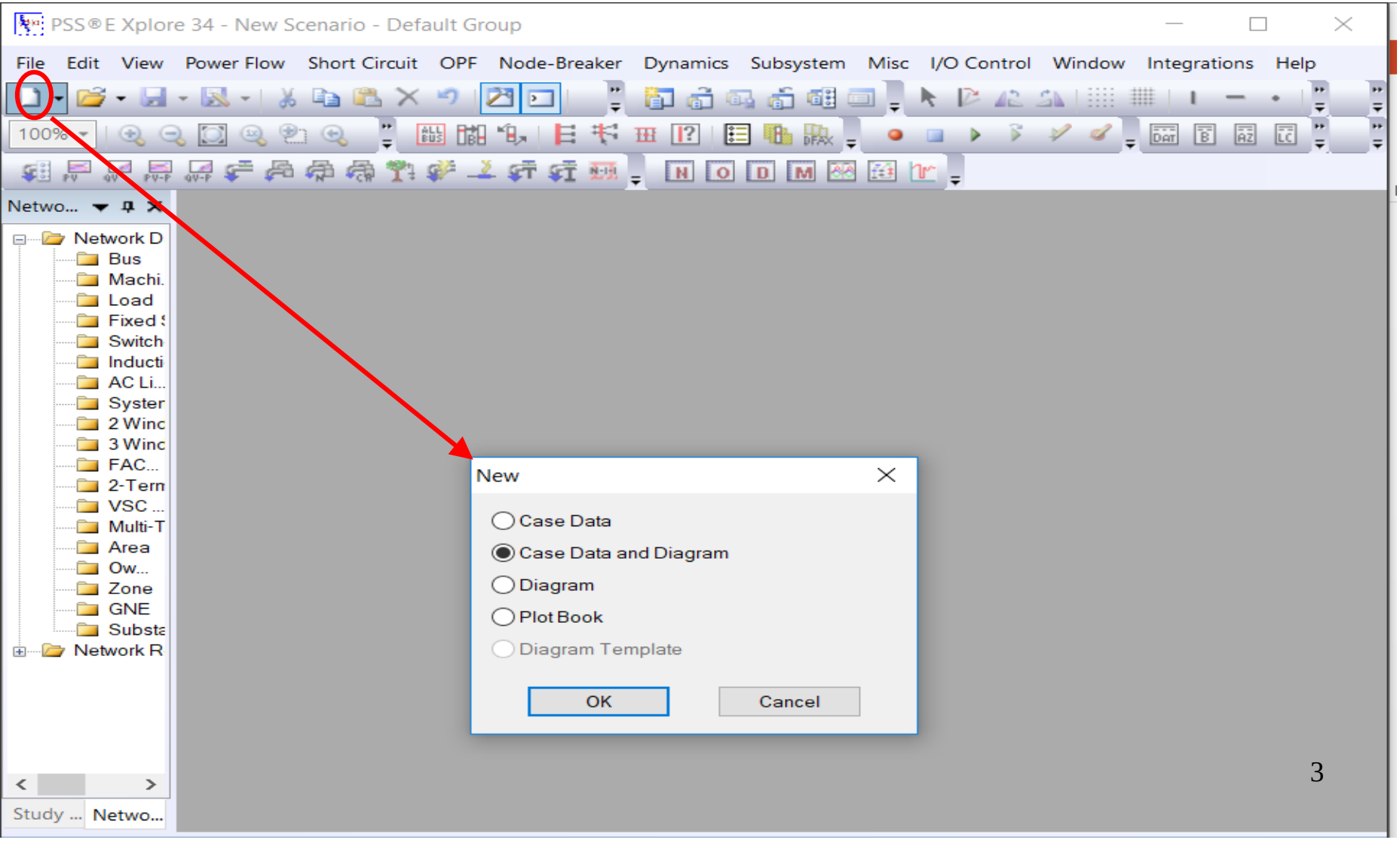
Introducción al PSS/E

Flujos de carga y simulaciones dinámicas

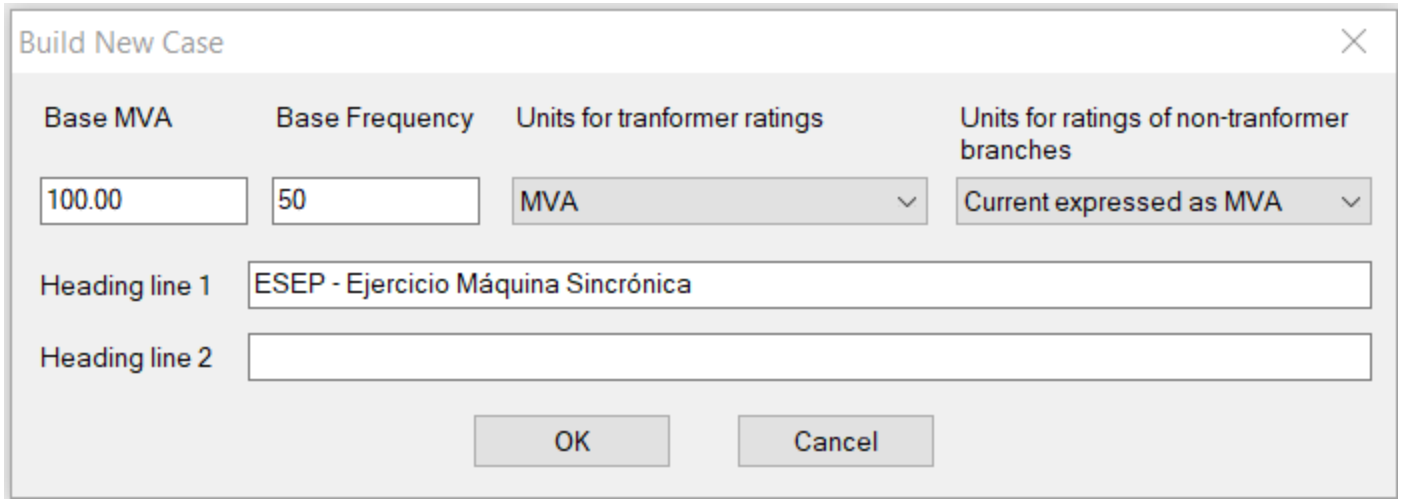
Estructura de Archivos

- Archivos:
  - *.sav
    - Archivo binario con modelo del sistema y solución del flujo de carga guardado
  - *.sld
    - Archivo binario con el esquema unifilar asociado a un archivo *.sav
  - *.dyr
    - Archivo de texto con información para los modelos dinámicos
  - *.outx
    - Archivo con canales de salida de corrida dinámica
- IMPORTANTE
  - Archivo sav y slider se **guardan por separado**.

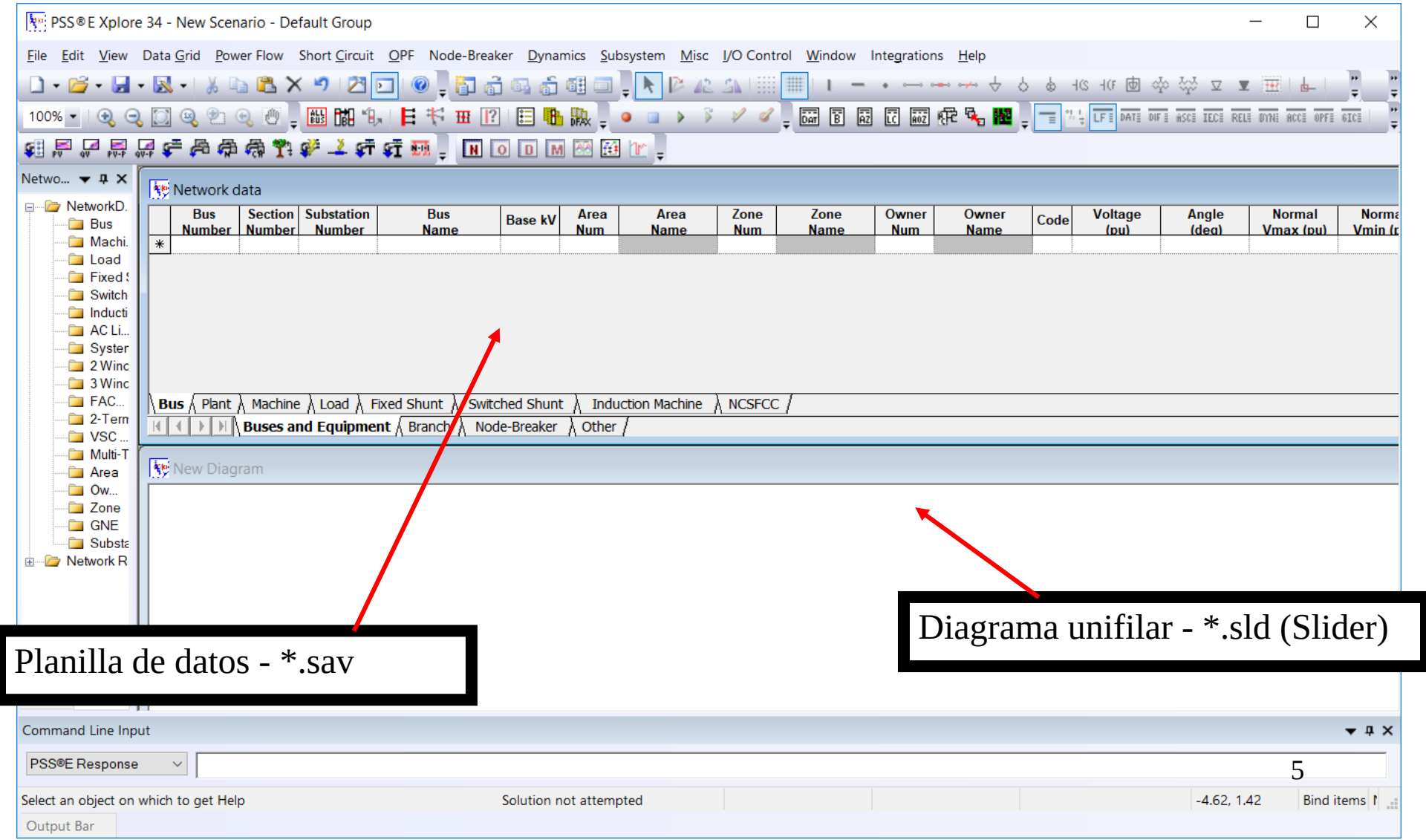
Crear un caso nuevo



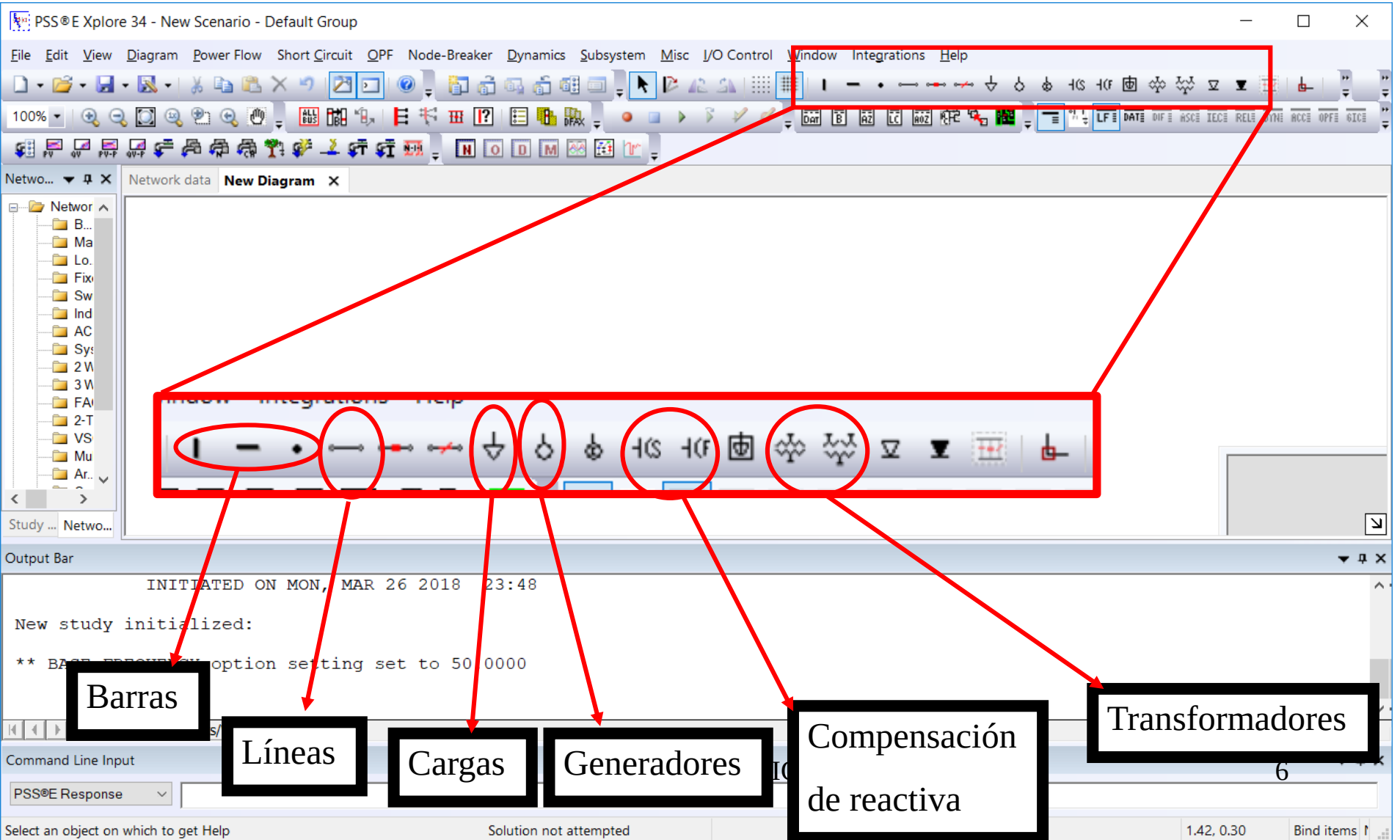
Crear un caso nuevo



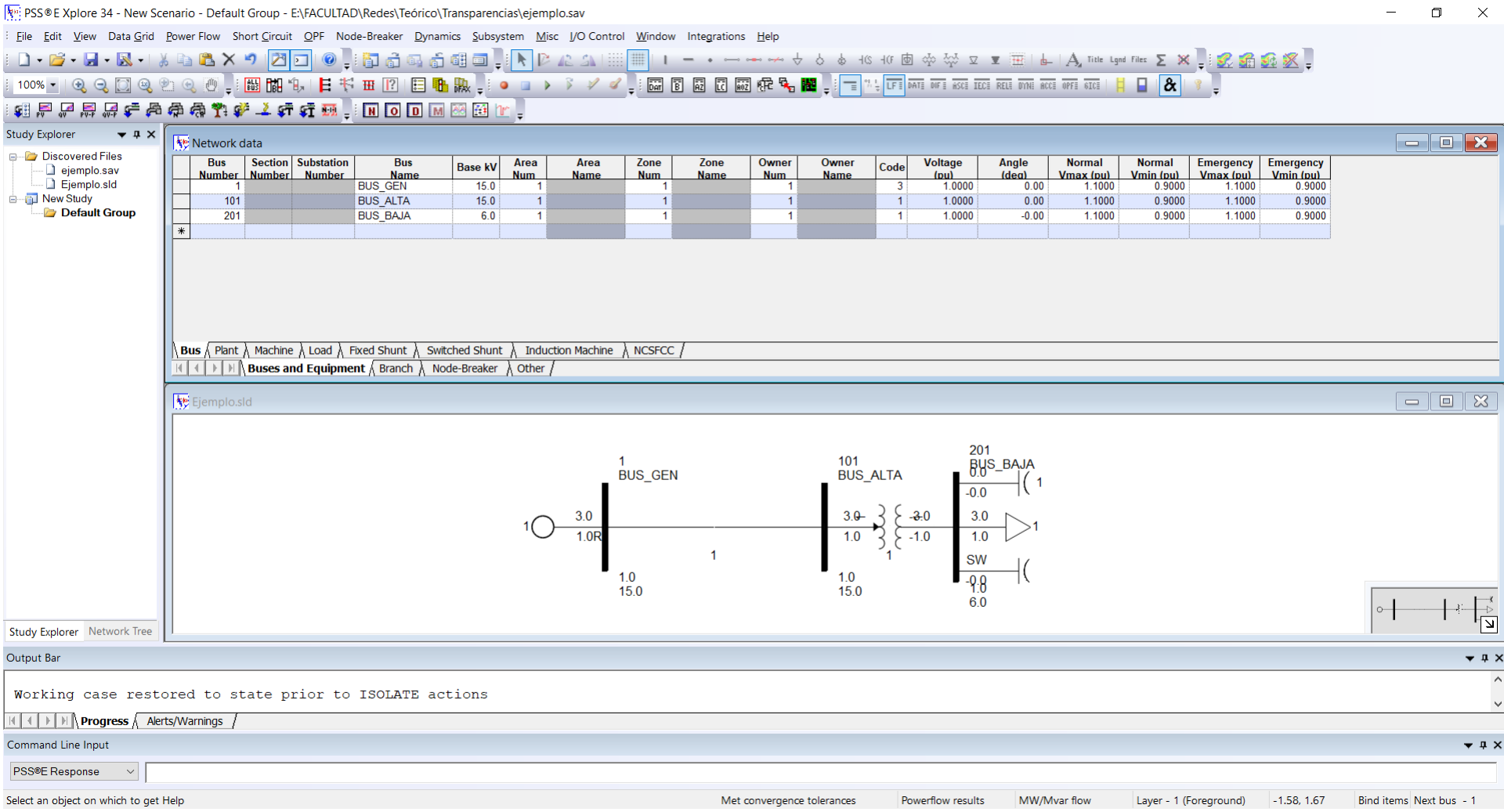
Crear un Caso nuevo



Modelo estático de la red



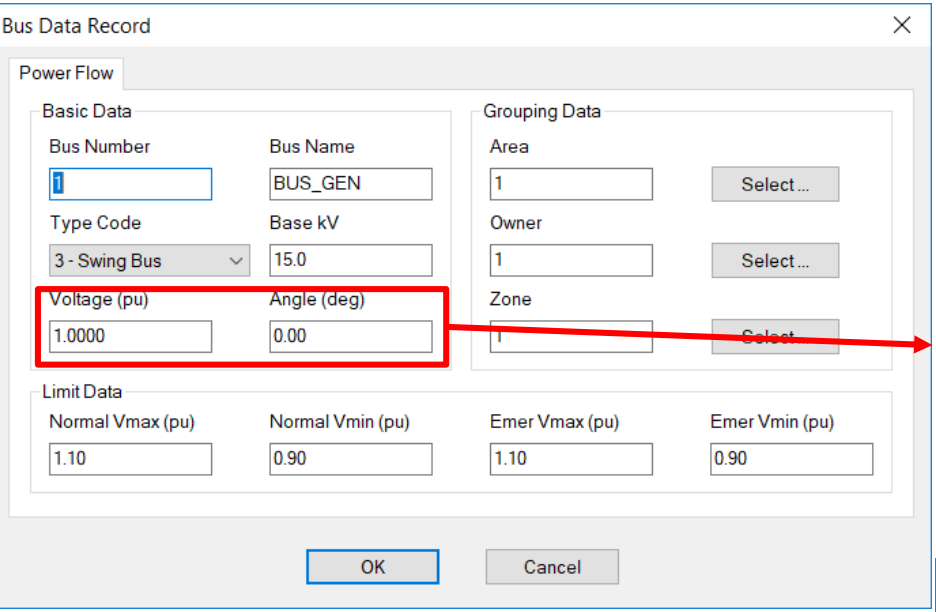
Modelar la red: Ejemplo



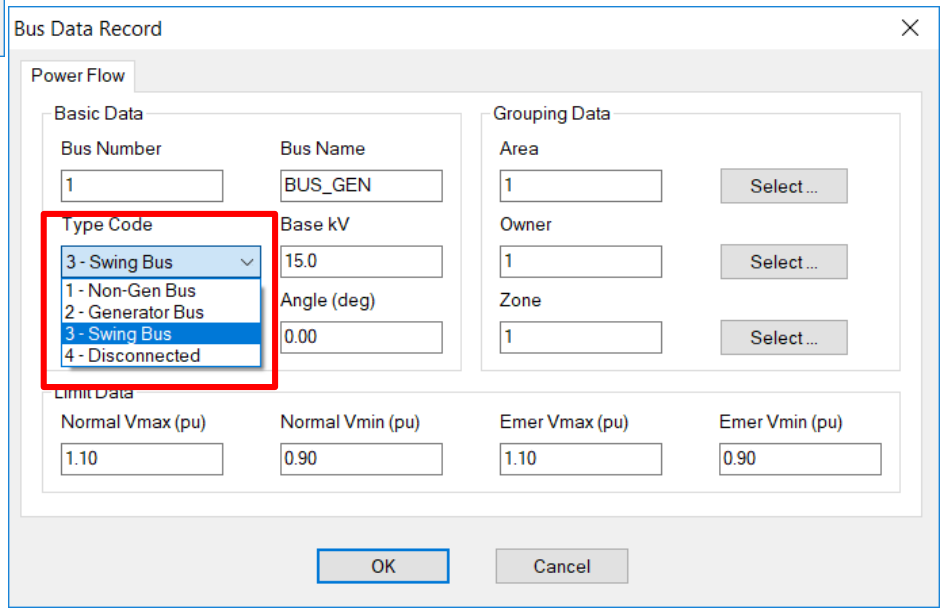
Modelar la red: Ejemplo

- Los cuadros de datos a continuación se muestran al hacer doble clic sobre el componente dibujado en el diagrama Slider

Bus (barra)



Resultado del Flujo de Carga, no es una consigna.



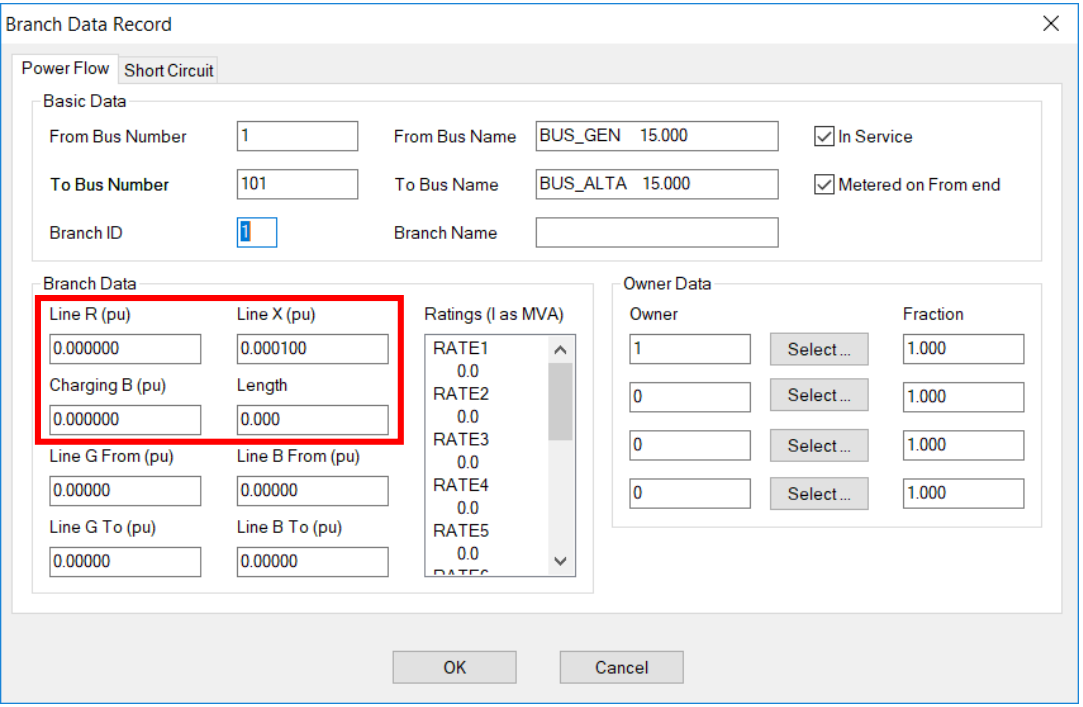
Tipo de Barra

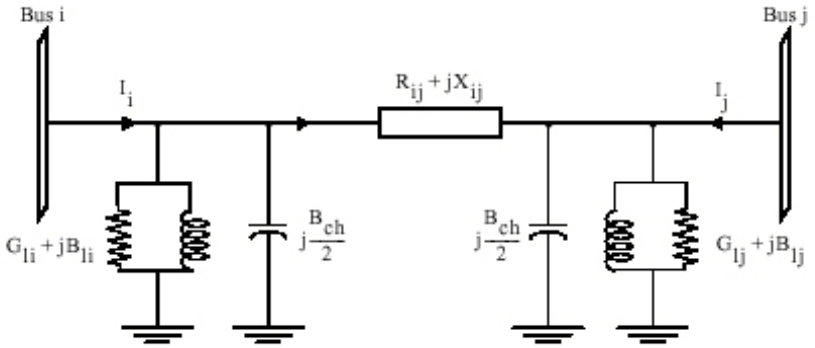
<u>Non-Gen Bus</u>: barras sin generación (barras PQ por ej)

<u>Generator Bus</u>: Barras PV

<u>Swing Bus</u>: Barra Flotante (un caso SAV debe tener por lo menos una)

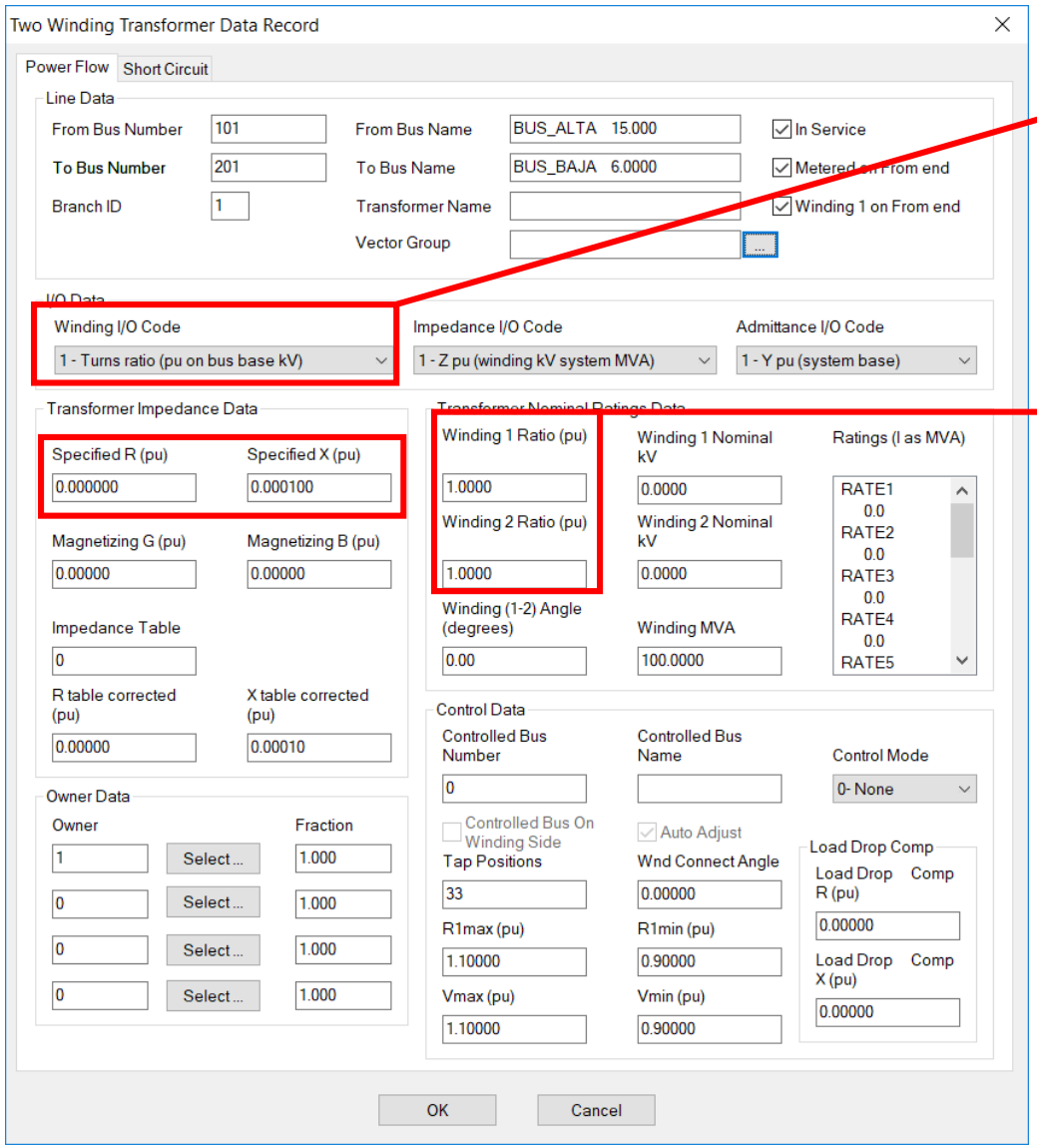
Branch (Línea o cable)





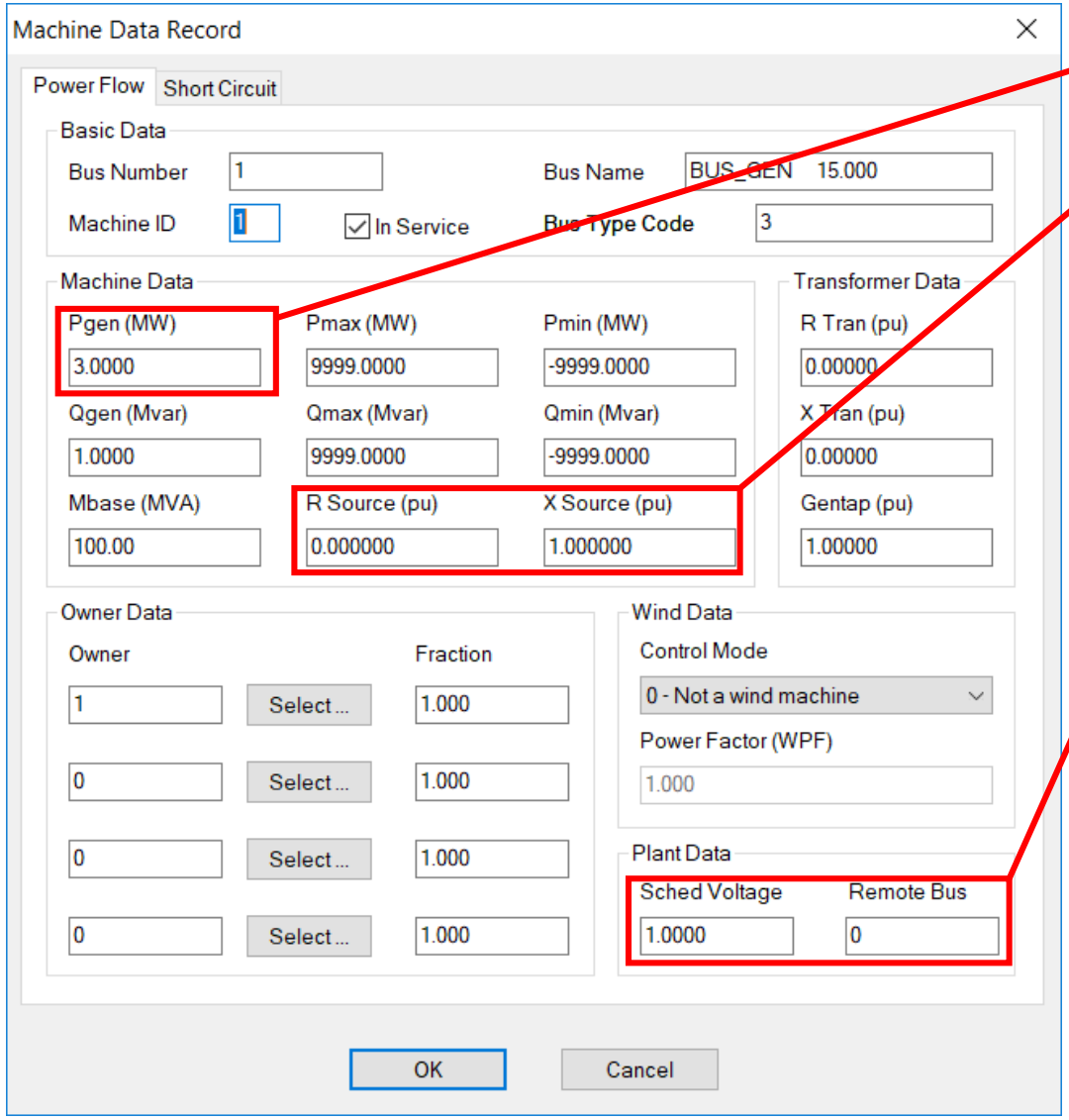
- <u>Suceptancia B</u>: se ingresa B, luego PSSE divide entre 2 para construir el modelo.

Modelar la red: Transformer



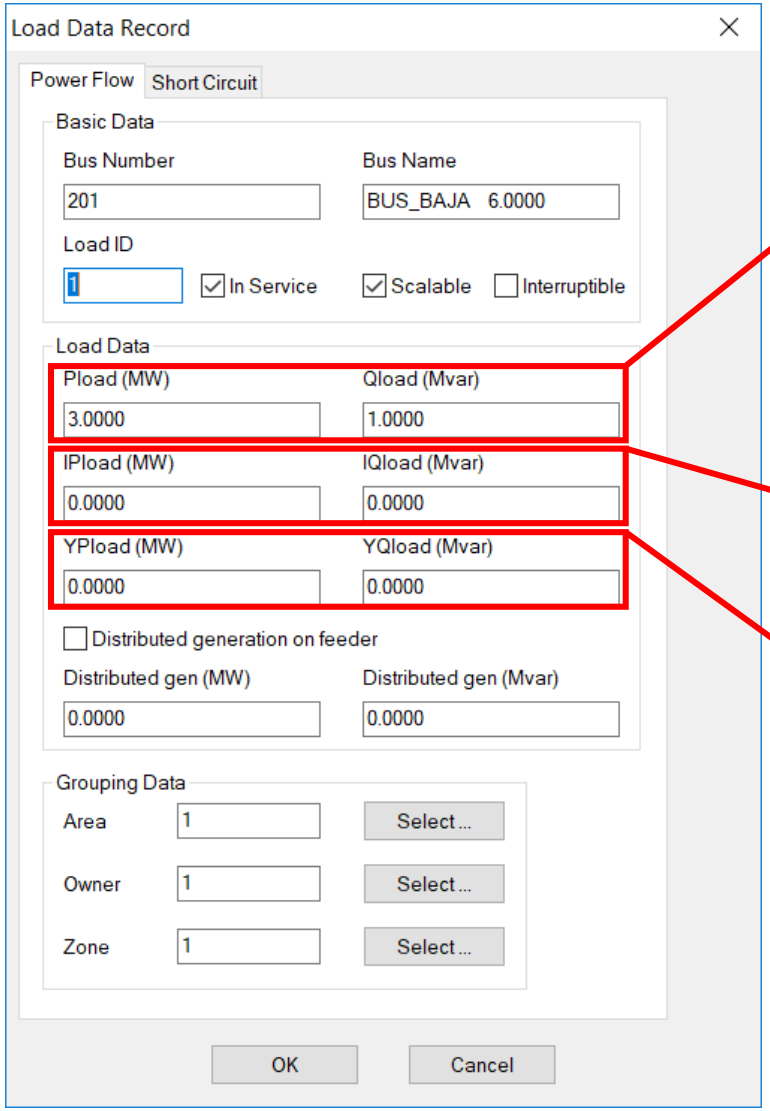
- Modo de entrada con la que se quiere ingresar la tensión nominal del TAP
- Tensión nominal del TAP del transformador expresado en pu
  - $\frac{Wind\ 1\ Ratio}{Wind\ 2\ Ratio} = rel\ de\ transf\ en\ pu$
- Modo de ingreso de la impedancia de cortocircuito
- Impedancia de cortocircuito en pu

Modelar la red: Machine



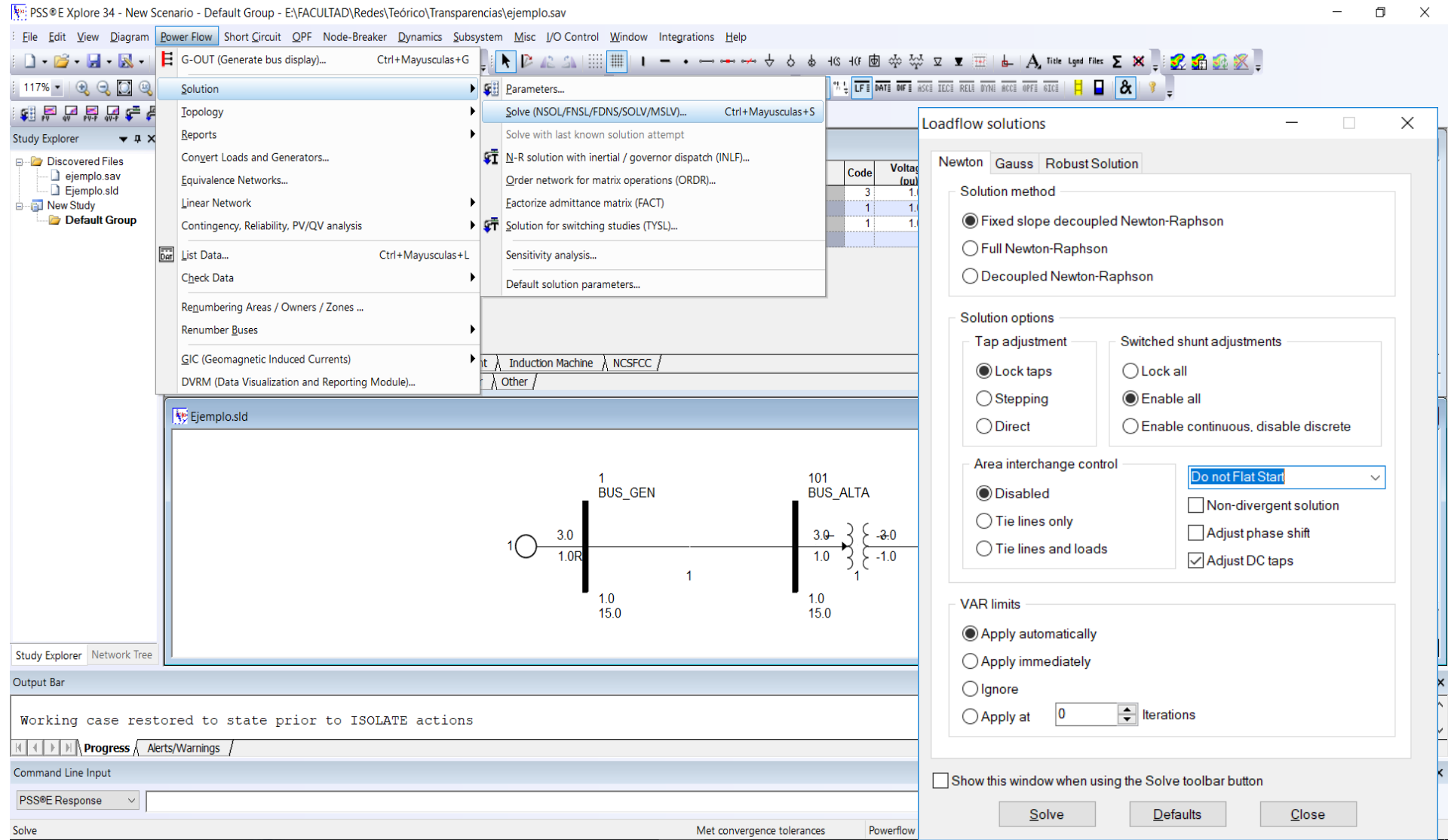
- Consigna de potencia activa
- ZSOURCE
  - Para simulación dinámica:
    - unsaturated subtransient impedance
    - unsaturated transient impedance
  - Para estudios de cortocircuito:
    - saturated subtransient or transient impedance
- Consigna de tensión

Load

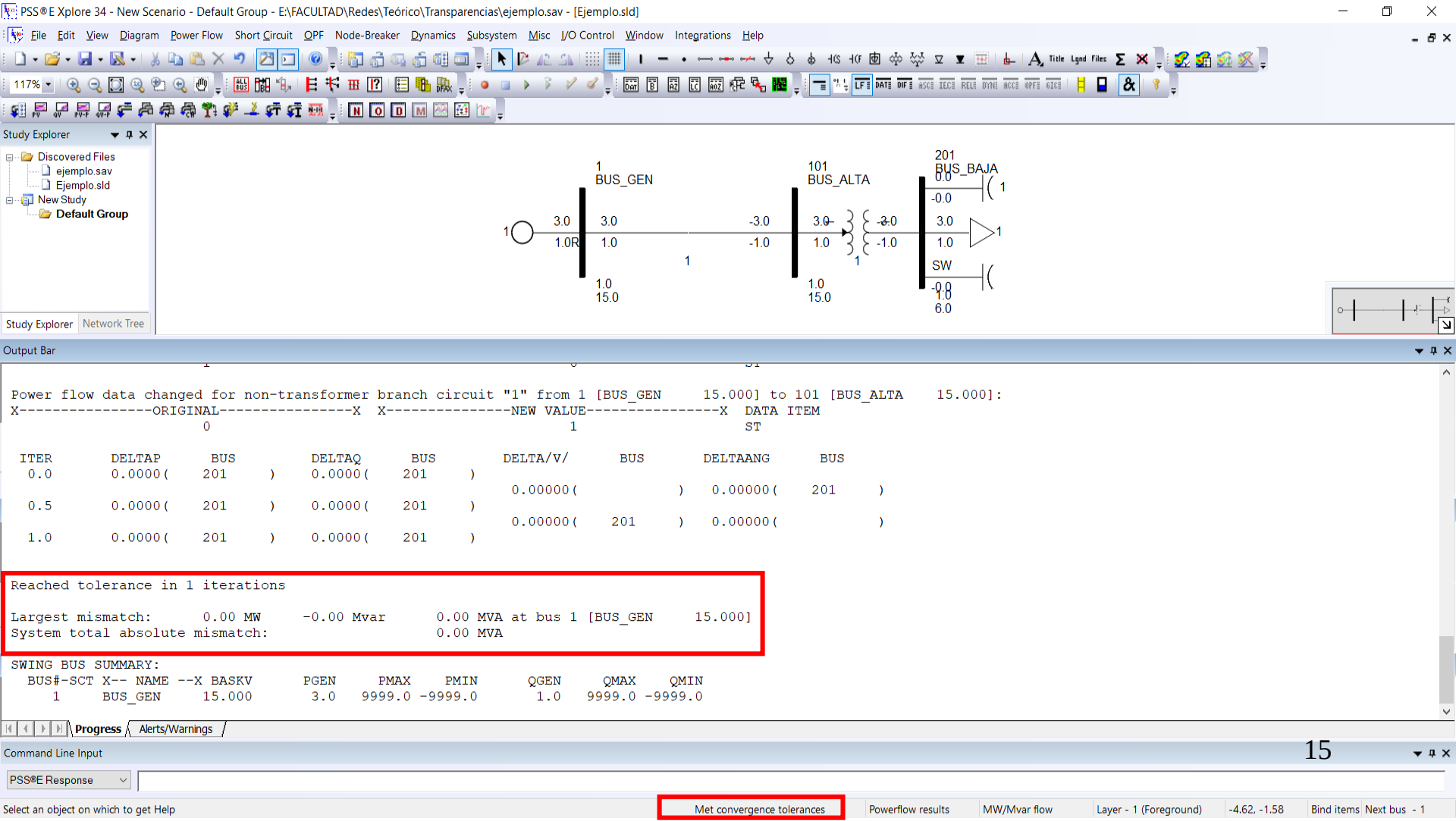


- P y Q constantes con la tensión
  - Si V de la barra > PQBRAK
  - PQBRAK variable de ajuste bajo “Power Flow/Solution/Parameters”
- P y Q como corriente constante
- P y Q como impedancia constante

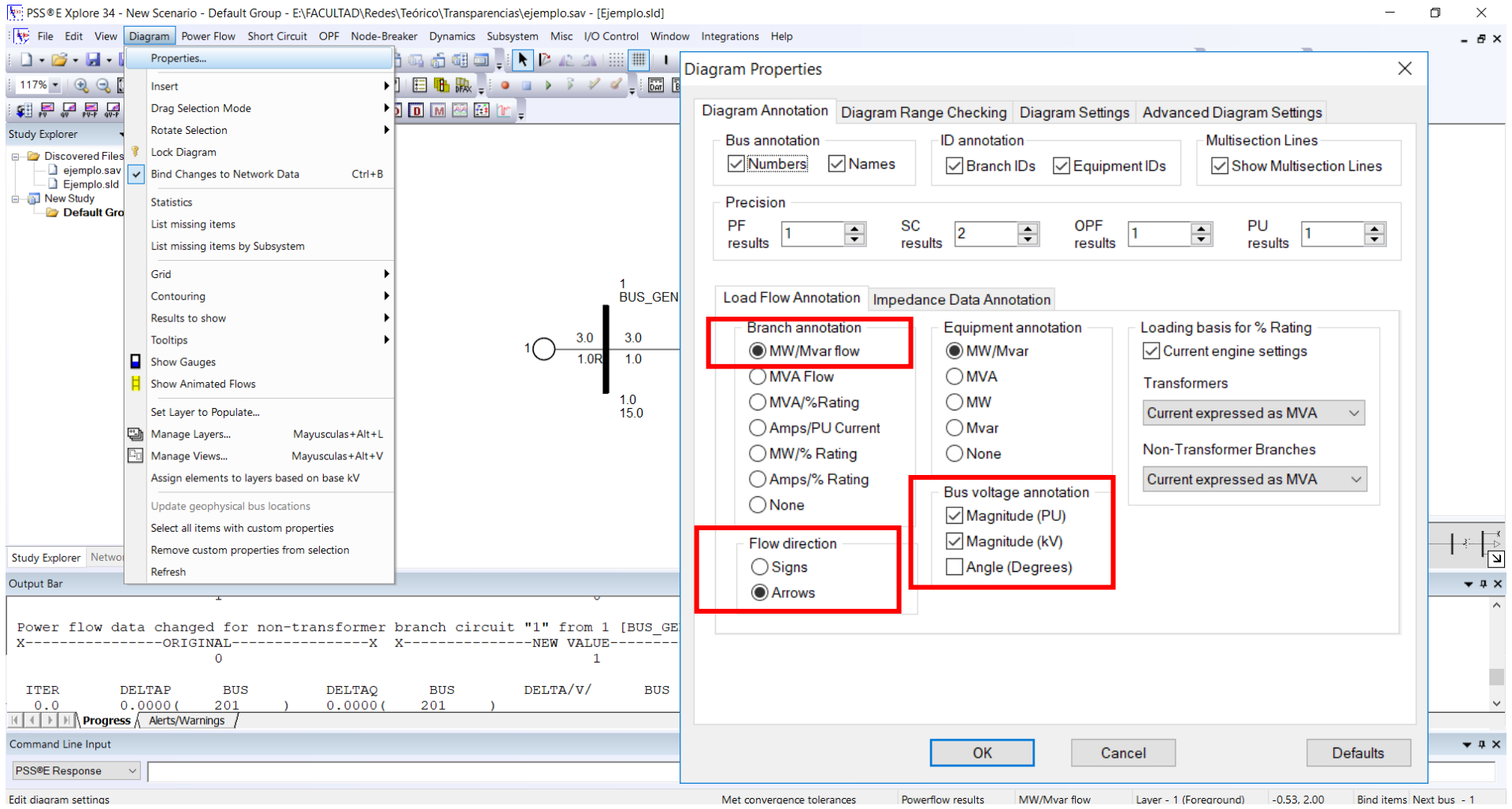
Correr un flujo de carga



Chequear convergencia



Información en el Slider



Modelo dinámico de Generadores

Table 1: Summary of Generator Models in Terms of Data Used

Reactance and Time Constants Used	Model				
	GENSAL and GENSAE	GENROU and GENROE	GENDCO	GENTRA	GENCLS
X_d	✔	✔	✔	✔	✔
X_q	✔	✔	✔	✔	
X'_d	✔	✔	✔	✔	✔
X'_q		✔	✔		
X''_d	✔	✔	✔		
X''_q	*	*	*		
X_l	✔	✔	✔	✔	
T'_{do}	✔	✔	✔	✔	
T'_{qo}		✔	✔		
T''_{do}	✔	✔	✔	✔	
T''_{qo}	✔	✔	✔	✔	
Saturation Factors	✔	✔	✔	✔	
T_a			✔		

*X''_q is assumed to be equal to X''_d.

Modelo dinámico de Generadores

- GENSAL y GENSAE (Salient Pole Machines)
  - GENSAL curva de saturación con ley cuadrática
  - GENSAE curva de saturación con ley exponencial
  - Reactancia subtransitoria = ZSORCE del flujo de carga
  - Si representan N máquinas idénticas en paralelo
    - Ingresar datos en pu con MVA base de una sola máquina
    - Especificar MBASE en el flujo de carga = N x MVA_base_una_máq
    - Reducir MBASE en el flujo de carga es como disparar un porcentaje equivalente de máquinas
    - MBASE no debería incrementarse durante la simulación
  - El disparo y reconección se puede realizar cambiando el código del bus
    - "1" para disparo y "2" para reconexión
  - T''d0 y T''q0 deberían ser mayores que 4.ΔT (condiciones iniciales sospechosas)
- GENROU y GENROE (Solid Rotor Machines)
  - Idem GENSAL y GENROE
  - Requiere información adicional: T'q0 y x'q

Modelo dinámico de Generadores

1.21 GENSAL

Salient Pole Generator Model (Quadratic Saturation on d-Axis)

This model is located at system bus #_____ IBUS,

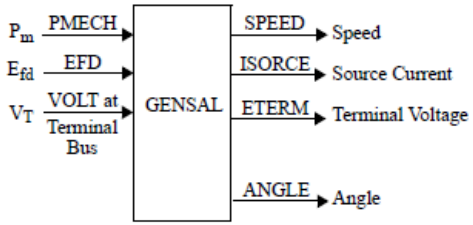
Machine identifier #_____ ID,

This model uses CONs starting with #_____ J,

and STATEs starting with #_____ K.

The machine MVA is _____ for each of units = _____ MBASE.

ZSORCE for this machine is _____ + j _____ on the above MBASE.



CONs	#	Value	Description
J			T'_{do} (>0) (sec)
J+1			T''_{do} (>0) (sec)
J+2			T''_{qo} (>0) (sec)
J+3			H, Inertia
J+4			D, Speed damping
J+5			X_d
J+6			X_q
J+7			X'_d
J+8			$X''_d = X''_q$
J+9			X_l
J+10			S(1.0)
J+11			S(1.2)

Note: X_d, X_q, X'_d, X''_d, X''_q, X_l, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

1.19 GENROU

Round Rotor Generator Model (Quadratic Saturation)

This model is located at system bus #_____ IBUS,

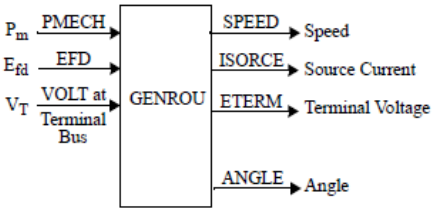
Machine identifier #_____ ID,

This model uses CONs starting with #_____ J,

and STATEs starting with #_____ K.

The machine MVA is _____ for each of _____ units = _____ MBASE.

ZSORCE for this machine is _____ + j _____ on the above MBASE



CONs	#	Value	Description
J			T'_{do} (>0) (sec)
J+1			T''_{do} (>0) (sec)
J+2			T'_{qo} (>0) (sec)
J+3			T''_{qo} (>0) (sec)
J+4			H, Inertia
J+5			D, Speed damping
J+6			X_d
J+7			X_q
J+8			X'_d
J+9			X'_q
J+10			$X''_d = X''_q$
J+11			X_l
J+12			S(1.0)
J+13			S(1.2)

Note: X_d, X_q, X'_d, X'_q, X''_d, X''_q, X_l, H, and D are in pu, machine MVA base.

X''_q must be equal to X''_d.

IBUS, 'GENSAL', ID, CON(J) to CON(J+11) /

IBUS, 'GENROU', ID, CON(J) to CON(J+13) /

Modelo dinámico de Generadores

Representación de la saturación

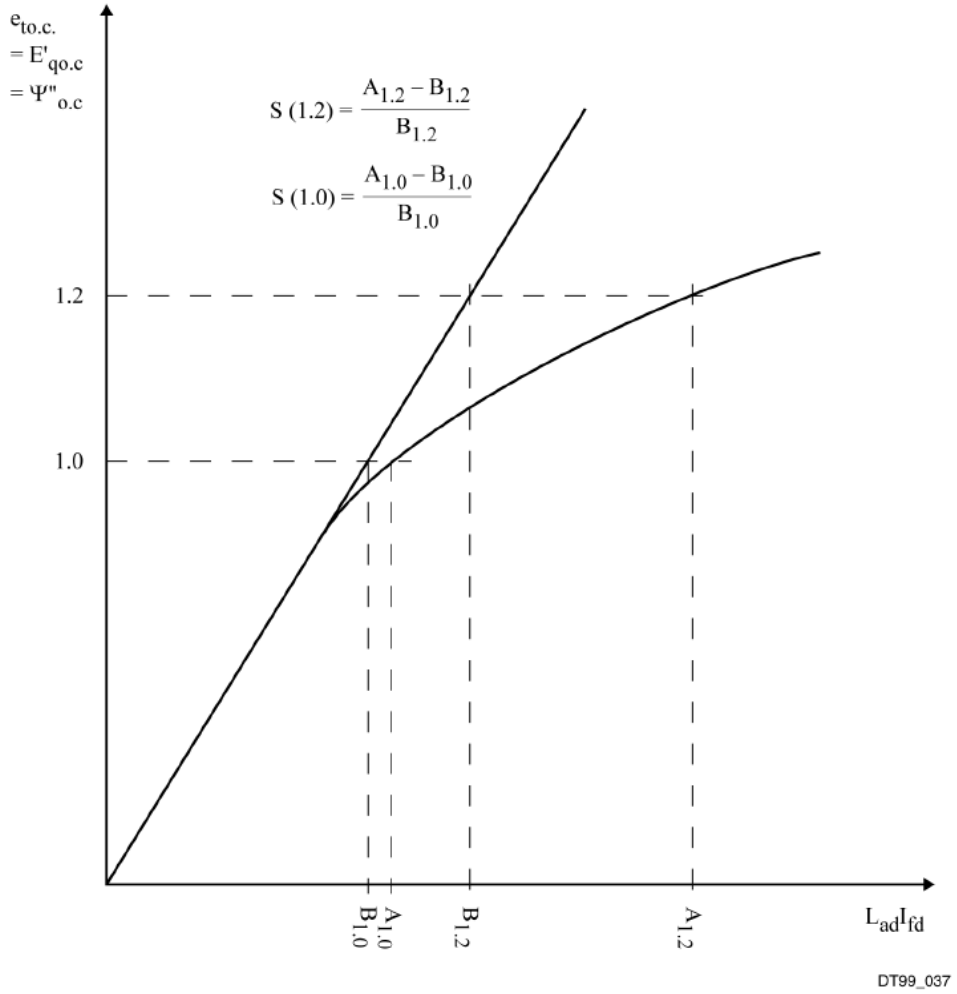


Figure 15-6. Definition of Saturation Factor, S, for Entry as Generator Data

Modelo dinámico de Generadores

- GENCLS
  - GENCLS is the classical constant voltage behind transient reactance generator model.
  - Setting the type code of the terminal bus to 1, or the generator status flag to zero, removes the unit from service.
  - After being initialized in STRT, EFD(I) for GENCLS models should not be changed during a run.
  - It is not valid to use an excitation system to vary EFD in conjunction with the GENCLS model.

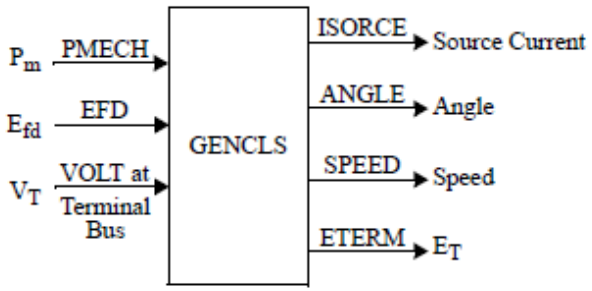
Modelo dinámico de Generadores

1.16 GENCLS

Constant Internal Voltage Generator Model

This model is located at system bus #____ IBUS,
Machine identifier #____ ID,
This model uses CONs starting with #____ J,
and STATEs starting with #____ K.
The machine MVA base is _____ for each
of _____ units = _____ MBASE.

ZSORCE for this machine is _____ + j
_____ on the above MBASE.



CONs	#	Value	Description
J			H, Inertia[1]
J+1			D, Damping constant

[1] H and D are in pu machine MVA base.
If H is 0, then DSTATE(K) and DSTATE(K+1) will always be zero.

STATEs	#	Description
K		Δ speed (pu)
K+1		Angle (radians)

IBUS, 'GENCLS', ID, CON(J) and CON(J+1) /

Modelo dinámico de Generadores

Ejemplo archivo DYR

E:\FACULTAD\ESEP\Clase_PSSE\ej_maq_Parte_1.dyr - Notepad++

File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?

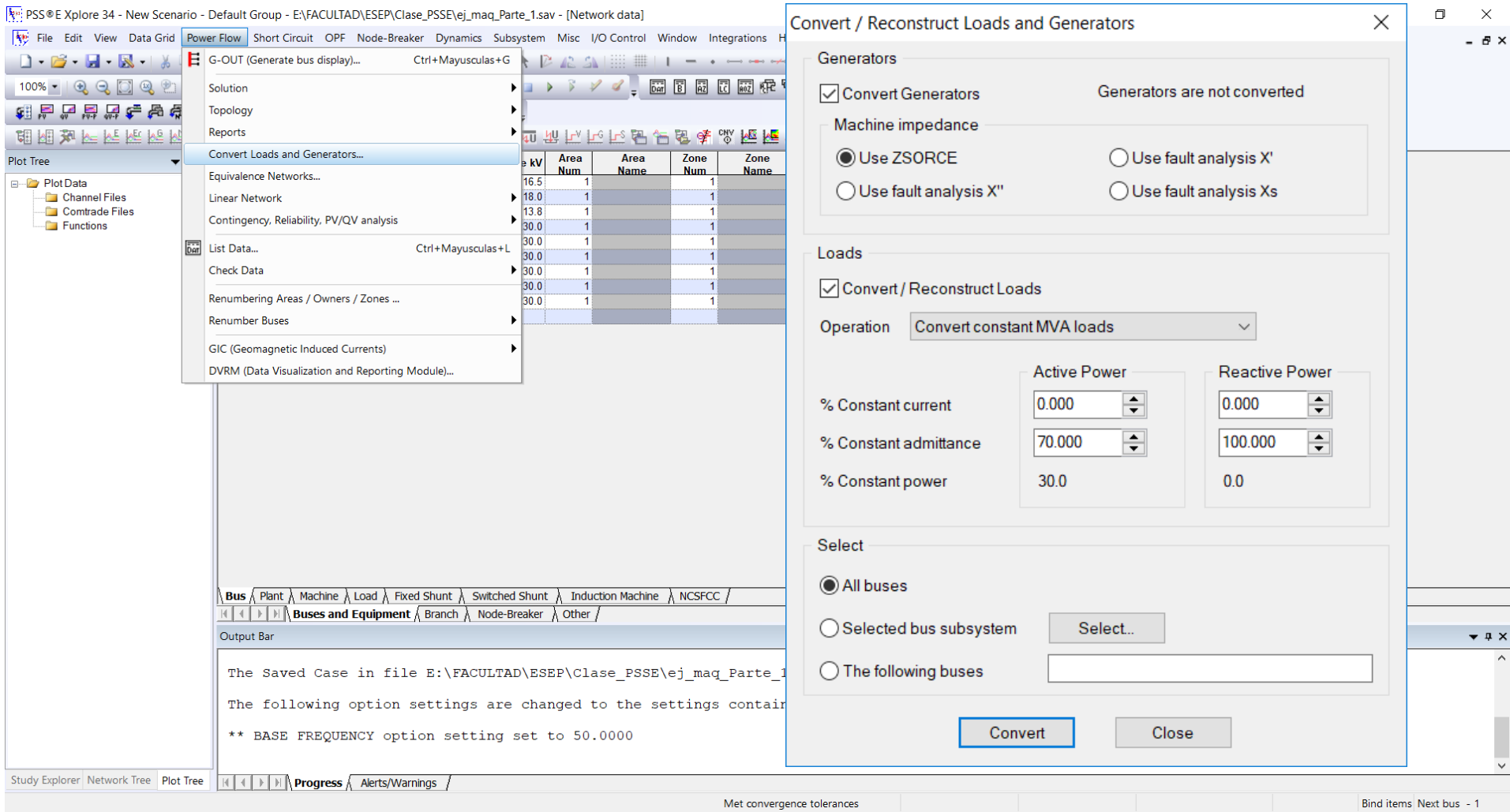
ej_maq_Parte_1.dyr | ej_maq_Parte_2.dyr | ej_maq_Parte_4.dyr | Parte_1.py

```
/Maquina 1, GENSAL
/IBUS,  Modelo ,   ID, T'd0, T''d0, T''q0,     H, D,    Xd,     Xq,    X'd, X''d,     Xl, S(1.0), S(1.2)
    1, 'GENSAL', 'G1', 8.96,  0.05,  0.05, 23.64, 0, 0.146, 0.0969, 0.0608, 0.01, 0.0336,      0,      0

/Maquina 2, GENROU
/IBUS,  Modelo ,   ID, T'd0, T''d0,  T'q0, T''q0,     H, D,     Xd,     Xq,    X'd,    X'q, X''d,     Xl, S(1.0), S(1.2)
    2, 'GENROU', 'G2', 6.00,  0.05, 0.535,  0.04,   6.4, 0, 0.8958, 0.8645, 0.1198, 0.1969,  0.1, 0.0521,      0,      0

/Maquina 3, GENROU
/IBUS,  Modelo ,   ID, T'd0, T''d0,  T'q0, T''q0,     H, D,     Xd,     Xq,    X'd,    X'q, X''d,     Xl, S(1.0), S(1.2)
    3, 'GENROU', 'G3', 5.89,  0.05,   0.6,  0.04,  3.01, 0, 1.3125, 1.2578, 0.1813,   0.25, 0.15, 0.0742,      0,      0
```

Normal text file | length : 764 lines : 12 | Ln : 11 Col : 23 Sel : 0 | 0 | Windows (CR LF) | UTF-8 | INS

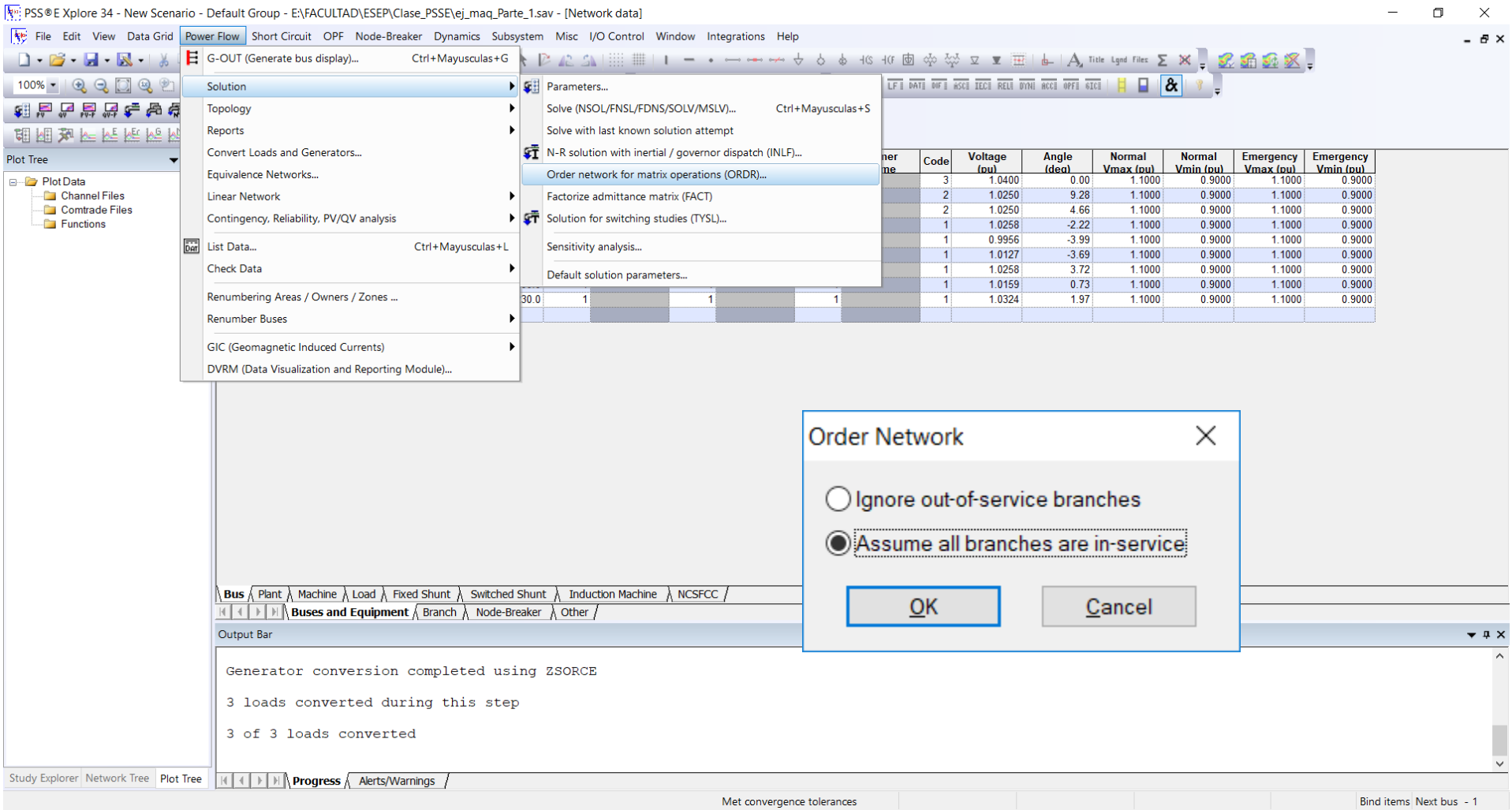
Simulación dinámica

Paso 1: Convert Loads and Generators



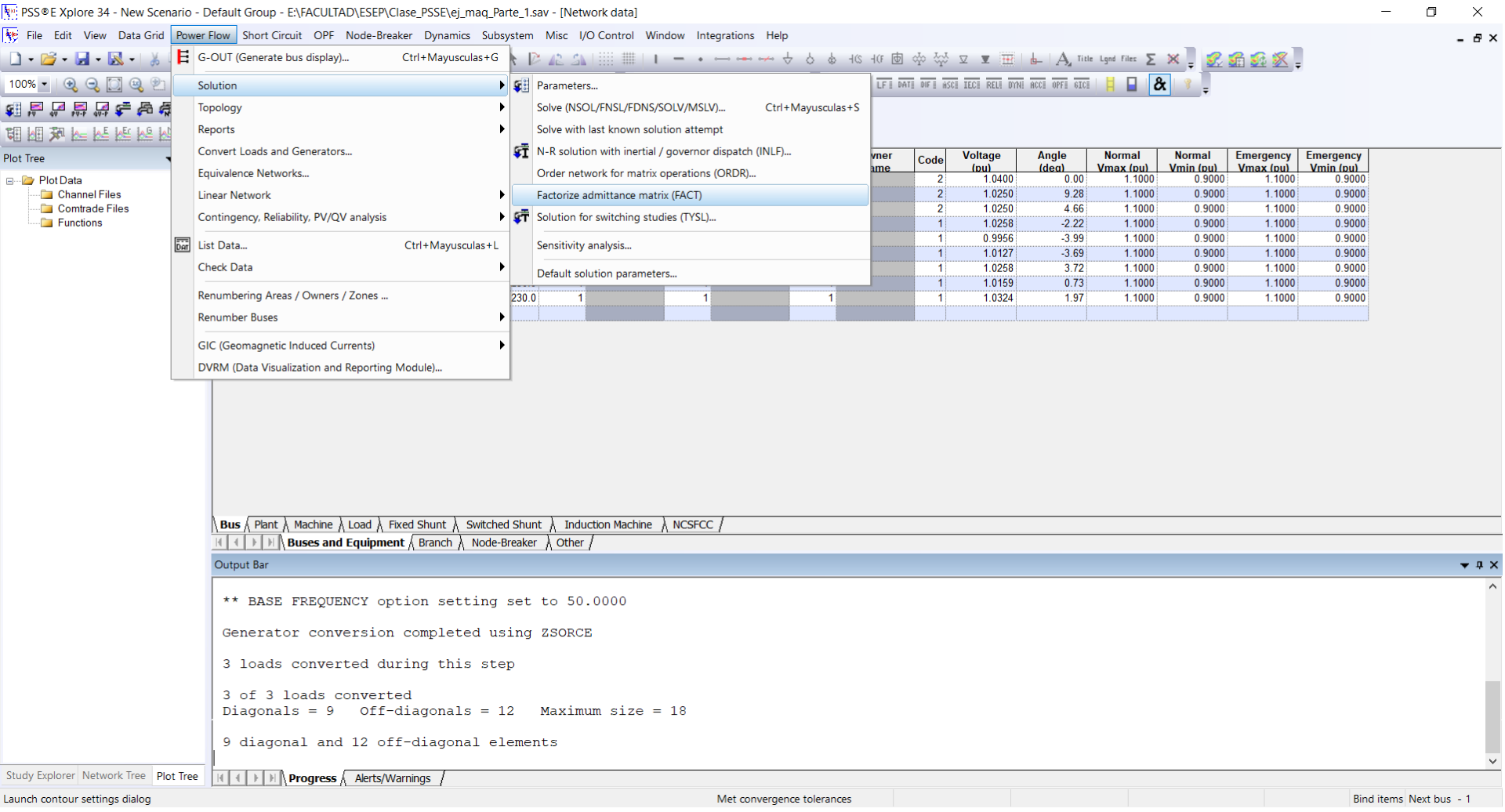
Simulación dinámica

Paso 2: ORDER



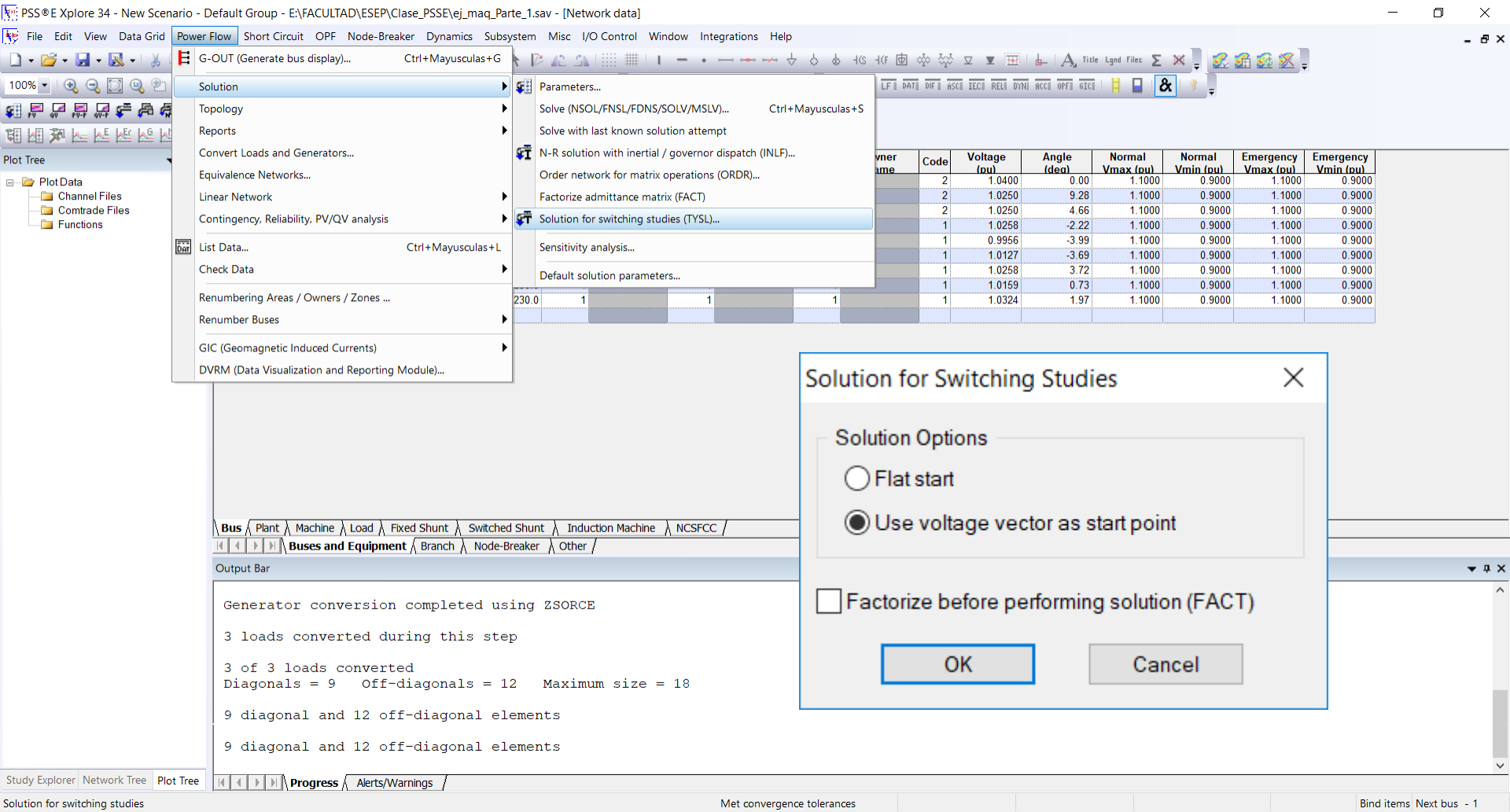
Simulación dinámica

Paso 3: FACT



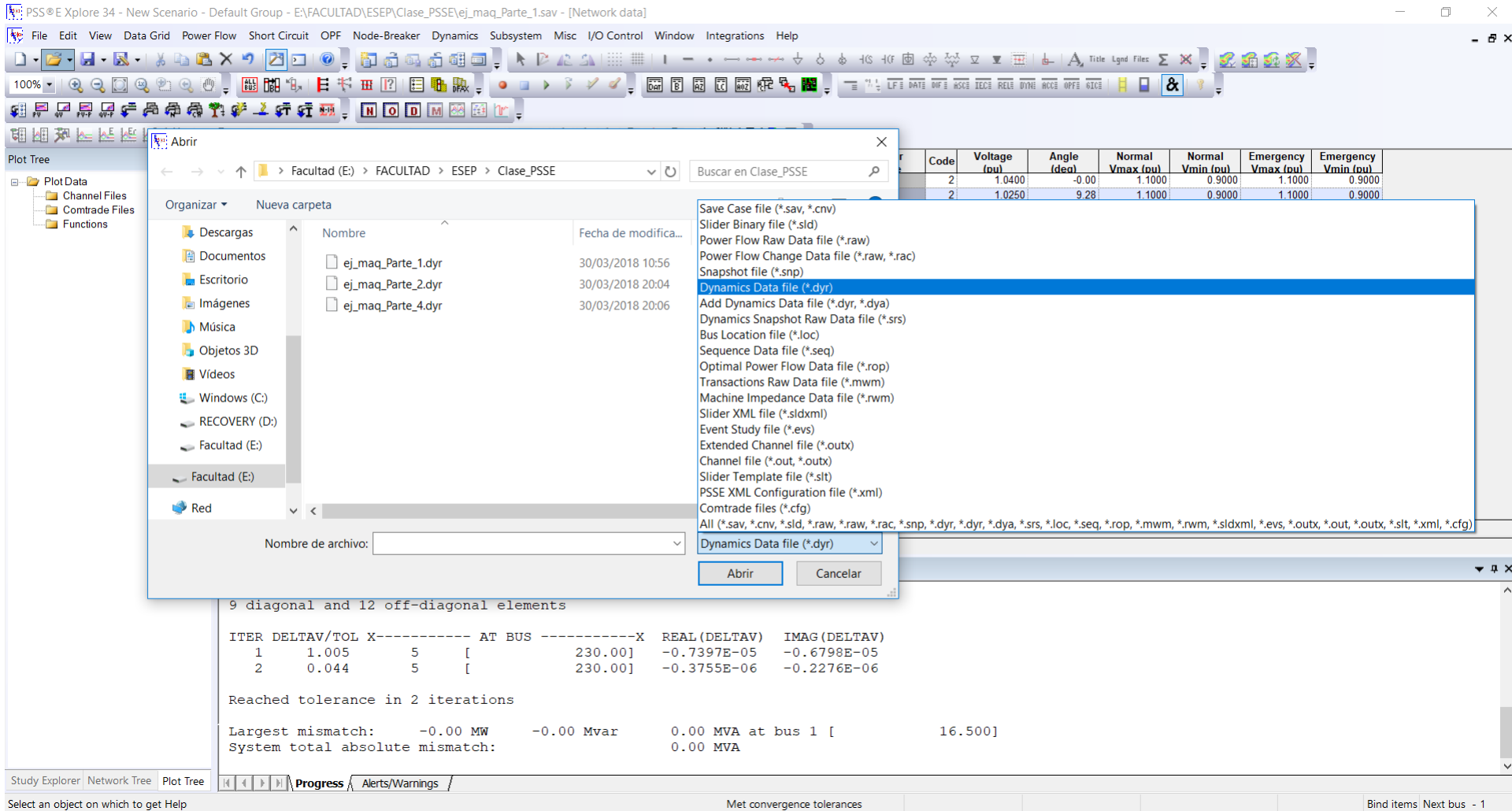
Simulación dinámica

Paso 4: TYSL



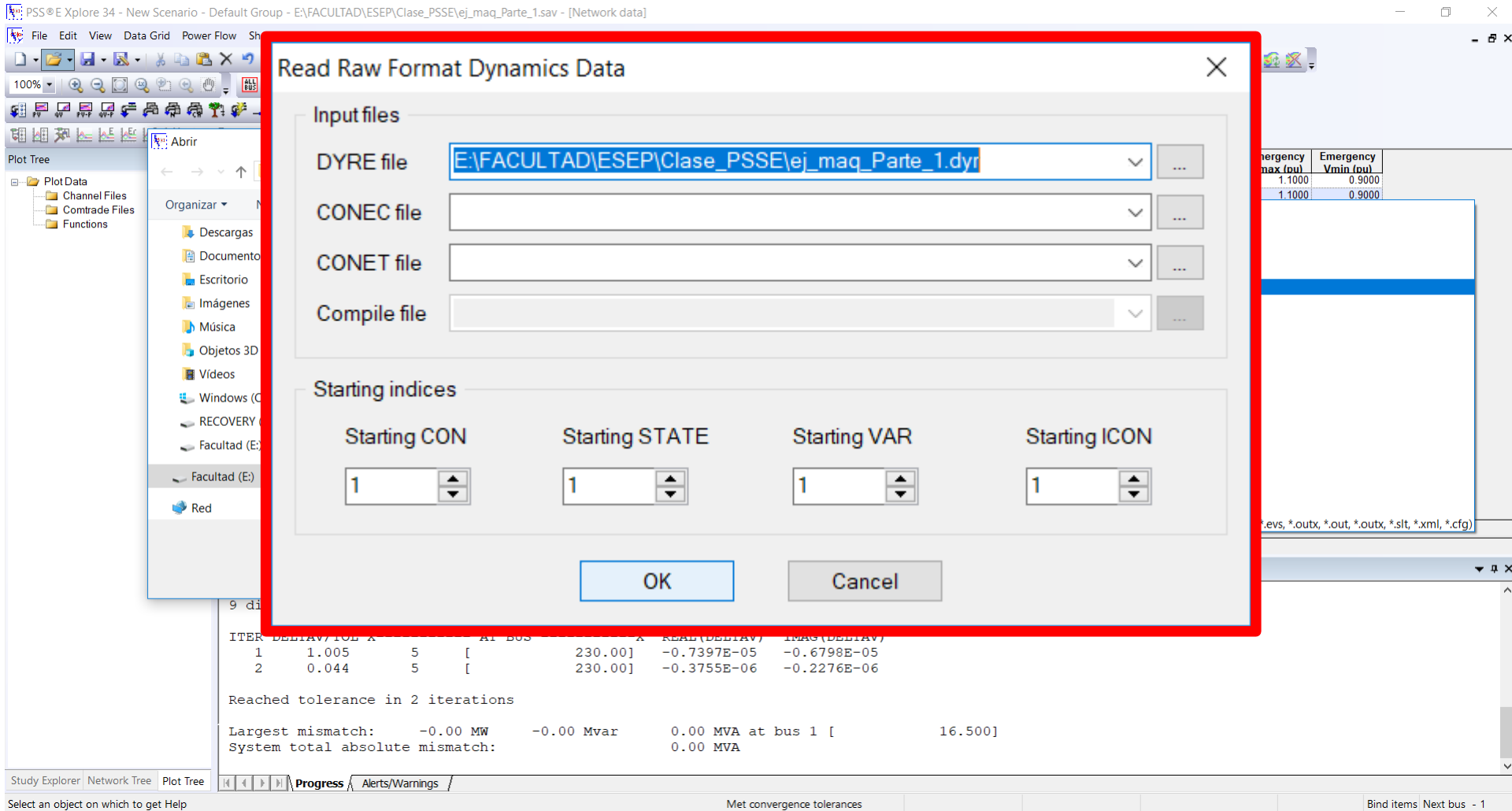
Simulación dinámica

Paso 5: Abrir archivo DYR



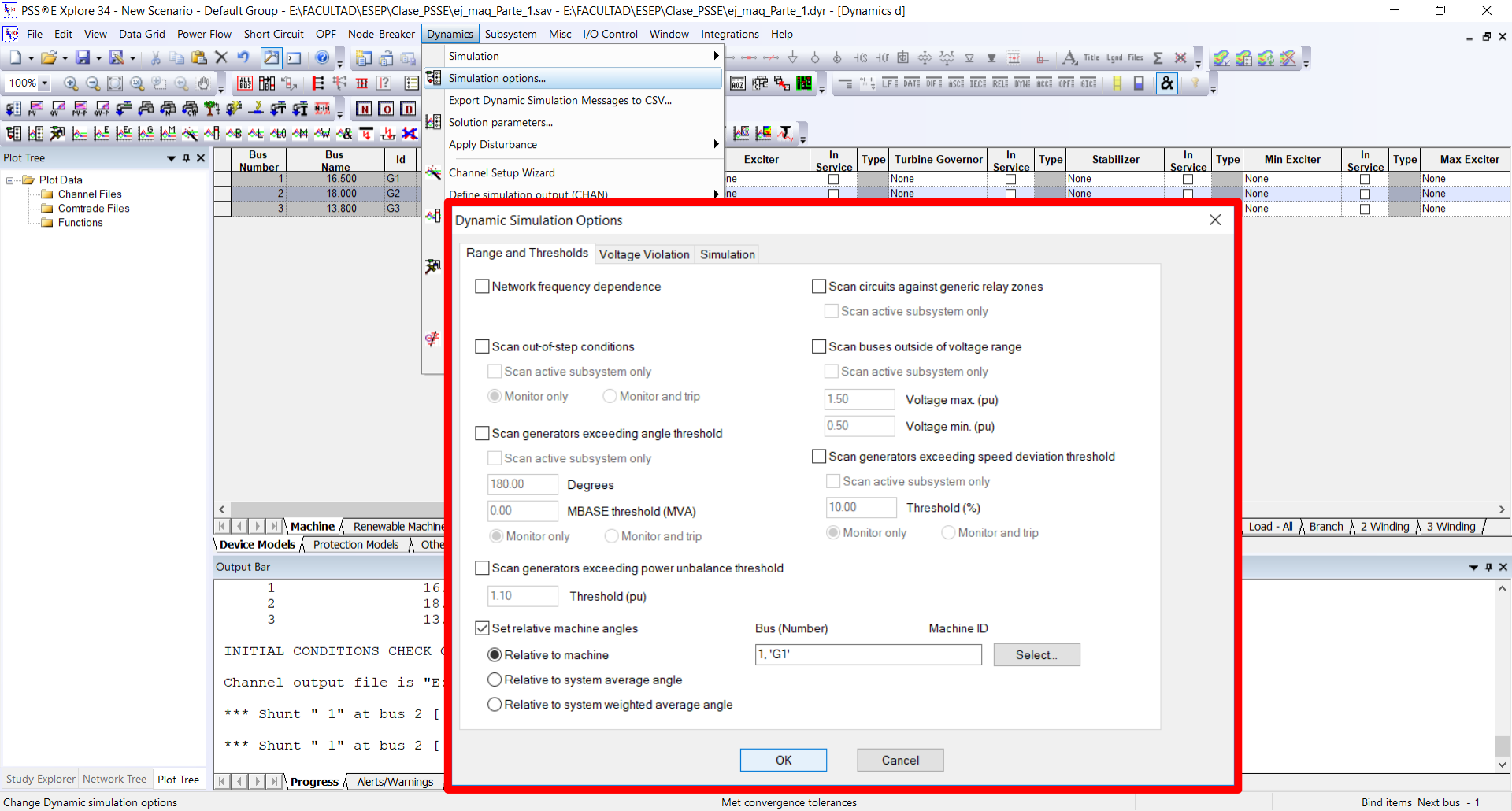
Simulación dinámica

Paso 5: Abrir archivo DYR



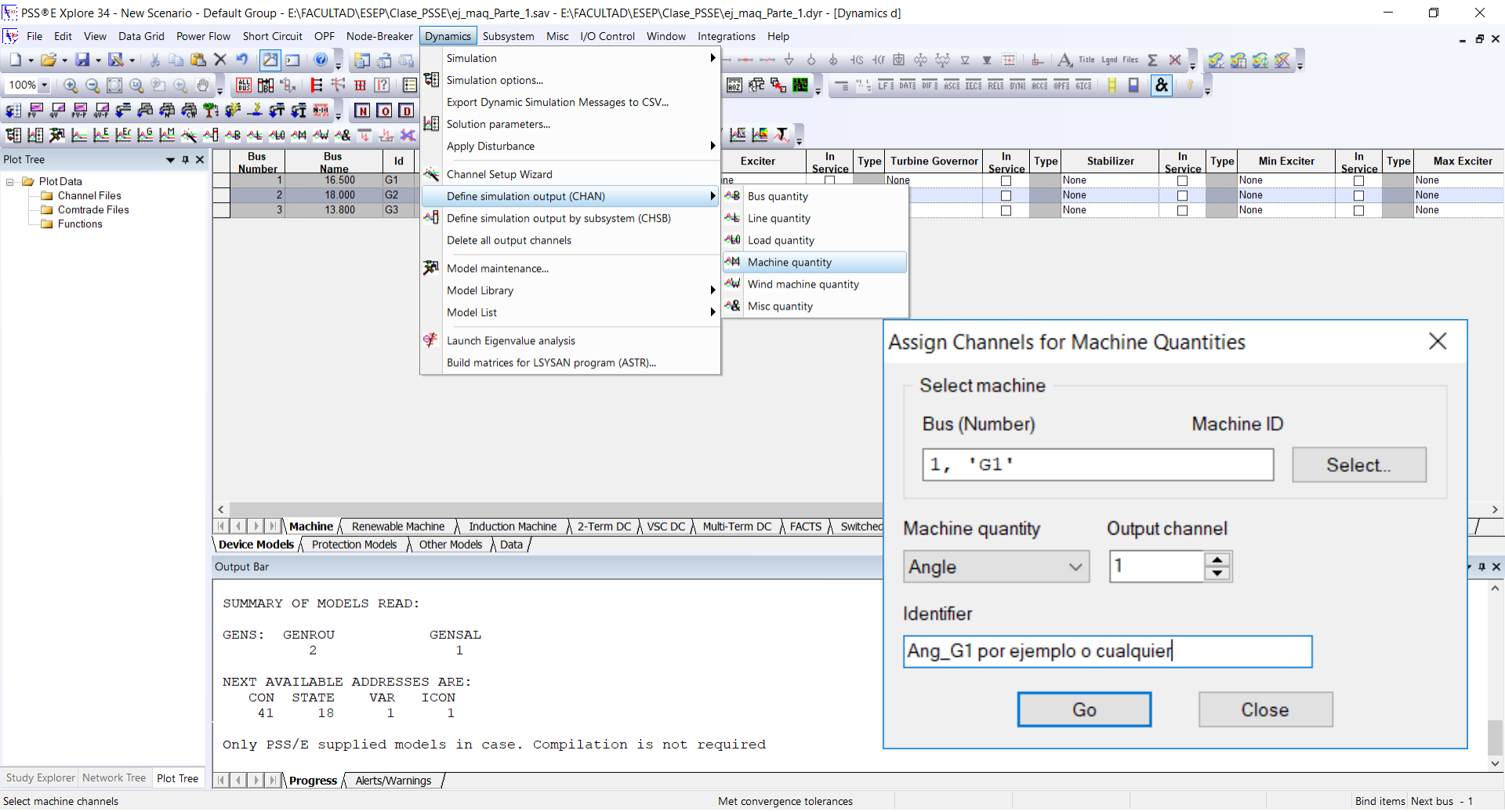
Simulación dinámica

Opcional: Set relative machine angles



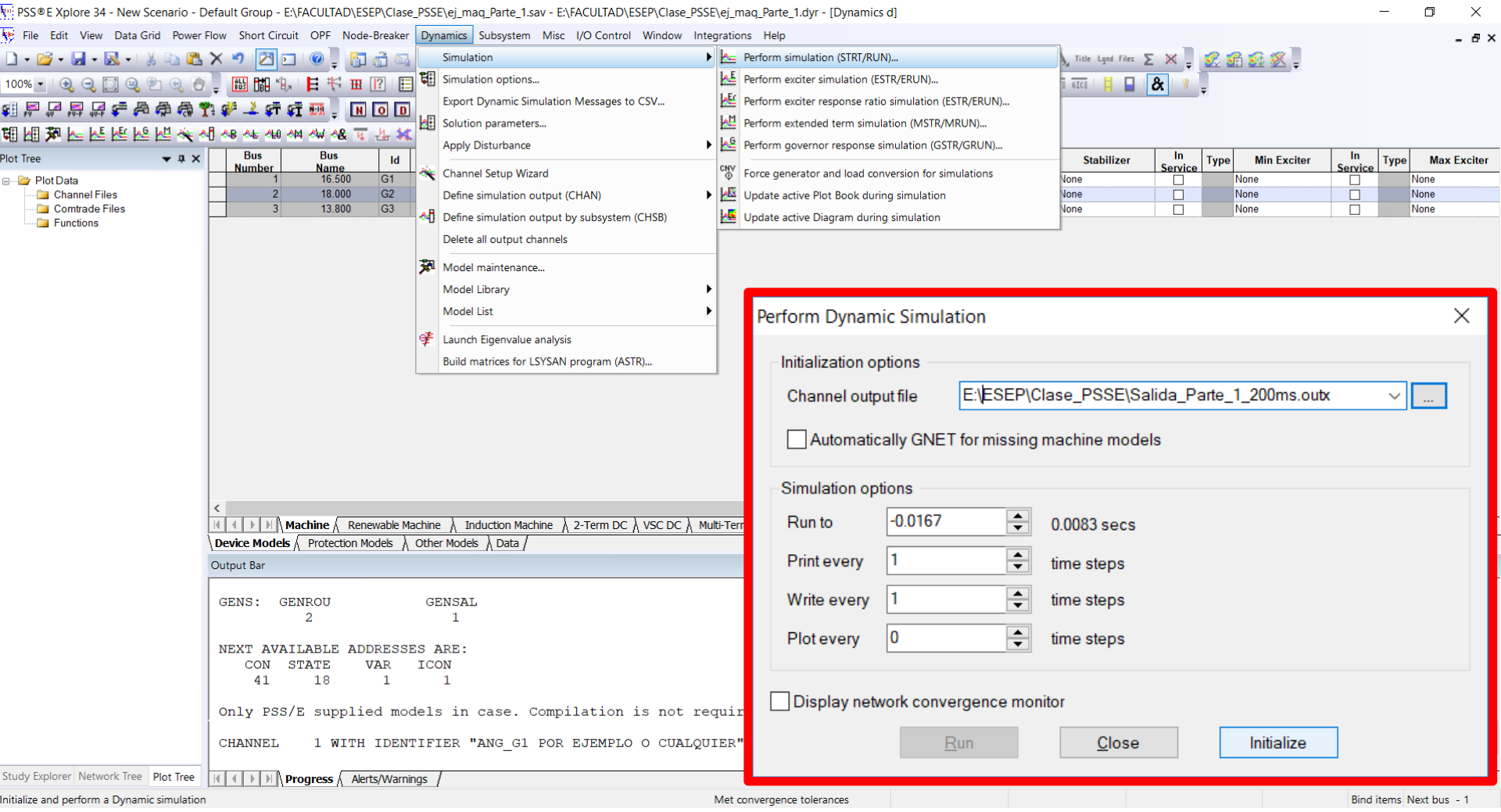
Simulación dinámica

Paso 6: Definir canales



Simulación dinámica

Paso 7: Inicializar STRT



Simulación dinámica

Paso 7: Inicializar STRT

1	16.500	G1	247.50	☑	GENSAL	☑	Stnd	None	☐		None	☐		None	☐		None	☐		None
2	18.000	G2	192.00	☑	GENROU	☑	Stnd	None	☐		None	☐		None	☐		None	☐		None
3	13.800	G3	128.00	☑	GENROU	☑	Stnd	None	☐		None	☐		None	☐		None	☐		None

Machine | Renewable Machine | Induction Machine | 2-Term DC | VSC DC | Multi-Term DC | FACTS | Switched Shunt | Load - Bus | Load - Owner | Load - Zone | Load - Area | Load - All | Branch | 2 Winding | 3 Winding

Device Models | Protection Models | Other Models | Data

Output Bar

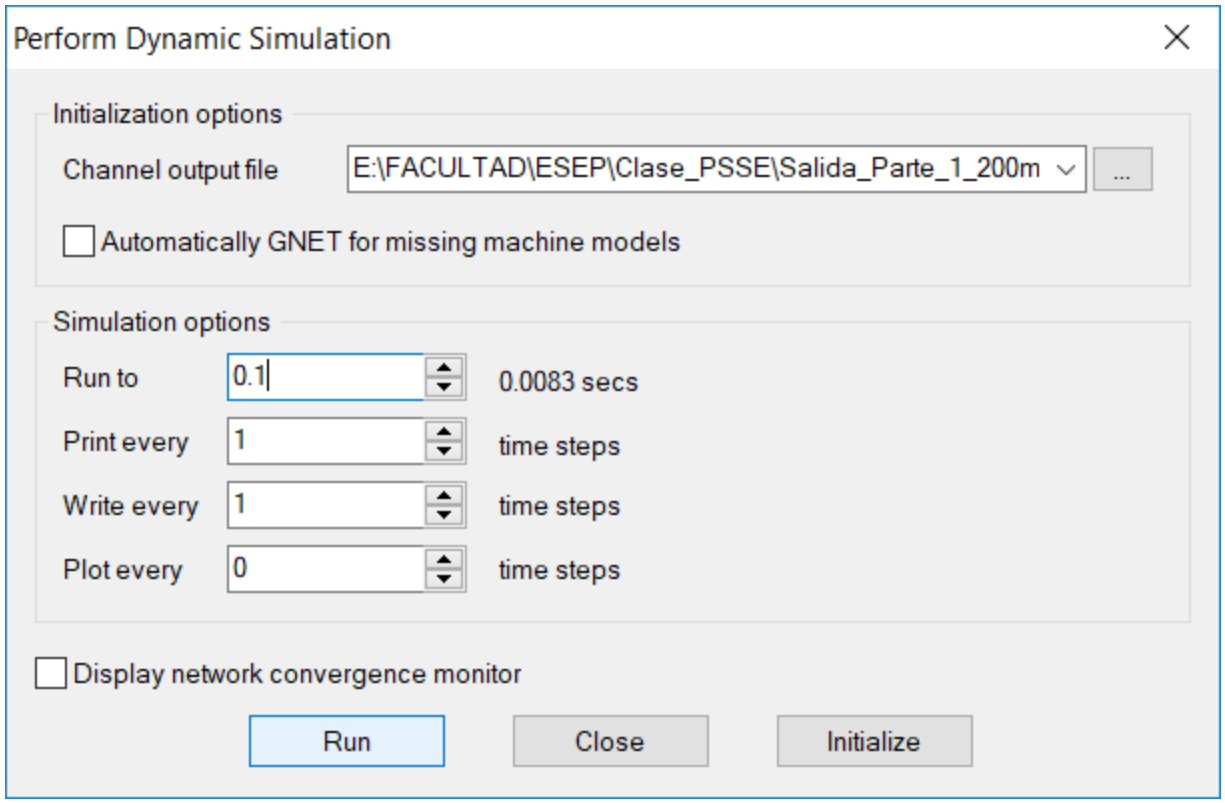
```
 INITIAL CONDITION LOAD FLOW USED 1 ITERATIONS

 ------------------------------ MACHINE INITIAL CONDITIONS ------------------------------
   BUS#-SCT X-- NAME --X BASKV ID  ETERM   EFD    POWER    VARS   P.F.  ANGLE   ID     IQ
      1               16.500 G1 1.0400 1.0560   71.64   27.04 0.9356   1.47 0.1122 0.2755
      2               18.000 G2 1.0250 1.2898  163.00    6.65 0.9992  43.46 0.4933 0.6662
      3               13.800 G3 1.0250 1.2498   85.00  -10.86 0.9919  46.17 0.3674 0.5400

 INITIAL CONDITIONS CHECK O.K.

 Channel output file is "E:\FACULTAD\ESEP\Clase_PSSE\Salida_Parte_1_200ms.outx"
```

Progress | Alerts/Warnings

Met convergence tolerances | Bind items Next bus - 1

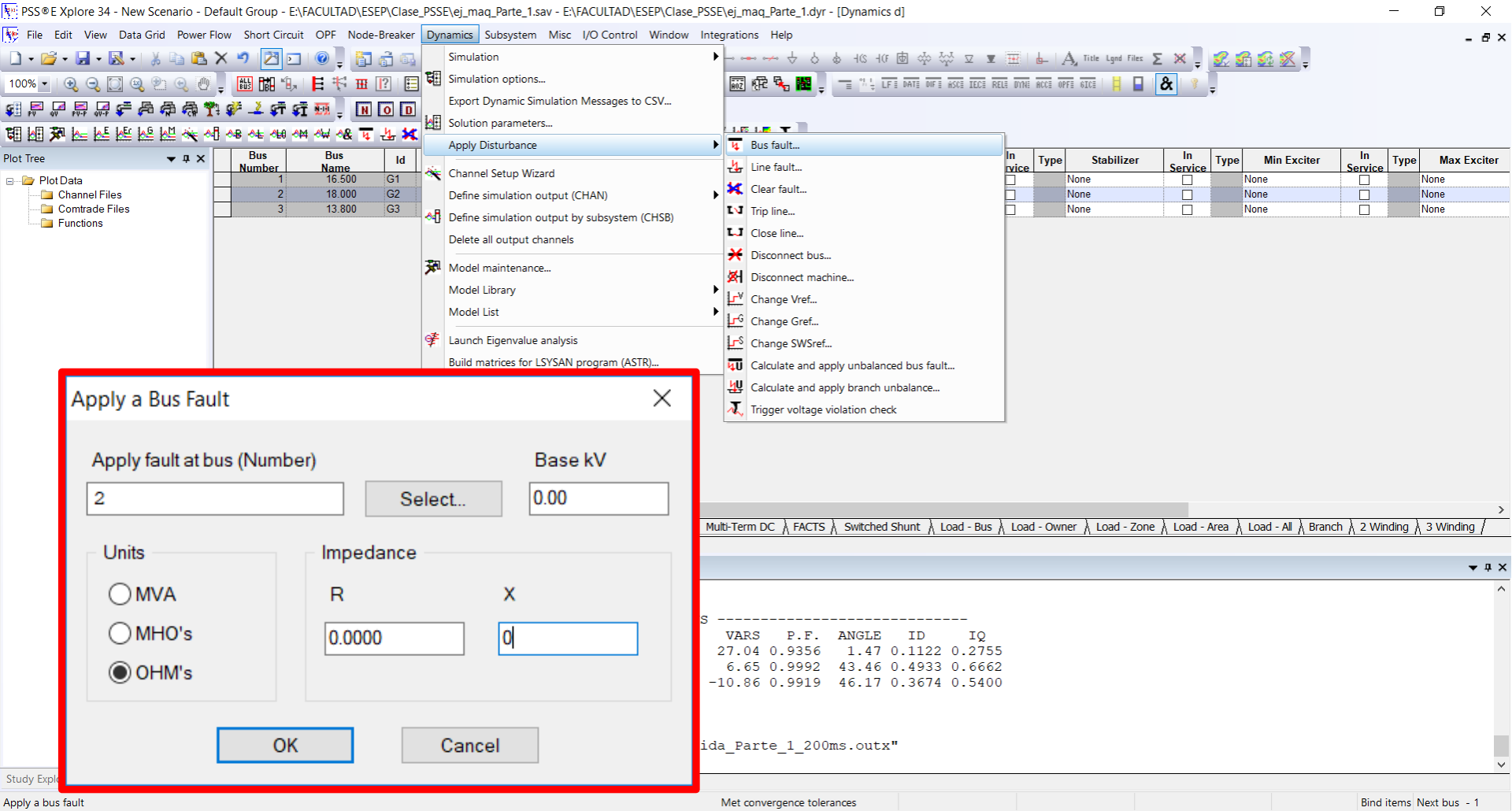
Simulación dinámica

Paso 8: RUN



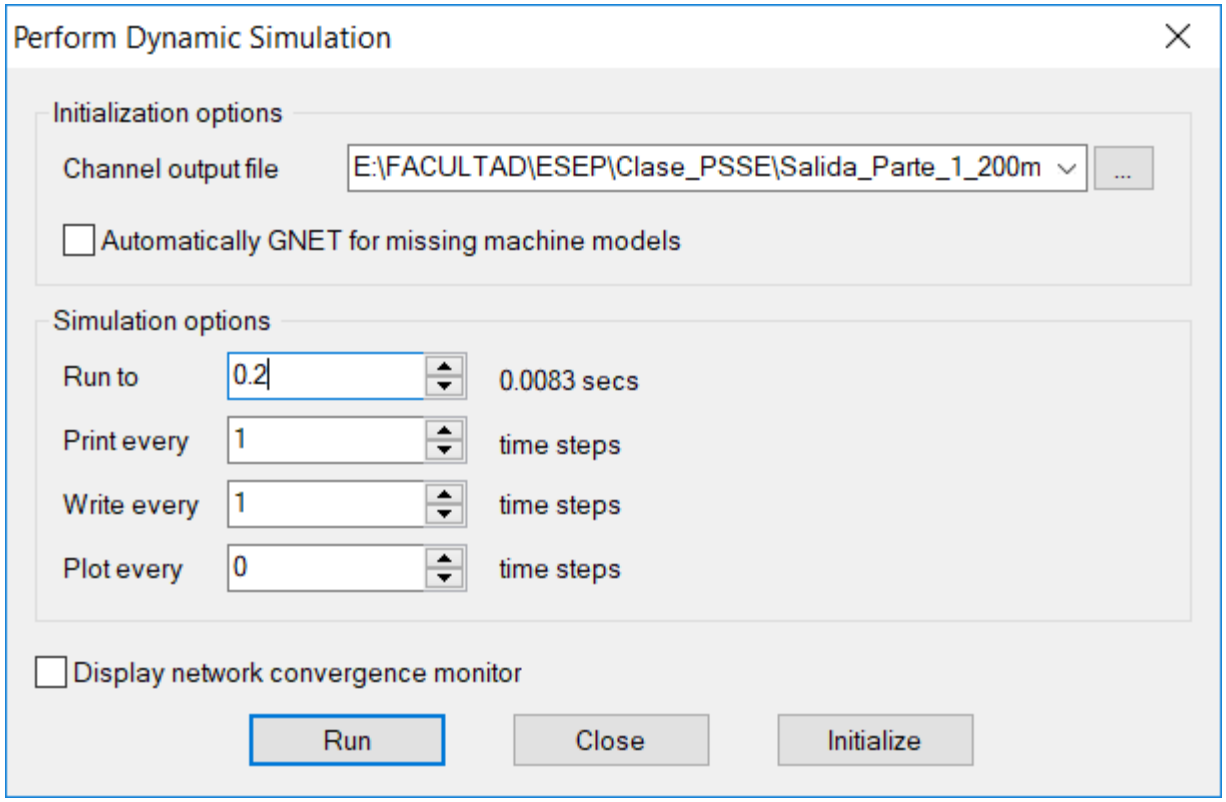
Simulación dinámica

Paso 9: BUS FAULT



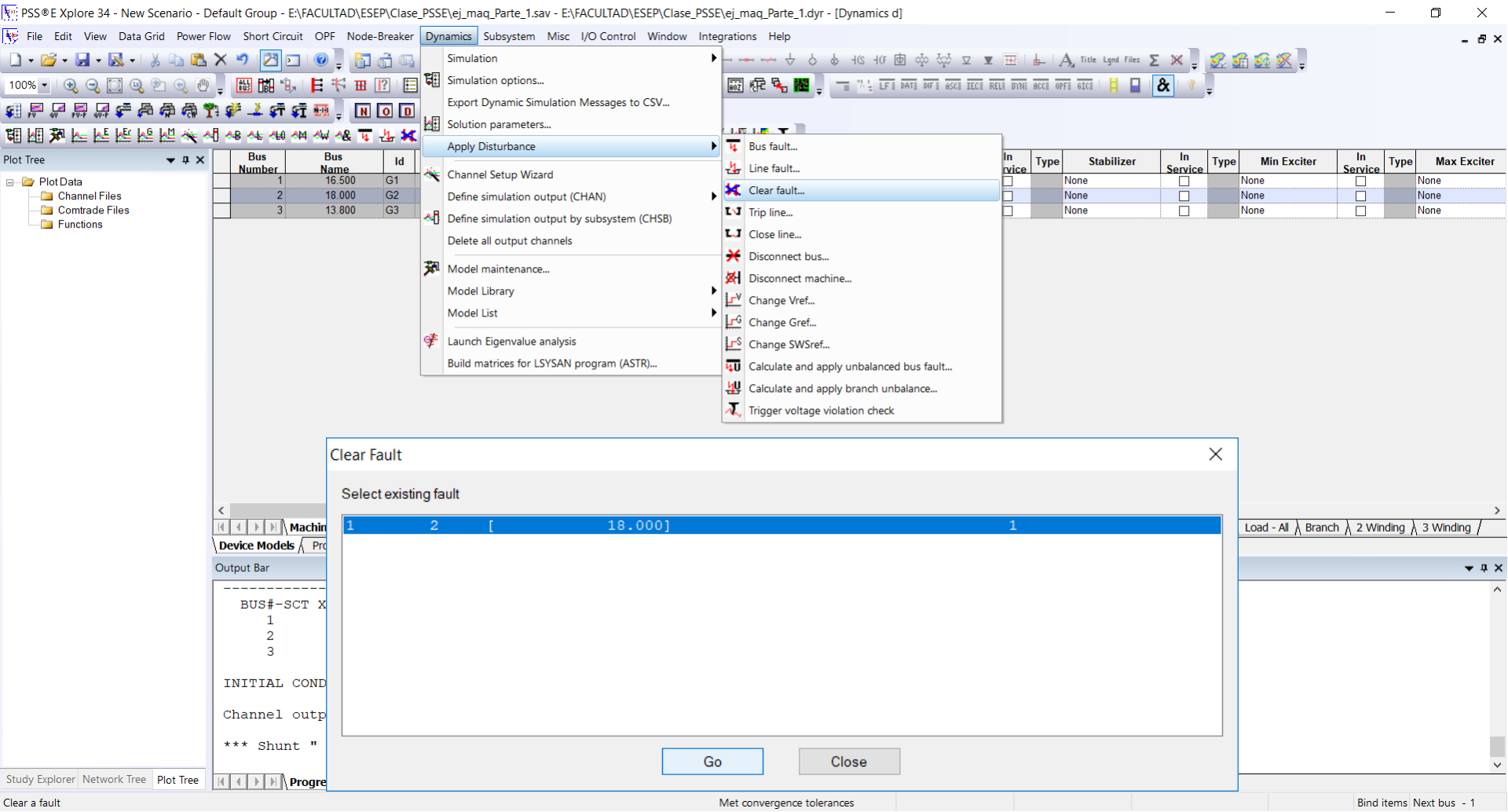
Simulación dinámica

Paso 10: RUN 100ms



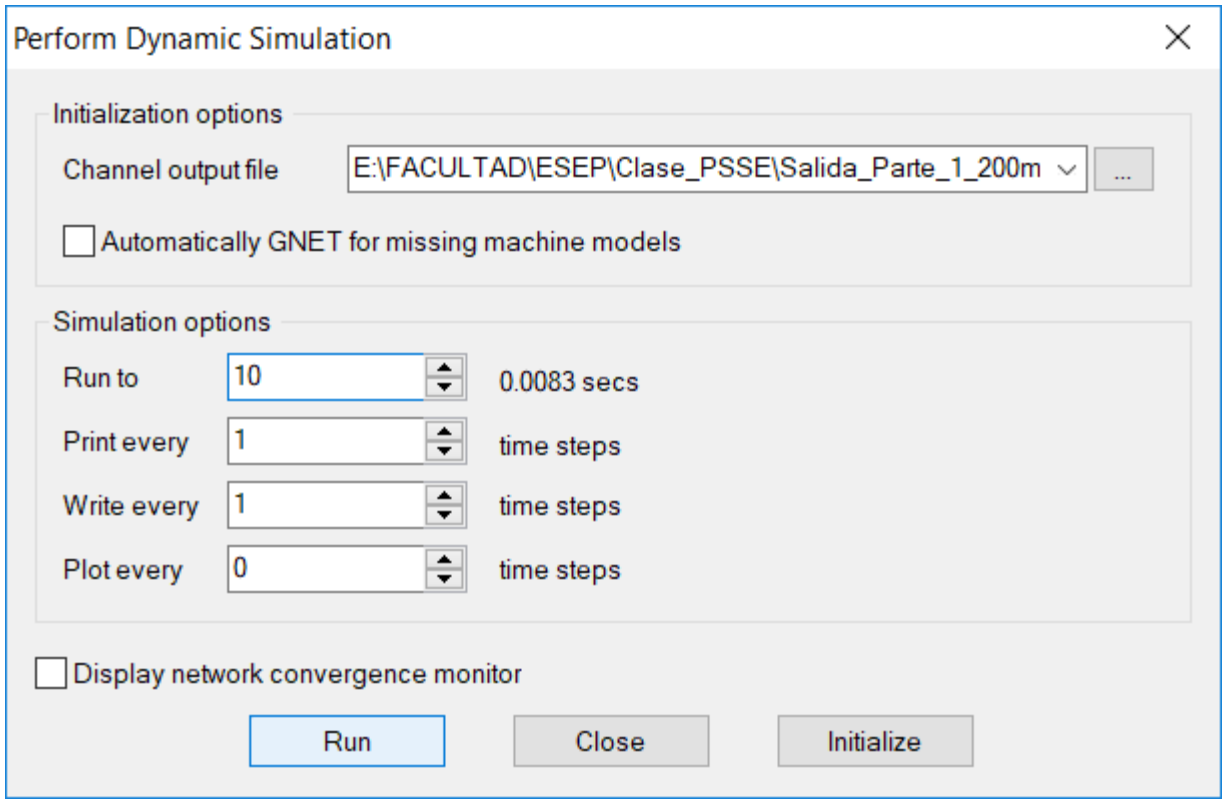
Simulación dinámica

Paso 11: CLEAR FAULT



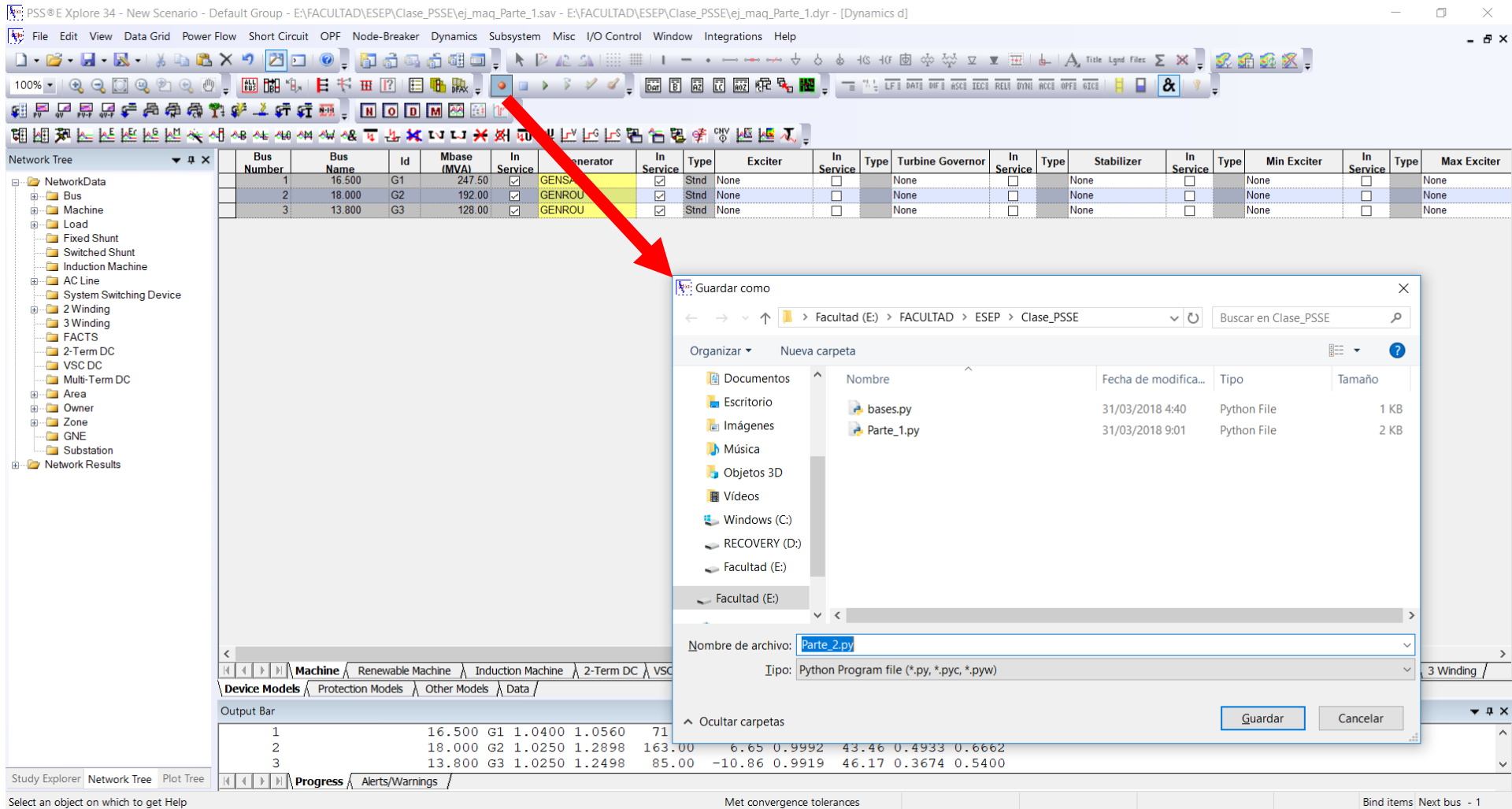
Simulación dinámica

Paso 12: RUN 10 s



Simulación dinámica

Automatización en PYTHON



Simulación dinámica

Automatización en PYTHON

E:\FACULTAD\ESEP\Clase_PSSE\Parte_1.py - Notepad++

File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?

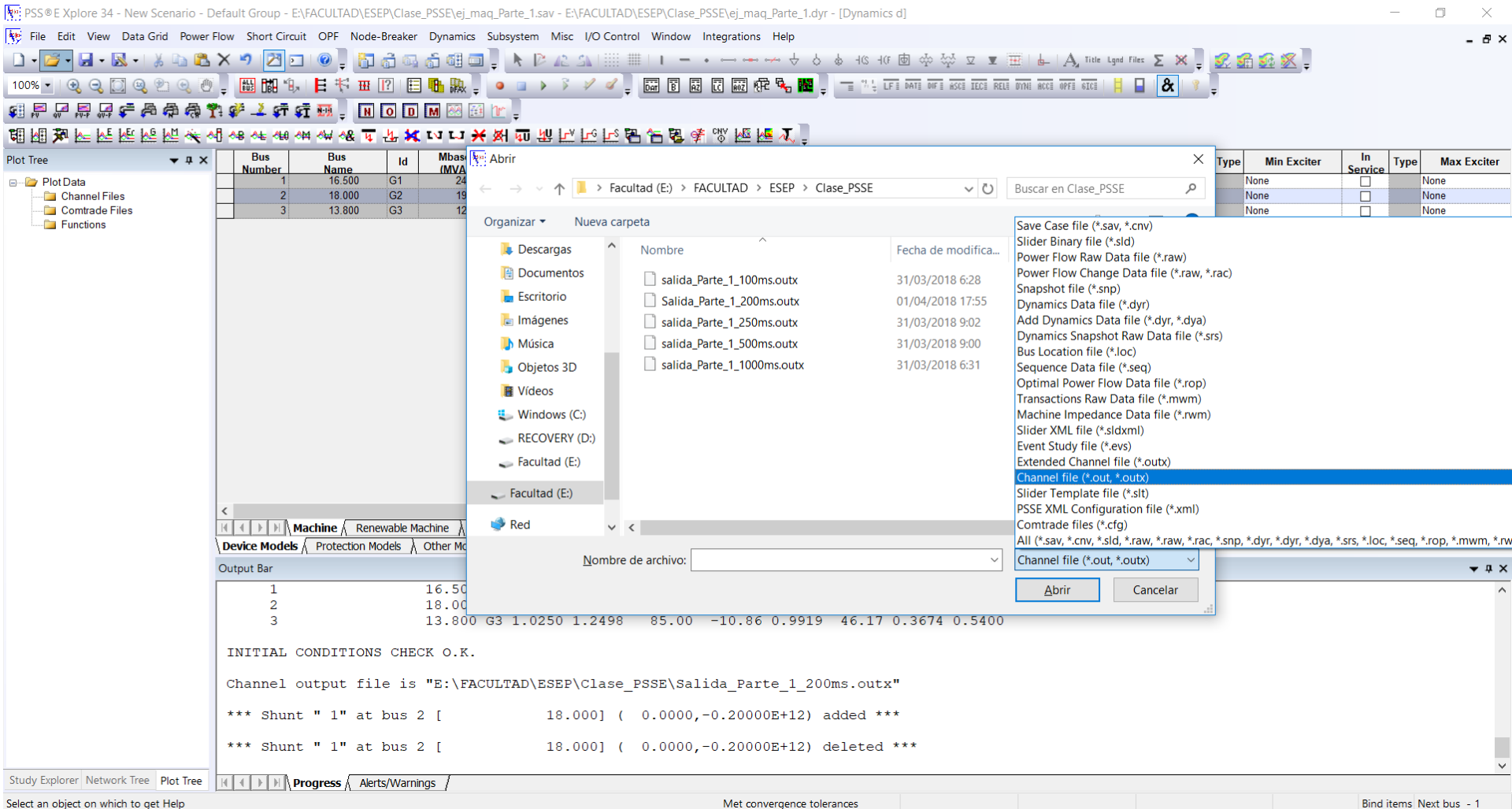
ej_maq_Parte_1.dyr | ej_maq_Parte_2.dyr | ej_maq_Parte_4.dyr | Parte_1.py

```
# File:"E:\FACULTAD\ESEP\Clase_PSSE\Parte_1.py", generated on SAT, MAR 31 2018   4:46, PSS(R)E release 34.03.02
psspy.cong(0)
psspy.conl(0,1,1,[0,0],[0.0, 70.0,0.0, 100.0])
psspy.conl(0,1,2,[0,0],[0.0, 70.0,0.0, 100.0])
psspy.conl(0,1,3,[0,0],[0.0, 70.0,0.0, 100.0])
psspy.ordr(0)
psspy.fact()
psspy.tysl(0)
psspy.dyre_new([1,1,1,1],r"""E:\FACULTAD\ESEP\Clase_PSSE\ej_maq_Parte_1.dyr""",r"""E:\FACULTAD\ESEP\Clase_PSSE\conec""",r"""
psspy.set_relang(1,1,r"""G1""")
psspy.machine_array_channel([1,1,1],r"""G1""",r"""Ang_G1""")
psspy.machine_array_channel([2,1,2],r"""G2""",r"""Ang_G2""")
psspy.machine_array_channel([3,1,3],r"""G3""",r"""Ang_G3""")
psspy.machine_array_channel([4,2,1],r"""G1""",r"""P_G1""")
psspy.machine_array_channel([5,2,2],r"""G2""",r"""P_G2""")
psspy.machine_array_channel([6,2,3],r"""G3""",r"""P_G3""")
psspy.machine_array_channel([7,3,1],r"""G1""",r"""Q_G1""")
psspy.machine_array_channel([8,3,2],r"""G2""",r"""Q_G2""")
psspy.machine_array_channel([9,3,3],r"""G3""",r"""Q_G3""")
psspy.machine_array_channel([10,4,1],r"""G1""",r"""E_G1""")
psspy.machine_array_channel([11,4,2],r"""G2""",r"""E_G2""")
psspy.machine_array_channel([12,4,3],r"""G3""",r"""E_G3""")
psspy.strt_2([0,0],r"""E:\FACULTAD\ESEP\Clase_PSSE\salida_Parte_1_250ms""")
psspy.run(0, 0.1,1,1,0)
psspy.dist_bus_fault(2,3,0.0,[0.0,0.0])
psspy.run(0, 0.25,1,1,0)
psspy.dist_clear_fault(1)
psspy.run(0, 10.0,1,1,0)

```

Python file | length : 1,466 lines : 29 | Ln : 19 Col : 59 Sel : 0 | 0 | Windows (CR LF) | UTF-8 | INS

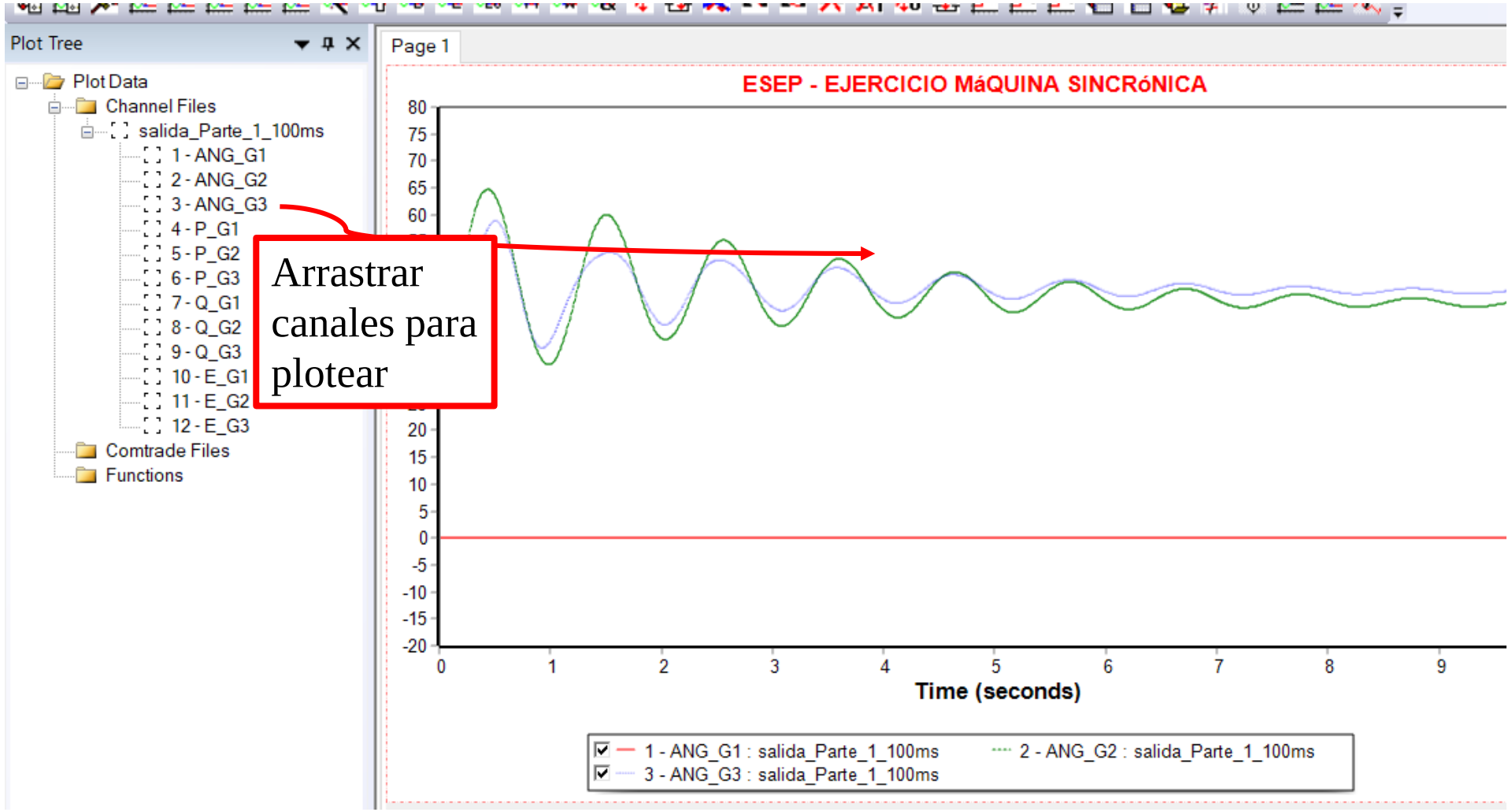
Simulación dinámica

Graficar canales de salida



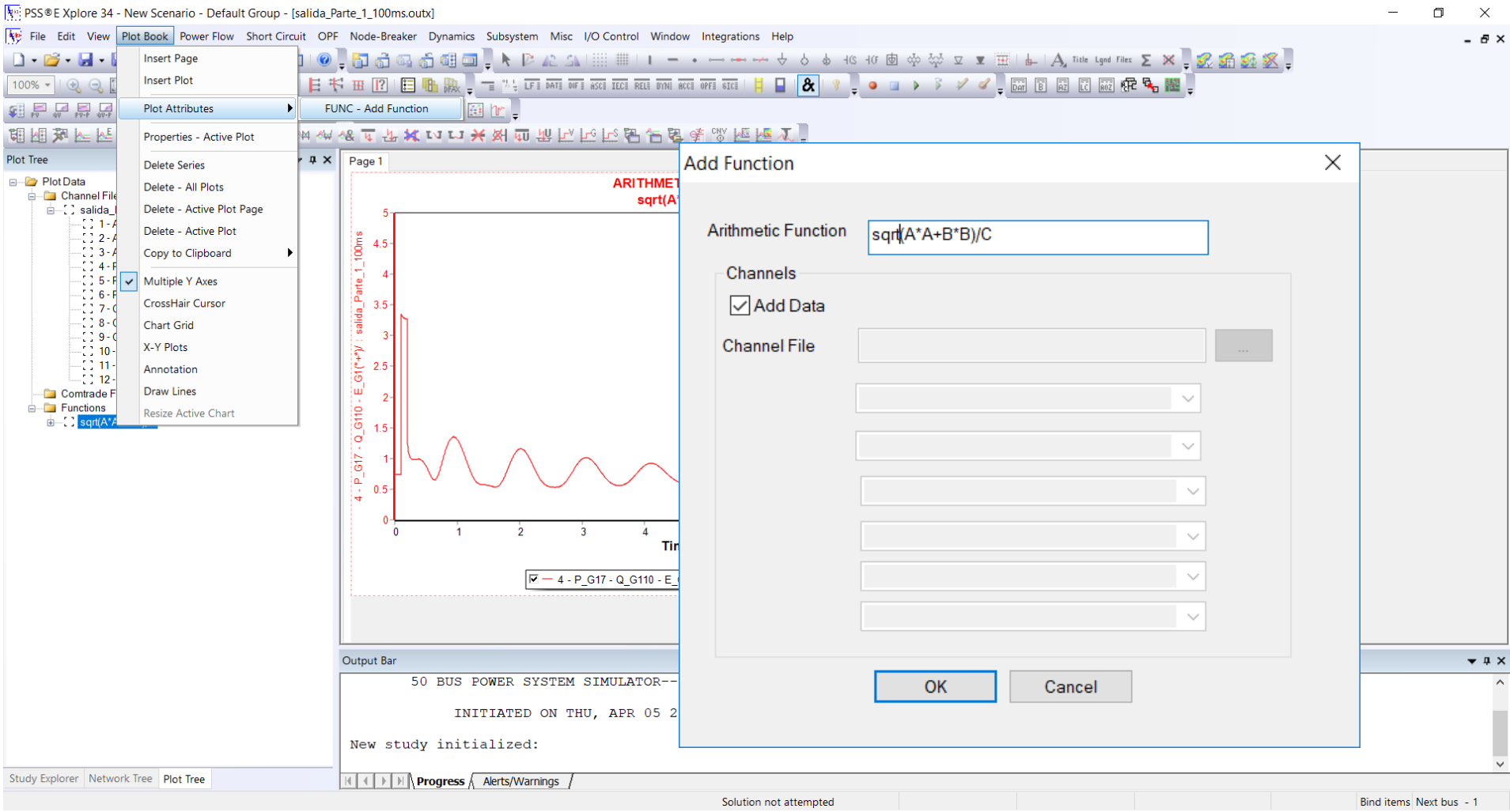
Simulación dinámica

Graficar canales de salida



Simulación dinámica

Graficar canales de salida



Simulación dinámica

Graficar canales de salida