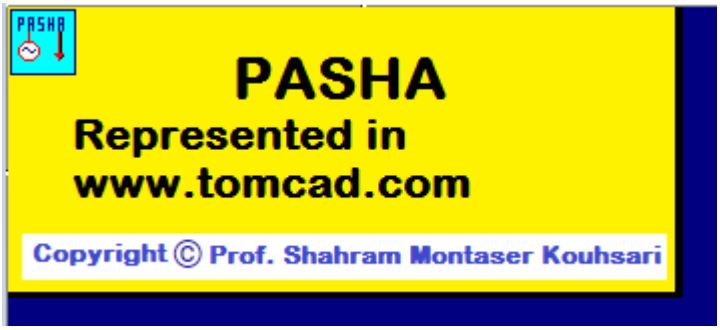

Chapters Summary

Power Apparatus & System Homological Analysis (PASHA) is a power system simulation package which performs serious engineering analysis. but it is also so interactive and graphical that it can be used to explain power system operations to non-technical audiences. It contains some very advanced, CO-ordinated algorithms for Load Flow, Optimal Power Flow, Short Circuit, Transient Stability and Frequency dynamics, equipped with, User Defined Equipment Modeling, Harmonic Analysis and filter design, Load Shedding, Motor starting, Relays checking and coordination, Circuit breaker checking, EMTP connection, Reliability evaluation, On line monitoring and control and makes extensive use of computer graphics to provide a flexible, highly interactive and user friendly procedure for system input, results output and program control functions. With Version 2000 we've made PASHA easier to use, yet even more powerful and more visual.

To provide an interactive working environment for the users PASHA uses menus, which are described in chapter two.

A particular system is entered to PASHA by drawing the network on the terminal screen. For all the components the corresponding data arrays are generated automatically (chapter 3). However, some of the symbols do not require to be drawn by the users and they will be shown on the single-line diagram whenever a data is entered for them. For example circuit breakers data when entered in the sending or receiving end of the circuits. To input the system parameters the user selects the edit option from the main menu of PASHA or directly from single-line diagram and this enables him to access the appropriate data tables for all the groups of components in the network diagram.

Once the required data table is displayed the user selects with the mouse cursor the data item to be entered or modified, and inputs the corresponding value using the keyboard (chapter 4).

By selecting the save option from the main menu the user can store the network entered and the associated data on disc storage so that it may be retrieved later at any further PASHA session (chapter 5).

The data base facility in PASHA allows data of standard types of equipment to be stored centrally for access at any time. Network data can therefore, be entered either

explicitly or by referring to the standard data base types. All the data base entries are stored automatically at the end of each PASHA session (chapter 9).

Once a network is constructed or one is retrieved from the file, the user is enabled to do the calculation by selecting his desired section from the PASHA menu. The calculation sections are described through this manual in chapter 6 to chapter 20.

When one of the calculation options is selected further menus of local options are presented which permit more detailed steering of a particular section of PASHA. When a local menu is finished with, selection of the [RETURN] option passes control back to the previous menu in the hierarchy, the MAIN menu being the highest. This hierarchy of control is inherent in PASHA to make it easy to both operate and understand by presenting the user with only those options necessary to run the particular section that he is in.

Chapter 1 describes the installation and system requirement.

Chapter 2 gives an overview of running PASHA package. The menu concepts are described and some basic settings are discussed.

Chapter 3 describes the drawing process. Using the draw keys defined in the drawing section it is a simple matter to draw a network diagram. Upon entering the drawing section the program enters 'drawing mode' in which the cross hair cursor can be considered as an 'intelligent paintbrush'. The cursor can be moved over the screen to the desired position, and a defined key pressed to draw a symbol at that position. A full range of keys is defined to allow drawing of all the necessary power system plant symbols. After drawing substation and/or junctions and their associated plant, it is then possible to connect them using circuits containing in line plant such as transformers etc. At any time in the drawing process corrections or changes can be made by entering either 'deletion mode', or 'move mode'. In the first of these, it is possible to delete any previously drawn elements. The second enables previously drawn plant and connections etc. to be moved to a new position on the diagram.

Chapter 4 describes how you can enter data for the drawn networks. The edit section of PASHA is used to enter the numerical network parameters, and to enable the modification of these parameters. It can be accessed both through menu options and directly from graphic single-line diagram. The network data is divided into separate plant groups, which are then organized in multi-section tables, which are displayed by PASHA as sets of 'edit pages'. Entry of data on these edit pages is by selection of the required data 'field', followed by simply typing in the numerical data. Most of the current pages of data are described in this chapter while those related to the specific calculations are described in their respective chapters. The data pages related to database are described in chapter 9.

Chapter 5 describes the method of saving and retrieving networks. The filing section of PASHA provides a comprehensive method of storing networks and their associated data, at any stage in their development, for later retrieval. The system files are divided into sets of two a 'father-son' organization to keep a fresh copy of the previous state of the files in case of file corruption. Networks can be both filed and retrieved, and during the storage process any unwanted networks can be deleted. To protect networks from unauthorized deletion an

optional password can be entered. PASHA filing section is downward compatible from version released in 1992 and they are not dependent to the operating system too. This means that the user can read the previous versions filing without knowing that it is filed with the previous version and PASHA takes care of the operating system file structure.

Chapter 6 describes the load flow study in PASHA package. The load flow section of PASHA provides a fast and reliable algorithm to determine power flows, busbar voltages and angles. All of the study results can be easily displayed on the network diagram or listed in a tabular form to the terminal or sent to a line printer or plotting file for later printing or plotting. The load flow section also provides a powerful method of interactively creating temporary outages for contingency analysis and load changes, which can be carried through to fault level studies. Multi slacks with different angles can be introduced and the initial condition for many studies like transient stability, motor starting, frequency dynamics, out of phase switching, etc. are prepared.

Chapter 7 is for fault studies. The fault level section of PASHA enables the user to calculate the fault level currents for a full range of fault types at each busbar or at any point along a branch in the system at user selectable times. The fault impedance and reactance can be changed at will. The fault current flows can be displayed to show the current contribution of each branch in the system. It is also possible to do a time simulation of a fault at a particular busbar, and plot the current waveforms. Symmetrical and asymmetrical busbar and branch faults will also be calculated, and all the branch flows will be reported on single-line diagram or in the list files.

Chapter 8 is for transient stability and dynamic frequency studies. The transient stability section provides a very powerful and fast method to simulate the dynamic response of the power system to many different types of switching operations. It is possible to simulate short circuits in all the plant, the clearing of these faults, induction motor starts etc. Full checks are made on the system data before the step simulation commences. A comprehensive analysis/display section is provided to display the results in a tabular or graphical form. In chapter 11 another powerful facility in PASHA i.e. Protective device performance simulation is described, This is a powerful facility especially when the dynamic performance of the relays are simulated in transient stability section.

Chapter 9 describes databases and their connection with the network edit pages. The data base section provides a very powerful method of creating a set of typical or specific plant parameters that can be easily included in new networks, without the necessity of entering specific parameters one by one. It is very flexible, and the links to the edit section of PASHA enable quick entry, and provide automatic scaling to the new system BASE. The use of passwords enable a large group of people to access the same database without corrupting each others entries.

Chapter 10 descries UDEM facility. The User Defined Equipment Modelling (UDEM) enables users to define their own models of power system plants in block diagram form which are called modules. These modules can be used to simulate the behavior of the models both in isolated condition and in the networks, which are constructed by PASHA where they are acting as a power system plant in the transient studies.

Chapter 11 is for protection relays. The implementation of protection coordination and analysis facilities within the PASHA package is described. These facilities include the simulation of phase and earth overcurrent, phase and earth distance, and unit protection schemes. The algorithms implemented provide a user friendly coordinated settings of the protective devices and for checking their performance both under steady state and transient conditions.

Chapter 12 is for reliability studies. The implementation of reliability evaluation facilities within the PASHA package is described. These facilities include the calculation of basic indices of reliability analysis. The algorithms implemented provide a user friendly calculation process for more elaborate reliability analysis of LOLE scenario. The analysis parameters enables the user to select the busbars or the areas he wishes to be considered 100% reliable in the calculation process. This is mostly needed for large-scale systems where the number of paths will be enormous otherwise.

Chapter 13 describes harmonic facility. The harmonic analysis section of PASHA provides a variety of reliable algorithms to perform a complete harmonic analysis of power system and determine harmonic distortions at all busbars, junctions and other power system elements. All of the study results can be easily displayed on the network diagram or listed in a tabular form to the terminal or sent to a line printer or plotting file for later printing or plotting. Harmonic analysis section also provides sensitivity calculations and possible resonance reports at all busbars. Bar charts are available for harmonic components of system voltages and currents directly through network single-line diagram. Graphical representation of frequency spectrum for all busbars in Cartesian and polar coordinates is another powerful feature of this section. Furthermore filter design of single tunes and high pass filters and filter cost optimization subsection incorporates state of the art nonlinear optimization techniques for providing the best suited filter to the power system. Harmonic voltage conversion procedure will help engineers to estimate the amount of harmonic currents injected by harmonic sources where there is not proper means of harmonic current measurements.

Chapter 14 describes Optimal Power Flow (OPF). OPF Starts from available system condition (off-line or on-line) and Optimal active and reactive power flow will be performed for the system. Up to fifth order generation cost/MW characteristics can be specified and both loss and cost optimization will be considered. (Supplied just for users bought this part of package).

Chapter 15 is for circuit breaker checking. The implementation of circuit breakers automatic checking facilities within the PASHA package is described. These facilities are branch from fault level analysis and include the calculation of actual fault currents, which goes through circuit breakers. The algorithms implemented provide a user friendly calculation process for an elaborate study calculations.

Chapter 16 is for fast transients studies using other available softwares which can be used in conjunction of PASHA package. (Supplied just for users bought this part of package).

Chapter 17 describes DC addition in PASHA package. (Beta version not supplied here).

Chapter 18 describes on line monitoring and control. By connecting PASHA to SCADA system the operators are assisted with a highly interactive and graphical tool which helps them in on line decision-making procedures. (Special version, not supplied here).
Chapter 19 is reserved for substation layout, which is currently under development.

Chapter 20 described the auxiliary software like for plotting comes with PASHA.