1. Network Simulator MODES

1.1. Purpose and capability of the program MODES

The program MODES serves for dynamic simulation of electric power system. It calculates electromechanical transients. The transient overview is in the following figure:

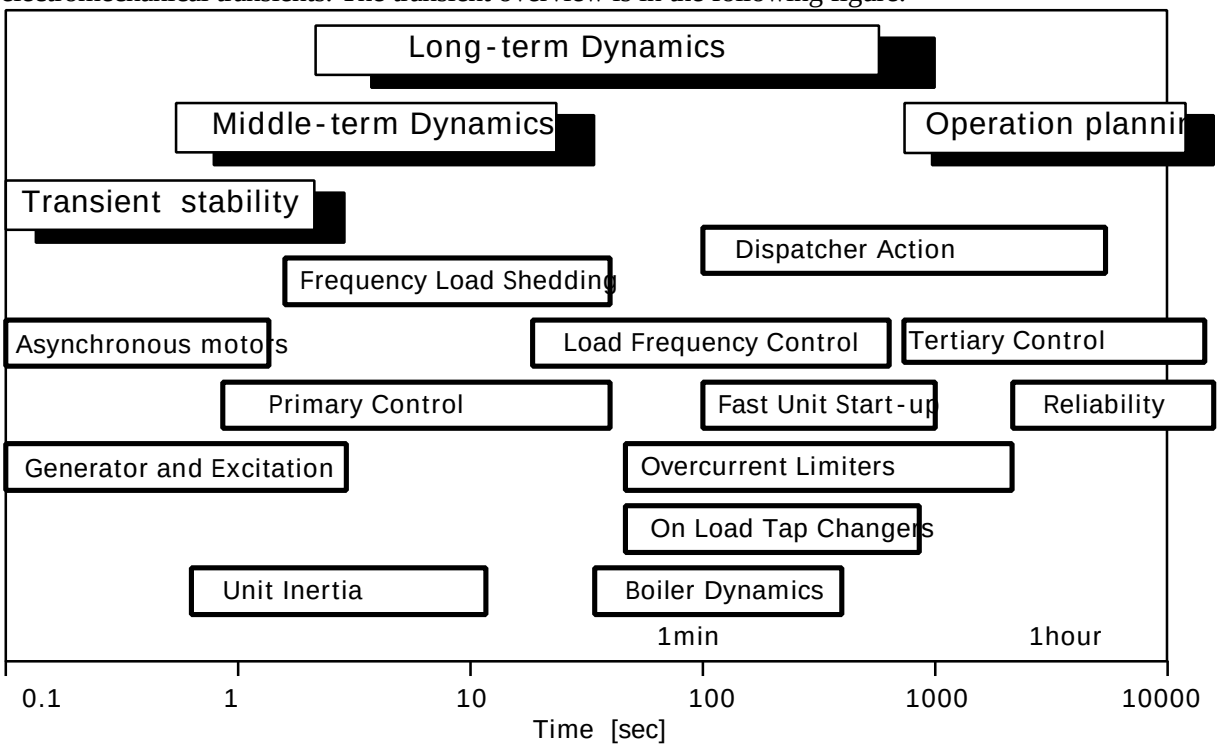

Fig. 1 The power system transients overview

The MODES makes possible to simulate:

1. **transient stability** of generators (loss of synchronism)
2. **middle-term dynamics** concerned with the primary control of frequency (frequency collapse)
3. **long term stability** concerned with LFC , OLTC and the excitation limiter actions (voltage collapse)
4. transient phenomena in **home consumption** of the units (driven start-up, switching over to back-up)
5. steady state stability - investigation of the power system for a small deviation (oscillations).

The MODES can be used for:

a) Education and study of transients
b) Studies of large power systems interconnection
c) Creation of defence plans against the system failures spreading
d) Creation of restorations plans after system black outs
e) Checking and optimisation of the load frequency and system voltage controls
f) Self-consumption of power plants analysis (motors start-up, back -up and so on)
g) Harmonic analysis of the power system.

The MODES is available in the two forms. The first is stand-alone application - exactly the package of applications, including the user interface MODMAN as well. The MODMAN manages input/output data - so called projects and cases, different auxiliary and additional programs, provide help).

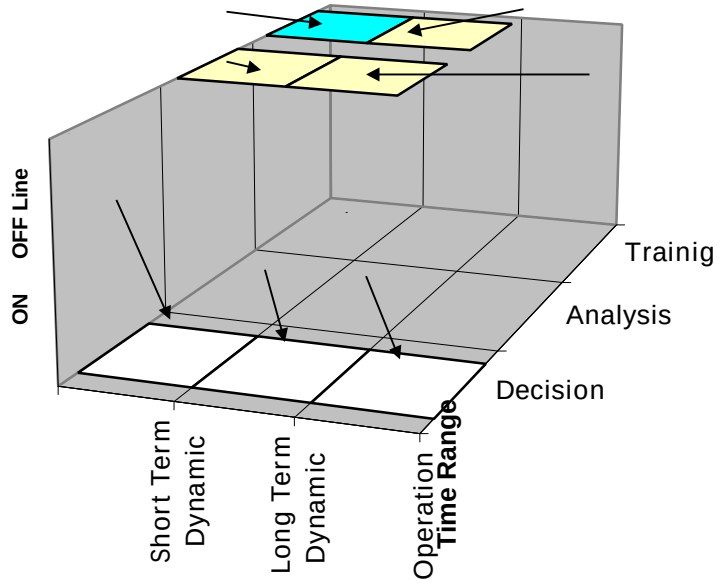

Fig. 2 The MODES applications overview

The second form of MODES is a DLL, which is able linking with arbitrary program supporting the DLL in the Microsoft WINDOWS environment. The possibility of the reference to the MODES application is added to the standard MODES models. The necessary interface functions for data exchange between applications are developed as well. The DLL form makes possible to implement MODES to the user complex application like energy management system, dispatcher training simulators, security tools and so on.

The underlined applications are under operation and the others are developed or under consideration.

The Security Assessment identifies transient stability problems due to network contingencies. The Network Simulator is a decision-aided tool for network operators. It can check possible transactions in the network to prevent thermal overloading, voltage and frequency collapses. The Integrated Network Tool makes possible co-ordination between the electric and thermal networks (power system and district heating systems) by co-generation units regulation.

The aforementioned three applications used real-time data from EMS. The time ranges are several seconds for short-term dynamics, minutes for long term dynamics and several hours for operation.

1.2. Data managing –workspace concept

All data are situated into so called workspace. The workspace is a collection of the projects and other input data for the MODES package applications and it has the following structure:

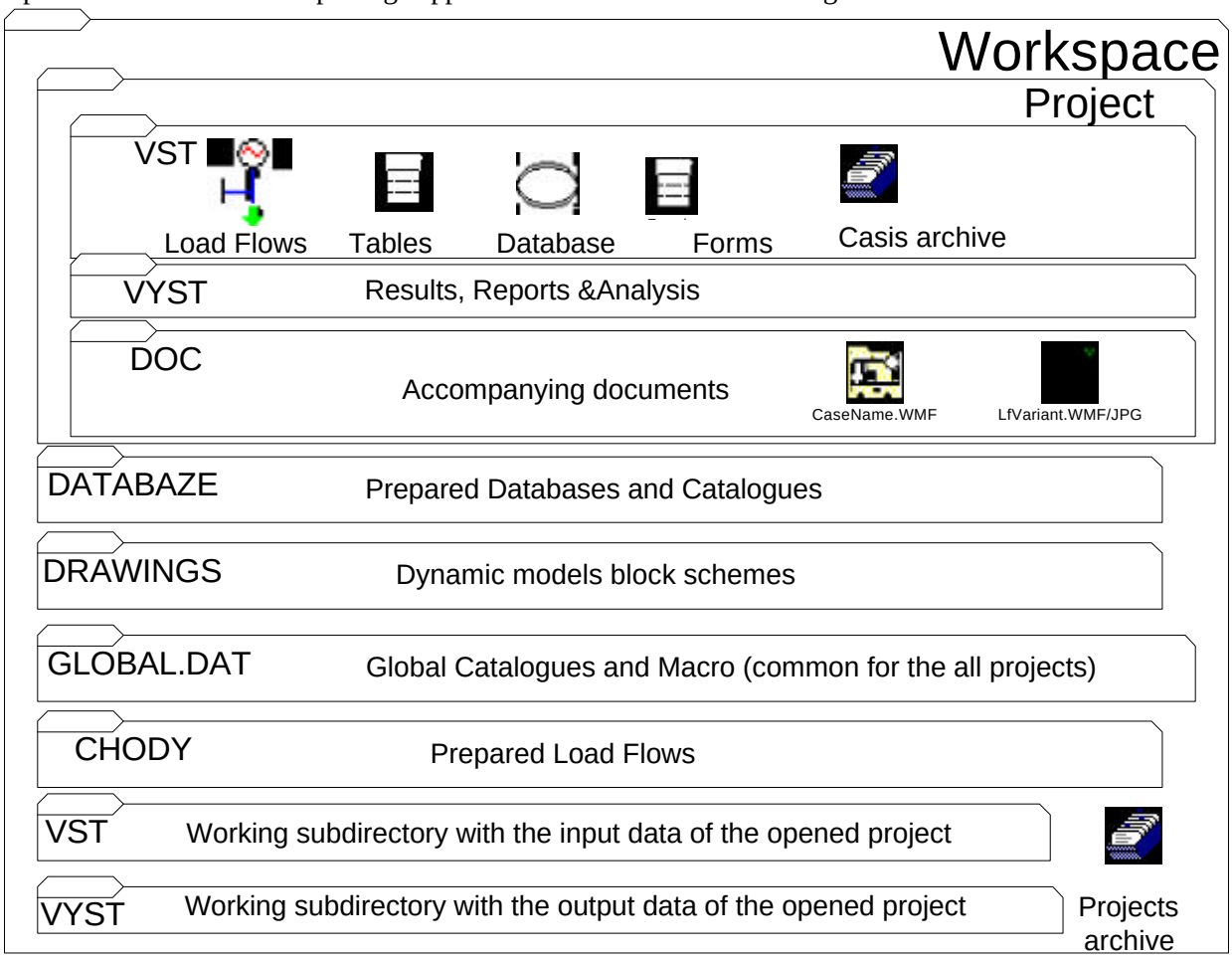

Fig. 3 The workspace scheme

Workspace is physically situated into the MODES working directory (when it has been installed). All information about stored projects is saved in projects archive called PROJECTS.ARC.

The project is a collection of cases. All information about stored cases of a project is saved in cases archive called CASES.ARC.

Case is a collection of input files for one dynamic calculation. The stored cases are visualized by Projects tree in the Explorer.

1.3. Input data

The MODES uses three dimensional data model, which is depicted in the following figure.

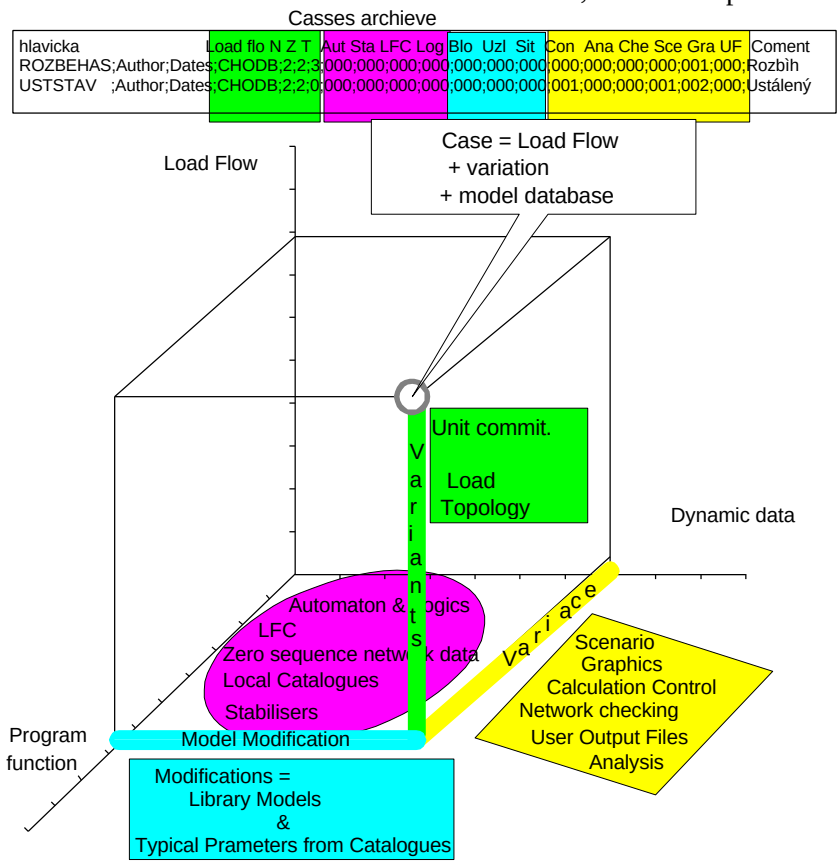

Fig. 4 The three dimensional data model

The input data consist of:

- load flow data (so called variants)
- control equipment data
- dynamic model data (so called modifications)
- program function data (so called variations).

1.4. Output data

The MODES provides the following possibilities:

- showing information on display during calculation (so called graphic)
- saving the simulated variables time courses into output files (so called user output files)
- checking of values of predefined network variables (so called network checking)
- reporting the calculation into output files (so called reports)
- providing analysis of network state, primary and secondary control (so called analysis).

The graphic mediates interaction between user and program during simulation. It makes possible:

- to inform about case and projects name
- to message the events
- to show up to four charts with up to seven time courses of selected variables
- to show instantaneous values of variables from charts
- to signal exceeding limits for „on line“ checking
- to manage program by hotkeys F1-F8
- to stop and continue the calculation after stopping by key.

The user files can be used for:

- results visualisation by a text editor
- charts creation by a spreadsheet application (eg. EXCEL)
- results visualisation as a chart, coping and pasting it into the documents (in the WMF format)
- predefined EXCEL sheets.

2. User Interface MODMAN

The interaction between user and the program MODES is executed by user interface called MODMAN. The MODMAN makes possible:

- access to the input and output data (all data is saved in ASCII files)
- projects and cases management
- to run the programs of package by menu and buttons
- on-line help.

The user interface called MODMAN has the following components:

- Menu
- Toolbar
- Projects Explorer
- Load Flow Editor
- Unit Models Editor
- Status bar

The MODMAN provides:

- navigation in workspace by the Explorer
- projects management by the Project menu
- cases management by the Cases menu
- new projects creation by the Project editor
- new cases creation by the Case editor
- starting the package applications by menu Run or the toolbar
- Context and What this help, ToolTips and information in the status bar
- access to input files by menu in text or dialogue regime and creation of new variations
- load flow data editing by integrated the Load Flow Editor and creation of new variants
- dynamic data editing by integrated the Unit Model Editor and creation of new modifications.
- access to the user output by the Results menu in text or graphic regime
- access to the reports and analysis by the Reports and Analysis menu.

Three stage help is implemented in the MODMAN:

1. Tool Tips, which is activated by cursor moving above controls. The Tool Tips can be cancelled by unchecking the check box Tool Tips in the Editors and Dialogues
2. What This? help is available in Editors and Dialogues, which have the Question mark button at the upper right corner (there are not Min and Max buttons). Help is activated by F1 key.
3. Context hypertext help is available in the MODMAN and Explorer. Help is activated by F1 key in the context mode or by **Help** command in the complex mode.

User interface MODMAN is an independent WINDOWS application, which creates the „superstructure“ of the MODES DOS program.

3. Power system modelling

Power system consists of equipment for electricity generation, transmission, distribution and consumption, including control and information subsystems. The conceptual scheme is in the following figure:

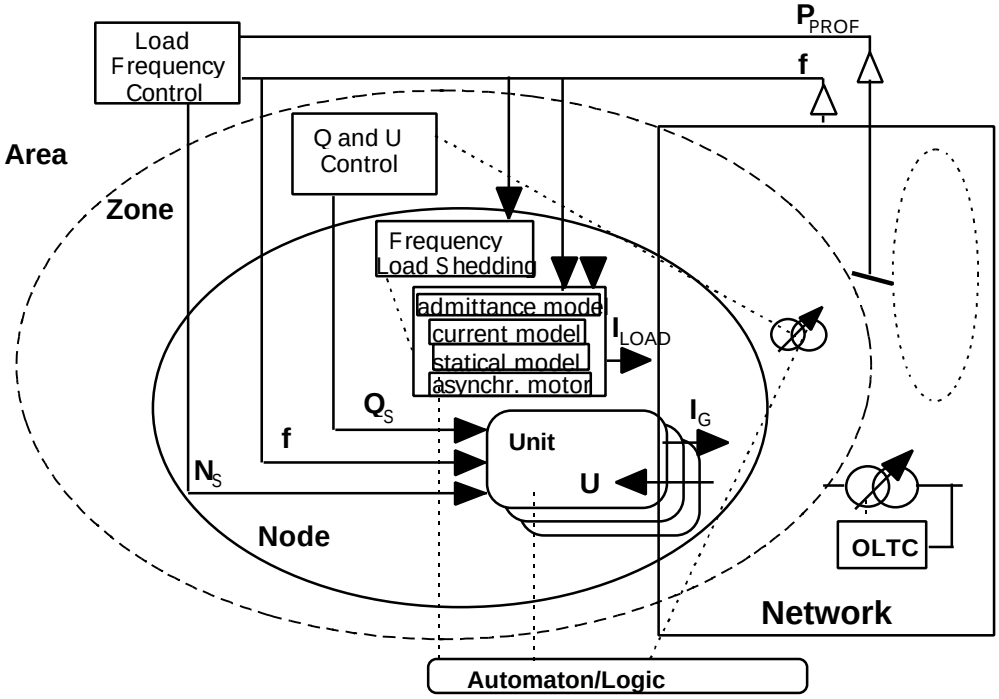

Fig. 5 The conceptual scheme for power system modelling

The **units** correspond to the power stations consisting from physical units. The transmission and distribution consists from network and loads. The **branches** and **nodes** correspond to these parts of power system in a model.

The power system can be divided among **areas.** The each **area** can have load frequency control (LFC). The set of the tie lines between two areas is called **profile**.

The abstract entity called **automatons**, **logics** and external **stabilisers** are designed to model of control and protection equipment.

So that the following entities could by modelled in the MODES version 2.2/5:

- **units,** which modelled synchronous and asynchronous machines
- **transformers** with on load tape changers
- **branches** and **nodes** with corresponding load
- **node** load frequency shedding
- **area** load frequency control
- automatons
- logics
- stabilisers.

The MODES library contains all usual models for network, generators, prime movers and excitation systems, asynchronous motors, loads and so on. Besides it contains special control models as LFC, four stages load frequency shedding and OLTC.

3.1. Unit modelling

The **unit** consists of the synchronous generator, exciter, prime mover, source of energy and theirs control systems. The coupling between these components are depicted in the following figure:

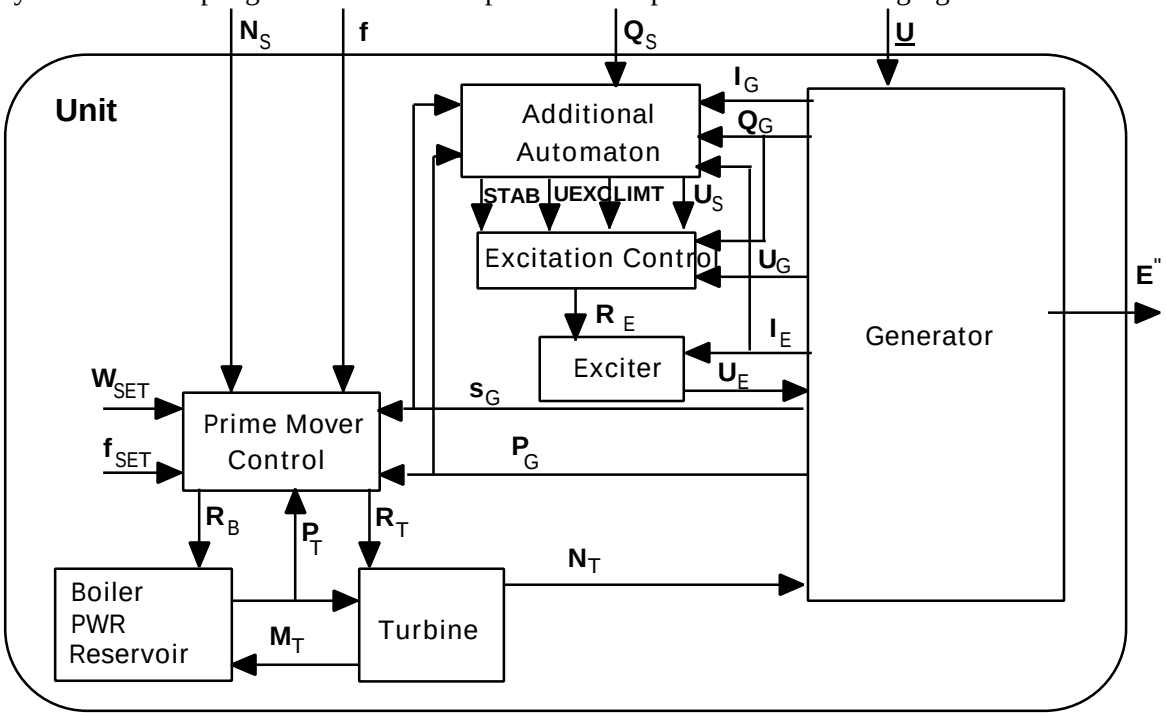

Fig. 6 The block scheme of the unit model

The marked values in this figure represent the coupling variables, which create the inputs and outputs of individual objects. The N_S and Q_S/U_S control variables have a special meaning.

The N_S control variable is reference output from LFC and Q_S is a reference reactive power if the **unit** is controlled by pilot node controller.

The example of complexity of the models implemented in the MODES is the following scheme:

Steam Unit Model for the Island Operation

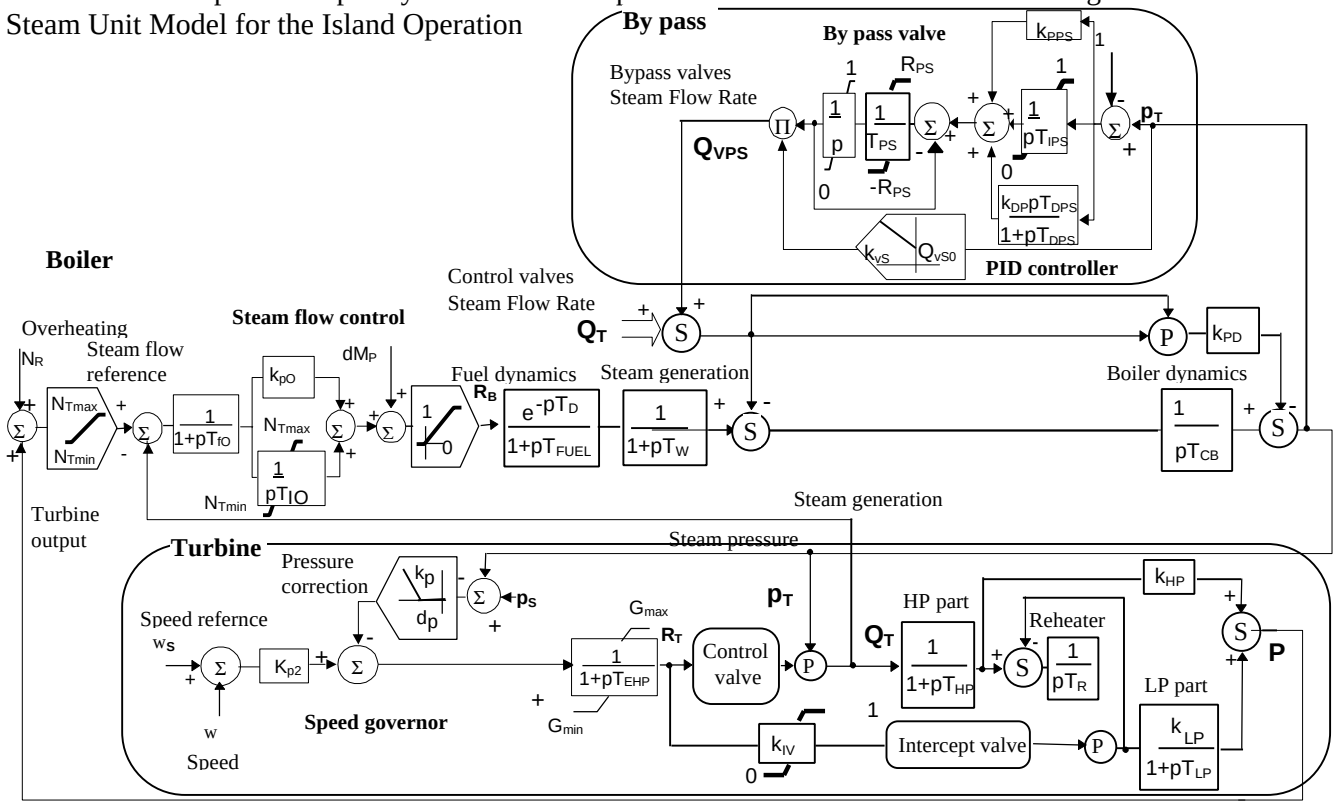

Fig. 7 the steam unit model in the island operation

3.2. Control equipment modelling

There are the following control equipment models implemented in the MODES:

- Four stages of load frequency shedding
- On load tape changers
- Load frequency controllers
- External stabilisers
- Automaton and logics
- External regulators.

The common model of the LFC was created on the base of synthesis of structures used in the CENTREL. The resulting model is in the following figure

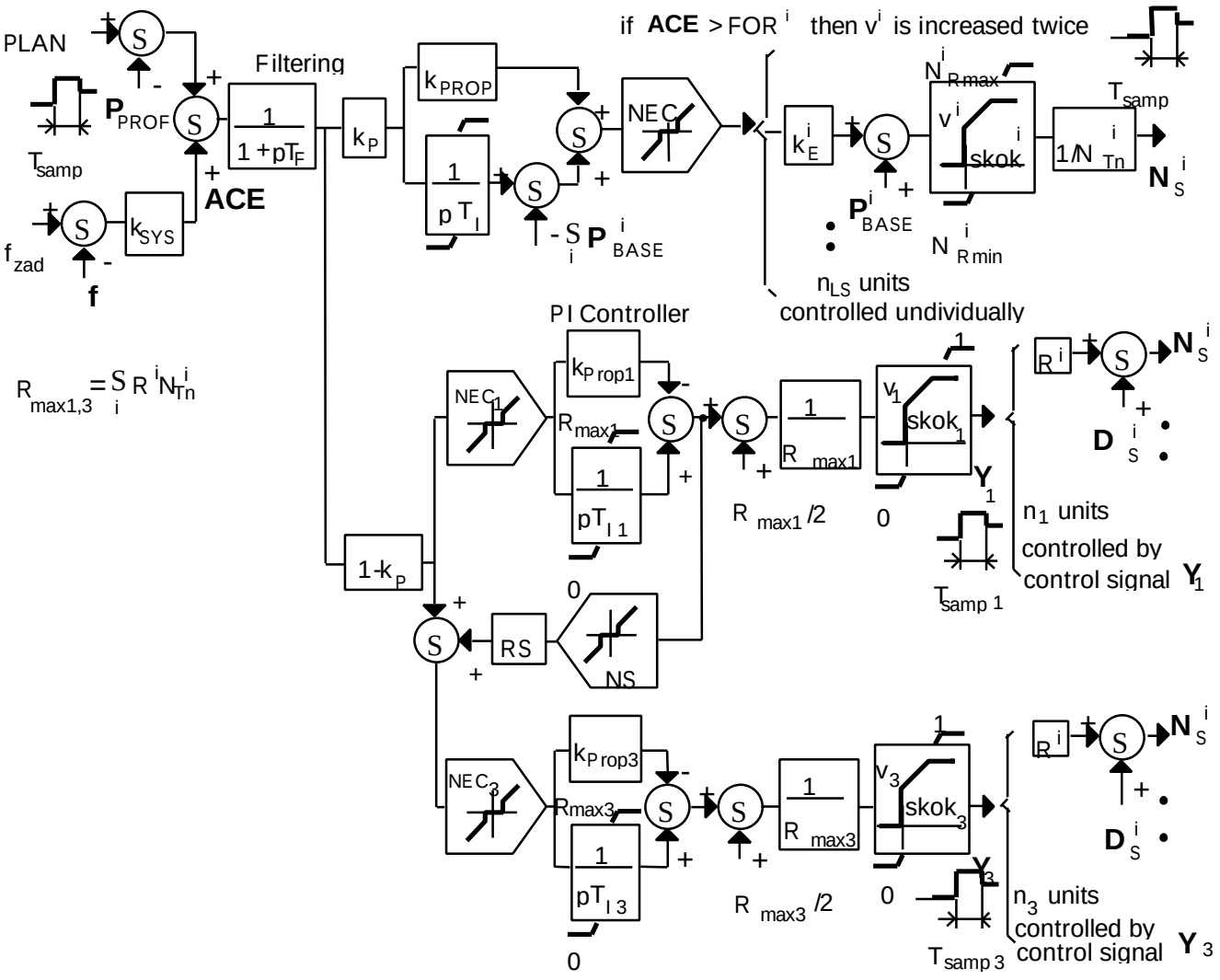

Fig. 8 The common model of the load frequency controller

The load frequency control evaluates so called ACE - area control error. It is possible to divide this control error into two parts. A separate controller processes each part.

The first one is the individual **unit** control. The output from PI controller is divided by the participation coefficient into the individually controlled **units.** If the control range is exhausted for all individually controlled **units** (Ns^i equal $N_{Rmax}{}^i$ or $N_{rmin}{}^i$) the integrator is blocked.

The second part uses two control signals Y_1 and Y_3, which are sent to the controlled units. So that the controlled units may be divided into two parts (e.g. into "fast" and "slow" ones) and each part has its own PI controller and a load limiter. The reference set point of the controlled units is created by the sum of the basic load D_s and the multiple of the secondary control band R and control signal Y. It is possible to load more the „slow“ units (controlled by Y_3) by the by pass denoted RS. So that he „fast“ units (controlled by Y_1) may be released and prepared for subsequent regulation cycle.

The second example of the controlling structure objects is general-purpose automaton model. The structure of automaton model is shown in the following figure:

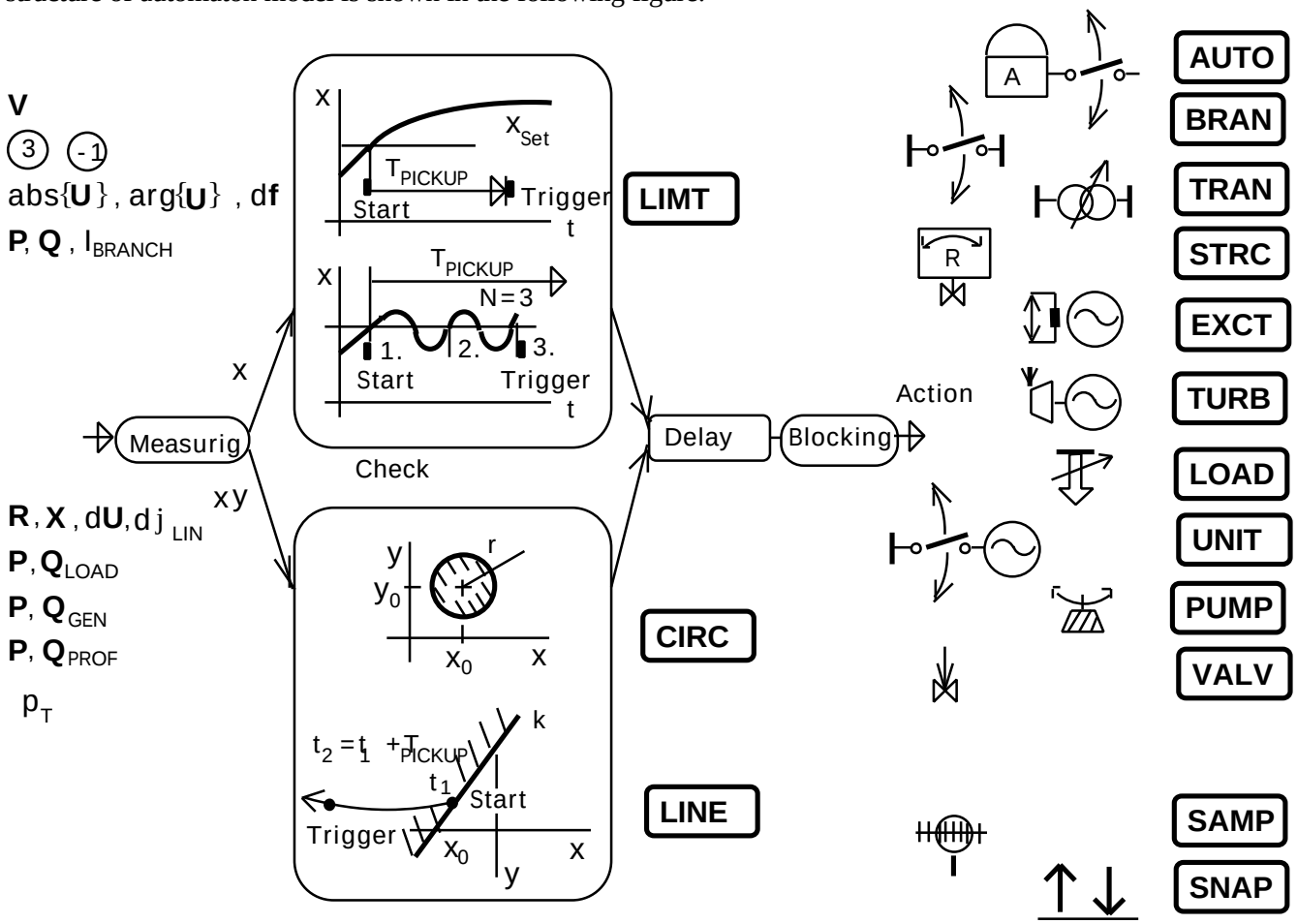

Fig. 9 The Scheme of a General -purpose Automatics Model Operation

The automaton has the following parts:

- Measuring
- Checking
- Delaying
- Blocking.

More detailed description is in the Guide.

3.3. Events modelling –scenario concept

The transient's phenomena are invoked by actions. The following table gives overview of possible scenario, automatics/logics and hotkey actions:

Code	Description	Name of	1st param.	2nd param.	Hotkeys
'AUTO' 'STAB' 'LOGC'	**Automaton** activation (I=1)/ blocking (I=0) **Stabiliser** activation (I=1)/ blocking (I=0) **Logic** activation (I=1)/ blocking (I=0)	**Automaton** **Stabiliser** **Logic**	I I I		
'BRAN'	switching ON/OFF (I=0/1), switching off in from/to node (-4/4)	**Branch**	I		**F1**
'F_LO'	Switching off one /two phases (I=1/2)	**Branch**	I		
'TRAN'	change of transformer ratio	**Branch**	abs{dPt}[pu]		**F2**
'STRC'	change of turbine control mode	**Unit**	I		**F8**
'EXCT'	change of excitation control set value	**Unit**	dU/dQ[pu]		**F6**
'TURB'	change of prime mover control set value	**Unit**	dN/dW[pu]		**F7**
'LOAD'	step change of load dPload and dQload	**Node**	dPload[%]*	dQload	**F4**
'UNIT'	**Unit** ON (I=1) OFF (I=0)	**Unit**	I		**F5**
'LFCS'	change the **area** LFC set-up value	**Area**	Plan[MW]		
'LFCB'	secondary P/f control OFF(I=0) ON(I=1)	**Unit**	I		
'PUMP'	switching to pumping mode I=1 (for hydro turbine)	**Unit**	I		
'VALV'	activation (I=1)/ blocking (I=0) of fast valving	**Unit**	I		
'FREQ'	change of frequency set value df for prime mover control	**Unit**	df [pu]		
'SYNC'	synchronisation	**Unit**	1		
'ANAL'	carry out of network analysis	**Area**			
'FOUL'	short circuit located in Loc from beginning (from node)	**Branch**	Loc[%]	Xshunt[Ω]	
'FSLG,FDLG F_LL'	Single-line ground, double line –ground , line to line short circuit located in Loc from beginning	**Branch**	Loc[%]	Xshunt[Ω]	
'CLER'	short circuit clearing: I=3; SC+3phases I=0 beginning (from node) I= -2; end (to node) I= 2	**Branch**	I		
'EXCH'	additional harmonic signal into excitation control	**Unit**	amplitude[pu]	ω[rad/s]	
'TURH'	additional harmonic signal into prime mover control	**Unit**	amplitude[pu]	ω[rad/s]	
'EXCS'	additional step signal into excitation control	**Unit**	step[pu]		
'TURS'	additional step signal into prime mover control	**Unit**	step[pu]		
'MARK'	mark the number on the i^{th} trajectory in graphic	'i'	number [1-9]		
'FICT'	set the logical state on value I	**Automaton**	I [1/0]		
'RAMP'	ramp change of load dS rate	**Node**	dS [%]	rate[%/min] *	
'ISLN'	switch to the island control mode I=1	**Unit**	I		
'PAR#'**	change the model parameters	**Unit**	i ***		
'OLTC'	Change the OLTC reference voltage	**Cont.Node**	dU		

* percentile increasing from the initial value

** # is sequential number of section in the parameter catalogue

*** is sequential number of parameter set ,1 is for the 1st set in the global catalogue („default" parameters) following the sets from local catalogue and then rest of the global catalogue

4. Simulation examples

This part describes prepared projects, which present the possibility of the MODES.

4.1. Short term dynamics

Project SHORT deals with short-term dynamics (several seconds) of power system disturbed by short circuits. There are several pattern cases:

- SHORTCIR shows basic concepts of the MODES - graphics and scenario
- TAND_AUT presents a controlling object called automaton
- AUTOLOG presents another controlling object called logic

.

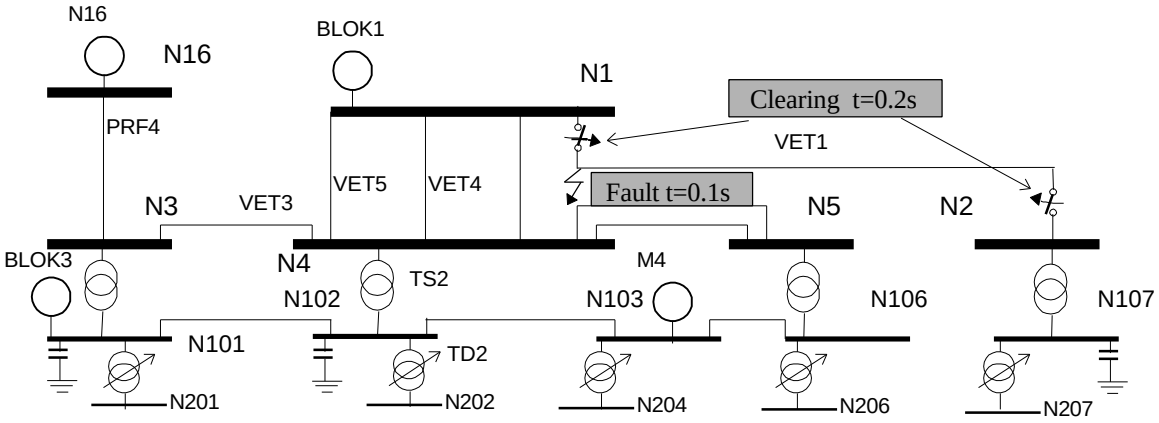

Fig. 10 Scheme of a fault and clearing application by scenario

The following figure shows the time courses of selected variables in predefined spreadsheet.

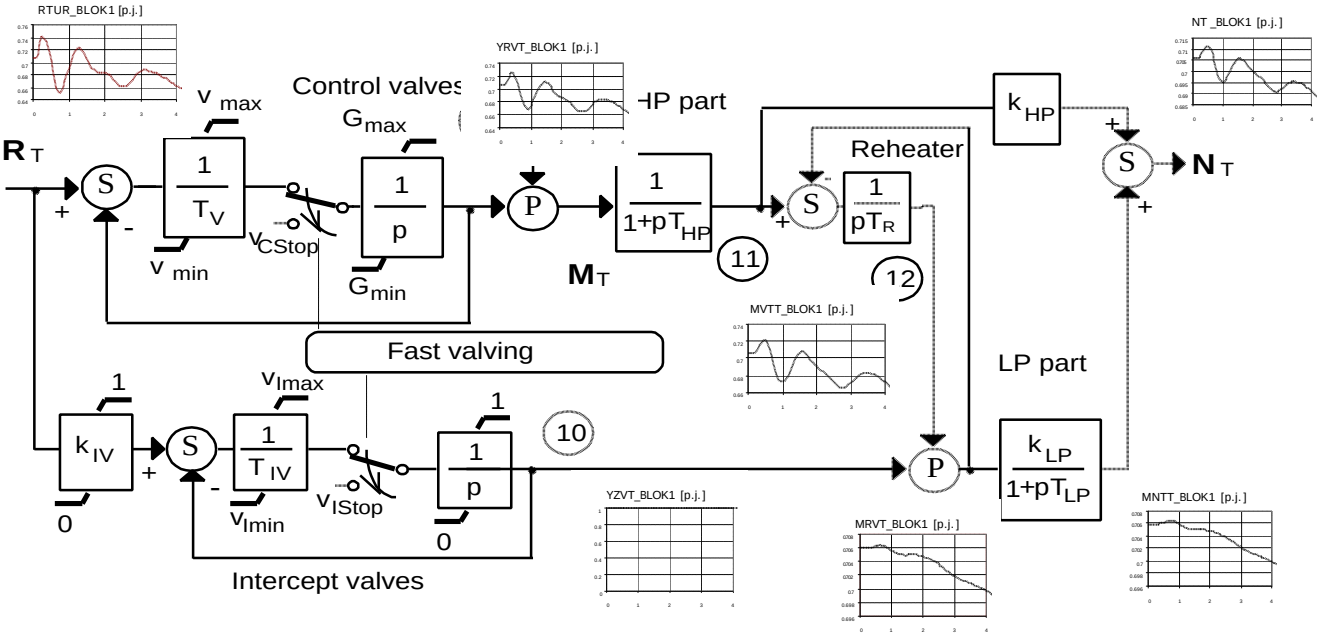

Fig. 11 Time courses of turbine variables during a near short circuit

4.1.1. Dynamic (transient) stability - protection modelling by automaton

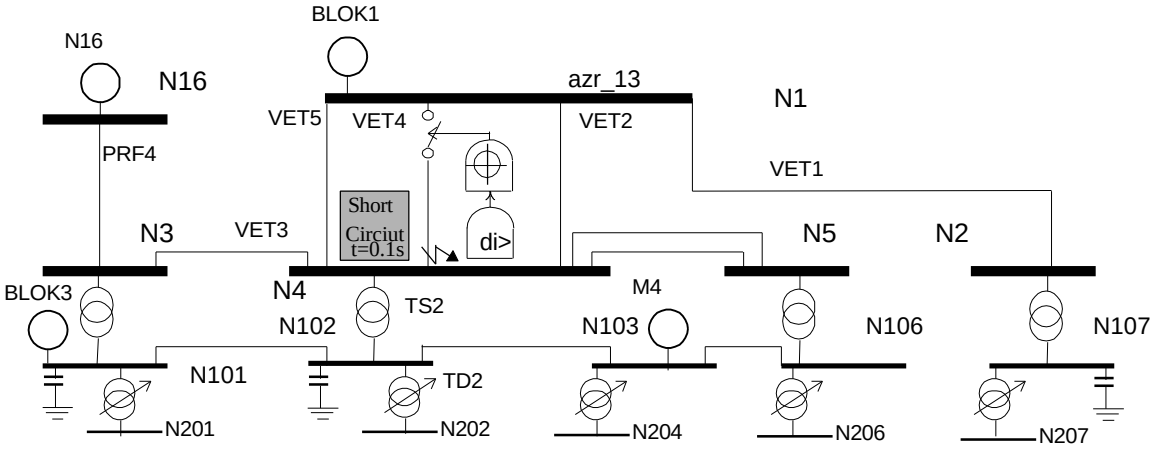

Fig. 12 Scheme of fault application by scenario and clearing by automaton

4.1.2. Dynamic (transient) stability - protection modelling by automaton and logic

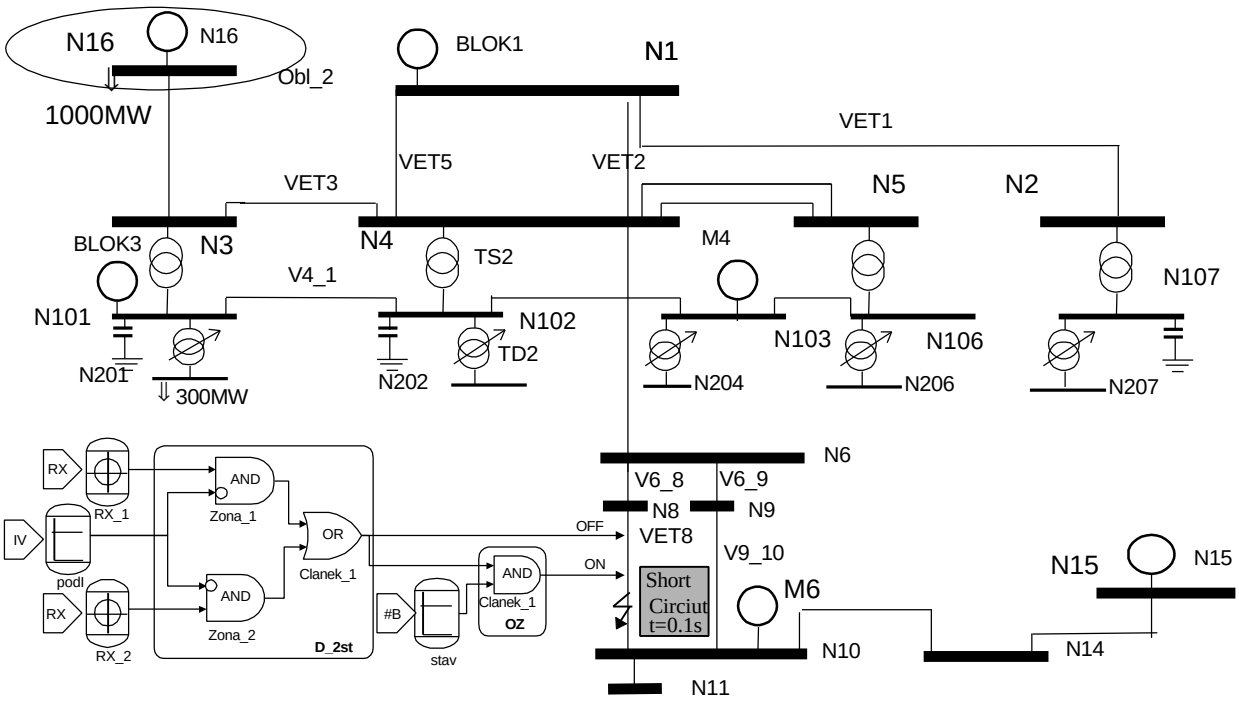

Fig. 13 Scheme of fault and clearing application by scenario

4.2. Mid term dynamics

Project MIDDLE deals with mid term dynamics (tens seconds) of power system disturbed by a unit outage. There are several pattern cases:

- UNIT_OUT shows primary frequency control after a unit outage in the interconnected power system
- LOADSHED presents load frequency shedding operation

4.2.1. Mid-term stability -primary frequency control

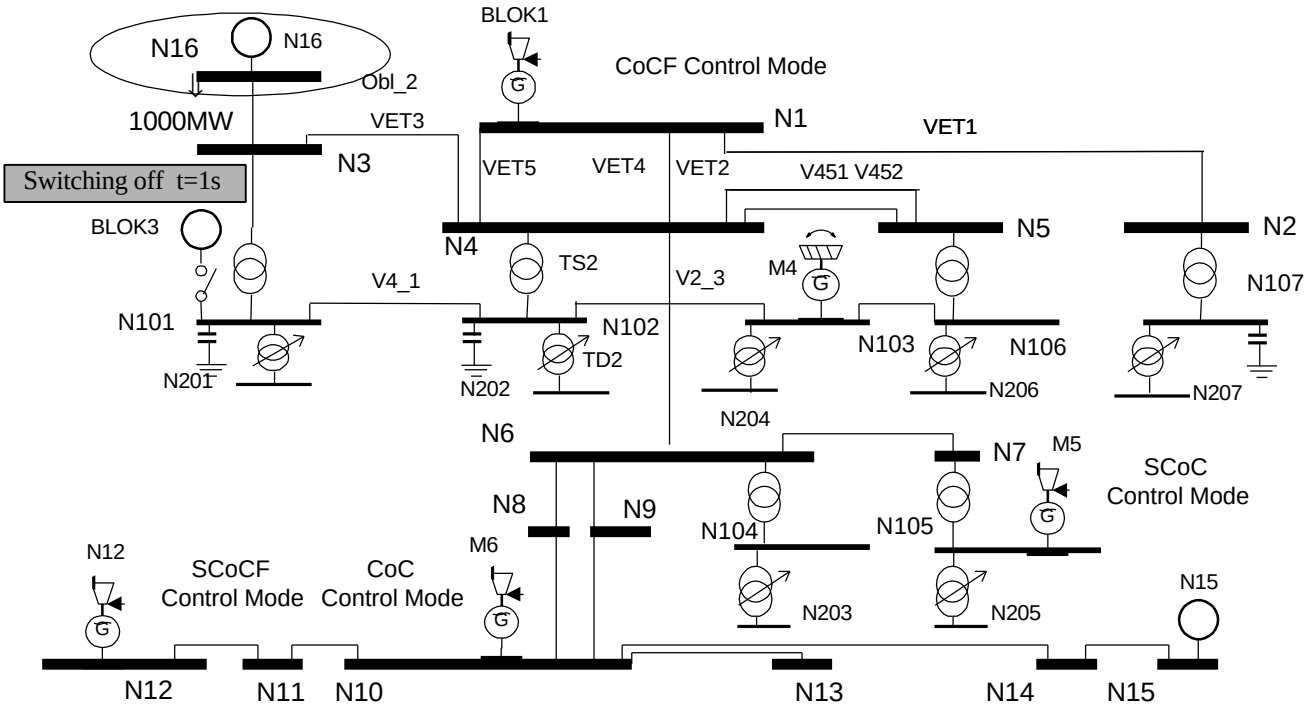

Fig. 14 Scheme of unit outage modelling by scenario and primary frequency control allocation

4.2.2. Mid-term stability -frequency load shedding

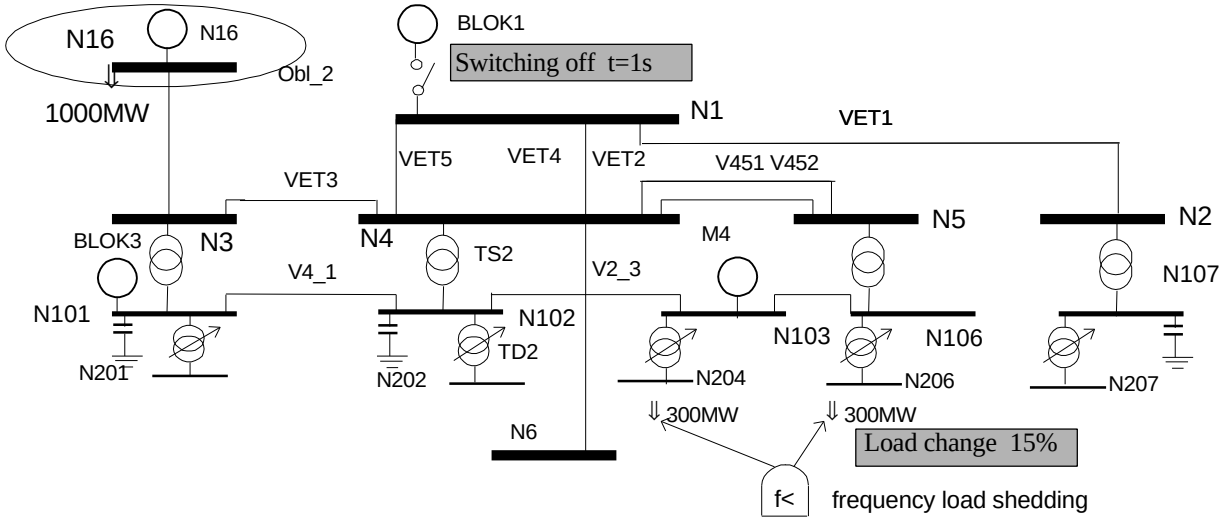

Fig. 15 Scheme of unit outage modelling by scenario and frequency load frequency allocation

4.3. Long term dynamics

Project LONG deals with long term dynamics (several - tens of minutes) of power system disturbed by outages or load changes. There are several pattern cases:

- ACTIV_LFC shows load frequency control after a unit outage in the interconnected power system
- VOLT_COL presents voltage collapse
- OLTC_SET shows OLTC reference value - prevention of voltage collapse

4.3.1. Long-term stability -load frequency control

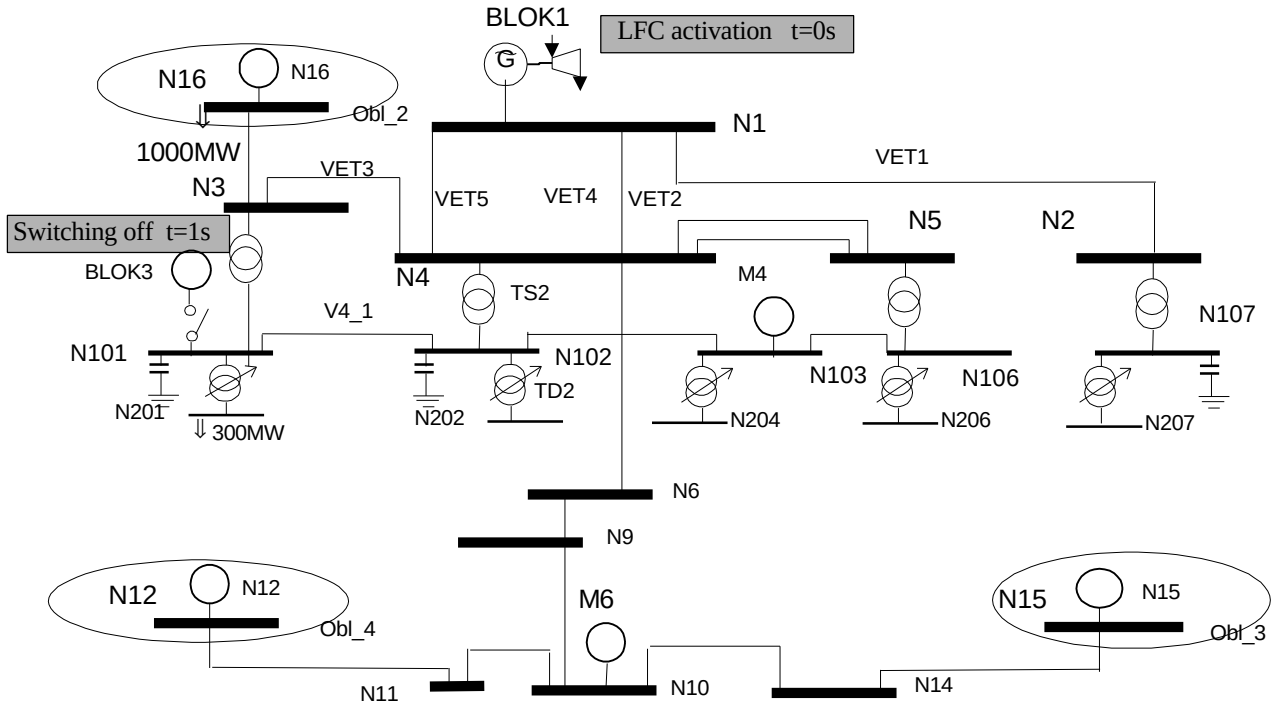

Fig. 16 Scheme of unit outage modelling by scenario and load frequency control activation

4.3.2. Long-term stability -voltage collapse

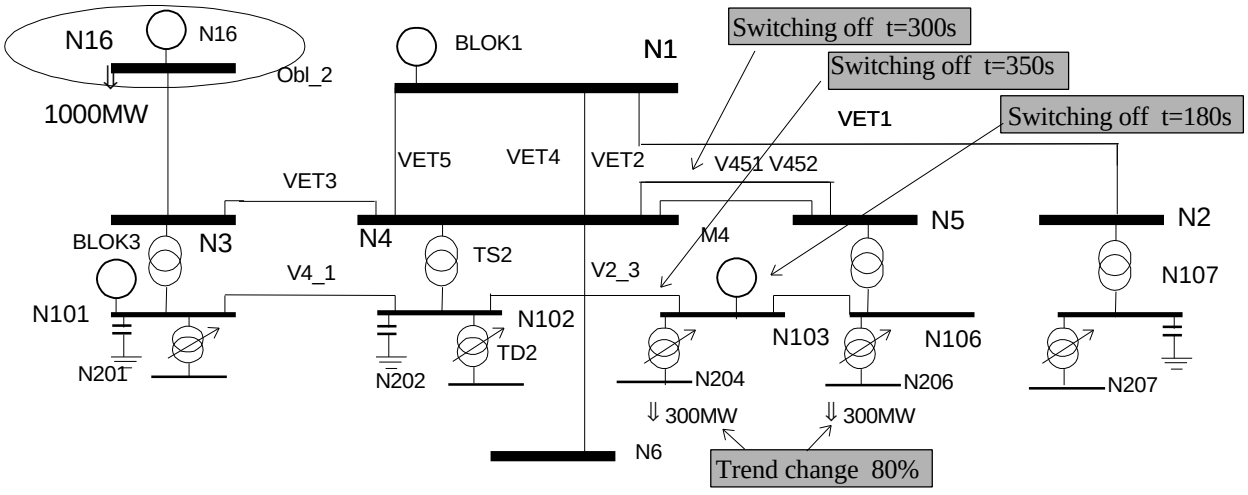

Fig. 17 Scheme of voltage collapse invoked by OLTC actions, unit and line outages

4.4. Island operation

Project ISLAND deals with dynamics of isolated part of power system so called island as opposite regime of interconnected operation.. There are several pattern cases:

- ISLAND shows frequency collapse due to reserve active power insufficiency
- SYNCHRON presents an island re -synchronisation

4.4.1. Island operation -frequency collapse

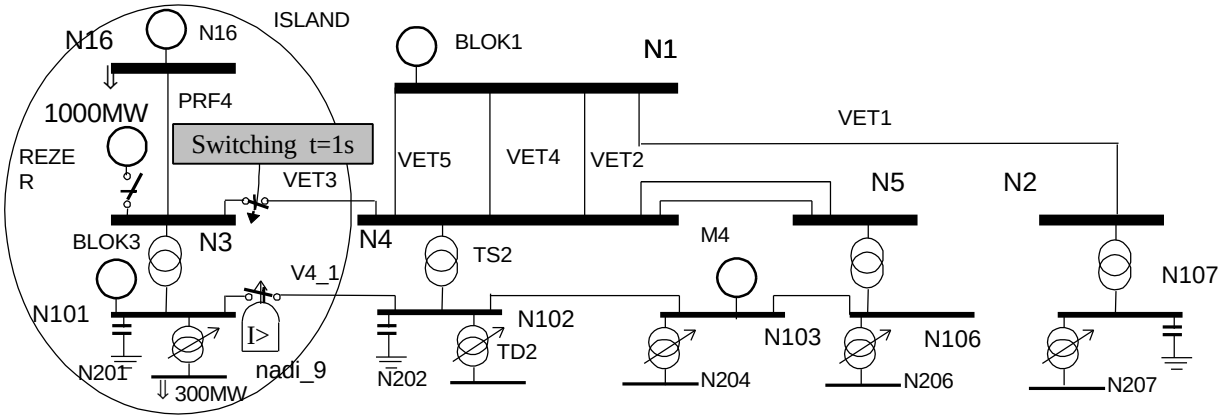

Fig. 18 Scheme of an island operation

4.4.2. Island operation - re synchronisation

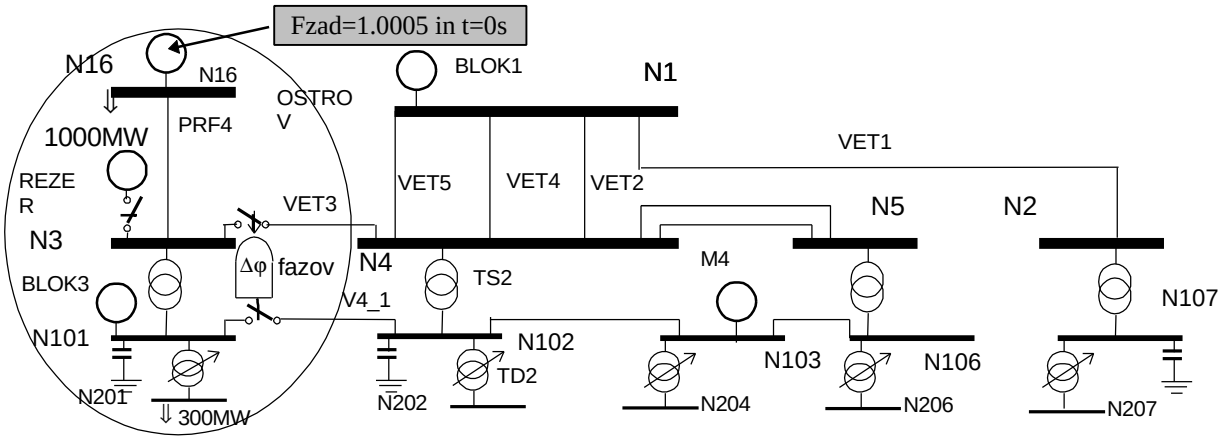

Fig. 19 Scheme of an island re-synchronisation

5. Basic information

The input and output files for the MODES are stored in project subdirectories[1] of the working directory[2]. The files contain data for solved problems, which are identified as **projects**. These **projects** are shown like tree in the left side of user interface MODMAN. The partial problems called **cases** are solved in the frame of projects. The **case** corresponds of a set of input files, which has identity (name and description). The **cases** may be accessed and recalculated.. The **project** is a set of **cases** with common basic model databases and parameters catalogues.

Basic interaction with the MODES is provided by so called **graphic**. The appearance of graphic may be set by menu „**Modify/Graphic**“. Time courses of the selected variables may be stored in so called **user output files** for post processing. The contents of the **user output files** is set by menu „**Modify/ User Files**“.

The network data (or load flow) is the base for dynamic calculation. They are created by **nodes** connected by **branches.** So-called **units** corresponding to the synchronous and asynchronous machines are connected to the **nodes.** The network data managed by Load Flow Editor (accessed by menu „**Modify/Units**“ or by toolbar).

The dynamic calculation is a response of dynamic model to the different events, which is modelled system subjected. The MODES software contains library of models for:

- **units** defined in model **database** (accessed by Unit Model Editor by menu „**Modify**/**Unit Models**“ or by toolbar)
- **nodes** loads defined in model **database** accessed by menu „**Modify**/**Nodes Models**“
- on load tape changers defined in model **database** accessed by menu „**Modify**/**Network Models**“

So called **database** is input file with records linking objects (**units. nodes** and **branches**), library models and parameters from so called **catalogues**. The **catalogues** store the sets of parameters for dynamic models of:

- generators
- exciters
- excitation control
- additional excitation equipment -PSS, under/over excitation limiters and secondary Q controller
- turbines
- prime mover control
- additional turbine equipment like speed controller, acceleration relays, by passes and so on
- boilers and PWR reactors
- asynchronous motors
- drived mechanism
- static load
- frequency load shedding
- on load tape changers
- dynamic load
- equivalent (aggregated) asynchronous motor.

So called **additional stabilisers** may be connected to the unit. The data for **additional stabilisers** are accessed by menu „**Modify**/ **Stabilisers**“. The **additional stabilisers** measure the selected unit or network variable and their output signal is added to excitation of prime mover control of selected **unit**. The each so called **area** may have load frequency control defined by menu „**Modify**/**LFC**“. The **area** is a set of **nodes**, which have the same area number.

Above all the user can defined so called **automaton** and **logic**. The **automaton** measures the selected variable and performs predefined **action** when defined conditions are satisfied. List of possible **actions** is on the page 10. The logic consists of logical AND and OR elements, which measure logical state of selected **automaton** (from this point of view is logic **superstructure** of **automatons**) and performs the similar actions like **automaton**. The tables of **automatons** and **logics** are accessed by menu „**Modify**/**Automaton**" and „**Modify**/**Logics**.

The predefined sequence of **actions** is called **scenario**. The scenario may be created and modified by menu „**Modify/Scenario**“.

5.1.1. Program operation

Package installation

See the CD cover to install the MODES package. Real numbers must be written with decimal point-dot (NO COMMA!) in the input files (or forms and tables). The dot should be set as decimal symbol for editing the

[1] Is directory with the same name like project containing two subdirectories VST (with input data files) and VYST (with output files)
[2] Is directory selected during installation, it contains subdirectories with input data and executable files

input files from the MODMAN in the WINDOWS environment. It may be checked from start-up menu by Settings/Control Panels/Regional Settings/Numbers Decimal Symbol.

Run the MODES package

Click on the blue MODES icon in working directory (in explorer or file manager) or workplace to run the user interface MODMAN. You can see the tree of projects on the left. Click double on the projects icon to see embedded cases.. Information about project or case is actualised in the frame **Project Specification** or **Case Specification** when you browse Projects tree. Click on the case icon to see set of input files (saved in the project directory) in the **Case Files** box. Click on the file icon[1] to see the content in the right text box. Use menu „**Modify**" to modify these files.

Open the project:

- Click on the project name 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**)**.

Open case:

- Click on the case name in the **Projects Cases** tree..
- Click  icon se on toolbar or use menu **Cases/Open** - case icon is getting pink and the MODES is ready recalculate selected case.

Run dynamic simulation

If you have ready project (after load flow calculation and models initialisation) you can click on  or use menu **Run/Simulation**.

So called **graphic** is loaded after input data reading. Graphic shows:

- 1, 2 or 4 charts with up to seven time courses of selected per unit variables in the each chart.
- text box with current simulation time and named variables
- text box with variable identification -symbol, unit, object name and colour
- 9 hotkeys with pictograms for „on-line" actions (see the table on the following page)
- two labels in upper part - the right is overridden by program logging.

The box **E**nd is showed when the final time of the calculation is reached. Press the key E to remove graphic and return to the MODMAN. You can interrupt dynamic simulation by Esc key and continue by C key pressing.

The number of charts and variable selection is set by menu „**Modify/Graphic**".

The parameters for load flow and dynamic calculation (simulation time, sampling period, integration step range and so on) are set by menu „**Modify/Control".**

Load Flow calculation

If you want recalculate the initial load flow you can click on  icon or use menu „**Run/Load Flow"**. The load flow uses only nodes and branches data and rewrites the input file with node data.

„On line" action:

Some action is possible to carry out during the simulation by hotkeys **F1** - **F9**..

- Press the selected hotkey F.
- Write the unit, node or branch name to the text box and blanks so that the first character of the name would on quit left.
- Use the key →←(with Num Lock offf) to move between box
- Use the space key to change state ON/OF (Zap/Vyp)
- Set the parameters according the table on the next page.
- Press the Enter to continue calculation.

[1] four types of input files are recognised by icons - load flow files, tables, databases and forms

Graphic set-up:

- Choose the menu „**Modify/Graphics“** to open Graphic.
- Write 1/2/4 to the text box **Number of Graphs** and the range for **Y Axis** for the each chart
- Check the **Complex Plane** for complex mode
- Press the button **Add Variables** to open dialogue for adding another variable
- Select the object from **Object** list and the variable type in the frame **Object Type**
- Select the variable from the **Variable Description** list (or click on the button in block scheme)
- Press the **Add** button to join the variable to the list of the variables (up to 7 is possible) and **Escape.**
- Write the text to the **Label** box.
- Check the **Step Changes** box to see step changes during network commutations
- Press the **OK** to rewrite the original input file (option No) or create new input file variation (option No).

You can use menu „**Cases/Save As**“ to creation of new case if you have variations.

User Output Files Set-up

The MODES stores the time courses of selected units and network variables into ASCII files (located in VYST subdirectory). These files can serve for post-processing by external spreadsheets or by MODMAN tool..

- Select the **User File** from menu **Modify** to open the dialogue
- Press the **Add User File** button, select the file type eg. **Variables from Display (**then the file content corresponds to the variables in the cart in the graphics).
- Check the **Use the Generic Name** to force files names specified in the **Generic Name** text box. If it is empty the MODES uses name of the case. Uncheck the **Use the Generic Name** to specify own file name with path.
- Press the **Add** button to update files list (up to 12 files) and **Escape** button.
- Close the dialogue by OK or Cancel.

View of the User Output Files:

The MODMEN makes possible to see output files in text (standard option) and graphical mode (checked **Results/As Graph** when the calculation is finished.

- Choose the menu **Results** and select the user file type (the MODMAN shows available files if you use generic names)
- Select the file by **Select** button in **File Selector** dialogue.
- The chart is showed in graphical mode (checked **As Graph**). Press the **Copy to the Clipboard** button to copy the chart in the WMF format. Then it is possible to use paste or paste special to import chart to the documents.
- The text editor is used in text mode (unchecked **As Graph)**. Standard text editor is NOTEPAD and user can replace it be own selection by menu **Option.**

Reports

The MODES writes the messages into report. This reports is accessed by menu **Reports:**

- **Initialisation -** information about input data reading.
- **Events -** information about events and action during simulation
- **Step** -information about integration step changing and CPU time.
- **Init.Conditions** -dynamic model initialisation and initial condition calculation
- **Motor Conditions** - initialisation of asynchronous motors model .
- **Check** reports about exceeding of limits for network variables (predefined by menu the menu „**Modify/Check“)**

Exceeding of limits are signalised by pictograms in the graphic.:

Analysis

The MODES provides the analysis:

- The network state (initial, final and difference between them)
- The primary frequency control
- The secondary P/f control (load frequency control).

The requirements on the analysis should be set before simulation by the menu „**Modify/Analysis“**. After the simulation are results available by the menu „**Analysis“.**

6. Future developing

The next version of MODES software implements the following improvements:

- the network (load flow) data in PTI format (for PSS/E program) would be accessed directly (without transformation to the load flow data in MODES format)
- the external regulator will be available
- the MODMAN would provide an automatic creation of documents with results of the MODES calculations.

Appendix 1. Projects samples overview

The following ready projects are copied during the package installation:

- SHORT - short term dynamics after short circuit in the network
- MIDDLE - mid term dynamics solving the frequency stability after unit outages till 30 second
- LONG - long term dynamics solving the frequency and voltage after unit outages till 30 minutes
- MOTOR - motors start -up and back-up in home consumption
- ISLAND - island operation and its re-synchronisation
- DIESEL - back-up sources modelling
- NESYMETR – unsymmetrical faults

SHORT - Short term dynamics

This project contains the following cases:

🗀 UST_STAV initial steady state without any action
🗀 ZKRAT_3F three phase short circuit cleared by scenario
🗀 CCT_15 critical clearing time calculation
🗀 CCT_5 critical clearing time calculation with automatic stability check
🗀 ZKRATAUT three phase short circuit cleared by automaton
🗀 KOMPLEX the appearance impedance is showed in the complex together with automaton characteristic**.**

The network scheme with the short circuit is as follows:

MIDDLE - Mid term dynamics

This project contains the following cases:

🗀 ZAKLADNI basic case of unit outages shows the primary frequency control operation
🗀 MODIFN12 change the primary reserve on unit N12
🗀 FREKVODL frequency load shedding after unit outage.

ISLAND - Island operation

This project contains the following cases:

🗀 ISLAND transit to the island (see the following scheme) in primary control mode
🗀 PRIMREG like ISLAND but the steam turbine on unit BLOKU3 are replaced by hydro one
🗀 OTACREG transit to the island in speed control mode
🗀 OSTRREG transit to the island in island control mode
🗀 OTACREGP transit to the island in speed control mode with power surplus
🗀 OSTRREGP transit to the island in island control mode with power surplus
🗀 STARTREZ fast unit start-ups
🗀 SYNCHRON re-synchronisation of the island by synchrocheck

DIESEL-Island operation with the diesel-generator

This project contains the following cases:

🗀 USTSTAV initial steady state of network feeded by diesel-generator
🗀 ZKRATKOM short circuit on diesel-generator terminal
🗀 SKOKQZAT step change of reactive load
🗀 STEPTEST step change of active load
🗀 ROZBEHAS asynchronous motor start-up from the diesel-generator
🗀 ROZBBRZD asynchronous motor start-up with the diesel-generator braking
🗀 ROZBZMEN asynchronous motor start-up with changing of the diesel-generator parameters.

Appendix 2. CURRICULUM VITAE

Karel MÁSLO, MSc., PhD.

Year of birth	1956
Nationality:	Czech
Education:	Received his Master's degree in 1980 from Czech Technical University in Praha, 1985 received Ph.D. degree.
Position:	Senior Engineer in the Power System Analysis Department.
Languages:	Russian, English
Expertise	Power System Modeling and Simulation

EXPERIENCE

1999 to date	CEPS, a.s. (Czech Transmission Company)	senior engineer responsible for studies of power system dynamic and system services analysis member of UNIPEDE subgroup Connection rules and management of ancillary services
1992 to 1999	CEZ a.s., Transmission Grid Div. (Czech Power Company)	dynamic stability expert responsible for the creation of dynamic models and dynamic calculation; member of ad hoc CALCAG Working Group for calculations of CENTREL member of Working Group for preparation the Defence Plan Against Spreading of System-wide Disturbances; member of CIGRE TF 38-02-08 Long Term Dynamic member of CIGRE JWG 39/11 Power System /Power Plant Interaction
1988 to 1992	Power Research Institute of Prague	research work in dynamic simulation co-operation in the field primary and load frequency control from point of view interconnection of the Czech Power Company to UCPTE, co-operation on the Study for the Connection of Czechoslovak Network to UCPTE Network
since 1985	the Czech Technical University	university teacher research work in electromagnetic and electromechanical transients area part time work in the Czechoslovak Control Center: power system reliability area

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