

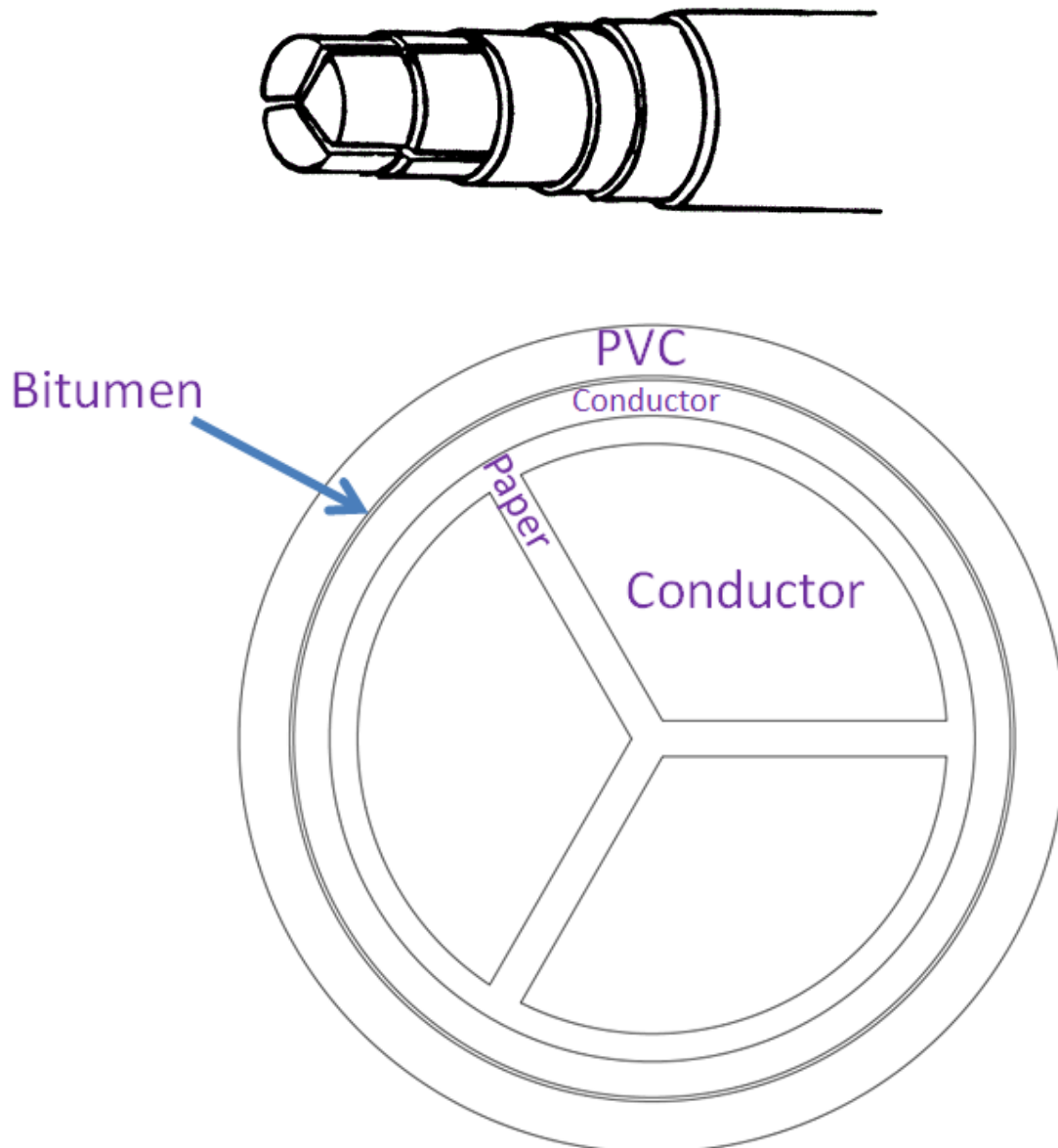
The Low Voltage Thermal Modelling Tool Version 1 Quick Start Guide

This quick start guide for the LV-TM1 (Low Voltage Thermal Modelling Tool Version 1) is structured as follows:

1. Section 1 provides overview of the LV-TM.
2. Section 2 explains how to run simulations using the LV-TM.
3. Section 3 describes the graphs that are created by the LV-TM.

1. Introduction

The LV-TM1 is an excel workbook that has the capability to simulate the thermal behaviour of a 185mm² BICC Consac cable when it is used as a radial LV distributor to connect dwellings and/or other loads and generators to the rest of the electrical power network. The central feature of the LV-TM1 is a simple linear thermal model of a BICC Consac cable which was derived from a high fidelity FEA model of the cable when buried 0.5m deep in regular (for the UK) soil conditions. A pictorial and cross sectional drawing of the BICC Consac cable is provided below.



2. Running Simulations

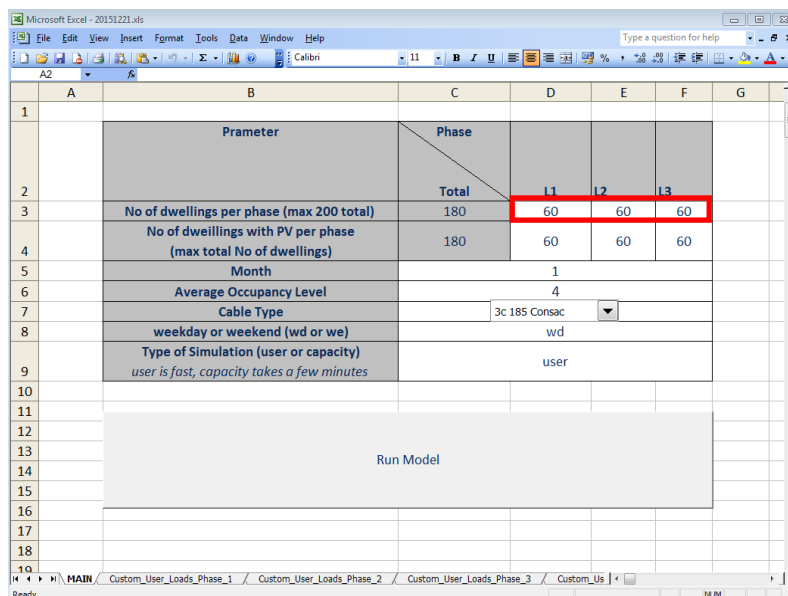
2.1 “MAIN” Sheet

The “MAIN” sheet of the LV-TM1 allows the user to specify the following seven inputs of the simulation:

1. No of dwellings
2. No of dwellings with PV per phase
3. Month
4. Average Occupancy Level
5. Cable Type
6. Weekday or Weekend
7. Type of Simulation

Each of these seven inputs is highlighted in individual screenshots shown below and provided with accompanying explanation.

2.1.1 No of Dwellings



The screenshot shows an Excel spreadsheet with the following data:

Prameter	Phase	L1	L2	L3
No of dwellings per phase (max 200 total)	Total	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	Total	60	60	60
Month		1		
Average Occupancy Level		4		
Cable Type		3c 185 Consac		
weekday or weekend (wd or we)		wd		
Type of Simulation (user or capacity)		user		

This is the number of dwelling loads that are connected to each phase L1, L2 and L3 of the distributor. The maximum total number of dwellings allowed across the three phases is 200.

2.1.2 No of dwellings with PV per phase

Prameter	Phase			
	Total	L1	L2	L3
No of dwellings per phase (max 200 total)	180	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	180	60	60	60
Month	1			
Average Occupancy Level	4			
Cable Type	3c 185 Consac			
weekday or weekend (wd or we)	wd			
Type of Simulation (user or capacity) <i>user is fast, capacity takes a few minutes</i>	user			

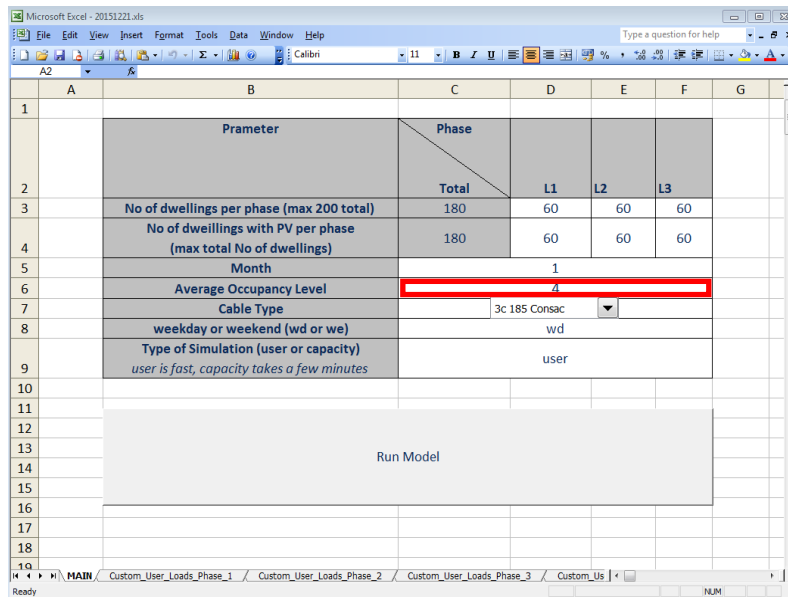
This is the number of dwellings that have active PV installations which are all assumed to be rated at 3.6kW. The maximum number for each phase is equal to the number of dwellings specified for that particular phase by the aforementioned “No of Dwellings” input.

2.1.3 Month

Prameter	Phase			
	Total	L1	L2	L3
No of dwellings per phase (max 200 total)	180	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	180	60	60	60
Month	1			
Average Occupancy Level	4			
Cable Type	3c 185 Consac			
weekday or weekend (wd or we)	wd			
Type of Simulation (user or capacity) <i>user is fast, capacity takes a few minutes</i>	user			

This input specifies the month of the year and can be any number ranging from 1 (January) to 12 (December).

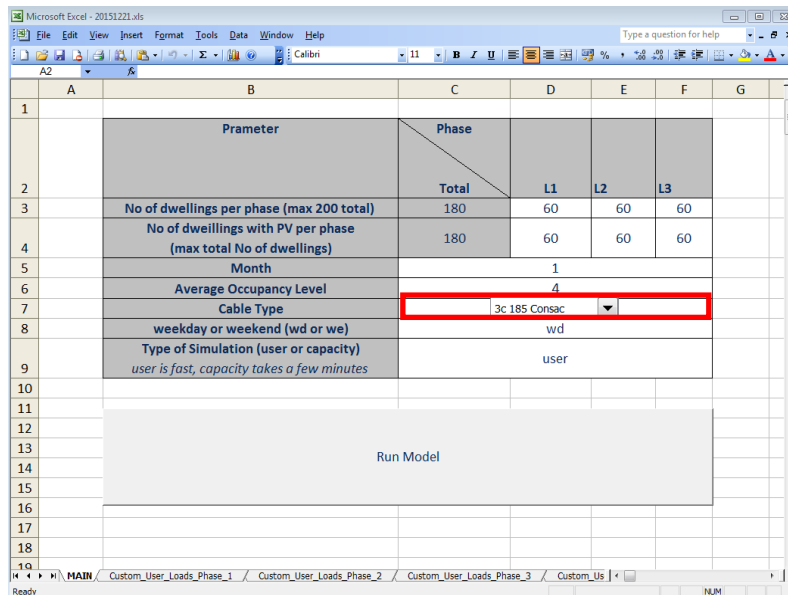
2.1.4 Average Occupancy Level



Prameter	Phase			
	Total	L1	L2	L3
No of dwellings per phase (max 200 total)	180	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	180	60	60	60
Month	1			
Average Occupancy Level	4			
Cable Type	3c 185 Consac			
weekday or weekend (wd or we)	wd			
Type of Simulation (user or capacity) <i>user is fast, capacity takes a few minutes</i>	user			

This input specifies the average number of people residing in each dwelling and can be any number in the range from 3 to 8.

2.1.5 Cable Type



Prameter	Phase			
	Total	L1	L2	L3
No of dwellings per phase (max 200 total)	180	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	180	60	60	60
Month	1			
Average Occupancy Level	4			
Cable Type	3c 185 Consac			
weekday or weekend (wd or we)	wd			
Type of Simulation (user or capacity) <i>user is fast, capacity takes a few minutes</i>	user			

This option allows the user to specify from a drop down list the cable type that is used in the simulation, the LV-TM1 only has one option which is the 3 core 185mm² BICC Consac Cable.

2.1.6 Weekday or Weekend

Prameter	Phase			
	Total	L1	L2	L3
No of dwellings per phase (max 200 total)	180	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	180	60	60	60
Month	1			
Average Occupancy Level	4			
Cable Type	3c 185 Consac			
weekday or weekend (wd or we)	wd			
Type of Simulation (user or capacity) <i>user is fast, capacity takes a few minutes</i>	user			

This enables the user to specify that a weekend or weekday load profiles are used for the simulation by entering either “we” or “wd” into the cell.

2.1.7 Type of Simulation (user or capacity)

Prameter	Phase			
	Total	L1	L2	L3
No of dwellings per phase (max 200 total)	180	60	60	60
No of dwellings with PV per phase (max total No of dwellings)	180	60	60	60
Month	1			
Average Occupancy Level	4			
Cable Type	3c 185 Consac			
weekday or weekend (wd or we)	wd			
Type of Simulation (user or capacity) <i>user is fast, capacity takes a few minutes</i>	user			

The simulation types of either “user” or “capacity” can be selected. If the user requires only the simulation that they specified using the other input parameters, “user” should be selected from the drop down list. If the user wants to identify for a given user-specified month of the year and either weekday or weekend the thermal capacity of the cable, defined as the maximum number of dwellings and PV connections for which the thermal constraint of 80 degrees C is not breached, they should specify “capacity”. It should be noted that “user” simulations are very fast and usually take less that 20 seconds to execute, whilst “capacity” simulations take several minutes.

2.2 Custom Load Profiles

The user can specify custom loads for each of the three phases by entering appropriate values in the following sheets:

- “Custom_User_Loads_Phase_1”
- “Custom_User_Loads_Phase_2”
- “Custom_User_Loads_Phase_3”

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		Load Profiles (A)												
2	Load no	1	2	3	4	5	6	7	8	9	10	11	12	13
3		00:00												
4		00:30												
5		01:00												
6		01:30												
7		02:00												
8		02:30												
9		03:00												
10		03:30												
11		04:00												
12		04:30												
13		05:00												
14		05:30												
15		06:00												
16		06:30												
17		07:00												
18		07:30												

The user can define up to 200 load profiles which are sampled every 30 minutes using the columns of this worksheet, the first one is highlighted in the screen shot above.

2.3 Custom Generation Profiles

User can specify custom generation profiles for each of the three phases by entering appropriate values in the following sheets:

- “Custom_User_Generators_Phase_1”
- “Custom_User_Generators_Phase_2”
- “Custom_User_Generators_Phase_3”

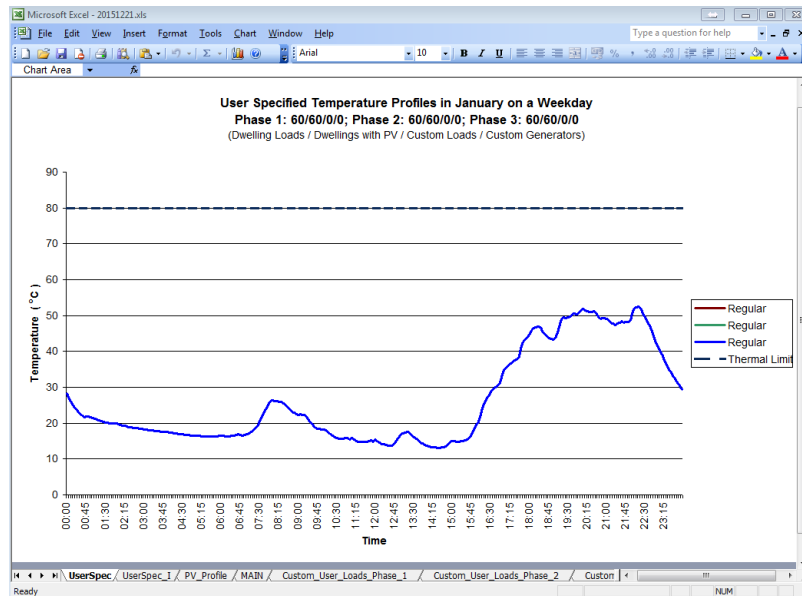
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		Generator Profiles (A)												
2	Generator no	1	2	3	4	5	6	7	8	9	10	11	12	13
3	00:00													
4	00:30													
5	01:00													
6	01:30													
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13	05:00													
14	05:30													
15	06:00													
16	06:30													
17	07:00													
18	07:30													

The user can define up to 200 generator profiles which are sampled every 30 minutes using the columns of this worksheet, the first one is highlighted in the screen shot above.

3. Graphs

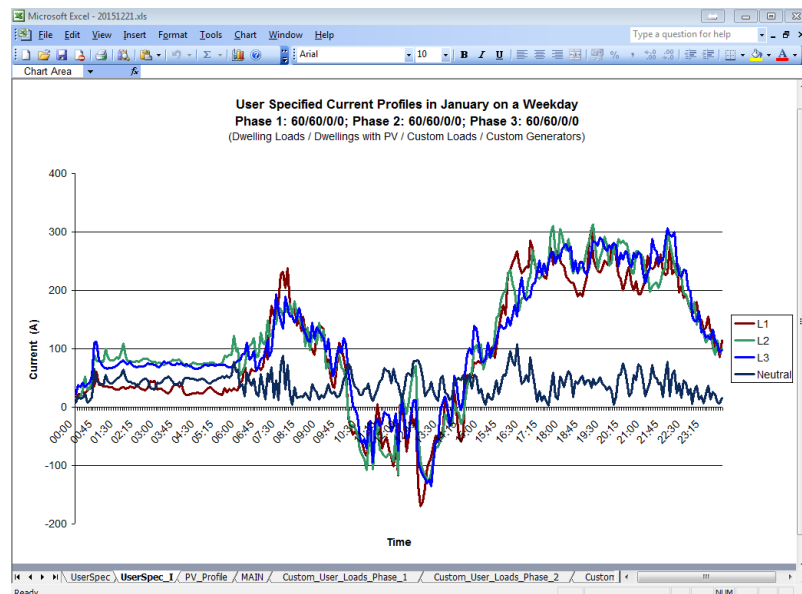
LV-TM1 generates several graphs to display the results of the simulations. Each of these graphs is described in this section.

3.1 UserSpec



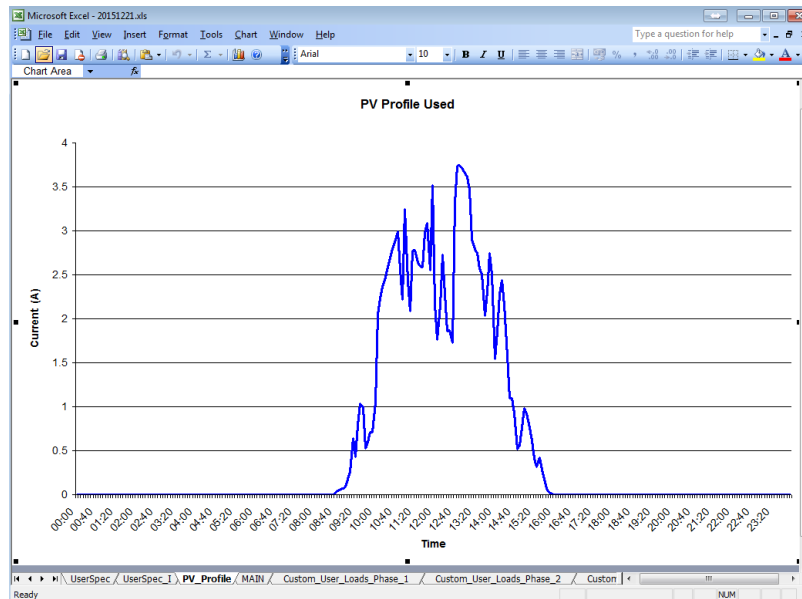
This graph is made available for both “user” and “capacity” simulation type. It shows the 24 hour temperature profile for the specific inputs that the user specified on the MAIN page. The title of the graph displays the input parameters that were specified by the user.

3.2 UserSpec_I



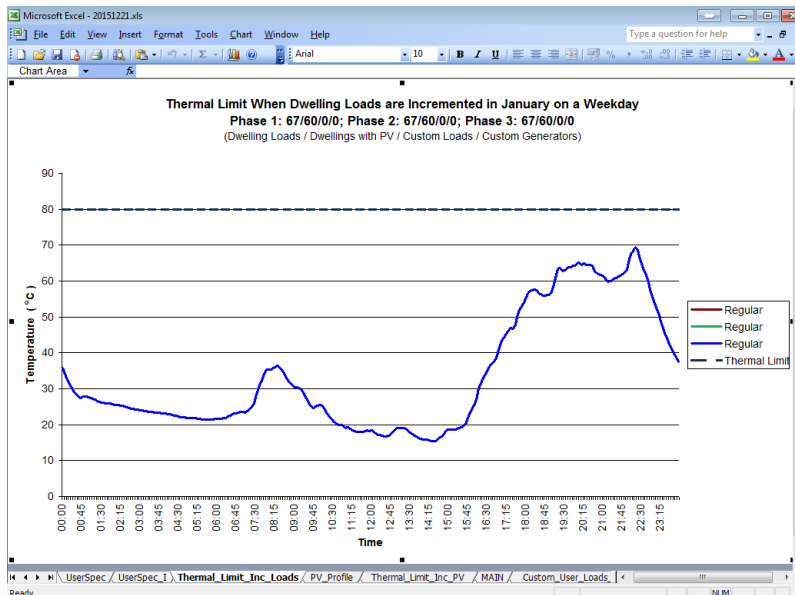
This graph is available for both “user” and “capacity” simulation type. It displays 24-hour profiles of phase and neutral currents for the specific inputs that the user specified on the “MAIN” sheet.

3.3 PV_Profile



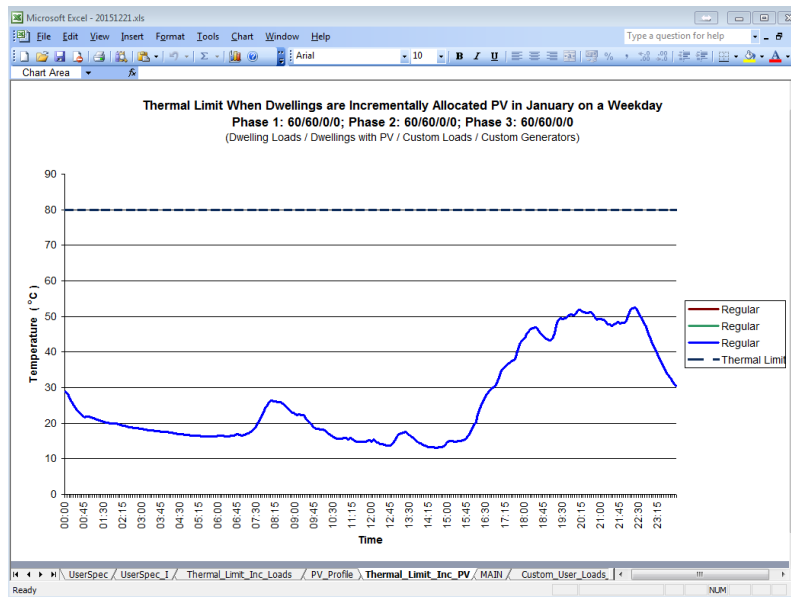
This graph is available for both “user” and “capacity” simulation type. This graph shows the 24-hour profile of an individual PV installation. This profile is month-specific.

3.4 Thermal_Limit_Inc_Loads



This graph is available for “capacity” simulation type only. It shows the 24-hour temperature profile obtained for the maximum (up to 200) number of dwelling loads connected to the LV distributor that do not breach the temperature constraint of the cable. The number of PV installations is specified on the “MAIN” sheet.

3.5 Thermal_Limit_Inc_PV



This graph is available for “capacity” simulation type only. It shows the 24-hour temperature profile obtained for the maximum (up to the number of dwellings specified on the “MAIN” sheet) number of dwelling loads considered to have PV installations that do not breach the temperature constraint of the cable. The number of dwellings is the same as the user specified on the “MAIN” sheet.