Introduction

Dynamic simulation consists of at least these four steps:

- 1. Load flow preparation
- 2. Dynamic model assigning
- 3. Simulation parameters
- 4. Simulation and results evaluation.

This short tutorial describes these steps on the simple case study (based on Example 1 from the EUROSTAG – Tutorial).

Some operation instructions are in the User manual which is available from menu File/Programs documents.

Example – Input data

The network with necessary load flow data are in the following figure:



Load depends on voltage and frequency according to relations:

 $P=P_0(U/U_0)*(f/f_0) Q=Q_0(U/U_0)^2$

It corresponds so called static load model (Application Guide [1] chapter 4.1):

 $\begin{aligned} &PSTAT = P_0(t)^* (1 - Ap - Bp + Ap^*U + Bp^*U^2)^* (1 + Cp^*s_U) / (1 - Ap - Bp + Ap^*U_0 + Bp^*U_0^2) \\ &QSTAT = Q_0(t)^* (1 - AQ - BQ + AQ^*U_0 + BQ^*U_0^2)^* (1 + CQ^*s_U) / (1 - Ap - Bp + Ap^*U_0 + Bp^*U_0^2) \\ &With \text{ parameters: } Ap = 1, Bp = 0, Cp = 1 \quad AQ = A_0 / tg \quad BQ = 1 + B_0 / tg \quad CQ = C_0 / tg\phi \quad A_0 = 0, B_0 = 0, C_0 = 0 \\ &Generator \text{ parameters are } Un = 24 \text{ kV}, \cos\phi n = 0.956, Sn = 1150 \text{ MVA}, X_d = 2.57, X_d = 2.57, X_d = 0.422 \text{ , } X_q = 0.662 \end{aligned}$

 X_{d} "=0.3, T_{d0} '=7.695 s, T_{q0} '=0.643 s, T_{d0} "=0.061 s, T_{q0} "=0.095 s, T_{m} =2H=12.6 s.

Use constant Efd for excitation system model (CONST) and standard turbine model (STAN) according following figure¹:



Power control loop is open (switch is in OFF position) with A1=1. Nominal turbine power is Ntn=1000MW. Turbine and speed governor are represented by following parameters: $k_N = Sn/Ntn=1.15$, $d_{Sp}=0$, $k_{Sp}=25$, $T_{EH}=0.01$ s, $T_V=0.01$ s, $T_{HP}=0.01$ s, $T_R=10$ s, $k_{HP}=0.3$, $k_{LP}=0.7$. Other parameters are default.

Following events will be simulated:

- 1. step change of load of 50+j25 MVA,
- 2. switching off the line LINE1_2A.

¹ More details on power system modeling is in Application Guide [1] which is available from menu File/Programs documents

Load flow data

The best way to prepare new load flow is using of New project and editing its data. <u>To Open the project:</u>

- Click on the project name NEW in the **Projects** tree.
- Click icon on toolbar or use menu **Project/Open**.
- Confirm **OK** and the MODMAN overwrite working subdirectories VST a VYST by projects files (use the menu **Project/Save** or **Save As** to save proceeding project data).

There is only one case named UST_STAV in the NEW project and we use it as a base for our new network creation. Click icon to open Load Flow Editor. Adaptation the two nodes network contains the following steps:

- 1. to rename the node names UZEL1 and UZEL2 to NHV1 and NHV2
- 2. to change the reference voltage Uv from 400 kV to 380 kV
- 3. to change the consumption and generation Pload/Qload and Pgen/Qgen to 0
- 4. to change the reactive power range Qmin-Qmax to 0
- 5. to rename the line name VED1_2 to LINE1_2A
- 6. to change the line parameters R=3, X=33, B=386
- 7. to rename the Unit Name BLOK1 to GEN and Node Name to NGEN
- 8. to change of nominal power Sn=1150, Ntmax=1000 (nominal turbine power) and unit transformer ratio pt=1

It will be done simply by editing of cells in tables of nodes, branches and units.

To add new parallel line LINE1 2B:

• Use menu Edit/Add branch

• Complete form for the similar parameters like LINE1_2A

🐂 Form fo	r parameter	set up for	bran	ch determit	ne the topolog	/ firstly				
Sequention Number: 2	From Node:	To Node:	•	R [Ohm]: 3	X [Ohm]: 33	B [mikroS]: 386	State [0/1]:	Imax/Smax [A/MVA 1200 symmetrical data	^{r]} 🔲 Typical data	
Branch Name:										
LINE1_2b				 Branch Typ Line 	C Transf.					
ок										
Cancel		C NUUE								

• Click on the **OK** button

Then we add two new nodes NGEN and NLOAD. <u>To add new node:</u>

- Click in the table of nodes (the table must be yellow).
- Use menu Edit/Add node
- Complete the following form for NGEN node (it is PU type node due to connected generator GEN).

💐 Form fo	or paramete	r set up for r	node				
Identification Node	Area Number:	Reference Voltage [kV]:	Set Voltage [kV]:	Set Delivered Power [MVV]:		Qmin [MVAr]:	Qmax [MVAr]:
3	1 💌	24 💌	24.5	0.]	-300	600
Identification Name:		- Node	e Type —— ฉ	Active Load IMWI:	Reactive Load [MVAr]:	_	
NGEN		(€ Pi	J -+	0	0]	
ок			otor			🔽 Add branch	Cancel

• Click on the **OK** button

• Complete the following form – determine From Node number 1 firstly (in the Topology frame) and then select Transf. for Branch Type.:

💐 Form fo	r parameter set u	p for bran	ch determi	ine the topology	/ firstly				
Form fo Sequention Number: 3 Branch Name: T1-3	r parameter set u Topology From Node: To I 1 3	p for bran	ch determi Pk [%]: 0.24 Sn [MVA]: 1300 Branch Ty C Line	ine the topology uk [%]: 10 From node side 400 pe (• Transf.	/ firstly i0 [%]: 0.4 To node side Ur 24 Tap+ [-]: 10	Tape [-]: 0 Ratio incremen 1 Tap- [-]: 10	State [0/1]:	Smax [MVA] 1300	 ■ Nameplate data Add to 3 wind.transf.table Typical data: Main370_MVA ▼ Save
OK Cancel	C Nuce C	NUUE							

• Repeat preceding steps for NLOAD node (it is PQ Node Type with Reference voltage 150 kV and Active/Reactive Load 600/200) and T4_2 branch (determine To Node number 2 firstly and then select Transf. for Branch Type and check Nameplate data, From/To node side Un is 158/400 kV).

To add new parallel line LINE1_2B:

- Use menu Edit/Add branch
- Complete form the similar parameters like LINE1_2A NGEN
- Click on the **OK** button

To remove unit EKV_TS:

- Click in the table of units (the table must be yellow) in the row with EKV_TS (▶ must be in the left column)
- Press the Delete key and confirm deleting
- Press OK button

Before computing this new load flow it is necessary to perform the following steps:

- 1. define new Reference node (slack bus) to 3
- 2. press the **Save** button
- 3. confirm the topology variation by Yes button
- 4. complete the form New Load Flow Specification
- GLOAD is an identificator and Description is adjusted according the new network
- 5. click OK button
- 6. confirm the load and units variation by Yes buttons

Prew Load Flow Spec	ification	
Load Flow Definition:		
-Load Flow Definition:	Load Flow Name: GLOAD	
Load Flow Description: Generator feeding the lo Simple four nodes network OK	iad through double lines ' ork'	

Now it is possible to recalculate the load flow by pressing **Recalculate LF**. After recalculating the first table with nodes is refreshing. Because the voltage in the NLOAD is low (146.3), we increase it.

To change the voltage of the NLOAD:

- Click in the table of branches in line T2-4 (the table must be yellow and ▶ must be in the left column)
- Change the ratio (it is denoted abs{Up/Uk}) of the T2-4 from 0.9993 to 0.94
- Press Save button and No for new variant conformation.
- Press **Recalculate LF** button to calculate new load flow.

The voltage is 156.95 kV. The load flow data is prepared for other steps. The load flow data overview is in this form:

₽.	LF editor	GLOAD100	Project:NE	₩ Case	:UST_ST	AV													<u>? ×</u>
File	Show B	dit Load Flo	w Dynamic	: Initialisat	tion Sear	ch One line	e scheme												
ΓG	enerator fe	eding the load	through the o	double line	e				Reference I	Power [MVA]	eference Nodes	;							Save
'Si	nple four no	ides network							100	[3								E×it
			1				D 10.0.0		Table of	Nodes: GLOAI	0100.ust								
-	IdentN 1	NodeName NHV4	aldNumber 1	UV[kV] 380	absU(kV) 402.1	argU[deg]	Pload(MW)	Uload(MVAr)	Pgen(MW	Ugen(MVAr	Ucomp(MVAr) U	min(MVAr) (Jmax[MVAr]						New Load
	2	NHV2	1	380	389.97	-6.0884	0	0	0		0	0	0						
	3	NGEN	1	24	24.5	0	0	0	604.82	226.57	0	-300	600						
►	4	NLOAD	1	150	156.95	-12.087	600	200	0	(C	0	0	0						
*											<u> </u>								
																			Flows
									T	able of Branch	es: GLOAD ON	ret							
	SeqB	BranchName	Fro	miNode	TojNode	R(Ohr	n) X(0ł	nm) B(mik	<ros) ab:<="" td=""><td>{Up(-)/Uk(-)}(-</td><td>) arg{Up(-)/L</td><td> k(·)}(deg)</td><td>State(0/1)</td><td>Gi(mikroS)</td><td>Bi(mikroS)</td><td>Gj(mikroS)</td><td>Bj(mikroS)</td><td>Imax/Smax(</td><td>A/MVA) RO</td></ros)>	{Up(-)/Uk(-)}(-) arg{Up(-)/L	k(·)}(deg)	State(0/1)	Gi(mikroS)	Bi(mikroS)	Gj(mikroS)	Bj(mikroS)	Imax/Smax(A/MVA) RO
	1	LINE1_2A		1	2		3	33	386	1		0	1	0	0	0	0		1200
	2	LINE1_2B		1	2		3	33	386	1 000		0	1	0	0	0	0		1200
-	3	T1-3 T2-4		2	3	0.05	0 0.0	93	0	1.053	·	0	1	0	0	0	0		1000
*		14-7		-		0.00			-	0.0-	·								1000
◀																			Þ
	StateG	UnitName	Nod	eName	N	lumber(-)	Sn(MVA)	Ntmin(MW)	Ntmax(MW) Xd	0 Pt(-		<t(·)< th=""><th>Part Mode(</th><th>J</th><th></th><th>Load Flow Calc</th><th>ulation: ——</th><th></th></t(·)<>	Part Mode(J		Load Flow Calc	ulation: ——	
	1	GEN	NGE	N			1150	100	1000)	0 1		0	0 -	1 Recalcu	late LF	wed Power Unb	alance (MVA	2
*																Allo	wed Number of	Iteration:	30
															Program	UST 2.2/8	1		<u> </u>
															I(c) Karel I	Maslo PhD 1	994-2003		
															Serie:7_2	2003	1		
															t calculatio	on of the Jacol	bian in the each	iteration	
															Generato Simple fou	r teeding the li ir podes petw	oad through the	double line	
															Nodes nur	hber, Number a	and Id.number of	f slack nodes	Refere 4 1
															Iteration p	rocess overvi	ew		
															max.error	teration Num. ∋= oz i i	:		
															Calculation	time[h min se	c 0.01*sec] 0	0 0 0	
																			-

Directly from the Load Flow Editor is possible to initialise dynamic models nevertheless no dynamic models are defined. The MODES uses default dynamic models¹ and typical parameters². After selecting **Dynamic initialisation** from the menu three blank text boxes appear in the middle - it means, that starting dynamic models are initialised well and it is possible to carry out next step – specify dynamic models. Press Exit button to return to MODMAN environment.

¹ It is classical model for generators and standard model for turbine

² The first set of typical parameters in the global catalogue is default

Dynamic Models

Simply way to assign dynamic data to units is using Unit Models Editor.

- Click on the Unit Models Editor icon \bigcirc on the toolbar.
- Click on the unit GEN
- Press Add record button
- Press yellow Generator button and select PARK model from the list box
- Press green Exciter button and select CONS model from the list box
- Press blue Turbine button and switch OFF radio button
- Press Change all models to replace default models and confirm all changes

Now we change parameters by simply editing of default parameters. Press again yellow **Generator** button. Then click on the last blank row in the table and press **Add parameters** button. The default set of parameters are copied to this row and it can be edited. Click again in the new row and repair parameters according chapter Example – Input data. Then click on the other row (symbol of pencil disappears) and click back to the editing row. Press the **Change parameters** to exchange default parameters for this new set of parameters S1100.

Generators	Un	Cosn	Sng	Xd	Xq	Xd1	Xd2	Xt	Td01	Td02	Tq02	Tm	Xq1	Tq01	Coment
	(kV)	(-)	(MVA)	(-)	(-)	(-)	(-)		(s)	(S)	(s)	(s)	(-)	(s)	
S1100	<mark>24</mark>	0.956	<mark>1150</mark>	<mark>2.57</mark>	<mark>2.57</mark>	<mark>0.422</mark>	<mark>0.3</mark>	0	7.695	0.061	0.095	<mark>12.6</mark>	.0662	0.643	1100MW from Example 1

We edit parameters for turbine model. Press again blue **Turbine** button. Click on the default set of parameters and press **Change parameters** button. Further procedure is similar like for generators. Changed parameters are bold in the following table.

Turbines	kN	ΤV	TI	T _{HP}	T _R	T _{LP}	Vm	V _{mx}	V _{lmi}	V _{Ima}	V _{Csto}	V _{Isto}	G _{mn}	G _{mx}	K _{LP}	K _{HP}	k _{IV}	Coment
	(-)	(s)	(s)	(s)	(s)	(s)	n	(-/s)	(-/s)	(-/s)	(-/s)	(-/s)	(-)	(-)	(-)	(-)	(-)	
T1000	<mark>1.15</mark>	.01	0.2	<mark>.01</mark>	<mark>10</mark>	<mark>0.4</mark>	-1	<mark>0.1</mark>	<mark>-4</mark>	0.67	<mark>-4</mark>	<mark>-4</mark>	0	1	<mark>0.7</mark>	<mark>0.3</mark>	2	Turbine from

The last changes apply to governor. Press again blue **Prime mover control** button and repeat the editing process. Changed parameters are bold in the following table.

Regulator	· A1 (-)	A2 (-)	TI (s)	TIB (s)	T _N (s)	T _{EH} (s)	kT (-)	k -	k _{Sp} (-)	k _{Fr} (-)	K _{COR} (-)	k _{Pres}	k _{For} (-)	GEN (-)	vN %/min	step (%)	dFr (%)	dSp (%)	d _{Pres} (%)	dP %	N _{Fmax} (%)	N _{Fmin} (%)	Coment
OPENL	1	0	<mark>50</mark>	100	1	0.01	1.5	1	<mark>25</mark>	0	0	1	<mark>0.5</mark>	1	1	0	0	0	0	0	<mark>1.25</mark>	1.25	open loop with speed

The following screen shows the final models selection.

	Generato	rs	in modification:	Overcurre	nt limiter	Island contro	I Stoten	ateol	Change neromet	ers					
	C As.motor	rs	ND -	Underexcita	tion limiter	Fast falving	g control								
	Modification		in basic	System s	abiliser	Overspeed cor	troi Chan	ge model	Add parameter	s					
	Blok.001		database:	Q cont	roller	Speed contro Prime mover	Change	all models	Add record						
	1 - Obl1	<u></u>		control		control		OFF	Remove recor	d					
				*.=	$\overline{\bigcirc}$	M	6	ON Speed	OK						
					E =var 6=var				Cancel	-					
		_		Exciter	Generator	Turbine	Source								
			i)					Scheme	OK CAT						
Generators	UnfkVi	Cosn(-)	Sna(MVA)	Xdf	Set o Xafri	of unit models type Xd1(-)	Cal parameters Xd2(-)	TOM TYP_BL XtFil	UK.LAT catalogue Td01(s)	s Td02(s)	Ta02(s)	Tm(s)	Xa1(-)	Ta01(s)	Bstat(-)
defaul	17.5	0.85	235	2.5	2,5	0.425	0.3	0.1	8	0.06	0.4	12	2.5	8	0
defaul	17.5	0.85	235	2.5	2.5	0.425	0.3	0.1	8	0.06	0.4	12	0.425	8	0
J950	24	0.864	1100	2.5	2.5	0.425	0.3	0	8	0.06	0.4	12	0.425	8	0
J950+T	24	0.864	1100	2.5	2,5	0.425	0.3	0.1	8	0.06	0.4	12	0.425	8	0
J390+T	15	0.867	450	2.7	2.6	0.36	0.29	0.13	8.5	0.05	0,35	8	0.36	8.5	0
P260+T	15	0.867	300	2.7	2.6	0.36	0.29	0.13	8.5	0.05	0,35	8	0.36	8.5	0
S195+T	15	0.867	225	2.7	2.6	0.36	0.29	0.13	8.5	0.05	0,35	8	0.36	8.5	0
P130+T	15	0.867	150	2.7	2.6	0.36	0.29	0.13	8.5	0.05	0.35	8	0.36	8.5	0
P3500T	24	0.7	5000	2.5	2.5	0.425	0.3	0.13	8	0.06	0.4	12	0.425	8	0
V130+T	15.75	0.867	130	1.16	0.77	0.42	0.25	0.1	7.6	0.038	0.43	5.75	0.42	7.6	0
S1100	24	0.956	1150	2.57	2.57	0.422	0.3	0	7.695	0.061	0.095	12.6	0.0662	0.643	0
DIESEL	6.3	0.8	7.9	1 38	0.69							02.00	D EQ	3	0.0091
*						0.23	0.12	0	6	0.06	0.4	3.36	0.03		
*							0.12	0	8						

After changing models and editing parameters press OK, confirm new modification and saving new parameters into catalogues as well.

Data for load models are managed by Nodes Models Editor.

Click on the Nodes Models Editor icon on the toolbar.

- Click on the node NLOAD
- Press Add record button

•

- Press purple **Static load** button
- Move slider for Static load to 100%
- Press Change participation button
- Write 1 to the text box Number of active record in Modification.

Now we change parameters by simply editing of default parameters. Click on the last blank row in the table and press **Add parameters** button. The default set of parameters are copied to this row and it can be edited. Click again in the new row and repair parameters according chapter Example – Input data. Then click on the other row (symbol of pencil disappears) and click back to the editing row. Press the **Change parameters** to exchange default parameters for this new set of parameters LINEAR displayed in the following table:

Regulator	AP (-)	BP (-)	CP (-)	A0 (-)	B0 (-)	C0 (-)		Coment
LINEAR	1	0	1	0	0	0		Linear P dependency on U /f for Example 1

The following screen shows the final models selection.

of Nodes: - IV1 IV2		Activ Eile	e Database	Akc Nun Rec	tive Models nber of Acti ords in	xe	- Model Se Termos	lection —	1			- Participa	ation on	the Load Mo	del —	Dynamic	load	
ÆN OAD		Uzly.	.004	Moc 1	lification:		Stati	c load	i			0 Coi) nstant a	0% ctive current	1	0 Static los	0% :d	1
				Nun Rec Date	nber of Acti ords in Bas abase:	ive sic	Equiv as J	nic laad valent notor				0 Coi)	0% eactive curre	í ent	0 IEquivaler	100%	1
				10			Load fr she	equency dding				0	<u> </u>	0%	1	0 Chang	0% je Participati	0n
Taable of	typical pa	rameters fo	or: Static load	P=P0*(1	I-BP+AP*du	J+BP*U*	U)*(1+CP*c	lf) Q=Q0*(-I	BQ+AQ×dL	J+BQ*U*U)*(1+C0*df	/tg(fi))/tg(f	i) for UK		1	e		
etaul	Ap(-)	DP(-)	- LD[-]]	A0[-]]	0.75	0	Unin(-)	uuiin (-)	uunz(-)j	dunis(-)]	0uni4(*)	Standard	Clobal	act publicool	the	first stage		
dinita	0	1	n	0	n	:8:	8.8	0	n	.8	n:	constant	Local					104
BECNA		.8	1.2	-19	12	-5	0.5	0	0	0	0		Local		0			101
	0.5	8.81	12		8:003	-0.15	8.8	0.02	8:009	8	0	Self cons	Local		the	or o enete hannee		
NEAR	1	:8	1	0	0	:0)	8.8	0	0	8	0	lenear	Local		uno.	occorria orago		
																<u> </u>		
															0	·		100
															1000	0%	i.	
															the	third stage		
																<u> </u>		
															0			100
																	e.	
														K	the	tourth stage		
														<u> </u>	1			100
	() 10		() Log	<u> </u>	Iodel Parar	neters for	Selected	Node:NLO	AD			10 10	12 1 10	10 10				
tat_chal Ap	(-) B	0[·] [·]) B	0(-) [C(1.1	Umin(-j ji		sumz(-) (dum3(-)	aum4(-)	Repear	Natalite			Chops	o Volumo	1
1												acredi	LOUGI	•		Criang	je volume	_
iool Tins		Change	1		s. f T	1000	1 5	Base	2	1	014	1	2	a 1				
	pa	rameters	Add	paramet	ters	-Add re	30010	Remov	/e record		OK		Cano	e				

Press OK, confirm new modification and saving new parameters into catalogues as well.

Dynamic models are ready now and it is possible to run the simulation by clicking on icon OL in the toolbar. Standard graphic occurs on the display (Active and reactive power output PG and QG, speed deviation SG and terminal voltage UG of the first generator) and it shows a steady state. Press E key to exit

We can save our work in this phase like case. Click on the menu Cases/Save as and fill the following form.

sting Cases: ITSTAT	Case Name:		
ST_STAV	INITSTAT		Save
	Author:		
	uživatel		Cancel
	Created:	Modified:	
	6.8.2008	6.8.2008	
	Description:		
	Initial state with defined dyn	namic models	

Then press the Save button. Now we can continue the solution.

Simulation parameters

Simulation parameters contains especially:

- Simulation time and sampling periods
- Definition of scenario sequence of simulation events
- Definition output variables displayed during simulation
- Determination of output files for post processing.

Click on the menu Modify/Control to change simulation parameters and fill the following form:

Calculation parameters; NEW;	INITSTAT	
Dynamic Calculation	Load	Flow Calculation
 Initialisation Mode Calculate Initial Condition and I 	rup the simulation	
C Run the simulation from the init	ial state	
C Run the simulation from the fin-	al state of the prece	eding simulation
C Run the simulation from the sn.	aped state of a prec vipitial condition only	eeding simulation
	Initial condition only	
Keep the Time after a Snap (R	eturn Mode) 🔲 ''Ri	eal Time'' Calculation
Time of Simulation End [s] Samplin	g Period [s]	
1.05		
Integration Step [s]		
Initial .05		
Minimum .0125		
Maximum 1		
Allowed Error (pu) of		
Iteration of the Metwork Equations	.002	
	1.002	
Allowed Number of Iterations		
10 🗖 Create a Dia	gnostic File	
		1 1
✓ Use the Tools Tips	OK	Cancel

Then press the OK button and confirm Yes to create new variant.

Simply way to define events is using Scenario dialog box.

- Click on the first icon in the third groups on the toolbar.
- Click on Add event button
- Write time 10 s
- Select Nodes in Object types frame
- Click on Add object button
- Select NLOAD from **Node** combo box
- Write deltaP=50*100/600=8.33 % and deltaQ=25*100/200=12.5 % into Parameter specification frame
- Press Add and Cancel buttons twice
- Click on **Add event** button once more
- Write time 20 s
- Select Branches in Object types frame
- Click on Add object button
- Select LINE1_2A from Line combo box
- Press Add and Cancel buttons twice, so that scenario dialog looks like:
- Press **OK** and confirm creation of new variant.

fime [s]:Key:	Event specification	
10, LOAD	step change of the load	
20, BRAN 10000 END	Nodes deltaP(%)	deltaQ(%/min)
	NLOAD ' 8.33	12.5
	Change the object	
	Add event Remove event	Clear all

Simply way to define output variables is using Graphic dialog box.

- Click on the second icon in the third groups on the toolbar.
- Write Example 1 to the **Left title** text box
- Write 4 to the Graphs number text box
- Click on **Clear** button in the 1st graph frame
- Click on Add variable button
- Select SG from Variables combo box
- Press Add and Cancel buttons
- Write 0 and 1.2 to the text boxes **Ymin** and **Ymax** in the 2nd graph frame
- Click on **Clear** button in the 2nd graph frame
- Click on Add variable button
- Select Nodes in Object selection frame
- Select NHV1 from Node combo box
- Select /U/ from Variables combo box
- Press Add and Cancel buttons
- Write 0 and 3.2 to the text boxes **Ymin** and **Ymax** in the 3rd graph frame
- Click on **Clear** button in the 3rd graph frame
- Click on Add variable button
- Select Branches in Object selection frame
- Press Add and Cancel buttons
- Similarly like SG Add variable NT (turbine output) into the 4st graph, so that graphic dialog looks like:
- Press **OK** and confirm creation of new variant.

It is necessary to define output files for investigation of simulation time courses after finishing of calculation. Click on the menu **Modify/User File** to define these files and fill the following form:

- Write Example 1 to the **Comment line** text box
- Delete Generic Name for User Files text box
- Click on Add User file button
- Select Variables from display tap
- Select Variables from the first graph radio button and press Add button
- Select Variables from the second graph radio button
- Press Add and Cancel buttons, so that scenario dialog looks like:



Then press the OK button and confirm Yes to create new variant.

Left title	INTELE	Right title		
EXAMPLE1		TRANSIENT STABILITY		
Graphs number 4 1st graph Variables Objects SG GEN'	V Axis Ymin 0 Ymax 1.1 Add varible Replace Remove	Complex plane	External source Y Axis Ymin 0 Ymax 1.2 Add varible Replace Remove Clear	
3rd graph Variables Objects *PV UNE1_2A*	Y Axis Ymin 0 Ymax 3.2 Add varible Replace Remove	Variables Objects NT GEN'	Y Axis Ymin 0 Ymax 1 Add varible Replace Remove Clear	
Tool Tip Help	Show the case nam	ie in Oł	Cancel	

Simulation and results evaluation

Now we can repeat the simulation by pressing the on icon \mathfrak{E} in the toolbar. You can see the system response on events determined by scenario directly on display. Because the response of the system and calculation result are satisfied we can save the calculation like case named like LINEOUT.

It is possible to show predefined variables time course after calculation. Check **As graph** check box in the **Results** menu and then click on the icon on the toolbar. Four icons appear on the toolbar. You can examine of time course by clicking on these icons. The following figures show the time courses.

The voltage /U/ decreases after load step change and line outage. Load decreases consequently due to regulation effect (especially due to voltage dependency). Frequency deviation increases due to power excess in the island.



Now when we have finished work we can save it like a project. Click on the menu **Projects/Save as** and define the name (e.g. Tutorial) and description.

Reference

[1] MODES 2.2/2 Application Guide 3rd Edition 10/1995