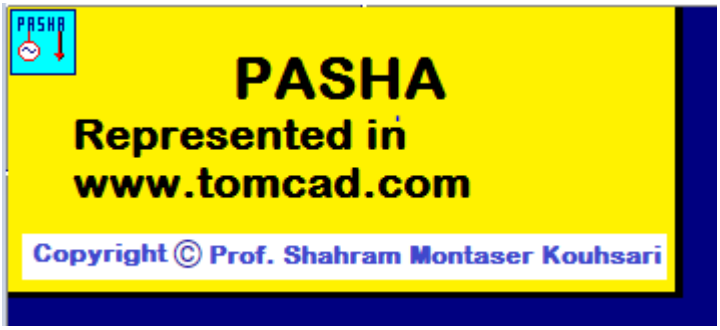


CHAPTER 15
CIRCUIT BREAKERS AUTOMATIC CHECKING

15.1 Introduction

The entire power system plant circuit breakers duties can be checked. This is achieved by using PASHA circuit breakers automatic checking. In order to check circuit breakers duties, those that are related to fault studies, you need to check the followings:

- Interrupting MVA (break duty) of circuit breaker should never be exceeded at the time that the circuit breaker contacts part. The time required for the circuit breaker contacts to be apart will vary over a considerable range, because of variation in relay time and in circuit breaker operating speed. The fewer cycles that required for the circuit breaker contacts to part, the greater would be the current to interrupt. Therefore, the maximum interrupting duty is imposed upon the circuit breaker when the tripping relays operate instantaneously. In all short circuit studies, for the purpose of determining interrupting duties, the relays are assumed to operate instantaneously.

- Momentary current (make duty) should never be exceeded at any operating voltage. Modern power circuit breakers generally have a momentary rating in rms amperes of 1.6 times the maximum interrupting rating in rms amperes. As a result, where there is no short circuit current contribution from motors, a check of interrupting duty (break duty} only is necessary. If this is within the circuit breaker interrupting rating then the maximum short circuit current, including the DC components will be within the momentary rating of the circuit breaker. But where there is short circuit contribution from motors, the momentary rating of the circuit breaker may be exceeded, before interrupting rating is exceeded in a given circuit. Whenever there are motors to be considered in the short circuit calculations, the momentary duty and the interrupting duty should both be checked. To check momentary duty the short circuit current must be determined at the first half cycle.

The fuses interrupting duty must also be checked. All fuses interrupting ratings are on the basis of maximum rms current that will flow in the first cycle after the short circuit occurs.
Besides it is common practice to consider the busbar short circuit current instead of what is actually flowing through the circuit breakers. Having these in mind and considering that the

three phase fault currents is not always the maximum short circuit current, you will find out that checking the circuit breaker duties in an actual plant is not always an easy job to do.

PASHA automatic circuit breaker checking will do the job of duty checking at a click of mouse. This is achieved because PASHA has a dynamic fault analysis as described in chapter 7 and it can also calculate asymmetric branch faults.

This part of manual describes the instructions for using automatic circuit breakers checking of PASHA package. It also refers to the representation of Molded Case Circuit Breaker (MCCB) and overload relays within PASHA package.

It is reported that one of our clients succeeded to check more than 2000 circuit breakers, fuses and MCCBs in a large industrial plant with a 133MHZ Pentium computer in 50 minutes using this facility of PASHA!

15.2 Overview of data organization in PASHA

To find out about the place of protection facilities in PASHA, an overview of what described in this manual is represented in this section.

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. To input the system parameters the user selects the edit option from the main PASHA and this enables him to access the appropriate data tables for all the groups of components in the network diagram. Circuit breakers can be entered in LINE DATA 6. Since it uses line data it is not required to draw them. When a particular circuit breaker entered in line data at sending or receiving end, the symbol of circuit breaker will be shown on single-line diagram automatically (please also see section 2.5.16 for NOR/DET).

Once the required data table is displayed the user selects with the graphic 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 (ch.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).

The circuit breaker data related to a particular system have been included with the network data in the form of new sections within the edit facility. PASHA will automatically generate the drawing symbols of the circuit breaker elements into the single-line diagram. Therefore, on the contrary to the other elements there is no need to draw these elements on single-line diagram.

The characteristics of the available circuit breaker devices, on the other hand, can be included in the data base facility and can be used in the editing.

15.1 Database

This section has been configured to provide input, editing and storage facilities for all the circuit breaker devices including MCCBs. Figure 9.1 in chapter 9 also reproduced here in figure 15.1 shows the data base menu, which displays additional options to enable, access to the circuit breaker data base page.


USE THE CURSOR TO SELECT ONE OF THE OPTIONS, OR TYPE 'H' FOR HELP
PRESENT DIRECTORY :
c:\pasha\forcabuw
SELECT TO CHANGE DATA BASE DIRECTORY
DATA BASE OPTIONS:
LINE DATA BASE
TRANSFORMER DATA BASE 1,2
GENERATOR DATA BASE 1,2
AVR DATA BASE 1,2
GOVERNOR AND TURBINE DATA BASE
INDUCTION MOTOR DATA BASE 1,2
PROTECTION DATA BASE -RELAYS 1,2,3,4,5
PROTECTION DATA BASE -FUSES 1,2,3,4
PROTECTION DATA BASE -DISTANCE RELAYS
CIRCUIT BREAKER DATA BASE
RELIBILITY DATA BASE
RETURN TO MAIN OPTIONS
COPYRIGHT (C) TOM InC 1988 TIME : 18:11:17 29/08/2001

Figure 15.1

15.3.1 Circuit breaker data base

The circuit breaker data base page is shown in figure 15.2.

TYPE : An integer number identifying each data base entry.

RAT-KV : Nominal rating KV.

RAT-KA : Nominal rating KA

BR-MVA(S) : Breaking capacity MVA Symmetrical.

BR-MVA(A) : Breaking capacity MVA Asymmetrical.

MA-KA(P) : Making capacity KA Peak.

BR-TIME : Breaking time in msec. If left blank the default of ANALYSIS PARAMETERS will be used.

LND-TYP : For MCCB enter the overload type (long delay). The type can be defined in fuse database.

SHD-TYP : For MCCB enter the short delay characteristic type as can be defined in O/C relay database.

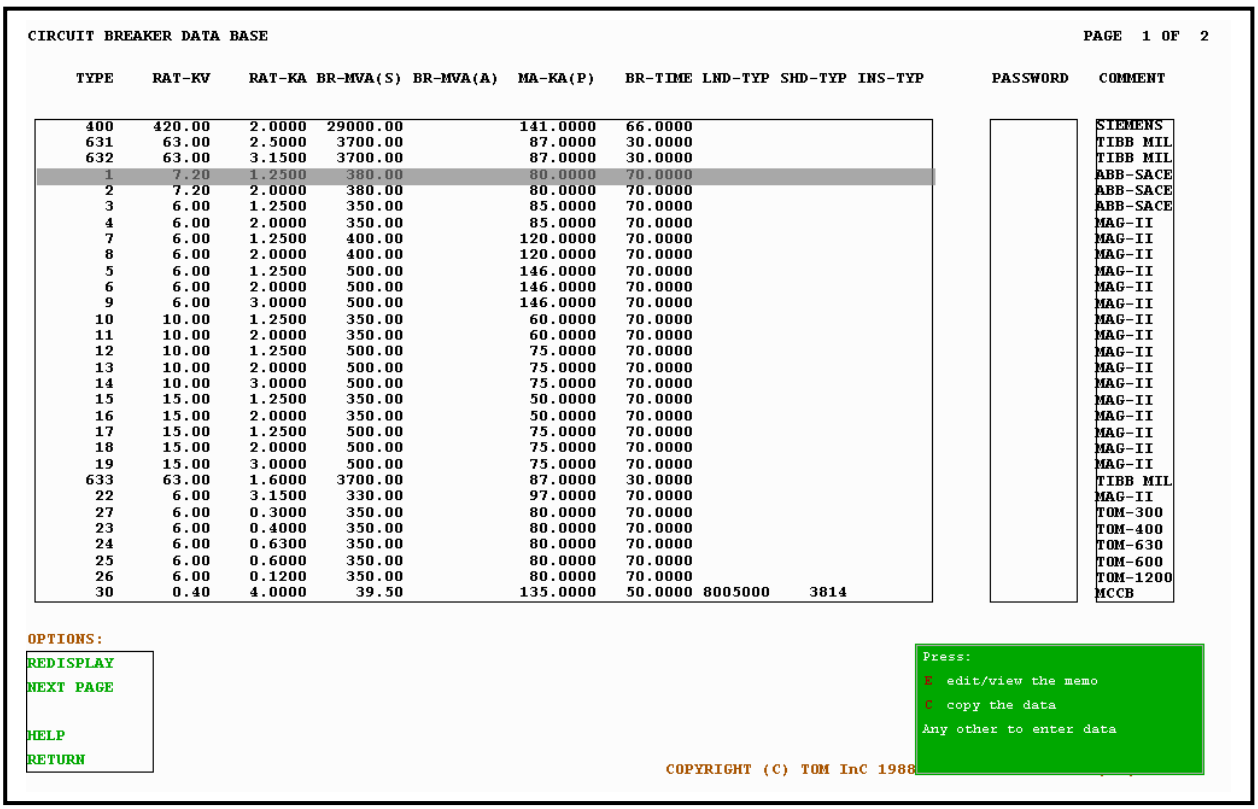
PASSWORD : Enter the correct password, but only when required.

COMMENT : Spare column for entry of an alphanumeric identifier.

NOTES:

1 The values are used in circuit breaker checking studies, transient stability and protection relays coordination

2 The nominal KA currents together with line MVA rating are used in load flow study for circuit overload indication



CIRCUIT BREAKER DATA BASE PAGE 1 OF 2

TYPE	RAT-KV	RAT-KA	BR-MVA(S)	BR-MVA(A)	MA-KA(P)	BR-TIME	LND-TYP	SHD-TYP	INS-TYP	PASSWORD	COMMENT
400	420.00	2.0000	29000.00		141.0000	66.0000					SIEMENS
631	63.00	2.5000	3700.00		87.0000	30.0000					TIBB MIL
632	63.00	3.1500	3700.00		87.0000	30.0000					TIBB MIL
1	7.20	1.2500	380.00		80.0000	70.0000					ABB-SACE
2	7.20	2.0000	380.00		80.0000	70.0000					ABB-SACE
3	6.00	1.2500	350.00		85.0000	70.0000					ABB-SACE
4	6.00	2.0000	350.00		85.0000	70.0000					MAG-II
7	6.00	1.2500	400.00		120.0000	70.0000					MAG-II
8	6.00	2.0000	400.00		120.0000	70.0000					MAG-II
5	6.00	1.2500	500.00		146.0000	70.0000					MAG-II
6	6.00	2.0000	500.00		146.0000	70.0000					MAG-II
9	6.00	3.0000	500.00		146.0000	70.0000					MAG-II
10	10.00	1.2500	350.00		60.0000	70.0000					MAG-II
11	10.00	2.0000	350.00		60.0000	70.0000					MAG-II
12	10.00	1.2500	500.00		75.0000	70.0000					MAG-II
13	10.00	2.0000	500.00		75.0000	70.0000					MAG-II
14	10.00	3.0000	500.00		75.0000	70.0000					MAG-II
15	15.00	1.2500	350.00		50.0000	70.0000					MAG-II
16	15.00	2.0000	350.00		50.0000	70.0000					MAG-II
17	15.00	1.2500	500.00		75.0000	70.0000					MAG-II
18	15.00	2.0000	500.00		75.0000	70.0000					MAG-II
19	15.00	3.0000	500.00		75.0000	70.0000					MAG-II
633	63.00	1.6000	3700.00		87.0000	30.0000					TIBB MIL
22	6.00	3.1500	330.00		97.0000	70.0000					MAG-II
27	6.00	0.3000	350.00		80.0000	70.0000					TOM-300
23	6.00	0.4000	350.00		80.0000	70.0000					TOM-400
24	6.00	0.6300	350.00		80.0000	70.0000					TOM-630
25	6.00	0.6000	350.00		80.0000	70.0000					TOM-600
26	6.00	0.1200	350.00		80.0000	70.0000					TOM-1200
30	0.40	4.0000	39.50		135.0000	50.0000	8005000	3814			MCCB

OPTIONS:

REDISPLAY
NEXT PAGE

HELP
RETURN

Press:
E edit/view the memo
C copy the data
Any other to enter data

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Figure 15.2

15.6 Edit : circuit breaker data

Figure 15.3 shows the layout for the main edit menu as shown in chapter 4. Circuit breakers and overload relays are included in line data 6. To choose this data page, the user must select the line data using the cursor and press 6 in the keyboard. Alternatively, he can locate the cursor over the line graphic symbol in the single-line diagram and press F6. The circuit breaker data page will be displayed and the selected line will be highlighted.

All the standard 'redisplay' facilities in PASHA as described in chapter 4 are included in these pages too.

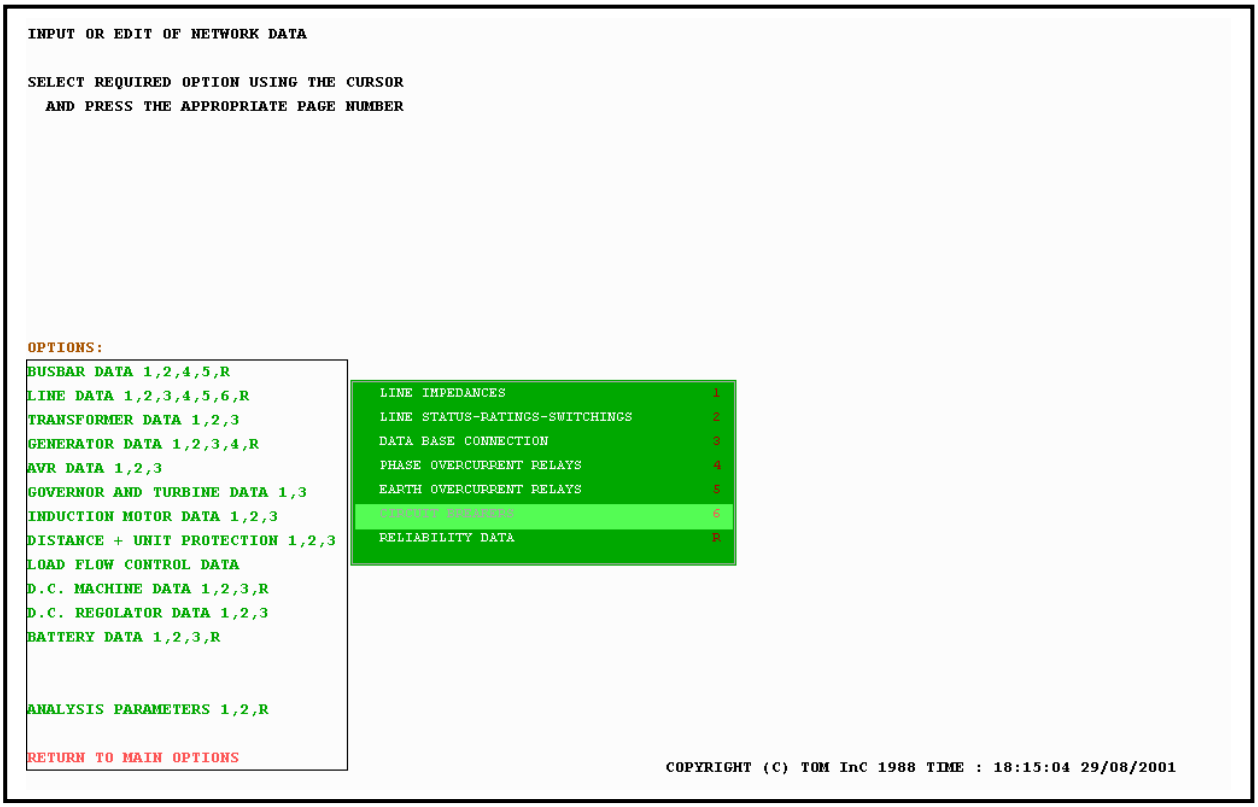

INPUT OR EDIT OF NETWORK DATA
SELECT REQUIRED OPTION USING THE CURSOR
AND PRESS THE APPROPRIATE PAGE NUMBER
OPTIONS:
BUSBAR DATA 1,2,4,5,R
LINE DATA 1,2,3,4,5,6,R
TRANSFORMER DATA 1,2,3
GENERATOR DATA 1,2,3,4,R
AVR DATA 1,2,3
GOVERNOR AND TURBINE DATA 1,3
INDUCTION MOTOR DATA 1,2,3
DISTANCE + UNIT PROTECTION 1,2,3
LOAD FLOW CONTROL DATA
D.C. MACHINE DATA 1,2,3,R
D.C. REGOLATOR DATA 1,2,3
BATTERY DATA 1,2,3,R
ANALYSIS PARAMETERS 1,2,R
RETURN TO MAIN OPTIONS
LINE IMPEDANCES 1
LINE STATUS-RATINGS-SWITCHINGS 2
DATA BASE CONNECTION 3
PHASE OVERCURRENT RELAYS 4
EARTH OVERCURRENT RELAYS 5
CIRCUIT BREAKERS 6
RELIABILITY DATA R
COPYRIGHT (C) TOM InC 1988 TIME : 18:15:04 29/08/2001

Figure 15.3

15.4.1 LINE DATA 6 - circuit breaker & overload relays

This data page enables the user to specify the circuit breakers located at the sending and receiving ends of each line. Figure 15.4 shows the layout of this page. It can be seen here that two identical tables are displayed for the sending and the receiving ends respectively, and each row contains the data related to a particular line, designated by corresponding, sending and receiving busbar names. The circuit breakers and overload relays data included on each table is defined as follows:

TYPE : The data base type number used to identify a Circuit Breaker device. An MCCB is specified with appropriate definition in database. Please see Circuit Breaker Data Base help information.

STATUS : Circuit breaker status, used to introduce any switching operations, particularly for transient stability studies. Please use line switching in the line data 2 page. Future version of PASHA will consider this operation too. At the present time just affect the On-Line Monitoring and Control.

Enter a zero (or leave blank), +1 or -1 to specify one of the following three switching modes:-

0 : normal circuit operation, no switching required.
+1 : circuit initially switched in to be disconnected at time SW-TIM1 and reconnected at time SW-TIM2.
-1 : circuit initially disconnected, to be switched in at time SW-TIM1 and disconnected again at time SW-TIM2

PL-S : Overload plug setting, in (%)

TM-S : Overload time setting.

Spares : are for future use

These quantities can be entered or modified by the user whenever the data page is displayed, using the input/edit facilities of PASHA. The current values will be stored together with the rest of the system data if the network is 'saved'. Therefore the information will be available for further work after the PASHA session is finished.

After entering an MCCB from database, the data page 6 contains an "M" in its "id" column. A relay type is also associated with. The CT-RAT is the ratting of MCCB. Any setting value not compatible with the ranges of quantities available for the corresponding data base type, will not be accepted and an error message is given immediately after entry. If the value is out of range, it will be adjusted to the corresponding limit. Any nonexistent plug setting will be adjusted to the next one available.

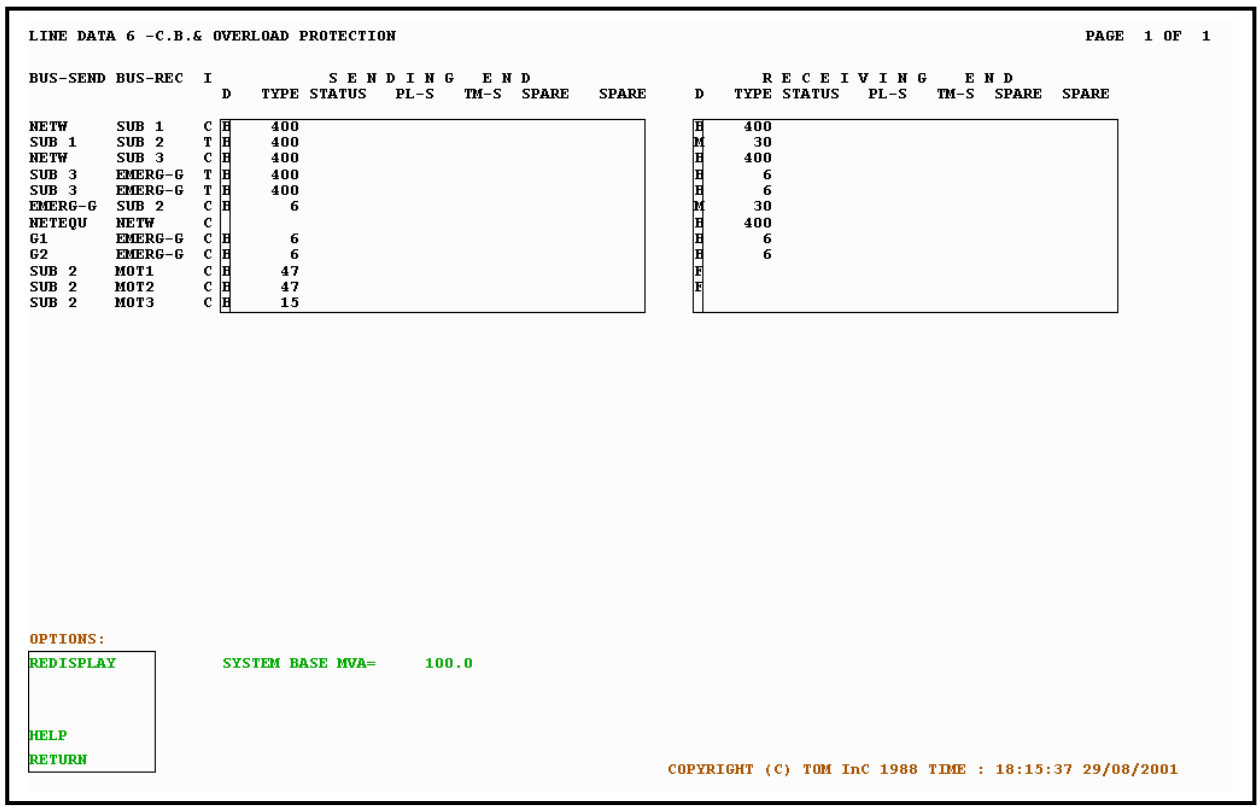

LINE DATA 6 -C.B.& OVERLOAD PROTECTION
PAGE 1 OF 1
BUS-SEND BUS-REC I
S E N D I N G E N D
D TYPE STATUS PL-S TM-S SPARE SPARE
R E C E I V I N G E N D
D TYPE STATUS PL-S TM-S SPARE SPARE
NETW SUB 1 C H 400 H 400
SUB 1 SUB 2 T H 400 M 30
NETW SUB 3 C H 400 H 400
SUB 3 EMERG-G T H 400 H 6
SUB 3 EMERG-G T H 400 H 6
EMERG-G SUB 2 C H 6 M 30
NETEQU NETW C H 400
G1 EMERG-G C H 6 H 6
G2 EMERG-G C H 6 H 6
SUB 2 MOT1 C H 47 E
SUB 2 MOT2 C H 47 E
SUB 2 MOT3 C H 15
OPTIONS:
REDISPLAY
SYSTEM BASE MVA= 100.0
HELP
RETURN
COPYRIGHT (C) TOM InC 1988 TIME : 18:15:37 29/08/2001

Figure 15.4

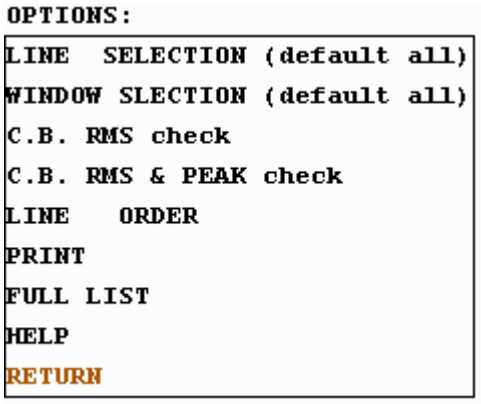
After entering data the single-line diagram shows the circuit breakers, fuses and MCCBs symbols. This is shown in figure 15.5.

15.5 Circuit breaker checking calculation facilities

Access to these facilities is gained by selecting the [C.B CHECK] option from the fault analysis menu as described in 7.3.6. This ensures that the network data are checked and prepared for fault calculations before checking the circuit breakers duties. The fault level section may be accessed either directly from PASHA main options, or passing through load flow. For the latter case the load currents are included in the fault calculations.

15.5.1 C.B checking menu

The layout of the circuit breaker checking menu is shown in figure 15.6 as well as in the following figure.



The two options [**C.B. RMS check**] and [**C.B. RMS & PEAK check**] are responsible to do the calculations and the other options either reroute the calculation to the user-desired direction or provide for him the ability to view or store the results. They are described in the following sections.

15.5.1.1 [LINE SELECTION (default all)]

This is used if you need to check circuit breakers located inside a particular line. When selected the computer draws the single-line diagram of the network and asks the user to select his desired line. The user specifies his desired line by clicking the mouse in any point inside the line. The name of the line selected will be written in front of this option.

The selection of this option cause that the circuit breakers located in both ends of the selected line will just be checked automatically, when the user selects calculation options. Otherwise the plant entire circuit breaker will be checked.

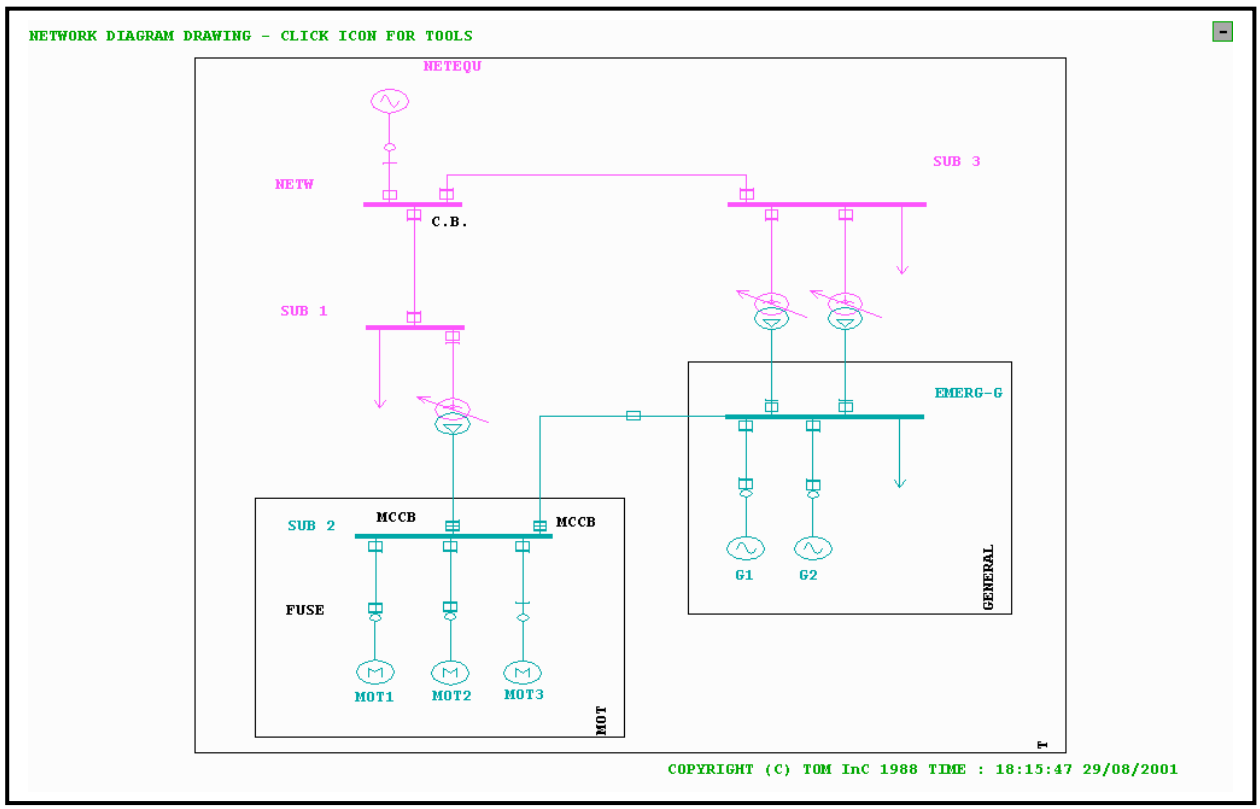


Figure 15.5

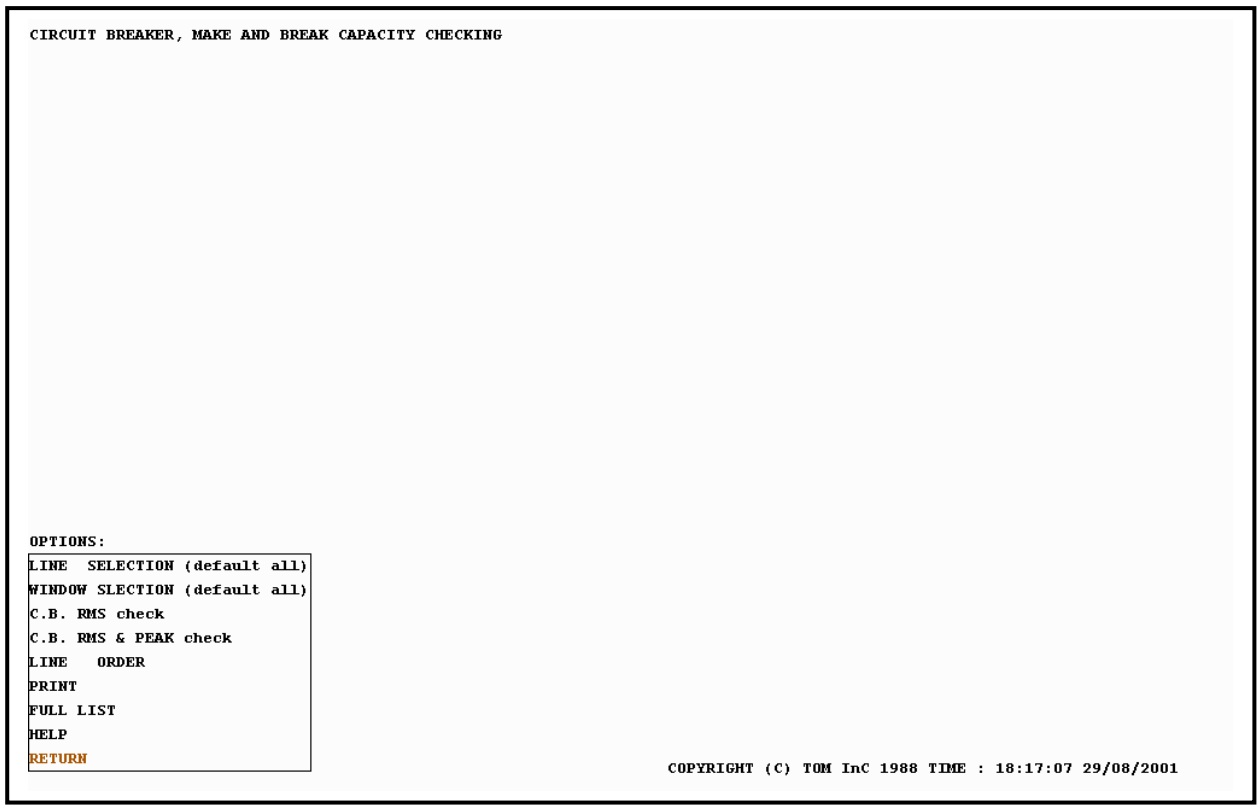


Figure 15.6

15.5.1.2 [WINDOW SELECTION (default all)]

When selected the computer draws the single-line diagram of the network and asks the user to select his desired window (area). The user specifies his desired area by clicking the mouse in any point inside the area. The name of the window selected will be written in front of this option. This is shown in figure 15.7.

The selection of this option cause that the circuit breakers located (including the far end lines ended) in the selected area will just be checked automatically, in response of the selection of any calculation options. Otherwise the plant entire circuit breaker will be checked.

15.5.1.3 C.B. RMS check

Upon selection of this option computer starts to check circuit breakers one by one against breaking duty. A symmetrical and asymmetrical LG, LL, LLG, LLL faults will be located at the line side (L/S) and in the busbar side (B/S) of each circuit breakers at the time of circuit breaker interruption specified in circuit breaker database. The maximum of the faults current goes through circuit breakers will be found. The results of the check made will be stored in a file and can be viewed using {FULL LIST] option, figure 15.9.

A counter will show the number of circuit breakers checked, figure 15.8. The calculations may be interrupted by pressing interrupt the key <O> or the key <X> stands for exit. The interruption would not be immediate in large-scale systems.

15.5.1.4 C.B. RMS & PEAK check

Upon selection of this option computer starts to check circuit breakers one by one against the breaking and making duties. A symmetrical and asymmetrical LG, LL, LLG, LLL faults will be located at the line side (L/S) and in the busbar side (B/S) of each circuit breakers at the time of circuit breaker interruption specified in circuit breaker database for breaking and at half a cycle for making. The maximum of the faults current goes through circuit breakers will be found. The results the check made will be stored in a file and can be viewed using {FULL LIST] option, figure 15.10.

A counter will show the number of circuit breakers checked. The calculations may be interrupted by pressing interrupt the key <O> or the key <X> stands for exit. The interruption would not be immediate in large-scale systems.

15.5.1.5 LINE ORDER/WINDOW ORDER

By default the circuit breakers are checked according to the order of the lines they are located at. The lines are ordered according to the order they have drawn. Selecting this option changes the order in which the checking calculations are performed.

By clicking on this option the option will be changed to WINDOW ORDER. While the option shows WINDOW ORDER, selecting the checking calculations as described in

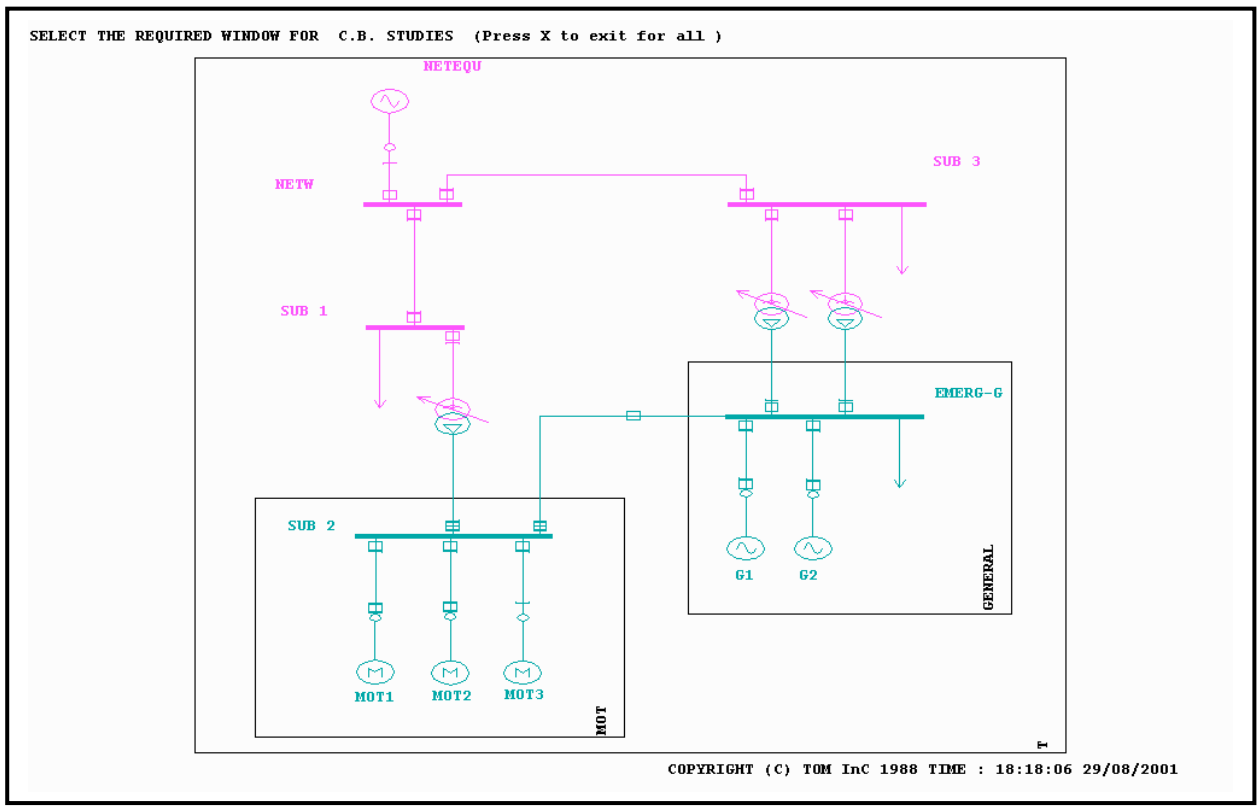


Figure 15.7

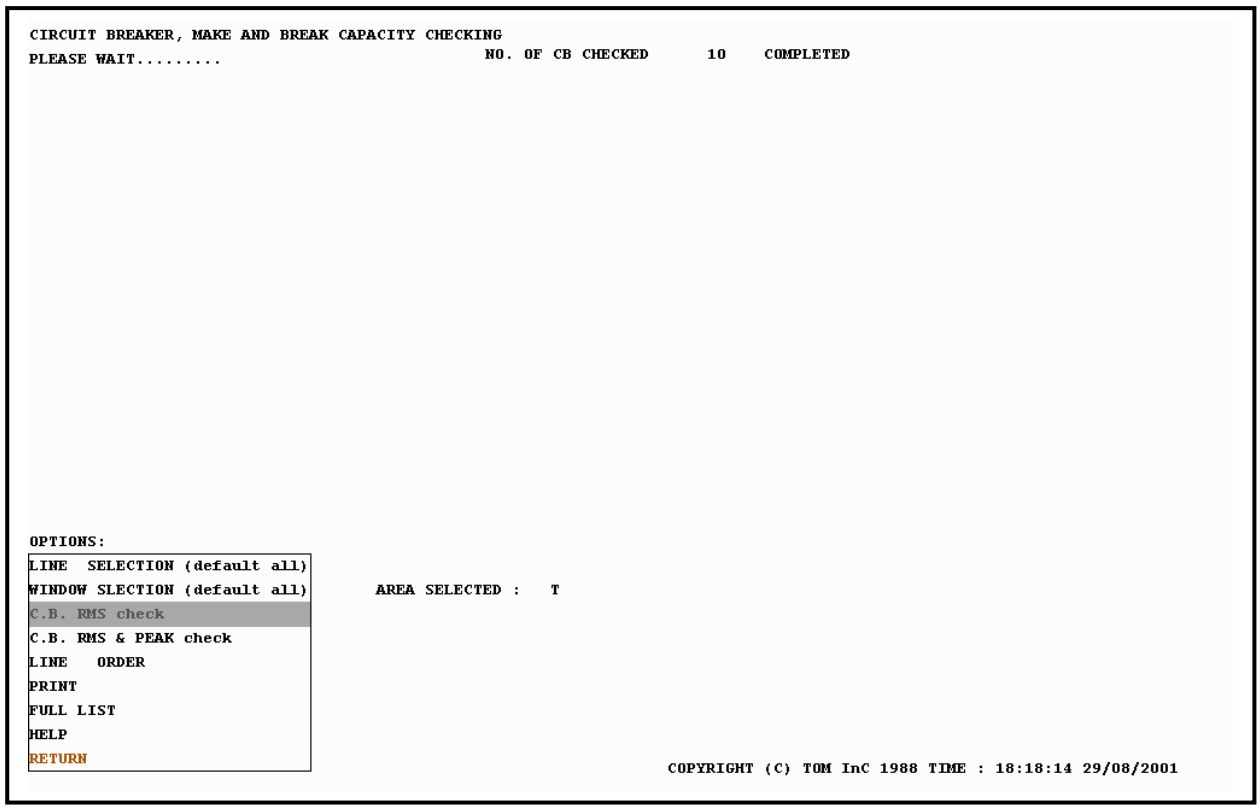


Figure 15.8

sections 15.5.1.3, and 15.5.1.4 will be proceed according to the order of the graphic areas that the circuit breakers are located. Otherwise the order of the lines that circuit breakers are located will be used.

15.5.1.6 [PRINT]

Sends the results of the last analysis to a line printer file (PRINTER.92). The listing contains what is described in the next section.

15.5.1.7 [FULL LIST]

Displays the results of the last calculation on the terminal. Figures 15.9 and 15.10 show examples of outputs obtained by selecting [**C.B. RMS check**] and [**C.B. RMS & PEAK check**] options. The interpretation of the results is discussed in section 15.5.3.

15.5.1.8 [HELP]

Displays the on-line HELP information on the terminal.

15.5.1.9 [RETURN]

Exits from this section to the fault analysis menu.

15.5.2 Result interpretation

Comparison of circuit breaker rating and short circuit duty will be shown on a table, which will flag any shortcoming of the device, by showing a percentage list. They are already shown in figures 15.9, and 15.10. The topics are shown in the following figure. They are stands for:

```
CIRCUIT BREAKERS CHECK RESULTS
==============================

SYSTEM TITLE : FOLAD MOBARAKEH AS 12/06/1377
STUDY  TITLE :
FAULT IMPEDANCE (R AND X) =    0.0000   0.0000 PU



FOR LINES INSIDE OR BEGIN FROM AREA :  RED-63

|              CIRCUIT BREAKER                          |FAULT MAXIMUM BREAK       AND MAKE(1/2c)|  RESULTS  |
|PASHA  |  C.B.  |DEVI|      BRANCH        |  MVA  |  KA   |LOC|    |MAX | TIME | FAULT |    | FAULT |BREAK|MAKE |
|TYPE   |  TYPE  | CE |SEND     RECV   LOC|  RMS  | peak  |ATE|TYPE|FOR | (ms) |  MVA  |TYPE|KA-peak|  %  |  %  |
|   631|TIBB MIL|C.B.|RED1     T1B-R     S| 3700.0|  87.0|L/S| LLG| Y  |  30.0| 2499.7| LLL|   56.8| 67.6| 65.3|
|   631|TIBB MIL|C.B.|RED1     T2B-R     S| 3700.0|  87.0|L/S| LLG| Y  |  30.0| 2501.6| LLL|   56.8| 67.6| 65.3|
```

PASHA TYPE: The database type as entered in section 15.3 and selected in section 15.4
C.B. TYPE : The manufacturer name as entered in COMMENT of 15.3
DEVICE : The name of device: C.B. for circuit breaker, MCCB for Molded Case Circuit Breaker, and FUSE for fuse
BRANCH : The line that circuit breaker is located. S for sending end R for receiving end

MVA RMS : The MVA symmetric duty as entered in 15.3
KA Peak : The KA peak as entered in 15.3

BREAK

LOCATE : The maximum fault location L/S for line side, B/S for busbar side
TYPE : The type of fault that causes maximum through fault currents
MAX FOR : Maximum fault current in phase: Red, Yellow, Blue
TIME : The fault incidence time. Circuit breaker breaking time as entered in 15.3
FAULT MVA : The calculated through fault MVA

MAKE

TYPE : The type of fault that causes maximum making through fault currents
FAULT KA-Peak : The calculated making through fault current
BREAK% : Percent through RMS fault current / breaking capacity
MAKE% : Percent through KA peak fault current / Making KA peak

The user is responsible to check the last two indices. If more than 100% the circuit breaker must be changed. More than 90% the circuit breaker must be checked occasionally.

```
CIRCUIT BREAKERS CHECK RESULTS
==============================

SYSTEM TITLE : MANUAL WITH RELAYS
STUDY  TITLE :
FAULT IMPEDANCE (R AND X) =     0.0000    0.0000 PU



FOR LINES INSIDE OR BEGIN FROM AREA :  T

|                CIRCUIT BREAKER                        |        MAXIMUM FAULT SEEN        | RESULTS  |
|PASHA  |  C.B.  |DEVI|      BRANCH          |  MVA  | FAULT  |    |MAX | TIME | FAULT | PERSENT  |
|TYPE   |  TYPE  | CE |SEND     RECV    LOC|  RMS  |LOCATION|TYPE|FOR | (ms) |  MVA  |    %     |
|    400|SIEMENS |C.B.|NETW     SUB 1     S|29000.0|LINESIDE| LLL³    |  66.0|25921.4|    89.38|
|    400|SIEMENS |C.B.|NETW     SUB 1     R|29000.0|SOURCE/S| LLL³    |  66.0|  952.5|     3.28|
|    400|SIEMENS |C.B.|SUB 1    SUB 2     S|29000.0|LINESIDE| LLL³    |  66.0| 1263.1|     4.36|
|     30|MCCB    |MCCB|SUB 1    SUB 2     R|   39.5|LINESIDE| LLL³    |  50.0|  893.8|  2262.82|
|    400|SIEMENS |C.B.|NETW     SUB 3     S|29000.0|LINESIDE| LLL³    |  66.0|19269.4|    66.45|
|    400|SIEMENS |C.B.|NETW     SUB 3     R|29000.0|SOURCE/S| LLL³    |  66.0|  410.6|     1.42|
|    400|SIEMENS |C.B.|SUB 3    EMERG-G   S|29000.0|LINESIDE| LLL³    |  66.0|  782.0|     2.70|
|      6|MAG-II  |C.B.|SUB 3    EMERG-G   R|  500.0|LINESIDE| LLL³    |  70.0|  821.9|   164.38|
|    400|SIEMENS |C.B.|SUB 3    EMERG-G   S|29000.0|LINESIDE| LLL³    |  66.0|  782.0|     2.70|
|      6|MAG-II  |C.B.|SUB 3    EMERG-G   R|  500.0|LINESIDE| LLL³    |  70.0|  821.9|   164.38|
|    400|SIEMENS |C.B.|NETEQU   NETW      R|29000.0|SOURCE/S| LLL³    |  66.0|34953.0|    120.53|

Continue listing? (Y or N or S)
```



```
COPYRIGHT (C) TOM InC 1988 TIME : 18:19:15 29/08/2001
```

Figure 15.9

```
CIRCUIT BREAKERS CHECK RESULTS
==============================

SYSTEM TITLE : MANUAL WITH RELAYS
STUDY  TITLE :
FAULT IMPEDANCE (R AND X) =     0.0000    0.0000 PU



FOR LINES INSIDE OR BEGIN FROM AREA :  T

|                CIRCUIT BREAKER                                |FAULT MAXIMUM BREAK        AND MAKE(1/2c)|  RESULTS  |
|PASHA  |  C.B.  |DEVI|      BRANCH          |  MVA  |  KA    |LOC|    |MAX | TIME | FAULT |     | FAULT |BREAK|MAKE |
|TYPE   |  TYPE  | CE |SEND     RECV    LOC|  RMS  | peak   |ATE|TYPE|FOR | (ms) |  MVA  |TYPE|KA-peak|  %  |  %  |
|    400|SIEMENS |C.B.|NETW     SUB 1     S|29000.0|  141.0|L/S| LLL|    |  66.0|25921.4| LLL|  260.8| 89.4|184.9|
|    400|SIEMENS |C.B.|NETW     SUB 1     R|29000.0|  141.0|S/S| LLL|    |  66.0|  952.5| LLL|    8.5|  3.3|  6.1|
|    400|SIEMENS |C.B.|SUB 1    SUB 2     S|29000.0|  141.0|L/S| LLL|    |  66.0| 1263.1| LLG|    9.8|  4.4|  7.0|
|     30|MCCB    |MCCB|SUB 1    SUB 2     R|   39.5|  135.0|L/S| LLL|    |  50.0|  893.8| LLL|   79.4|*****| 58.8|
|    400|SIEMENS |C.B.|NETW     SUB 3     S|29000.0|  141.0|L/S| LLL|    |  66.0|19269.4| LLL|  174.8| 66.4|123.9|
|    400|SIEMENS |C.B.|NETW     SUB 3     R|29000.0|  141.0|S/S| LLL|    |  66.0|  410.6| L-G|    4.1|  1.4|  2.9|
|    400|SIEMENS |C.B.|SUB 3    EMERG-G   S|29000.0|  141.0|L/S| LLL|    |  66.0|  782.0| LLG|    6.1|  2.7|  4.3|
|      6|MAG-II  |C.B.|SUB 3    EMERG-G   R|  500.0|  146.0|L/S| LLL|    |  70.0|  821.9| L-G|   86.8|164.4| 59.4|
|    400|SIEMENS |C.B.|SUB 3    EMERG-G   S|29000.0|  141.0|L/S| LLL|    |  66.0|  782.0| LLG|    6.1|  2.7|  4.3|
|      6|MAG-II  |C.B.|SUB 3    EMERG-G   R|  500.0|  146.0|L/S| LLL|    |  70.0|  821.9| L-G|   86.8|164.4| 59.4|
|    400|SIEMENS |C.B.|NETEQU   NETW      R|29000.0|  141.0|S/S| LLL|    |  66.0|34953.0| LLL|  377.1|120.5|267.5|

Continue listing? (Y or N or S)
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Figure 15.10

15.6 Summary

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.