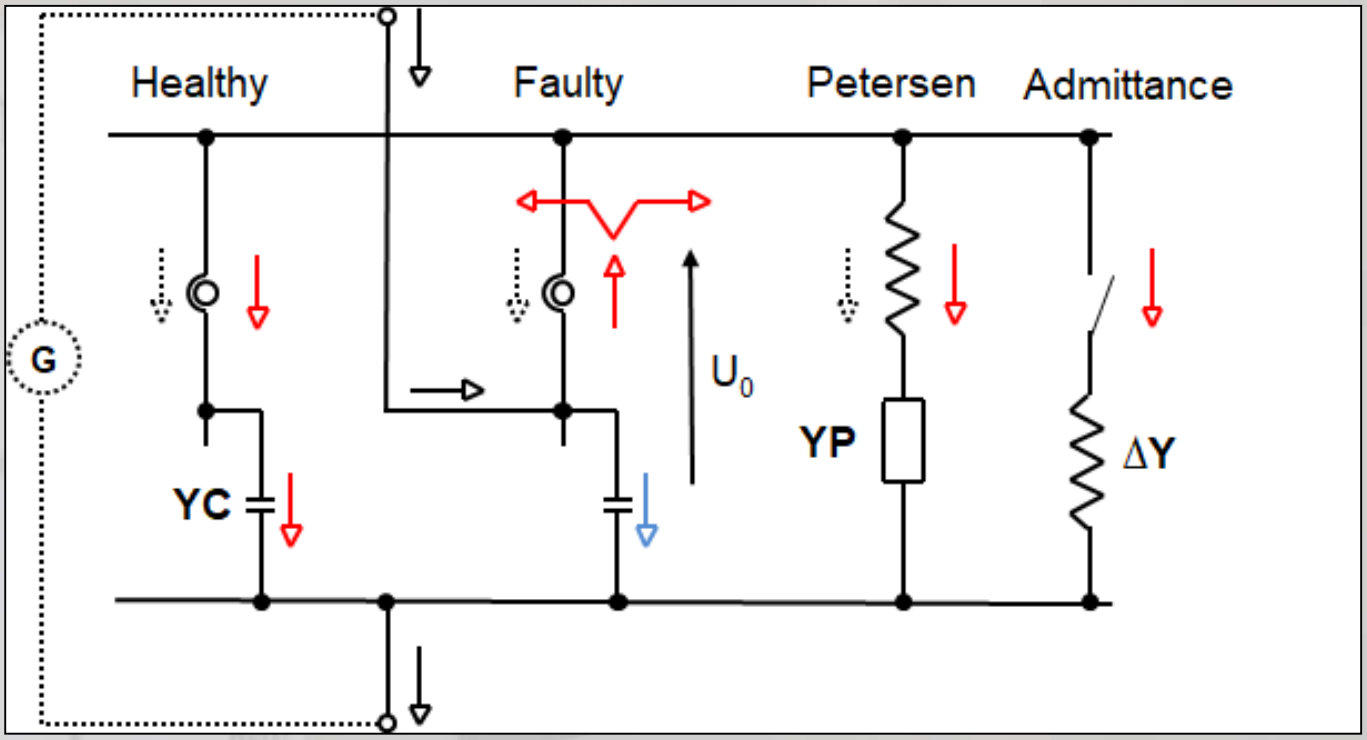
METODA TEMPORARA

- Avantaje
  - Nu necesita elemente primare sau secundare
  - Curentul homopolar nu este crescut
  - Solutie simpla
  - Putini parametri de setat
- Dezavantaje
  - Nu poate detecta defectele homopolare cu rezistenta de defect mare
  - Necesita masurarea U_0

METODA NOUA: PROTECTIA HOMOPOLARA PRIN ADMITANTA

METODA DE MODIFICARE A ADMITANTEI

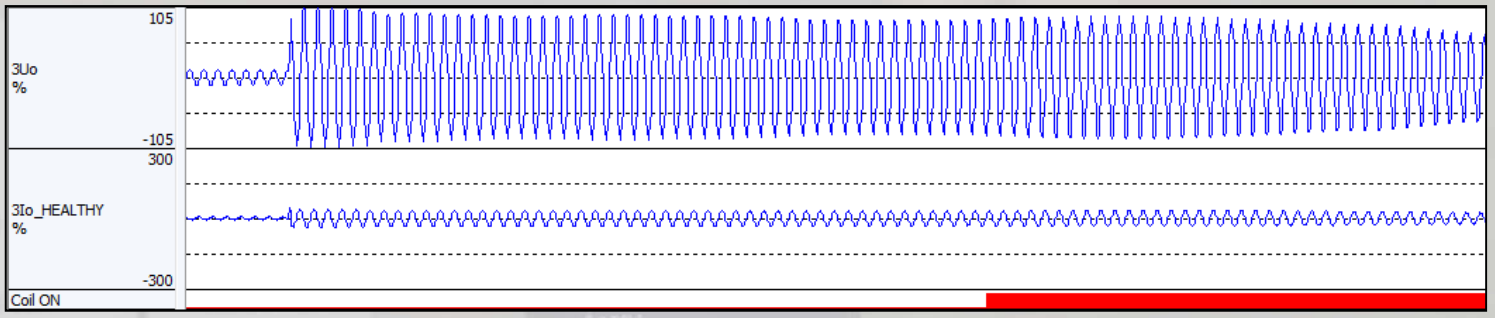
- Componenta retelei simetrice:



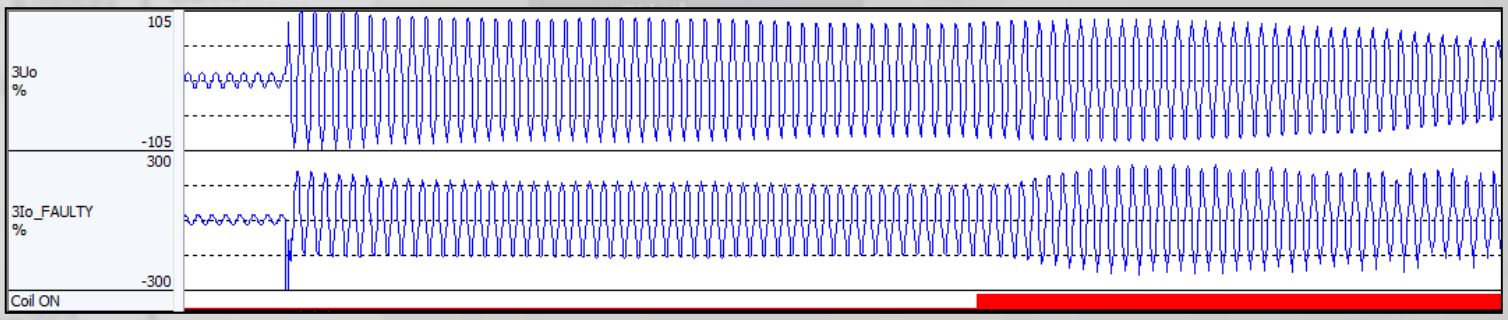
METODA DE MODIFICARE A ADMITANTEI

- Tensiunea si curentul homopolar

Feeder OK:



Feeder cu defect:



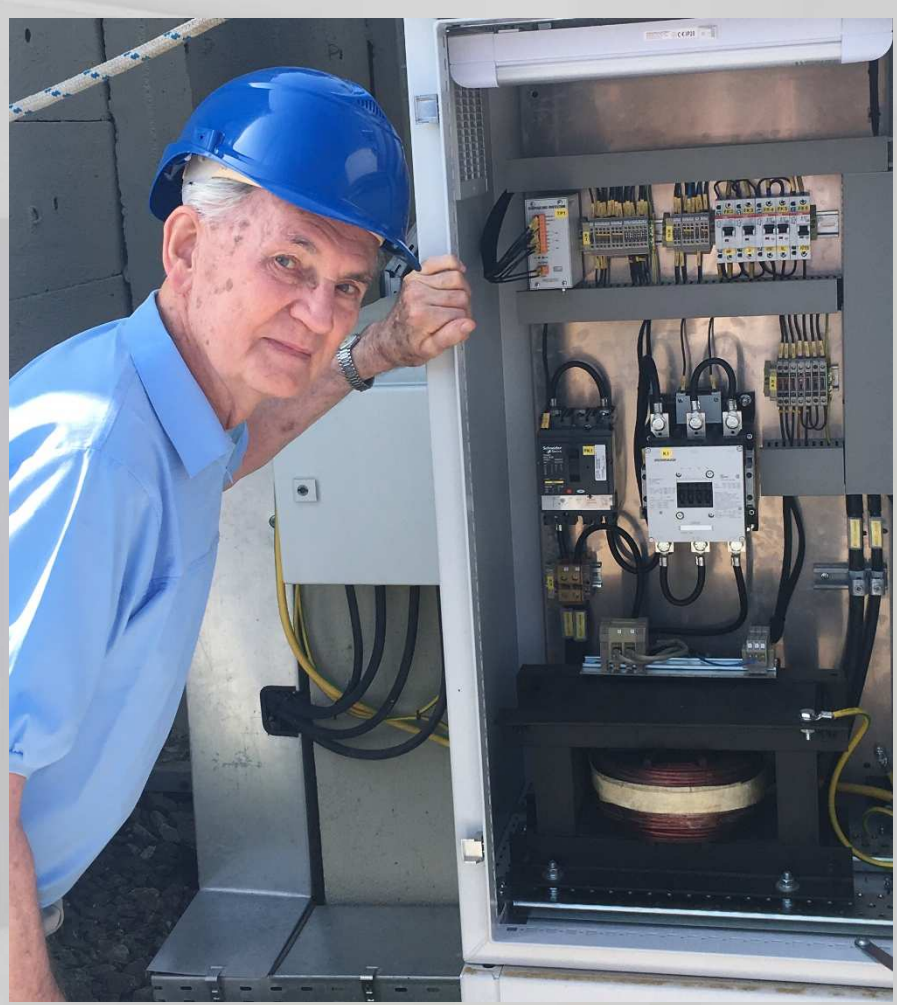
METODA DE MODIFICARE A ADMITANTEI

- Admitantele masurate ($3I_0/3U_0$):

	ΔY OFF	ΔY ON	Diferenta
Feeder OK	YC	YC	0
Feeder cu defect	-(YC+YP)	-(YC+YP+ΔY)	ΔY

METODA DE MODIFICARE A ADMITANTEI

- Implementarea:



METODA DE MODIFICARE A ADMITANTEI

- Parametri de setat sunt:
  - ($U_{0,min}$) si ($I_{0,min}$)
  - Raportul de transformare pentru trafo de tensiune si curent
  - Valoarea admitantei bobinei adaugate
  - Parametri liniei (in cazul calcularii locatiei defectului)

METODA DE MODIFICARE A ADMITANTEI

- Avantaje
  - Poate detecta defecte permanente cu rezistenta mare de defect
  - Curentul homopolar nu este crescut
  - Poate calcula precis rezistenta defectului
  - Poate separa tipurile de defect homopolar
  - Poate fi folosita pentru compensare adaptiva
- Dezavantaje
  - Nu poate detecta defecte intermitente: necesita o metoda diferita.
  - Necesita masurarea U_0







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