DESIGN
DELIVERY

Engineering
Services

VISION OSLO Extension Package
User Guide

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1 Introduction

'oslo_extension.py' is a Python-based tool package designed to streamline various workflow based on the VISION-OSLO software.

Recognizing the challenges posed by the text-format input / output of VISION-OSLO, 'oslo_extension.py' serves as an extension, facilitating the data input, model validation, extraction and evaluation of results with ease and efficiency.

As a summary, the following functions can be achieved with this package:

- OSLO model data preparation including bhtpbank file creation, impedance calculation, CIF file support and extra.oslo creation.
- OSLO model validation including generate various excel report for easy checking.
- OSLO model post data analysing including voltage analysis, supply point loading analysis, incoming feeder protection analysis, OLE loading analysis, grid compliance study, DC substation TRU & busbar & protection & track CB analysis, DC along track electrical equipment analysis, impedance bond analysis.

This guide provides detailed, sequential instructions on selecting the appropriate script for each task and outlines the procedures for their utilization.

2 Definitions

Table 2 List of Definitions

Term	Meaning
*.oof file	Once a V/O simulation is complete, an Oslo Output File named oof file will be generated, bearing the model's name. This file contains all simulation result RAW data.
*.lst.txt file	Once a V/O simulation is built, a checking output file named lst.txt file will be generated, bearing the model's name. This file contains all model set up text-based data.
PCC	Point in the public electricity supply system which is electrically closest to the installation concerned and to which other customers are or might be connected. The PCC is generally upstream from the installation concerned.
RMS	RMS is a statistical measure that calculates the square root of the average of squared values within a dataset. It is often used to quantify the magnitude or intensity of a varying quantity, such as voltage or current.
Script	A Python script is a sequence of instructions written in the Python programming language. It is a text file containing code that is executed by the Python interpreter. Python scripts are used to automate tasks, perform calculations, manipulate data, create programs, and build applications by utilizing the capabilities and features provided by the Python programming language.
V/O (VISION/OSLO)	Visualisation and Interactive Simulation of Infrastructure and Operations on rail Networks / Overhead System Loading
VBA	Visual Basic for Applications is an implementation of Microsoft's event-driven programming language Visual Basic 6.0 built into most desktop Microsoft Office applications.

3 Installation and General User Guide

3.1 Pre-requisites

- VISION-OSLO
- Python

For NR users, this could all be gained from IT software category.

3.2 Quick start

For first time user, disconnect NR-Corp network is required.

Copy and paste the following python file to your current working folder, double click it to launch the application and follow on-screen instructions.

- oslo_extension.py

Note that with NR-Corp network, the tool will have 5 seconds delay in start and cannot perform the installation or updating.

Users are recommended periodically use the tool when disconnected from NR-Corp network to receive the update.

These are the steps that need to be followed to install the update.

1. Disconnect the NR-Corp network.
2. Connect via your private internet (e.g., mobile phone hotspot). It is possible to connect via Zscaler. (Skip the first two steps if you are working from home)
3. Run 'oslo_extesion.py'

"oslo_extension.py" version 1.0.0 can be downloaded from:

https://github.com/NR-JYe/vo_addin/archive/refs/tags/v1.0.0.zip

For future release, it will be published on:

https://github.com/NR-JYe/vo_addin

NR users can copy the file from: ES-E&P System SharePoint \ 05 - Traction Power Modelling \ 04 - Vision Olso \ 04 - VISION OSLO Extension Tool

NR users can refer the quick guidance on VISION OSLO Quick Guide.

3.3 Support Contacts

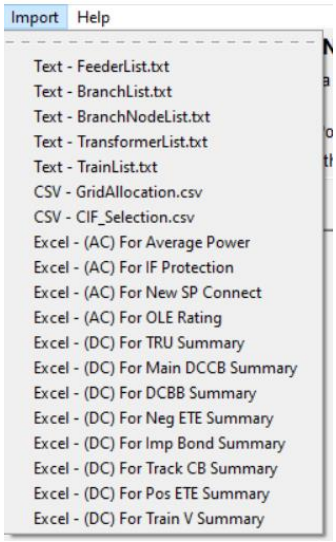
For any additional support, please contact:

Jieming.Ye@networkrail.co.uk (TBC)

Engineering Services, Network Rail.

4 Essential Text Input File Format

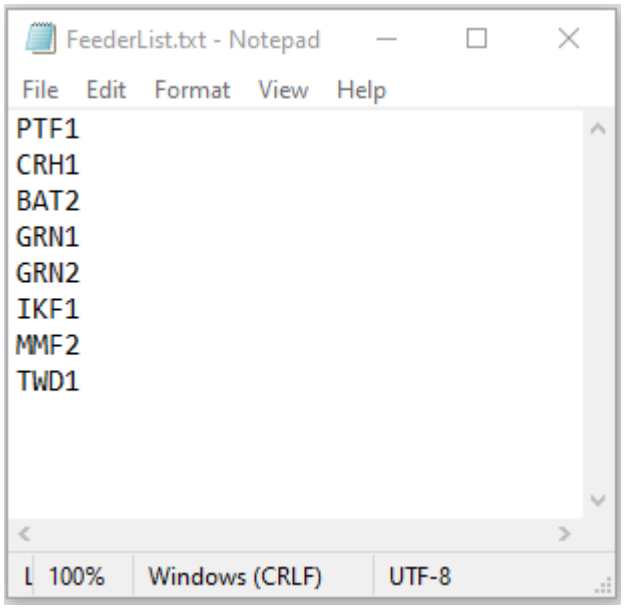
This tool package provides various essential input file templates to facilitate data extraction and analysis. Each imported file is associated with a specific assessment, ensuring that the software processes the data relevant to the intended analysis. The required files, each bearing verbatim names, are as follows:



This input data format for excel and csv will be detailed in the following relevant sections. The text file format and requirements are listed below.

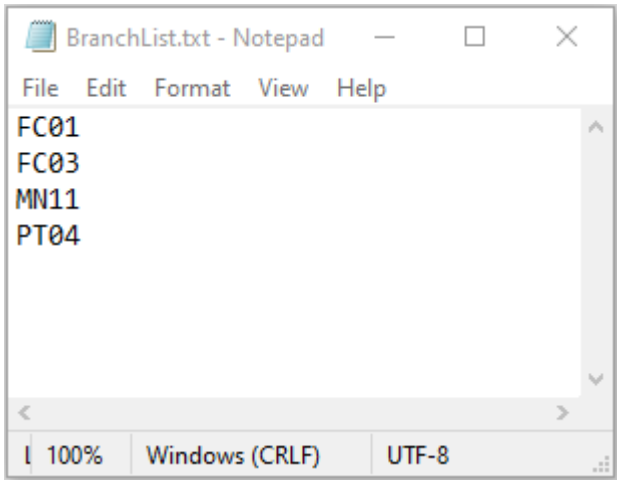
4.1 FeederList.txt

This file contains a list of all feeder stations of interest which will be used for Oslo result extraction and result process. The file contains the abbreviated names of supply points, in the format shown below, and can be generated from 'extra.oslo' file.



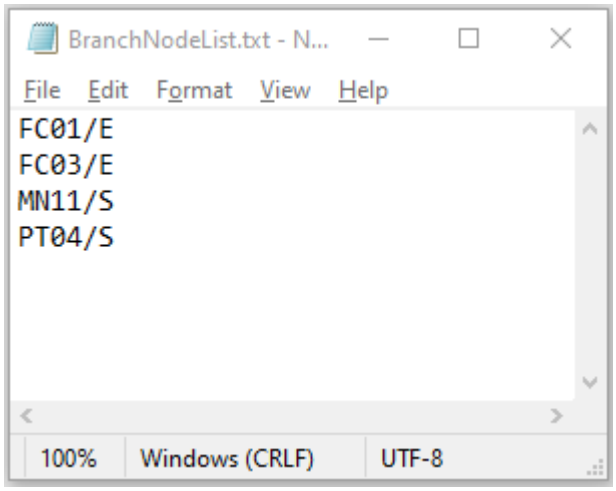
4.2 BranchList.txt

This file contains a list of all branches for which the results need to be extracted. Each line of the file represents a branch name in the format shown below.



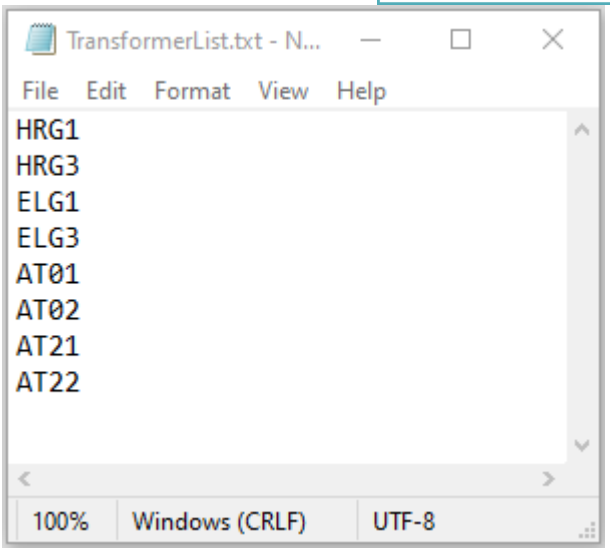
4.3 BranchNodeList.txt

This file contains a list of all branches for which the results need to be produced at the start or the end point. Each line of the file represents the branch and the node of interest (with letter 'S' for start and 'E' for end of the branch) in the format shown below.



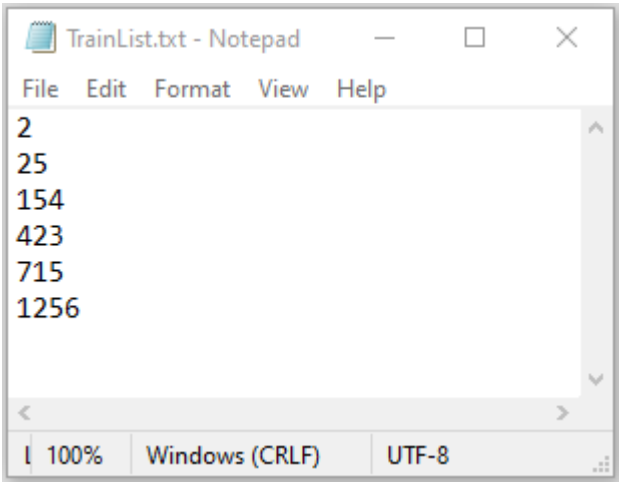
4.4 TransformerList.txt

This file contains a list of all transformers for which the results need to be extracted. The file contains the abbreviated names of transformers such as supply point transformers, auto transformers, two or three windings transformers in the format shown below, and can be generated from 'extra.oslo' file.

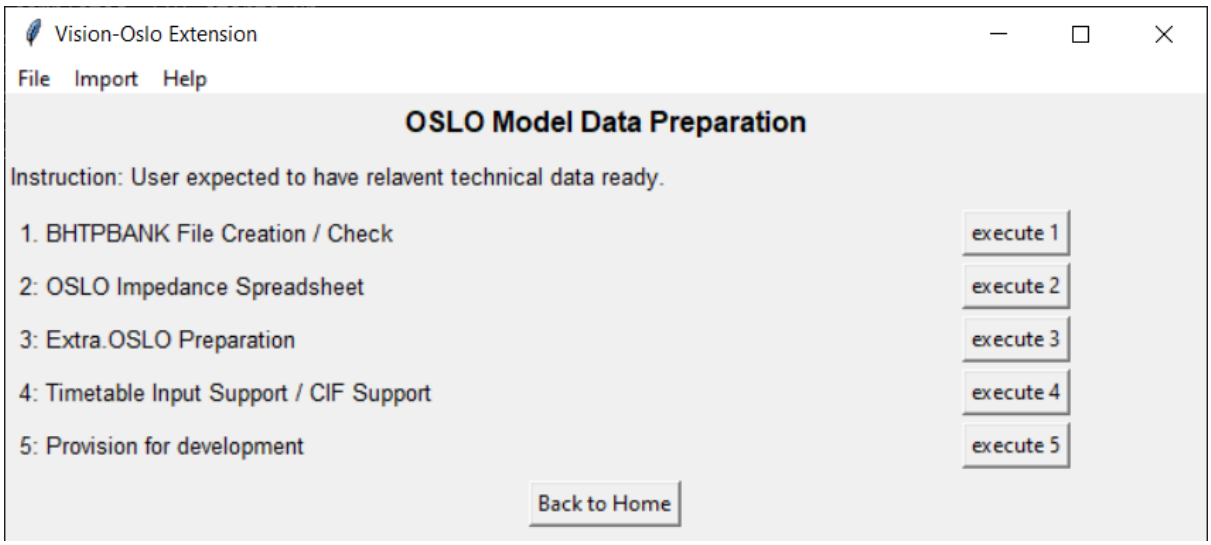


4.5 TrainList.txt

This file contains a list of all trains for which the results need to be produced. Each line of the file represents a train number, between 1 to 99999, in the format shown below.



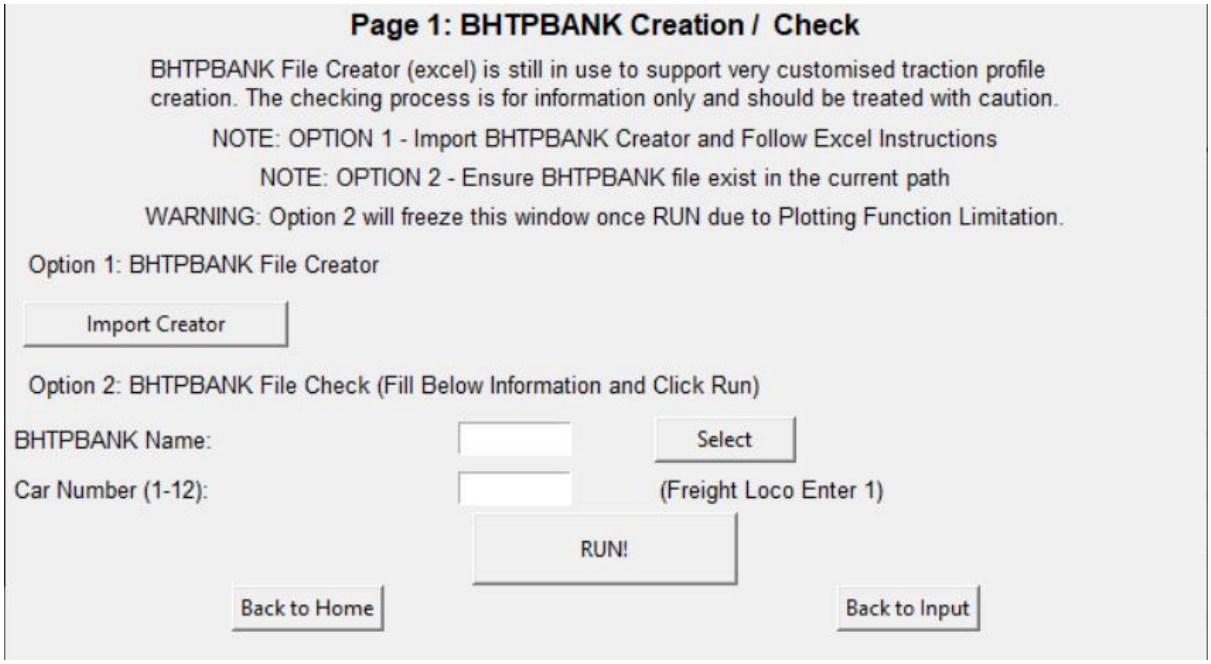
5 OSLO Model Preparation



This page is designed to support the modelling data preparation.

Due to the complexity of input data and various data formats from different sources, some functionalities are still considered to be best achieved by VBA application. Therefore, several excel spreadsheets with Marco are designed to support the model data preparation.

5.1 BHTPBANK File Creation & Check



Option 1 supports user create BHTPBANK traction file. Due to the complexity of the traction performance, VBA application is adopted. Click 'import creator' will generate an excel template in a user's current folder.

User should follow the excel first page on-screen instructions to create the BHTPBANK file.

Instruction: (VERSION 10)

STEP1:	Go to either 'AC Data Entry' or 'DC Data Entry' and input Information in places where not highlighted.
STEP2:	Go to 'Calculation' Tab. Adjust the Settings Highlight in RED. It is essential to validate the calculation is fit for purpose as it might be different for different classes.
STEP3:	COPY all section highlighted in YELLOW in 'Calculation' tab, PASTE in this tab from Row 3 onwards. (better with value only)
STEP4:	UPDATE header information in 'Header info' Tab. Be cautious the format.
STEP5:	Click 'Creat BHTPBANK' button.
STEP6:	Go back to Python tool to check the created file

GENERAL PRINCIPLES:

1. Cells highlighted in YELLOW is NOT recommended to touch as it contains important formula.
2. Cells highlighted in 'RED' controls limitation and setting.
3. Always check the output using Python tool.

If the manufacture data includes detailed information already (i.e. it covers different current drawn at different speed under different voltage levels), it is recommend to filter the data manually and adjust the 'Calculation' tab directly.

However, in most circumstances the manufacture will only provide traction profile under nominal voltage level, where the information could be input at 'DATA ENTRY' tab.

It should be noted that the table under 'Step 1b' highlighted in yellow will be the only table read by the 'Calculation' tab directly.

Step 1b: Calculation

Nominal Voltage Calculation

		Real Part		Imaginary Part	
Speed (km/h)	TE	Current (A)	%	Current (A)	%
0	250.00	0.00	1	0.00	1
1	250.00	3.27	1	-0.95	1
5	250.00	16.34	1	-4.77	1
10	250.00	32.68	1	-9.53	1
15	250.00	49.02	1	-14.30	1
20	250.00	65.36	1	-19.06	1
30	250.00	98.04	1	-28.59	1
40	250.00	130.72	1	-38.13	1
50	250.00	163.40	1	-47.66	1
60	250.00	196.08	1	-57.19	1
70	250.00	228.76	1	-66.72	1
80	250.00	261.44	1	-76.25	1
90	222.22	261.44	1	-76.25	1
100	200.00	261.44	1	-76.25	1
110	181.82	261.44	1	-76.25	1
120	166.67	261.44	1	-76.25	1
130	153.85	261.44	1	-76.25	1
140	142.86	261.44	1	-76.25	1
150	124.44	244.01	1	-71.17	1
160	109.38	228.76	1	-66.72	1

		Real Part		Imaginary Part	
Speed (km/h)	BE	Current (A)	%	Current (A)	%
0	0.00	0.00	1	0.00	1
1	250.00	-2.36	1	-0.69	1
5	250.00	-11.81	1	-3.44	1
10	250.00	-23.61	1	-6.89	1
15	250.00	-35.42	1	-10.33	1
20	250.00	-47.22	1	-13.77	1
30	250.00	-70.83	1	-20.66	1
40	250.00	-94.44	1	-27.55	1
50	250.00	-118.06	1	-34.43	1
60	250.00	-141.67	1	-41.32	1
70	250.00	-165.28	1	-48.21	1
80	250.00	-188.89	1	-55.09	1
90	222.22	-188.89	1	-55.09	1
100	200.00	-188.89	1	-55.09	1
110	181.82	-188.89	1	-55.09	1
120	166.67	-188.89	1	-55.09	1
130	153.85	-188.89	1	-55.09	1
140	142.86	-188.89	1	-55.09	1
150	124.44	-176.30	1	-51.42	1
160	109.38	-165.28	1	-48.21	1

AC DATA ENTRY | DC DATA ENTRY

Click 'Create BHTPBANK' file will pop up the window asking the user to select the address where to create such a file.

Once the file is created, user should check the file using Option 2.

Option 2 can be used to check all BHTPBANK file which was written in 'modern' format (refer OSLO Manual [2]). Option 2 requires:

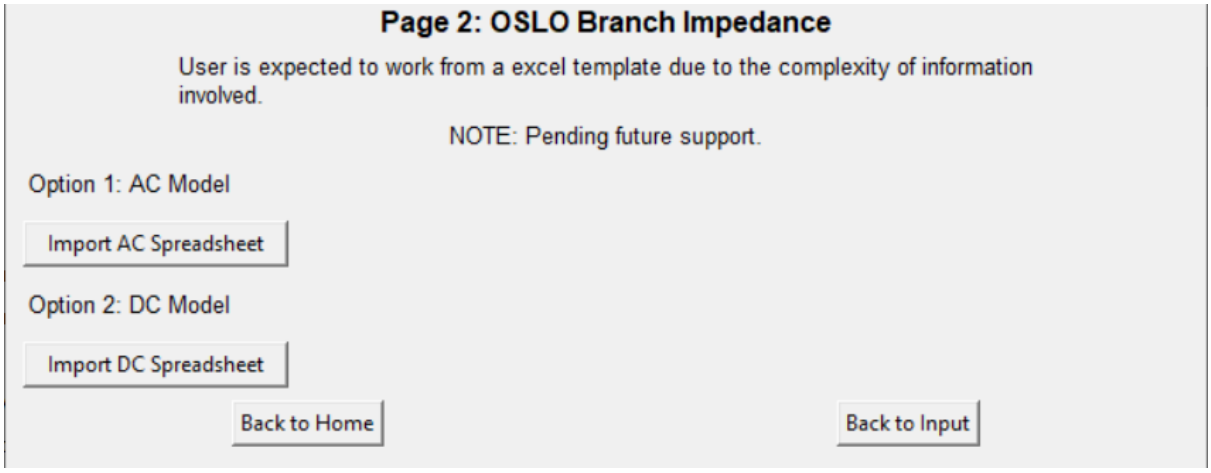
- BHTPBANK file name: This is the BHTPBANK file name (8 character) to be checked.
- Car Number: This is the number of cars the BHTPBANK represents. This number is used to check the sensible of auxiliary power.

Once Option 2 is select, user can click 'Run' to process the automatic checking.

The following output will be generated:

- BHTPBANK.csv: this file contains tabulated information of the bhtpbank file and detailed calculation during the process.
- Warning Summary.txt: this file contains all warnings and errors during the checking process. Note that user need to judge if warning is acceptable or not. Errors need to be cleared before BHTPBANK file to be used by OSLO model.
- Absolute Current.png, Current Limitation Curve.png, Electrical Braking Effort.png, Power Limitation Curve.png, Real Current.png, Regen Current.png, Regen Efficiency.png, Traction Efficiency.png, Tractive Effort.png: these plots show the information as the file name suggested and should be checked if these are sensible or not.

5.2 OSLO Impedance Spreadsheet Support

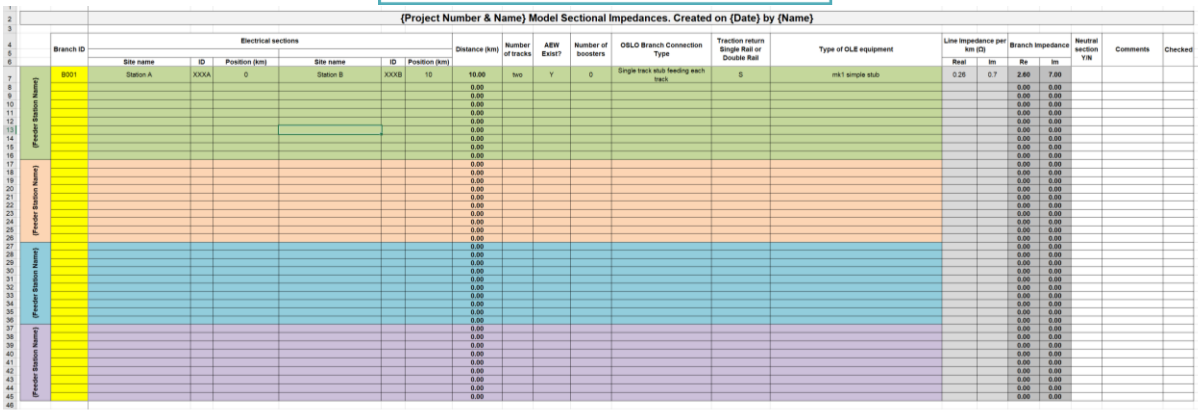


Due to the complexity of information and the fact that OLSO branch information needs to be manually input to the OSLO model, excel is still used to perform this support as a record. Option 1 and Option 2 will generate a template for AC / DC in your current folder if there isn't a one already available. User should open the template and modify the information as required.

Most importantly, the database summary (from ES-Traction Power Modelling Team) should be referred to select corresponding information to be input to the excel spreadsheet.

It should be noted that the whole process is pending further support, the objectives is to have the information automatically input into OSLO model instead of manually input.

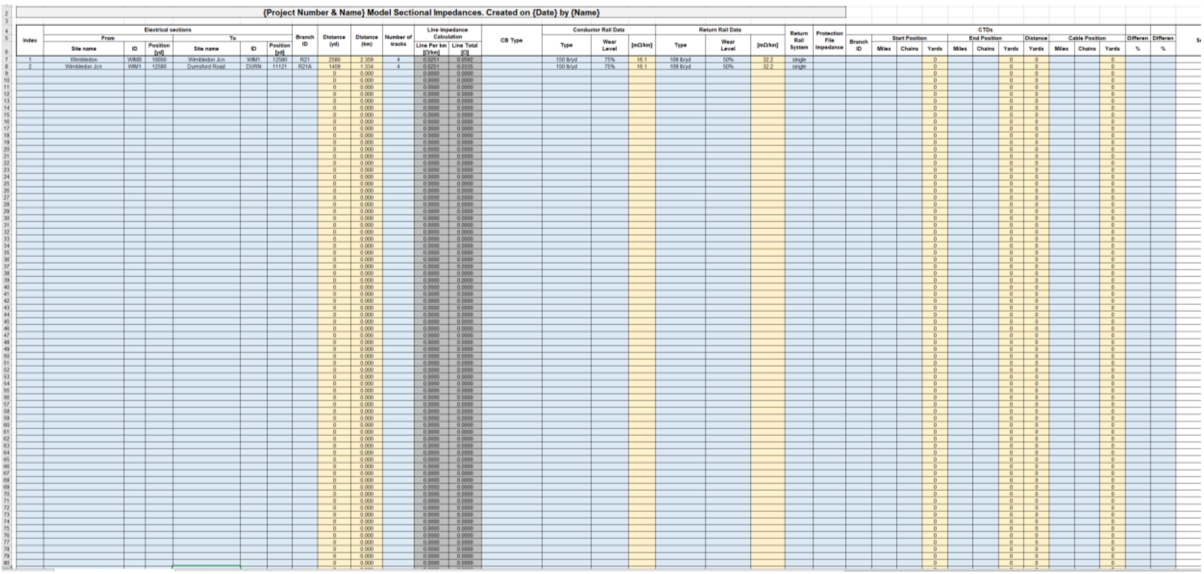
- Option 1: ac_oslo_section_impedance.xlsx will be created.



This impedance spreadsheet calculates the **total branch impedance** to be input into the OSLO model directly. User should enter the information from left to right in sequence in order to calculate the correct value in 'Branch Impedance' columns.

Note that the correct position in km should be input referring the distance between two node position. This is particularly important if the actual OSLO branch crossing an ELR change in VISION model.

- Option 2: dc_oslo_section_impedance.xlsx will be created.



This impedance spreadsheet calculates the **per km branch impedance** to be input into the OSLO model directly. User should enter the information as requirement below in order to calculate the correct value in 'Line Impedance Calculation' columns. The reason to arrange the table in this format is for easily copying existing database in without many modifications.

It should be note that,

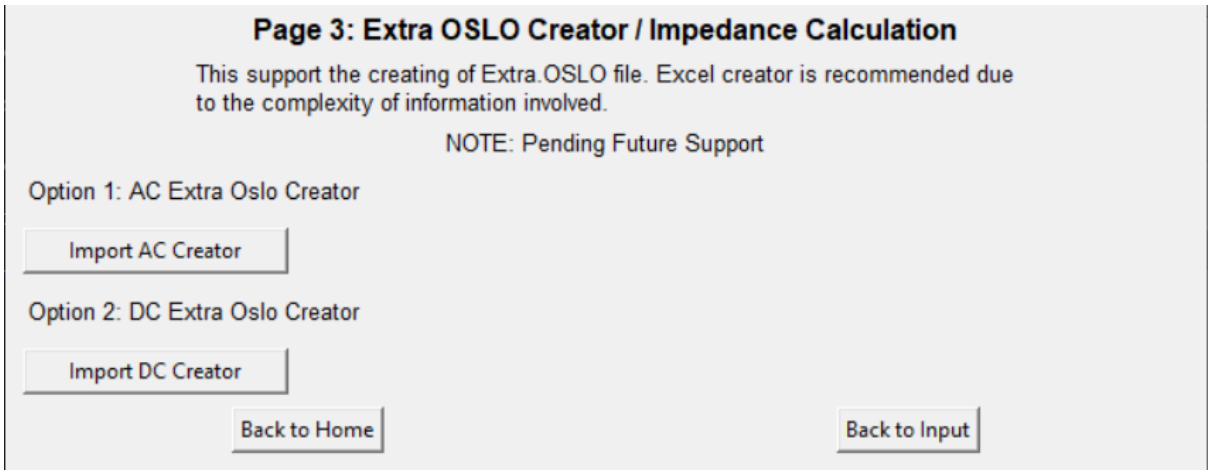
For all section highlighted in blue, information should be entered manually or copied and paste from a data source with value only. Drop down list selection is required for Conductor Rail Data and Return Rail Data.

For all section highlighted in yellow, user should not touch as it will break the formula. The value will be automatically popping up once you have all blue section information available.

5.3 Extra.oslo Preparation

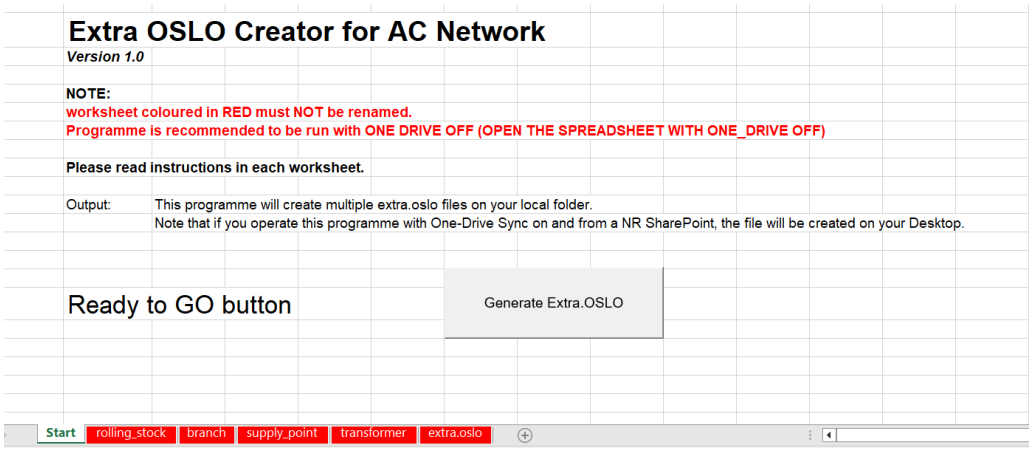
Due to the complexity of the impedance calculation depending on various settings, VBA application is adopted. Option 1 and Option 2 will generate a template for AC / DC in your current folder if there isn't a one already available. User should open the template and modify the information as required.

The source impedance calculation could be achieve automatically using the VBA application.



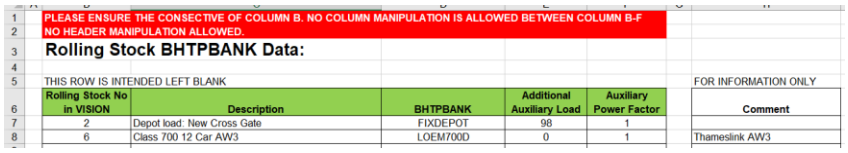
- Option 1: ac_extra_oslo_creator.xlsm will be created.

User should following excel on-screen instruction to update information as required.



It should be note that the default output with one-drive connection would be saved in:

"C:\Users\USER_NAME\OneDrive - Network Rail\Profile\Desktop"



PLEASE ENSURE THE CONSECTIVE OF COLUMN B. NO COLUMN MANIPULATION IS ALLOWED BETWEEN COLUMN B-F
NO HEADER MANIPULATION ALLOWED.

Rolling Stock BHTPBANK Data:

THIS ROW IS INTENDED LEFT BLANK — FOR INFORMATION ONLY

Rolling Stock No in VISION	Description	BHTPBANK	Additional Auxiliary Load	Auxiliary Power Factor	Comment
2	Depot load: New Cross Gate	FIXDEPOT	98	1	
6	Class 700 12 Car AW3	LOEM700D	0	1	Thameslink AW3

Rolling stock data can be input as required directly.

PLEASE ENSURE THE CONSECTIVE OF COLUMN C (INDEX). NO COLUMN MANIPULATION IS ALLOWED FOR COLUMN B-H.
NO HEADER MANIPULATION ALLOWED.

Additional Electrical Branches Data:

		Start		End		Value Refers to Impedance Spreadsheet		FOR INFORMATION ONLY
No	OSLO Branch ID	Location Name	OSLO Node ID	Location name	OSLO Node ID	Branch Resistance [Ω]	Branch Reactance [Ω]	Comment
1	AF01	Kentish Town Up	NKEN	Grahame Park	NGRA	0.1110	0.2010	ATF - Up Line
2	AF02	Kentish Town Down	NKEN	Grahame Park	NGRA	0.1039	0.4790	ATF - Down Line
3	CB01	Supply Point A	SUP1	ATFS + 25kV Cable	FED1	0.6798	0.9878	Cable

Branch data can be input as required directly. Note that the ATF impedance should be calculated using the impedance calculation spreadsheet.

PLEASE ENSURE THE CONSECTIVE OF COLUMN C (SUBSTATION OSLO ID). NO COLUMN MANIPULATION IS ALLOWED FOR COLUMN A-O.
NO HEADER MANIPULATION ALLOWED.

Supply Point Data:

Substation Name	OSLO Supply Point ID	OSLO Node ID	Type	No-Load Voltage [kV]	No-Load Voltage Phase Angle [deg]	Minimum Three Phase Fault Level [MVA]	Type of Grid Transformer	Source Resistance [Ω]	Source Reactance [Ω]	DNO TranX Resistance [Ω]	DNO TranX Reactance [Ω]	Total Resistance [Ω]	Total Reactance [Ω]
Braybrooke SGT2	BRY1	MRH1	AT	26.25	0	12000	SGT	0.0114	0.1143	0	0	0.0114	0.1143
Braybrooke SGT2	BRY3	MRH2	AT	26.25	0	12000	SGT	0.0114	0.1143	0	0	0.0114	0.1143
Sundon	SUN1	SUF1	Classic	25	0	3200	Large (15/18 MVA)	0.0476	0.3877	0	0	0.0476	0.3877
Sundon	SUN2	SUF2	Classic	25	0	3200	Small (10 MVA)	0.0476	0.3877	0	0	0.0476	0.3877

Supply point data should be input from left to right in sequence. Note that cells highlighted in yellow contains important formular which should not be touched or deleted.

Supply point "Type" (column E) and "Type of Grid Transformer" (column I) contain a drop-down list to select.

PLEASE ENSURE THE CONSECTIVE OF COLUMN C (SUBSTATION OSLO ID). NO COLUMN MANIPULATION IS ALLOWED FOR COLUMN A-Q.
NO HEADER MANIPULATION ALLOWED.

Transformer Data:

Transformer Name	Transformer Type	Transformer OSLO ID	Primary OSLO ID	Primary Voltage [kV]	Secondary OSLO ID	Secondary Voltage [kV]	Number of Parallel TranX	Transformer Spec	Transformer Tap Setting	FLR Tap Setting	Transformer Resistance [Ω]	Transformer Reactance [Ω]	FLR Reactance [Ω]	Total Resistance [Ω]	Total Reactance [Ω]
Braybrooke SGT2	Grid TranX	SGT2	MRH1	26.25	MRF1	26.25	1	ABB Spec	4	N/A	0.1000	3.7468	0	0.1000	3.7468
Braybrooke SGT2	Grid TranX	SGT1	MRH2	26.25	NMR1	-26.25	1	ABB Spec	4	N/A	0.1000	3.7468	0	0.1000	3.7468
Sundon	Grid TranX	SGT7	SUG1	26.25	SUF1	26.25	1	WCML Spec	3	2	0.1000	3.1008	1.9	0.1000	5.0008
Sundon	Grid TranX	SGT6	SUG2	26.25	SUF2	26.25	1	WCML Spec	3	2	0.1000	3.1008	1.9	0.1000	5.0008
Autotransformer XXX	Auto TranX	AT01	MRH2	27.5	BMR1	-27.5	2	Standard	Standard	N/A	3.6300	0.4033	0	3.6300	0.4033

Transformer data should be input from left to right in sequence. Note that cells highlighted in yellow contains important formular which should not be touched or deleted.

"Transformer Type" (column C), "Transformer Spec" (column J), "Transformer Tap Setting" (column K) and "FLR Tap Setting" (column L) contain a drop down list to select.

Once all information is input as required, user should click 'Generate Extra.OSLO' button from 'Start' tab.

- Option 2: dc_extra_oslo_creator.xlsm will be created.

User should following excel on-screen instruction to update information as required.

Extra OSLO Creator for DC Network
Version 1.0

NOTE:
worksheet coloured in RED must NOT be renamed.
Programme is recommended to be run with ONE DRIVE OFF (OPEN THE SPREADSHEET WITH ONE_DRIVE OFF)

Please read instructions in each worksheet.

Output: This programme will create multiple extra.oslo files on your local folder.
Note that if you operate this programme with One-Drive Sync on and from a NR SharePoint, the file will be created on your Desktop.

Ready to GO button — Generate Extra.OSLO

Start | rolling_stock | cables | substation_list | extra.oslo

It should be note that the default output with one-drive connection would be saved in:

"C:\Users\USER_NAME\OneDrive - Network Rail\Profile\Desktop\ExtraOSLO"

PLEASE ENSURE THE CONSECTIVE OF COLUMN B. NO COLUMN MANIPULATION IS ALLOWED BETWEEN COLUMN B-F
NO HEADER MANIPULATION ALLOWED.

Rolling Stock BHTPBANK Data:

THIS ROW IS INTENDED LEFT BLANK

Rolling Stock No in VISION	Description	BHTPBANK	Additional Auxiliary Load	Auxiliary Power Factor	FOR INFORMATION ONLY Comment
2	Depot load: New Cross Gate	FIXDEPOT	98	1	
6	Class 700 12 Car AW3	LOEM700D	0	1	Thameslink AW3

Rolling stock data can be input as required directly.

PLEASE ENSURE THE CONSECTIVE OF COLUMN C (INDEX). NO COLUMN MANIPULATION IS ALLOWED FOR COLUMN B-H.
NO HEADER MANIPULATION ALLOWED.

Additional Electrical Branches Data:

		Start		End			FOR INFORMATION ONLY	
No	OSLO Branch ID	Location Name	OSLO Node ID	Location name	OSLO Node ID	Cable Impedance [mΩ]	Cable Impedance [Ω]	Comment
1	A001	Southborough Tunnel North	SBO2	Southborough Tunnel South	SBO1	11.088	0.011088	
2	A002	GroveHill S/S	GHIL	Strawberry Tunnel South	GHI1	29.568	0.029568	
3	A003	Wadhurst Tunnel North	WAD2	Wadhurst Tunnel South	WAD1	33.88	0.033880	

Cables data can be input as required directly. Note that the cable impedance calculation needs to be further investigated due to the beta version of OSLO DC model engine.

PLEASE ENSURE THE CONSECTIVE OF COLUMN C (SUBSTATION OSLO ID). NO COLUMN MANIPULATION IS ALLOWED FOR COLUMN A-L.
NO HEADER MANIPULATION ALLOWED.

DC Substation Data:

Voltage Drop Across TRU [V] 40

NOTE: N-1 REFERS TO ONE TRU OUTAGE.

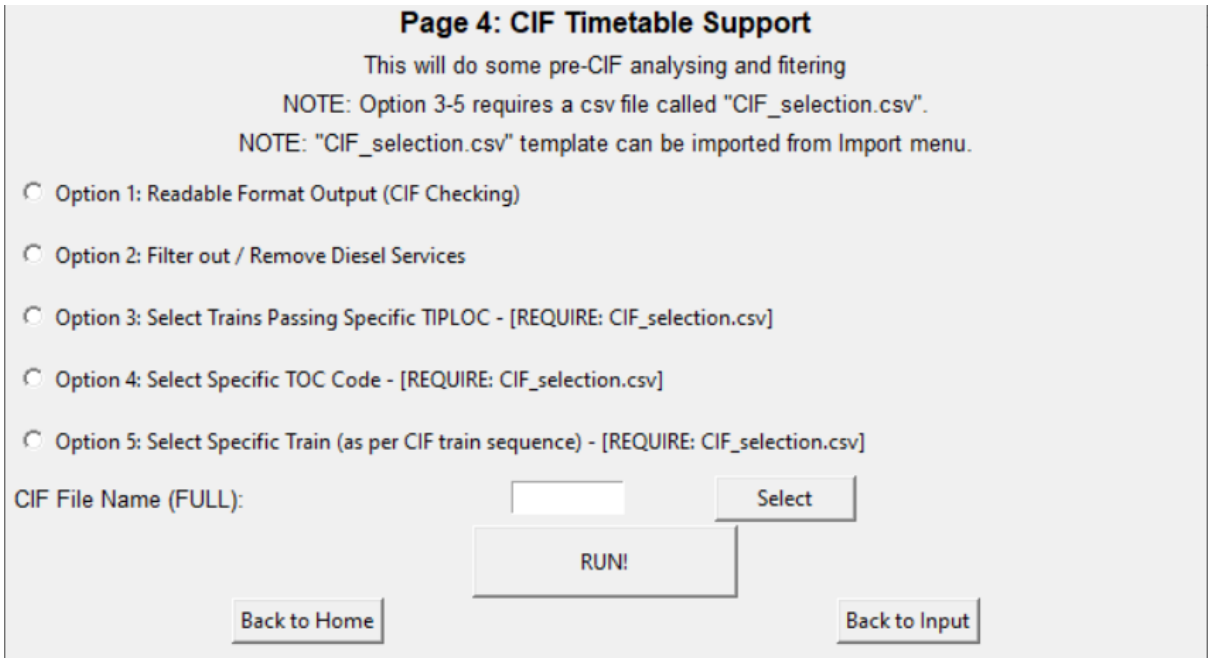
Substation Name	OSLO Node ID	Outage Scenario	Substation TRU Rating [MW]	Substation TRU Type	Number of TRUs	Substation No-Load Voltage [V]	N-0 Capacity [MW]	N-1 Capacity [MW]	N-0 Impe [mΩ]	N-1 Impe [mΩ]	FOR INFORMATION ONLY Comment
Abbey Wood	ABBY	3	3	G	1	790	3	0	10	10	Add as new
Abbotscliffe	ABBT	7	2.5	G	1	790	2.5	0	12	12	Updated
Adisham	ADIS	4	2.5	F	1	790	2.5	0	12	12	
Albany Park	ALPK	3	3	G	1	790	3	0	10	10	
Ashford	ASHF	8	3	F	2	790	6	6	5	10	
Balham	BALH		4	G	2	790	8	8	3.75	7.5	
Barming	BARM	7	3	G	1	790	3	0	10	10	
Barnehurst	BARN	8	3	G	1	790	3	0	10	10	
Bearsted	BEAR	5	3	G	1	790	3	0	10	10	
Bekesbourne	BEKE	3	2.5	F	1	790	2.5	0	12	12	

Supply point data should be input from left to right in sequence. Note that cells highlighted in yellow contains important formular which should not be touched or deleted.

Outage scenario number needs to be defined based on substation geographical location, the reason behind this is outside the scope of this document. Refer any DC related traction power modelling report for understanding.

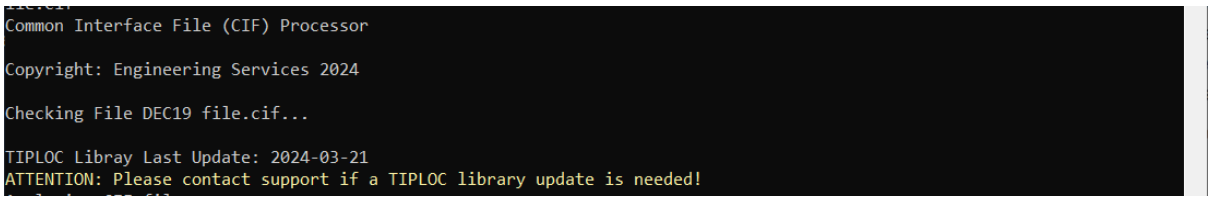
Once all information is input as required, user should click ‘Generate Extra.OSLO’ button from ‘Start’ tab.

5.4 CIF Timetable Support



This provides various CIF file modification methods. All options require at least CIF file saved in your current folder.

It should be noted that a TIPLOC – Railway Station Name library has been included in this tool. The last update information is available when running any options.



For option 3-5, 'CIF_selection.csv' is required as an additional input file. User's folder should contain the files as shown below.

This file can be generated using the 'CSV – CIF_slection.csv' option found in the 'Import' menu. This file follows the format shown below. After allocating the necessary information in the file, user must save and close it.

	A	B	C	D
1	TIPLOC_se	TOC_selec	Train_select_list	
2	BARKING	SR	10	
3	ACTONML	SW	11	
4			12	
5			13	
6			14	
7			15	
8			16	
9			17	
10			18	
11			19	
12			20	
13			21	
14			22	
15			23	
16			24	
17			25	
18				

The input requirements further explained in each section below.

5.4.1 Option 1 Output CIF file to a readable format

This option read the text-based CIF file and output into an excel-based file format. This supports further filtering which will be explained below.

Option 1 requires the full CIF file name to be entered or selected as an input.

The following files will be generated automatically:

- CIFName_Summary.csv: this file contains various summary information including a list of all TIPLOCs, a list of all timing locations, a list of all TOC codes, a list of all original stations, a list of all destination stations and the total number of services for each day. Note that the total number of services is for indication only as it does NOT consider whether a service entry is optional or cancelled or run in specific date range.

TIPLOC_all	Location_all	ATOC_Code_all	Origin_all	Destination_all	Monday_s	Tuesday_s	Wednesda	Thursday_	Friday_ser	Saturday_	Sunday_services
ABCWM	Abercwmboi	AW	Aberdeen	Aberdeen	6725	6887	6840	6897	6887	5243	3925
ABDARE	Aberdare	CC	Aberdeen Clayhills Carriage Ma	Aberthaw Tarmac Colas Rail							
ABGLELE	Abergele & Pensa	CH	Acton Terminal Complex	Acton Main Line							
ABHLJN	Abbeyhill Junctior	CS	Acton Yard GB Railfreight	Acton Terminal Complex							
ABINGTN	Abington	EM	Aldersbrook Up Carriage Holdir	Airport Tyne & Wear Metro							
ABRCYNS	Abercynon South	ES	Aldwarke UES	Aldersbrook Up Carriage Holding Sidings							
ABRD27	Aberdeen Signal A	EU	Alexandra Dock Junction Termi	Aldwarke UES							
ABRDCH	Aberdeen Clayhill	GC	Allerton Diesel Multiple Unit De	Alexandra Dock Junction Terminal Complex							
ABRDEEN	Aberdeen	GN	Allington ARC Siding	Allerton Diesel Multiple Unit Depot							
ABRDFJN	Aberdeen Ferryhi	GR	Angerstein Wharf GB Railfreigh	Allington ARC Siding							
ABRGVNY	Abergavenny	GW	Angerstein Wharf Tarmac	Amersham							
ABTH	Aberthaw	HT	Appleford Sidings	Angerstein Wharf GB Railfreight							
ABTH433	Aberthaw Signal (	HX	Arcow Quarry GB Railfreight	Angerstein Wharf Tarmac							
ABTH440	Aberthaw Signal (	LE	Ardingly	Appleford Sidings							

- CIFName_Detail.csv: this file contains a summary of all services basic information as recorded in the CIF file – BS and BX header. It also records the services departure and destination station and the total number of status changes en route, including the power mode after each status change.

Train_ID	Type	UID	Date_Run	Date_Run	Mon	Tue	Wed	Thr	Fri	Sat	Sun	BH	Status	Category	Identity	Headcode	Course_In	Service_C	Business_	Power_Ty	Timing_Lc	Speed	Operating	Seating_C	Sleepers
1	N	C00524	191215	200510	0	0	0	0	0	0	1		F	B4	6.00E+46		1	5.8E+07		D	2200	60			
2	N	C01880	191215	200510	0	0	0	0	0	0	1		F	A0	4C77		1	5.8E+07		D	600	75			
3	N	C01881	191215	200510	0	0	0	0	0	0	1		F	A0	6C77		1	5.8E+07		D	2000	60			
4	N	C01950	191215	200510	0	0	0	0	0	0	1		F	B4	6L12		1	5.9E+07		D	1200	60	Q		
5	N	C02187	191215	200510	0	0	0	0	0	0	1		P	XX	1D81	7031	1	2.2E+07		DMU		125		B	
6	N	C02350	191215	200510	0	0	0	0	0	0	1		F	B1	6F28		1	5.9E+07		D	1600	60	Q		
7	N	C02439	191215	200510	0	0	0	0	0	0	1		P	XX	1C09		1	2.3E+07		EMU	700	100	D	B	
8	N	C02440	191215	200510	0	0	0	0	0	0	1		P	XX	1C10		1	2.3E+07		EMU	700	100	D	B	
9	N	C02441	191215	200510	0	0	0	0	0	0	1		P	XX	1C76		1	2.2E+07		EMU	365	100	D	B	
10	N	C02451	191215	200510	0	0	0	0	0	0	1		P	XX	1T10		1	2.2E+07		EMU	365	100	D	B	

Resevatio	Connectio	Catering_	Service_Bi	Spare	STP_Indic	UIC_Code	ATOC_Co	Applicable	Retail_Ser	Info_Chan	Origin	Destinatic	Location1	Power_Ty	Location2	Power_Ty	Location3	Power_Ty	Location4	Power_Ty	Location5	Power_Ty	Location6	Power_Ty	Location7
							ZZ	Y			0	Merehead	Hitchin Up Yard												
							ZZ	Y			0	Scunthorp	Immingham Bulk Terminal Freightliner Heavy Haul												
							ZZ	Y			0	Immingha	Scunthorpe Coal Handling Plant Freightliner Heavy Haul												
							ZZ	Y			2	Burngullo	Bow East Exeter Riv	D			Acton Terr	D							
R		C					GC	Y			1	Kings Cro	Bradford I	Doncaster	DMU										
							ZZ	Y			0	Arpley Sid	Liverpool European Metals Recycling Mersey Dock & Harbour Company												
							TL	Y			0	Cambridge	Kings Cross												
							TL	Y			0	Kings Cro	Cambridge												
							GN	Y			0	Kings Cro	Cambridge												

- CIFName_ChangeEnRoute.csv: this file contains a summary of all status changes for all services as recorded in the CIF file – CR header.

Train_ID	TIPLOC	Location	Category	Identity	Headcode	Course_In	Service_Cc	Business_S	Power_Ty	Timing_Lo	Speed	Operating	Seating_Cl	Sleepers	Resevatior	Connectioi	Catering_C	Service_Br	Traction_C	UIC_Code	Retail_Service_ID
4	EXETRRY	Exeter Rive	B4	6L12		1	5.9E+07		D	2200	60	Q									
4	ACTONTC	Acton Terr	B4	6L12		1	5.9E+07		D	2200	60	Q									
5	DONC	Doncaster	XX	1D81	7031	1	2.2E+07		DMU		125		B		R		C				
193	CLCHSTR	Colchester	EE	5T84		1	2.2E+07		DMU	S	75	D									
227	PBRO	Peterboroi	XX	1L44	6181	1	2.2E+07		DMU	E	100		B		S						
228	PBRO	Peterboroi	XX	1L46	6201	1	2.2E+07		DMU	E	100		B		S						
236	PBRO	Peterboroi	XX	1N55	6691	1	2.2E+07		DMU	E	100		B		S		T				
237	PBRO	Peterboroi	XX	1N57	6711	1	2.2E+07		DMU	E	100		B		S						
238	PBRO	Peterboroi	XX	1N59	6731	1	2.2E+07		DMU	E	100		B		S						
254	EDINBUR	Edinburgh	XZ	1M16	3002	1	2.4E+07	1	E	595	80		S	B	A		R				
256	EDINBUR	Edinburgh	XZ	1S25	3001	1	2.4E+07	1	D	385	125		S	B	A		R				

- CIFName_Timetable.csv: this file contains all services detailed timetable in a tabulate csv format.

Train_ID	TIPLOC	Location	Arrival Tir	Depature/	Time(A/D)	Platform	Line	Path	Activity	Engineerin	Pathing Al	Performance Allowance
1	MERHFHH	Merehead Quarry Fre		23:55:00	23:55:00				TBPR			
1	WHTSXSG	Whites Cr	00:05:00	00:07:00	00:07:00				PRRM			
1	MERHDQJ	Merehead Quarry Jur		00:16:00	00:16:00							
1	ESTSOMJ	East Somerset Junctic		00:24:00	00:24:00	UGL						
1	BLBGJN	Blatchbridge Junction		00:32:00	00:32:00							
1	CLNKRDJ	Clink Road Junction		00:34:00	00:34:00							
1	FRWDJN	Fairwood Junction		00:38:00	00:38:00						1	
1	WSTBRYW	Westbury	00:42:00	00:44:00	00:44:00	2			A			
1	HWRDJN	Heywood Road Juncti		00:47:00	00:47:00							
1	LAVNGTN	Lavington		00:55:00	00:55:00							
1	WBORO	Woodborough		01:11:00	01:11:00	UGL						
1	BEDYN	Bedwyn		01:29:00	01:29:00	2						
1	NEWBURY	Newbury		01:43:00	01:43:00							
1	SCOTEJN	Southcote Junction		01:59:00	01:59:00							
1	RDNGORJ	Reading Oxford Road		02:01:00	02:01:00		DFR					
1	RDNGSTN	Reading		02:03:30	02:03:30	12	DRL					
1	RDNGKBJ	Reading Kennet Bridg		02:05:00	02:05:00		RL					

5.4.2 Option 2 Remove Diesel Services

Output file: CIFName_NoDiesel.cif

This process will do the following adjustment to the CIF file:

- It will remove all TIPLOC record section. (i.e. TI, TA and TD header)
- It will remove all BS header information without any timetable associated. (that usually the case for cancelled services record)
- It will remove BS header with the following power mode. It should be note that HST is current retained as high-speed train could be run with electric unit.
  - D
  - DEM
  - DMU
- Each time there is a power mode change in the timetable, it will create generate a new train service using the CR header info directly.

Users are suggested to check the generated new CIF with option 1 again to review the outcome.

5.4.3 Option 3 Filter against TIPLOC

Input file: CIF_selection.csv – 1st column

Output file: CIFName_TIPLOC.cif

This process will choose all services passing the TIPLOC as listed under the first column in "CIF_selection.csv". For a services under one BS header, as long as there is one TIPLOC located within

the TIPLOC list defined in the CIF_selection.csv, the whole journey from that BS header will be recorded in the new generated CIF file.

Note that this process does not remove diesel services and does not split the trains based on CR header record.

5.4.4 Option 4 Filter against TOC code

Input file: CIF_selection.csv – 2nd column

Output file: CIFName_TOC.cif

This process will choose all services that assigned with a TOC code as listed under the second column in "CIF_selection.csv". For a services under one BS header, the TOC code under BX header will be compared against the TOC list. It should be noted that if a service come with not valid TOC code, i.e. empty information, that service will still be recorded as to be decided by the user at a later stage.

Note that this process does not remove diesel services and does not split the trains based on CR header record.

5.4.5 Option 5 Filter against Train No

Input file: CIF_selection.csv – 3rd column

Output file: CIFName_Train.cif

This option should be used if any customized selection is expected based on the available CIF file. This process will choose all services that listed under the third column in "CIF_selection.csv".

It should be noted that Option 1 is required to be run to support the train list selection.

Note that the Train No in CIF_selection.csv refers to service number against the selected CIF, i.e. Column 'Train ID' from the 'CIFName_CIF_Details.csv'.

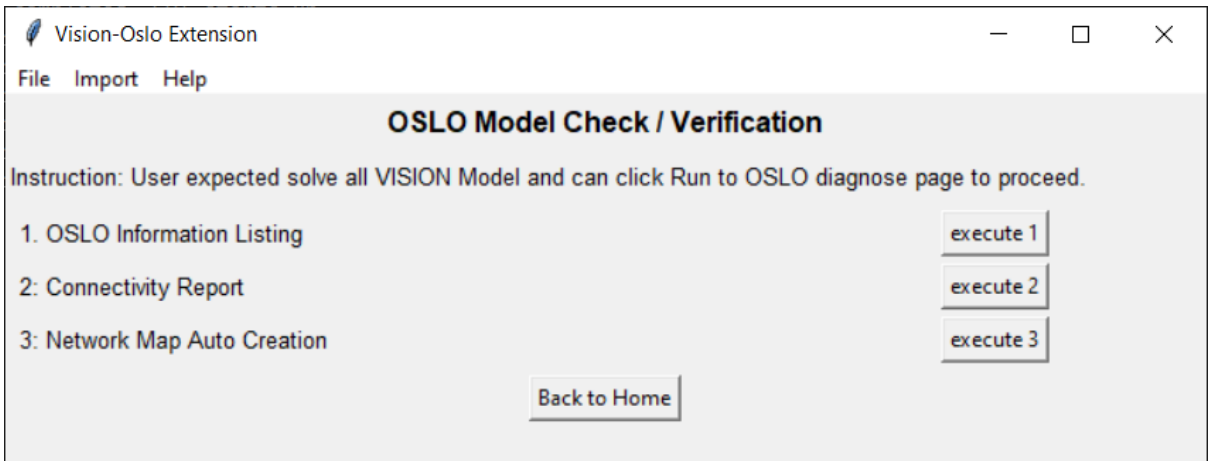
User could generate a unique list in excel based on customised requirements, such as running on specific day, departing from a specific station, with specific power mode, with specific head code, with specific speed profile, etc.

User could then copy the selected list into the 3rd column in 'CIF_selection.csv'. Run this option to generate a new CIF that covers the selected trains ONLY.

Note that this process does not split the trains based on CR header record.

5.5 Provision for development

6 OSLO Model Validation



This page is designed to support the additional OSLO model validation and trouble shooting.

For people who start working on an existing model, or act as the checker or reviewer, the output from this model validation could generate various report.

It should be noted that the default VISION-OSLO error should be cleared before using this function. (i.e., user should be able to click the run button and model is able to run to the first-time step).

Required input file for all options on this page:

***.lst.txt

This is the autogenerated list file containing all model information once all systematic checking passed.

6.1 OSLO information listing

Input:

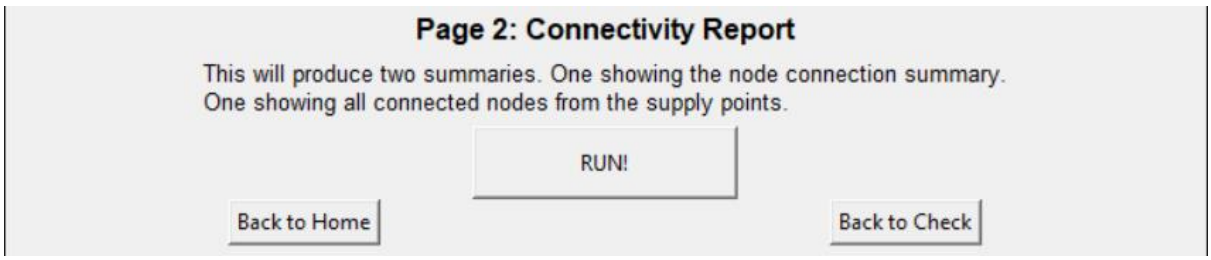
- Simulation name selected or input
- ***.lst.txt

This process generates the following reports:

- ***_error_warning.txt: This is a summary list of all warnings by VISION OSLO automatic checking process. It should be noted that it should only contains warnings as errors needs to be cleared before running this option.
- ***_branch.csv: This is a summary list of all branches in the model including OSLO branches, branches section in extra.oslo and transformer section in extra.oslo.

- ***_branch_detail.csv: This is a summary list of a detailed section after the VISION OSLO cross-checking process and including all stubs information. VISION OSLO cross checking will split the section into even smaller section based on VISION track ID in order to support the actual simulation run. The stub utilizes a different calculation mechanism during simulation which does not use 'Nodal Admittance Matrix' method as used by calculation method for branch data.
- ***_supply_point.csv: This is a summary list of all supply points in extra.oslo
- ***_transformer.csv: This is a summary list of all transformers in extra.oslo
- ***_node_connected_branch.csv: This is a summary list of all nodes and all branches that connected to each node. Note that this is useful information especially for OLE rating analysis or DC related analysis.

6.2 OSLO Connectivity Report



Input:

- Simulation name selected or input
- ***.lst.txt

This process generates the following reports:

- ***_node_connection_summary.csv: This is a summary of all interconnected nodes, directly or indirectly. This is particularly important for DC model because DC model require at least ONE supply point for each line. An ideal DC model should only contain ONE line as all substations should be interconnected.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	No	Node_ID																					
2	1	NBM1	SRD4	NKEN	ETH1	KSP1	NAPA	SRD1	KJNC	BOR1	WHJN	KHPN	KTJ1	KTJ2	BM1	MDRD	SRD3	SRD2	NGRA	HNDL	CTH1	KENT	KSP2
3	2	SUN1	SUD1	NTH2	BDF2	SHN1	ETH2	BDF3	ANT1	BDF1	BED1	BDF4	LOO2	LOO3	LEE1	NEE1	LOO1	LOO4	NUN1				

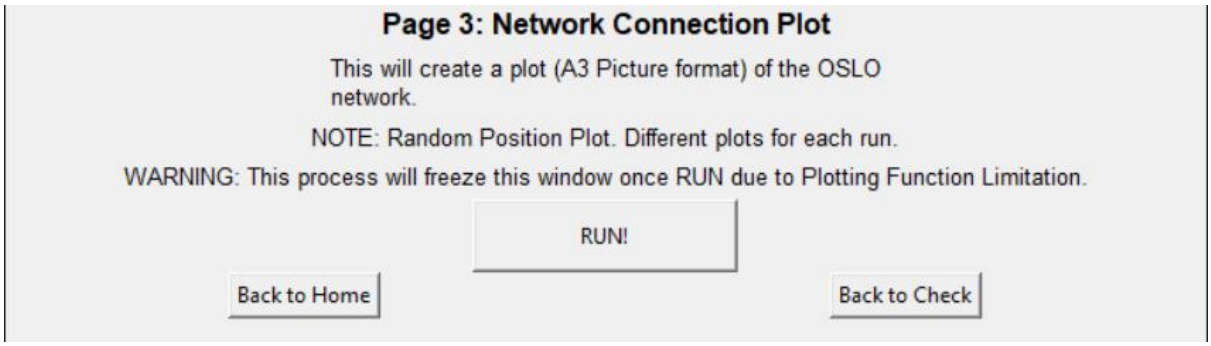
- ***_supply_point_connected_branches.csv: This is a summary of all interconnected branches, directly or indirectly, from a supply point. This is particularly useful for AC model to support umeanuseful analysis and OLE rating analysis.

No	SP_Name	SP_Node_	Connected_Branch_ID																			
1	BOF1	BOR1	320B	321B	323B	324B	328B	329B	330B	331B	332B	496B	497B	498B	501B	502B	503B	504B	505B	506B	507B	523B
2	SUF1	SUD1	362B	363B	364B	365B	598B	599B	600B	601B	623A	624A	625A	626A	627B	628B	629B	630B	631B	632B	633B	634B
3	BRF1	BRA1	641B	642B	643B	644B	645B	646B	647B	648B	649B	650B	651B	651C	652B	652C	653A	654A	655B	656B	AF11	AT15

- ***_supply_point_connected_nodes.csv: This is a summary of all interconnected nodes, directly or indirectly, grouped by each supply point. This Is particularly useful for AC voltage analysis.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	No	SP_Name	SP_Node_	Connected_Node_ID																			
2	1	BOF1	BOR1	BM1	CTH1	CTH2	ETH1	FARR	GP1	HNDL	KENT	KHPN	KJNC	KSP1	KSP2	KTJ1	KTJ2	MDRD	NAPA	NBM1	NGRA	NKEN	SRD1
3	2	SUF1	SUD1	ANT1	BDF1	BDF2	BDF3	BDF4	BED1	ETH2	LEE1	LOO1	LOO2	LOO3	LOO4	NEE1	NTH2	NUN1	SHN1	SUN1			
4	3	BRF1	BRA1	BRY1	COR1	COR2	HARJ	IRCH	KET1	KET2	KETT	NKET	NRY1	SHN2									

6.3 OSLO Network Map Plot



Input:

- Simulation name selected or input
- ***.lst.txt

Output: ****_Auto_Plot.png

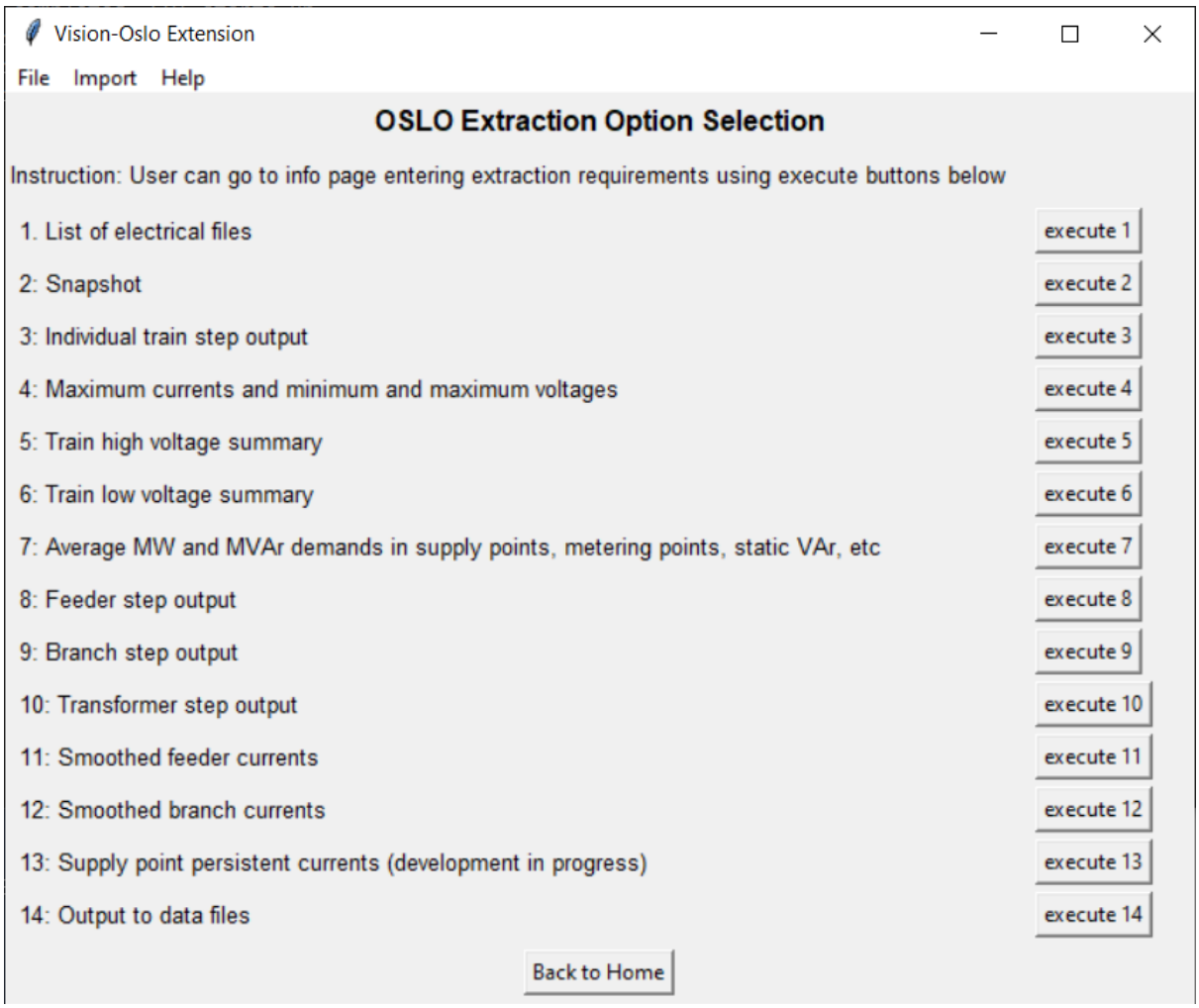
This function creates network plot using default algorithm. Due to the missing of geographical information in VISION OSLO model, the nodes are randomly allocated in the plot.

Every time the 'Run' button is clicked, an output file with a number suffix will be created in user's current folder. The number will be auto incremented for each run avoiding the overwritten of any previous plot.

Users are expected to check several graphs and choose the best one as some plots might have crossing lines in multiple places due to the complexity of the model.

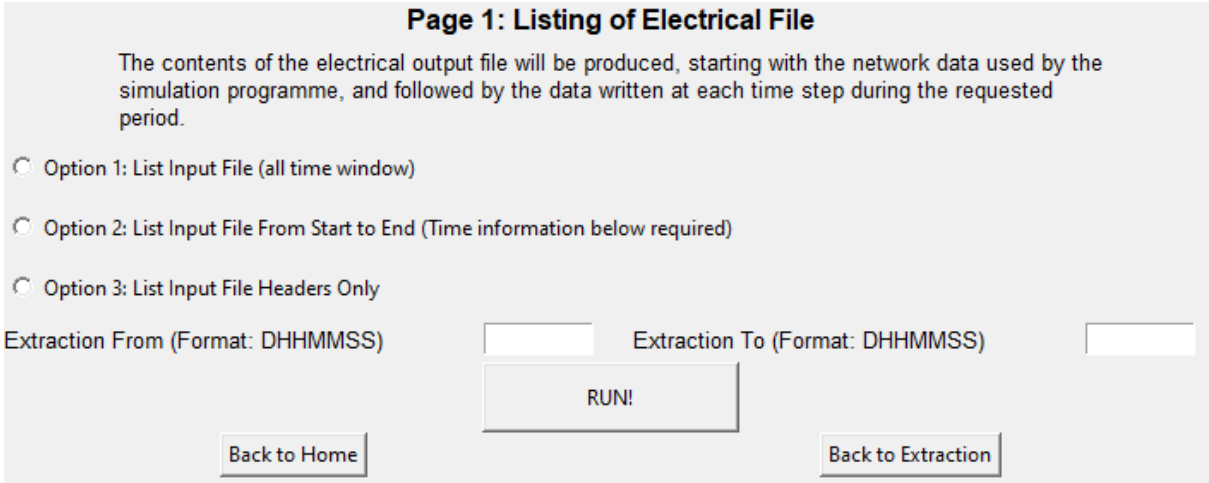
In output plot, red dots represent a supply point node, while blue dots represent other connection nodes (i.e., substation, junction, etc).

7 Default OSLO Extraction



On this page, users can extract simulation results using various assessment options. Oslo Output File (*.oof) is required for any assessments in this section. Refer to [3] for further details.

7.1 List of electrical files

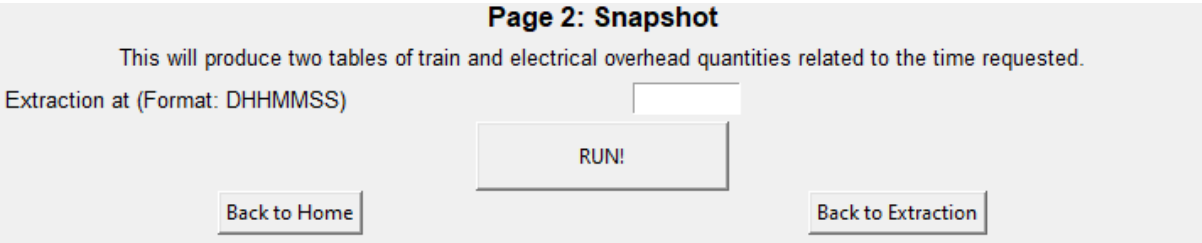


Output file: *.osop.lst

This section will generate a text file containing the electrical output, beginning with the network data used by the simulator program, and followed by the data written at each time step during the requested period. Three options are available in this section:

- Option 1, List Input File: provides the complete file over the entire simulation time which may be very large.
- Option 2, List Input File from Start to End: offers data written at each time step only between the times (in format DHHMMSS) allocated in the relevant boxes.
- Option 3, List Input File Headers Only: provides only the network data.

7.2 Snapshot

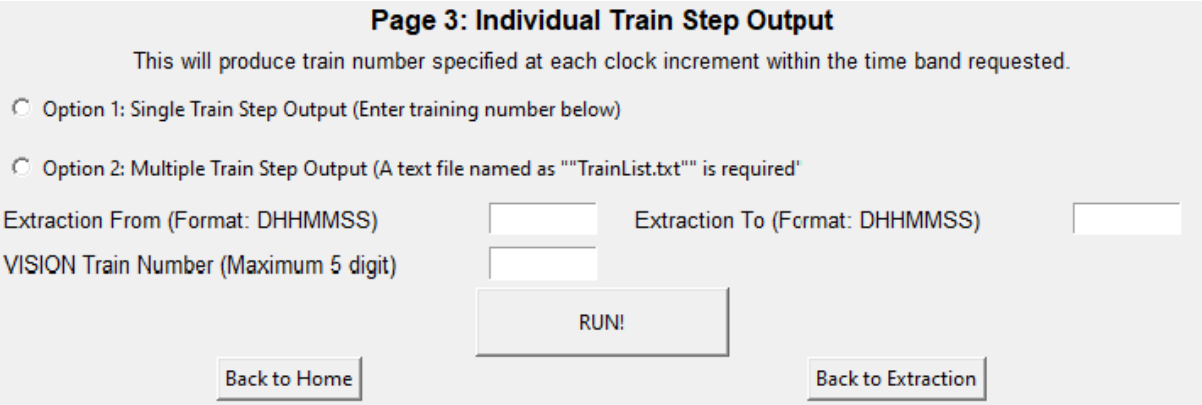


Output file: *.osop.snp

This section will produce a text file containing two tables of train and electrical overhead quantities related to the time allocated in the relevant box in format DHHMMSS.

- Table 1: relates to train data at that time; data includes train identification, positional of the train, train speed, tractive effort, current (A) drawn by the train and voltage (kV) at the train pantograph.
- Table 2: relates to the overhead network at that time, data includes the voltage (kV) for each node, the current (A) at the start and end of each branch and the relevant node voltage (kV) and current (A) for each supply point, metering point, static VAr compensator and motor alternator present.

7.3 Individual train step output

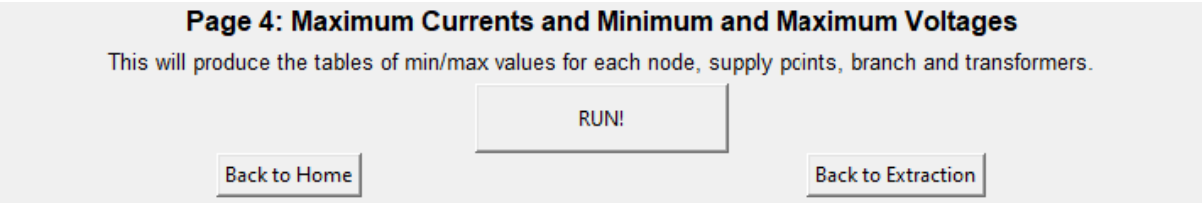


Output file: *.osop.ds1

This section will produce a text file containing Table 1 of Item 5.2 (Snapshot) for the train number specified at each time increment within the time band requested where times are in format DHHMMSS allocated in the relevant boxes. Two options will be available in this section:

- Option 1, Single Train Step Output: will produce train data for a train number specified in VISION Train Number box.
- Option 2, Multiple Train Step Output: will generate train data for a list of trains specified in 'TrainList.txt' file.

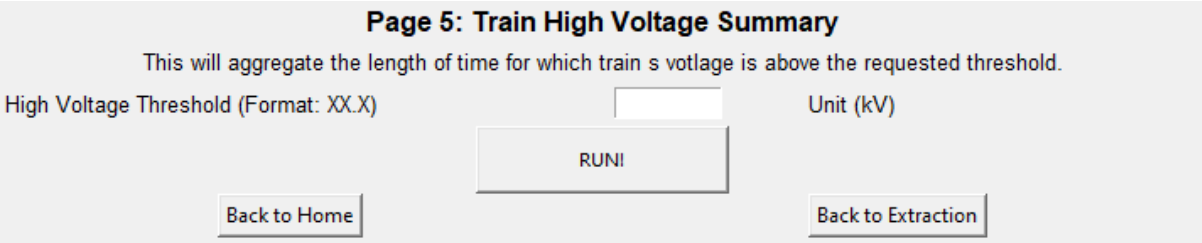
7.4 Maximum currents and minimum and maximum voltages



Output file: *.osop.mxn

This section will generate the tables of maximum and minimum instantaneous voltage (kV) and the relevant times for each node, maximum instantaneous normal current (A) and reverse current (A) and the relevant times for each supply point, maximum instantaneous current (A) and the relevant time passing through a branch and the maximum instantaneous current (A) and the relevant time for each winding of a transformer.

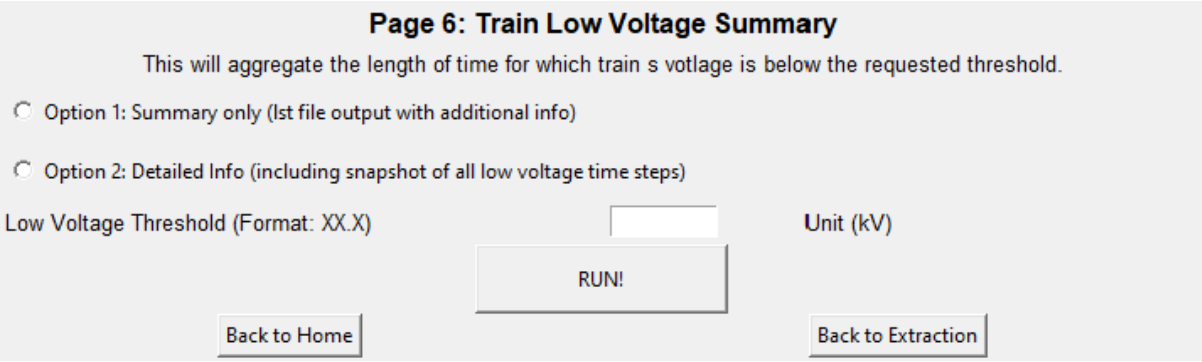
7.5 Train high voltage summary



Output file: *_maxtime.osop.vlt

This section will generate a text file containing trains data for all the trains running in the simulation. For each train in this file the software aggregates the length of time when the train's voltage is above the specified threshold allocated in the relevant box in format XX.X kV.

7.6 Train low voltage summary

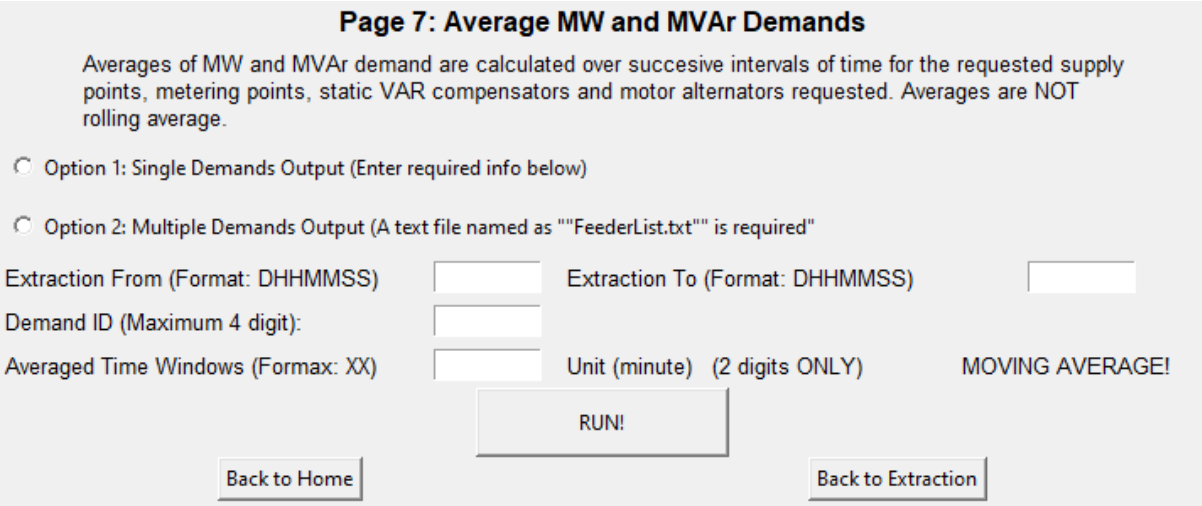


Output file: *_mintime.osop.vlt

This section will generate a text file containing trains data for all the trains running in the simulation. For each train in this file the software aggregates the length of time when the train's voltage is below the specified threshold allocated in the relevant box in format XX.X kV. Two options are available in this section:

- Option 1, Summary only: will generate the list of trains data including the sum total of time when the train's voltage is below the specified threshold for all the trains running in the simulation.
- Option 2, Detailed info.: Will generate a text file containing the data of Option 1, and Table 1 and Table 2 of Item 5.2 (Snapshot) for each time increment when the magnitude of the train's voltage is below the specified threshold.

7.7 Average MW and MVAr demands in supply points, metering points, static Var compensators and motor alternators



Output file: *.osop.pwr

This section will generate a text file containing the averages of MW (active power) and MVAr (reactive power) over successive intervals of time, in format XX minutes (e.g., every 15 or 30 minutes), for the requested supply points, metering points, static VAr compensators and motor alternators. Averages

are calculated at the start time and then at intervals of XX minutes for times less than or equal to the end time. The times are in DHHMMSS format.

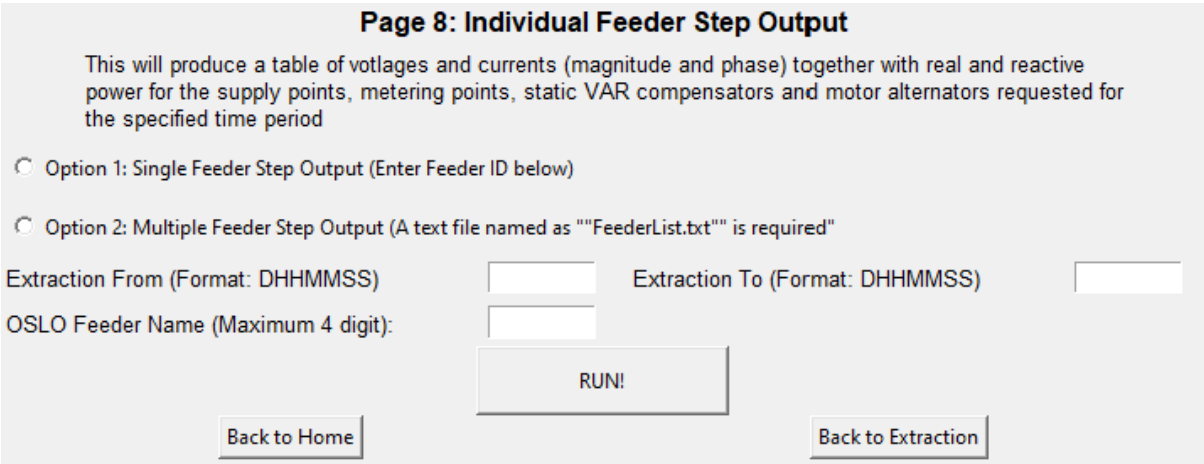
The results produced are the imported and exported active and reactive powers. They are based on the voltage at the relevant node, and the current in a specified path connected to the node as follows:

- For a supply point, the voltage is the voltage at the node to which the supply point is connected. The current is that which flows in the output impedance of the supply point.
- For a metering point, the voltage is the voltage of the relevant node, and the current is the total current in up to four branches at their points of connection to the node.
- For a static var compensator, the current is the total in the 'fixed capacitor' portion and the variable portion.
- Motor alternators are treated in the same way as supply points i.e., the current is that which flows in the impedance of the alternator, and the voltage is the voltage of the node to which the alternator is connected.

Two options are available in this section:

- Option 1, Single Demands Output: will produce the output file for the demand ID specified in the relevant box between the times (in format DHHMMSS) allocated in the relevant boxes.
- Option 2, Multiple Demands Output: will produce the output files for all demand IDs specified in 'FeederList.txt' file.

7.8 Feeder step output



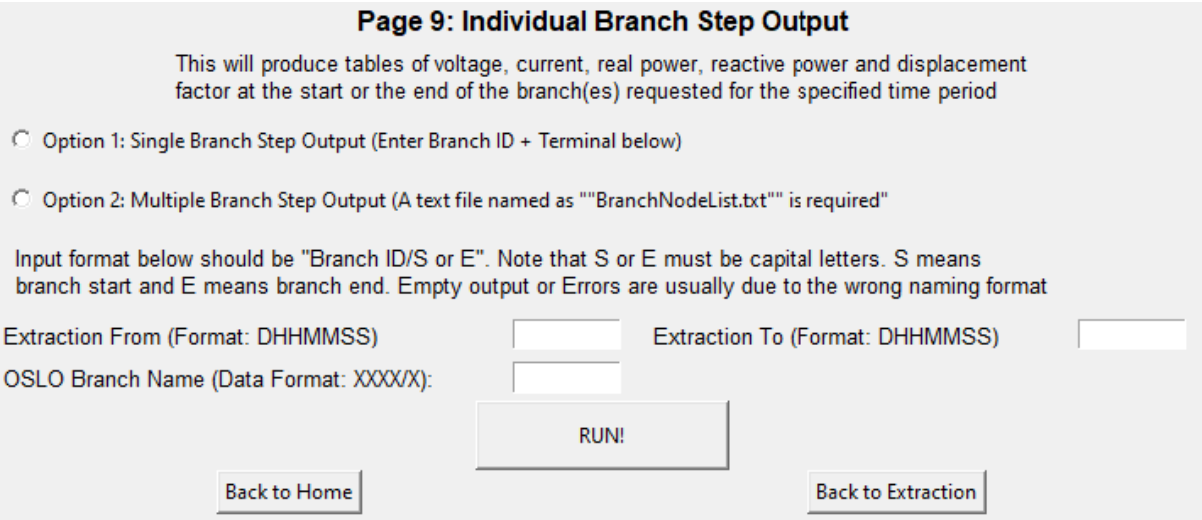
Output file: *.osop.d4

This section will generate a text file containing a table of active power (MW) and reactive power (MVAr) together with voltages (kV) and currents (A) (magnitude and phase) for the supply points, metering points, static VAr compensators and motor alternators requested for the specified time period in format DHHMMSS. Two options are available in this section:

- Option 1, Single Feeder Step Output: will produce the output file for the Oslo feeder name specified in the relevant box between the times (in format DHHMMSS) allocated in the relevant boxes.

- Option 2, Multiple Feeder Step Output: will produce the output files for all feeder names specified in 'FeederList.txt' file between the times (in format DHHMMSS) allocated in the relevant boxes.

7.9 Branch step output

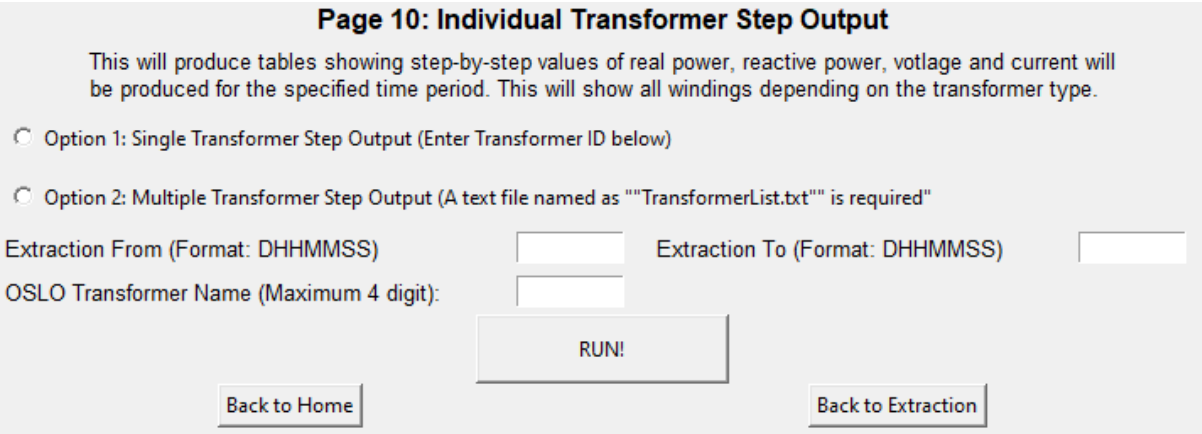


Output file: *.osop.d4

This section will generate a text file containing a table of active power (MW) and reactive power (MVAr) together with voltages (kV) and currents (A) (magnitude and phase) at the start or the end of a branch or branches. Two options are available in this section:

- Option 1, Single Branch Step Output: will produce the output file for the Oslo branch name specified in the relevant box in format XXXX/X (branch ID/value 'S' for start or 'E' for end, both in capital letter) between the times (in format DHHMMSS) allocated in the relevant boxes.
- Option 2, Multiple Branch Step Output: will produce the output files for all branch names specified in 'BranchList.txt' file between the times (in format DHHMMSS) allocated in the relevant boxes.

7.10 Transformer step output



Output file: *.osop.d4

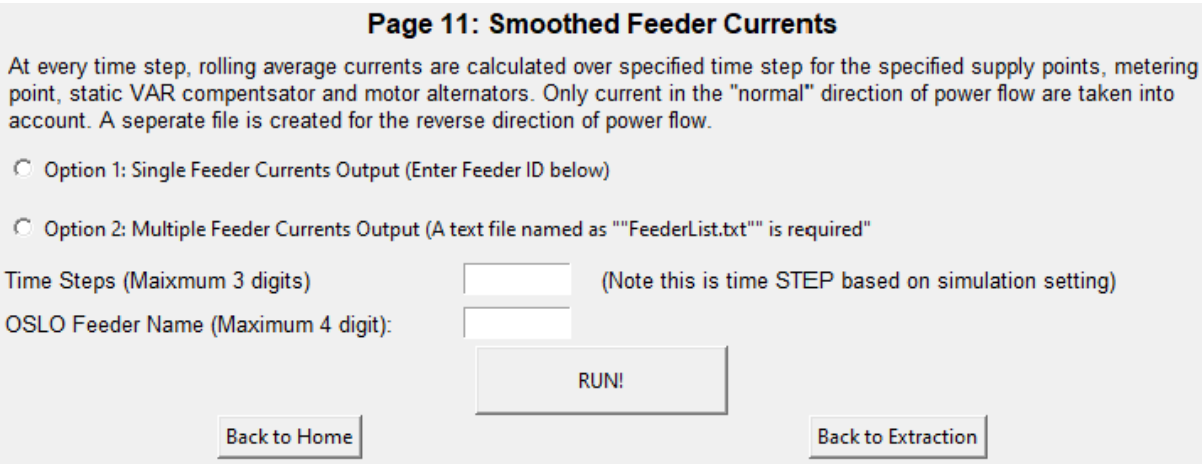
This section will generate a text file containing active power (MW), reactive power (MVAr), voltage (kV) and current (A) (magnitude and phase) of a transformer or transformers for the specified time period. The output produced depends on the type of transformer and is as follows:

- Normal two-winding transformer (type='N')
  Active and reactive power (MW/MVAr) based on the node voltage and transformer current at winding 1.
  Voltage (kV) and current (A) (magnitude and phase angle) on winding 1.
  Current (A) (magnitude and phase angle) on winding 2.
- Auto-transformer (type='A')
  Active and reactive power (MW/MVAr) based on the node voltage and transformer current at winding 1.
  Voltage (kV) and current (A) (magnitude and phase angle) on winding 1.
  Current (A) (magnitude and phase angle) in the centre-tap connection to the rails.
- Three-winding centre-tapped transformer (type='C')
  Active and reactive power (MW/MVAr) based on the node voltage and transformer current at winding 1.
  Voltage (kV) and current (A) (magnitude and phase angle) on winding 1.
  Current (A) (magnitude and phase angle) in the centre-tap connection to the rails.
- Two-winding transformer connected line-to-line (type='L')
  Active and reactive power (MW/MVAr) based on the node voltage and transformer current at winding 1.
  Voltage (kV) and current (A) (magnitude and phase angle) on winding 1.
  Current (A) (magnitude and phase angle) on winding 2.

Two options are available in this section:

- Option 1, Single Transformer Step Output: will produce the output file for the Oslo transformer name specified in the relevant box between the times (in format DHHMMSS) allocated in the relevant boxes.
- Option 2, Multiple Transformer Step Output: will produce the output files for all transformer names specified in 'TransformerList.txt' file between the times (in format DHHMMSS) allocated in the relevant boxes.

7.11 Smoothed feeder currents



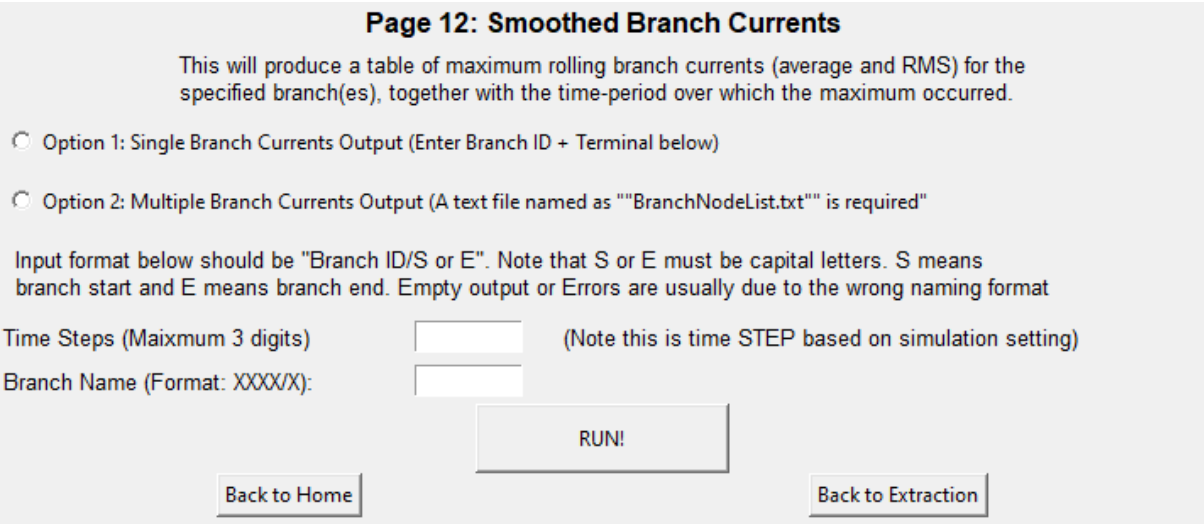
Output files: * _normal_fort.12 & *_reverse_fort.12

This section will generate a text file containing the maximum average current (A) and the times (between which the maximum average occurs) for the requested supply points, metering points, static VAr compensators and motor alternators. Averages are calculated over the time steps specified in Time Steps box (maximum 3 digits) at each time increment from the simulation start time and the maximum will be extracted from an average rolling time window across the entire simulation time.

Only currents in the "normal" direction of real power flow are considered. For supply points and motor alternators this means real power is being delivered to the overhead lines. For "reverse" direction a separate file will be generated. Two options are available in this section:

- Option 1, Single Feeder Currents Output: will produce the output file for the Oslo feeder name specified in the relevant box.
- Option 2, Multiple Feeder Currents Output: will produce the output files for all feeder names specified in 'FeederList.txt' file.

7.12 Smoothed branch currents



Output file: *.osop.mxn

This section will generate a text file containing the maximum average and maximum RMS current (A) and the times between which the maximum average or maximum RMS occurs for the requested branch or branches. Average currents and RMS currents are calculated over the time steps specified in Time Steps box (maximum 3 digits) at each time increment from the simulation start time and the maximum currents will be extracted from a rolling time window (average and RMS time windows) across the entire simulation time. Two options are available in this section:

- Option 1, Single Branch Currents Output: will produce the output file for the branch name specified in the relevant box in format XXXX/X (branch ID/value 'S' for start or 'E' for end, both in capital letter).
- Option 2, Multiple Branch Currents Output: will produce the output files for all branch names specified in 'BranchList.txt' file.

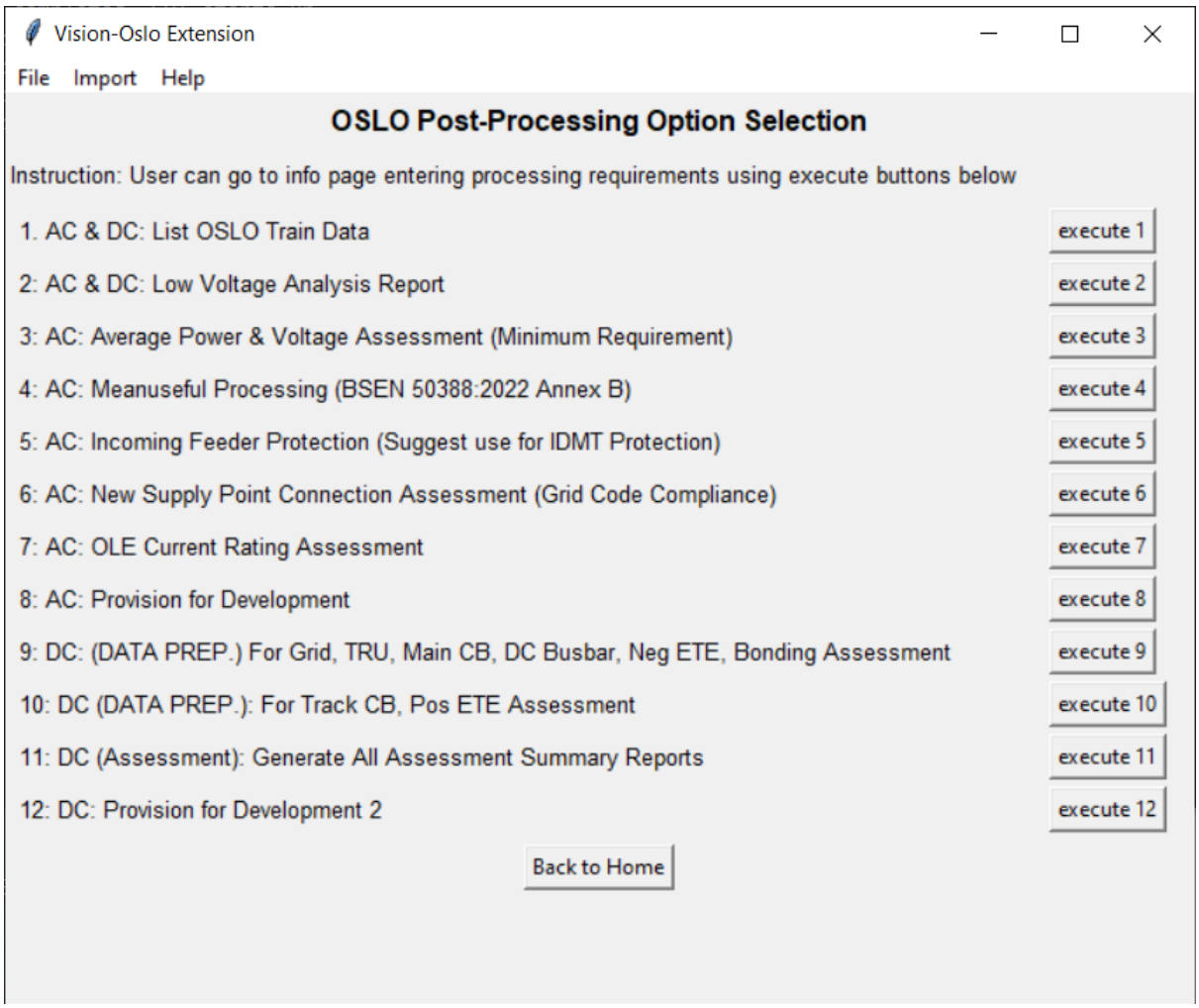
7.13 Supply point persistent currents

This function does not return meaningful output and is to be further investigated.

7.14 Output to data files

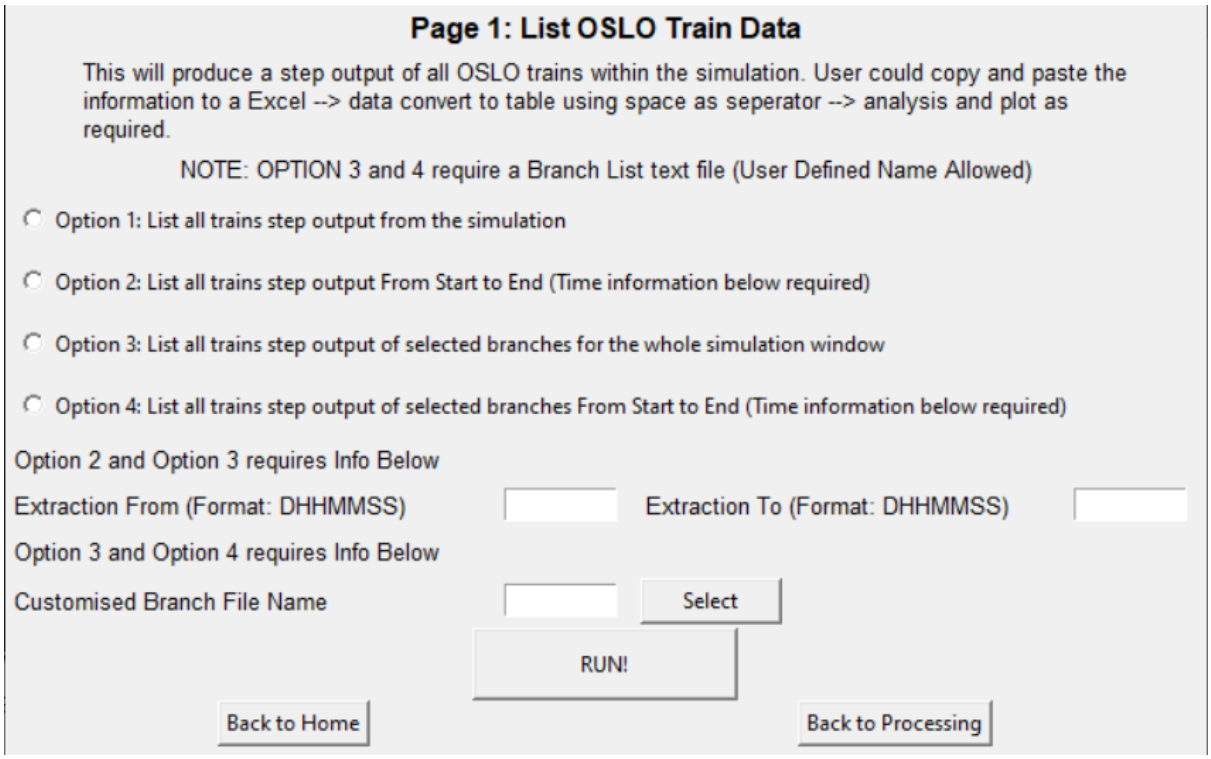
This function does not return meaningful output and is to be further investigated.

8 Customised Post-Processing



On this page, users can extract simulation results for specific AC and DC analyses such as low voltage, average power, negative phase sequence, mean useful voltage, current analysis, etc., using various assessment options to assess the simulation results against relevant standards.

8.1 AC & DC: List OSLO Train Data



Input file: ***.oof

Output file: ***.BranchName_timestart_timeend.csv

This function generates an excel based single csv file of detailed trains' step output during the selected time window and selected section. It calls list extraction first (see section 7.1 Option 1). Then it picks up all trains that located within the user defined branch list to be output to the csv file.

- Option 1: This will output all trains step output from the simulation.
- Option 2: [Read Time Info Input] This will output all trains step output within the selected time window from the simulation.
- Option 3: [Read Branch Name Input] This will output all trains step output within the selected branch list from the simulation.
- Option 4: [Read Time Info Input & Branch Name Input] This will output all trains step output within the selected time window and selected branch list from the simulation.

The output file will look like below:

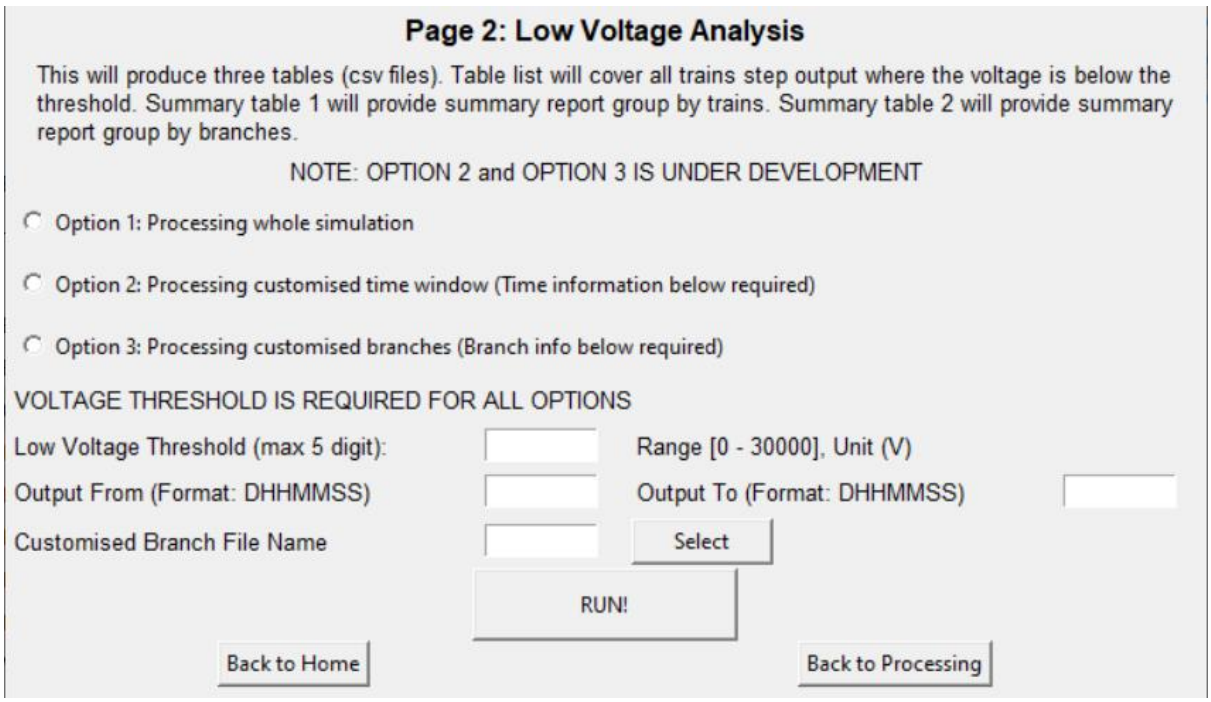
VO_ID	T_STEP	TIME	V_Re	V_Im	V_T	I_Re	I_Im	I_T	P_Re	P_Im	P_T	BRANCH	DELTA	E_TE	PERC%	DIS_GONE	INS_SPD	AV_SPD
1	25205	7.00.05	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0
1	25210	7.00.10	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0
1	25215	7.00.15	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0
1	25220	7.00.20	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0
1	25225	7.00.25	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0
1	25230	7.00.30	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0
1	25235	7.00.35	25012.3	-66.8	25012.39	5.6	0	5.6	140068.9	0	140068.9	007B	0.9753	0	0	0	0	0

It contains from left to right: Train VISION ID, Train Time Step (compare to 00:00:00), Train Time, Pantograph Real Voltage, Pantograph Reactive Voltage, Pantograph Total Voltage, Pantograph Real Current, Pantograph Reactive Current, Pantograph Total Current, Pantograph Real Power, Pantograph Reactive Power, Pantograph Total Power, Train Located Branch, Train Located Branch Position

(percentage relative to the branch start position), Train Tractive Effort in KN, Train Percentage Tractive Effort Applied, Train Distance Gone (relative to start station), Train Instant Speed, Train Average Speed.

Note that this function is useful when analysing a specific track section is required.

8.2 AC & DC: Low Voltage Analysis Report



Note that for version 1.0.0. All three options will perform exactly the same operation, as this is pending further development. User is suggested to use Option 1 only as Option 2 and 3 have additional checking of the input but does not perform different analysis.

Input file: *.oof

Required input: Voltage threshold with maximum 5 digit between 0 to 30000.

The function will call list extraction first (see section 7.1 Option 1). Then it performs some analysis based on the *.osop.lst file.

- Option 1: This will processing the whole list file.
- Option 2: [pending upgrade] This will check time input and process whole list file.
- Option 3: [pending upgrade] This will check the branch input and process whole list file.

This function generates three csv files:

- ***_train_list_below_VOLTAGE.csv: This file contains the detailed train's step output when the train's pantograph absolute voltage is below the voltage threshold. The step output format will following the same convention as mentioned before in section 8.1.

VO_ID	T_STEP	TIME	V_Re	V_Im	V_T	I_Re	I_Im	I_T	P_Re	P_Im	P_T	BRANCH	DELTA	E_TE	PERC%	DIS_GONE	INS_SPD	AV_SPD
1	25265	7.01.05	24707.6	-1166.4	24735.12	105.6	-4.6	105.7001	2609123	5365.44	2609128	007B	0.974	132187.7	1	11	15.27	7.59
1	25270	7.01.10	24285.7	-2284.8	24392.94	209.5	-18.8	210.3418	5087854	42954.24	5088035	007B	0.9701	119456.4	0.9037	47	29.16	22.67
1	25430	7.03.50	24081.6	-2729.9	24235.84	254.1	-28.1	255.649	6119135	76710.19	6119615	007B	0.8092	98973.6	1	1479	41.62	36.06
1	25435	7.03.55	24119.7	-2596	24259	242	-27.4	243.5462	5836967	71130.4	5837401	007B	0.8013	76373.1	1	1548	50.24	45.96
1	25440	7.04.00	24157.8	-2533.6	24290.29	236.1	-25.4	237.4624	5703657	64353.44	5704020	007B	0.7921	64619.7	1	1630	57.44	53.86

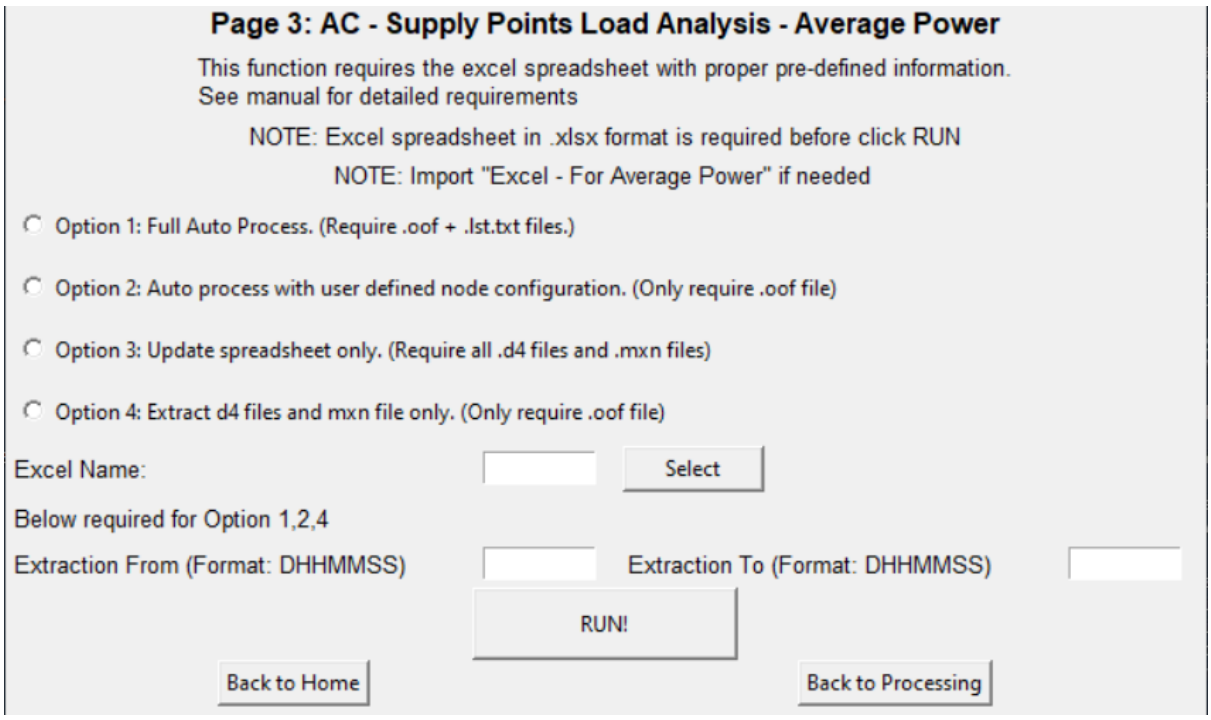
- ***_train_sum_below_VOLTAGE.csv: This file summarizes the total time steps that each individual train when the pantograph absolute voltage is below a threshold. It will output the information when the minimum voltage happened for each train. It contains additional two information, number of time steps the train voltage is below the threshold and the minimum voltage for each train.

Train No	No. of inst	Branch mi	VO_ID	T_STEP	TIME	V_Re	V_Im	V_T	I_Re	I_Im	I_T	P_Re	P_Im	P_T	BRANCH	DELTA	E_TE	PERC%	DIS_GONE	INS_SPD	AV_SPD
1	150	24235.84	1	25430	7.03.50	24081.6	-2729.9	24235.84	254.1	-28.1	255.649	6119135	76710.19	6119615	007B	0.8092	98973.6	1	1479	41.62	36.06
2	140	23819.92	2	25430	7.03.50	23547.7	-3590.9	23819.92	258.1	-38.3	260.9262	6077661	137531.5	6079217	004B	0.6535	99938.5	1	1478	41.22	35.79
3	66	24235.84	3	26030	7.13.50	24081.6	-2729.9	24235.84	254.1	-28.1	255.649	6119135	76710.19	6119615	007B	0.8092	98973.6	1	1479	41.62	36.06
4	102	23783.76	4	25875	7.11.15	23468.5	-3859.6	23783.76	257.5	-42.3	260.9512	6043139	163261.1	6045344	002B	0.8231	98217.8	1	102	41.78	36.25
5	60	24010.25	5	26630	7.23.50	23760.4	-3454.8	24010.25	255.8	-36.4	258.3769	6077910	125754.7	6079211	007B	0.8092	98973.6	1	1479	41.62	36.06
6	87	24034.51	6	27230	7.33.50	23752.4	-3671.7	24034.51	9.7	-1.5	9.815294	230398.3	5507.55	230464.1	008B	0.8879	1864.6	0.0149	29583	29.16	29.16

- ***_branch_list_below_VOLTAGE.csv: This file summarizes the total time steps that each individual branch when a train's pantograph absolute voltage located within that branch is below a threshold. It will output the information when the minimum train's pantograph voltage detected within that branch. It contains additional two information, number of time steps when the train voltage is below the threshold within that branch and the minimum voltage within that branch.

BRANCH	No. of inst	Branch mi	VO_ID	T_STEP	TIME	V_Re	V_Im	V_T	I_Re	I_Im	I_T	P_Re	P_Im	P_T	BRANCH	DELTA	E_TE	PERC%	DIS_GONE	INS_SPD	AV_SPD
007B	284	23534.7	13	28870	8.01.10	23116	-4419.6	23534.7	214.4	-40.3	218.1546	4956070	178109.9	4959270	007B	0.9701	119456.2	0.9037	47	29.16	22.66
001B	123	24393.88	1	26475	7.21.15	24266	-2494.5	24393.88	43	-4.4	43.22453	1043438	10975.8	1043496	001B	0.9925	5245.3	0.1739	44492	110.27	110.27
003B	24	24413.04	1	26490	7.21.30	24267.7	-2659.9	24413.04	42.9	-4.7	43.15669	1041084	12501.53	1041159	003B	0.0646	5245.3	0.1739	44997	110.27	110.27
004B	18	23819.92	2	25430	7.03.50	23547.7	-3590.9	23819.92	258.1	-38.3	260.9262	6077661	137531.5	6079217	004B	0.6535	99938.5	1	1478	41.22	35.79
002B	164	23783.76	4	25875	7.11.15	23468.5	-3859.6	23783.76	257.5	-42.3	260.9512	6043139	163261.1	6045344	002B	0.8231	98217.8	1	102	41.78	36.25
008B	277	23537.71	14	28870	8.01.10	23120.7	-4411	23537.71	208.2	-39.1	211.8397	4813730	172470.1	4816818	008B	0.8952	114322	0.8654	47	29.16	23.02

8.3 AC: Average Power & Voltage Assessment (Minimum Requirement)



Input & output file: *.xlsx

This section enables supply point load analysis. To utilize this section, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel – For Average Power' option found in the 'Import' menu. The template, named 'power_template.xlsx' (which can be renamed as desired), follows the format shown below. After

allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected from the 'select' button.

Supply Points	OSLO feeder name	Incoming Voltage (kV)	Incoming Feeders	Capacity (MVA)	Fault Level (MVA)	Feeder Station name	Cable Rating	FSC (MVA)	Supply Type	Supply Voltage (kV)
Gowkthrapple F4	GOW1	132	1	26	9722	Gowkthrapple FS		26	Classic	25
Gowkthrapple F5	GOW2	132	1	26	9722	Gowkthrapple FS		26	Classic	25

	Individual Feeding Sections		
Supply Point	Site name	Node ID	Min Voltage
Gowkthrapple F4	Gowkthrapple FS	GT1	
	Carstairs MPTSC	CA2	
Gowkthrapple F5	Gowkthrapple FS	GT2	
	Midcalder TSC	MR2	
	Addiewell TSC	AD1	
	Shotts MPTSC	SH1	
	Holytown TSC	HO1	
	Motherwell	MW1	
	Newton	NT2	

The necessary information is as follow:

- Supply Point: the desired name of the supply point.
- OSLO feeder name: identity of the node to which supply point is connected which must be identical to supply point node name in extra.oslo file.
- Fault level
- Feeder Station name: the name must be identical to supply point name when feeder station wise assessments such as NPS or MVA of the feeder station are required. When the feeder station name is identical for 2 or more feeders the software will aggregate the results to calculate Peak NPS (%) and Maximum Average Apparent Power (MVA) of the feeder station.
- FSC (MVA)
- Supply voltage: must be identical to supply point voltage specified in extra.oslo file.
- Site name: this part is optional, but it is worth mentioning that there must be a blank row between two supply points data in Individual Feeding Section.
- Node ID: must be identical to Node ID specified in V/O simulation. This item will be used as an input data for Option 2.
- Other fields are only for information.

In this section, four options are available as follows. One single Excel file can be used for all four options and the latest results will be automatically updated in the Excel file. The desired time period must be allocated for Option 1, 2 and 4 in format DHHMMSS.

Important note: All the results such as MVA, NPS and supply point data will be extracted across the specified time window, except for minimum and maximum voltages. The minimum and maximum voltages will be extracted over the simulation time as mentioned in Section 5.4 (Maximum currents and minimum and maximum voltages).

- Option 1: Full Auto Process. This option will generate the results for the entire feeding section of a supply point in the simulation, no matter if all the nodes linked to the supply point node in the simulation are in the Individual Feeding Sections or not. '*.lst.txt' and '*.oof' files are required for this option. The tool will perform connectivity checking (see section 6.2), extraction feeder step output (see section 7.8) and extract mxn output (see section 7.4). Should the results for user defined nodes are required Option 2 can be used.

- Option 2: Auto process with user defined node configuration. This option will generate the results for specified node in Individual Feeding Sections. In this option the minimum and maximum voltages (kV) of the feeding section of a supply point will be extracted only for linked nodes specified in Individual Feeding Sections. The linked nodes to the supply point node can be found in Data sheet. If specified nodes are identical to the nodes linked to the supply point node in the simulation the minimum and maximum voltages will be the identical to Option 1. Other results are identical to Option 1 in this option. Only '*.oof' file is required for this option.
- Option 3: Update spreadsheet only. This option will update the spreadsheet based upon the latest results for the supply points. All '*.d4' files for the supply points specified in the spreadsheet together with '*.mxn' file are required for this option. '*.oof' file is not required for this option. Similar to Option 2 the minimum and maximum voltages (kV) of the feeding section of a supply point will be extracted only for linked nodes specified in Individual Feeding Sections. The linked nodes can be found in Data sheet.
- Option 4: Extract d4 files and mxn file only. This option will generate d4 files (see section 7.8) related to the supply points specified in the spreadsheet together with mxn file (see section 7.4). '*.oof' file is not required for this option.

The output data for each sheet is described below.

Result: the results in this sheet are as follow:

Maximum Average Apparent Power (MVA)						Peak NPS (%)			Voltage (kV)	
Instantaneous	*01 Minute*	*02 Minutes*	*10 Minutes*	*20 Minutes*	*30 Minutes*	*01 Minute*	*10 Minutes*	*30 Minutes*	*Minimum*	*Maximum*
20.92	18.33	17.91	15.58	11.95	8.93	0.19%	0.16%	0.09%	19.90	25.57
28.87	24.02	21.96	13.95	10.84	9.29	0.25%	0.14%	0.10%	19.10	25.34

- Maximum MVA for each feeder for instantaneous, 01-min., 02-min., 10-min., 20-min., and 30-min. time windows. For 30-min. time window the results are highlighted in green if they are below 80% of FSC limit, yellow if they are within 20% of FSC limit, orange if they are within 10% of FSC limit and red if they exceed the limit.
- Peak NPS% for 01-min., 10-min., and 30-min. time window. The NPS% is derived from the simple formula below and the results are highlighted in different colours when they are assessed against the FSC limit. The NPS limit and the colour codes depend upon the voltage level and the region in which the study is carried out. For more information refer to Engineering Recommendation P24 and the Grid Code.

$$V_{NPS}\% = \frac{line - line\ load\ MVA}{fault\ level\ MVA\ at\ supply\ busbar} \times 100$$

- Minimum and maximum voltages (kV) of the entire feeding section of a supply point in the simulation will be shown here.

Maximum Incoming Feeder RMS Current (A)													
Instantaneous	*05 seconds*	*10 seconds*	*15 seconds*	*20 seconds*	*25 seconds*	*30 seconds*	*35 seconds*	*40 seconds*	*60 seconds*	*120 seconds*	*10 min*	*20 min*	*30 min*
928.30	928.30	925.80	923.67	921.91	920.27	893.37	868.49	849.24	804.78	779.92	671.04	558.35	466.54
1266.20	1266.20	1252.87	1239.59	1216.75	1170.21	1131.52	1108.48	1085.54	1032.56	938.48	670.21	553.92	482.52

- Maximum Incoming Feeder RMS Current (A). The table above is only for information in this section. To assess feeder station maximum current against protection settings, refer to section 8.5 (Incoming Feeder Protection).

Maximum Average Apparent Power (MVA)						Peak NPS (%)		
Instantaneous	*01 Minute*	*02 Minutes*	*10 Minutes*	*20 Minutes*	*30 Minutes*	*01 Minute*	*10 Minutes*	*30 Minutes*
38.51	32.22	31.16	22.27	19.37	16.23	0.33%	0.23%	0.17%

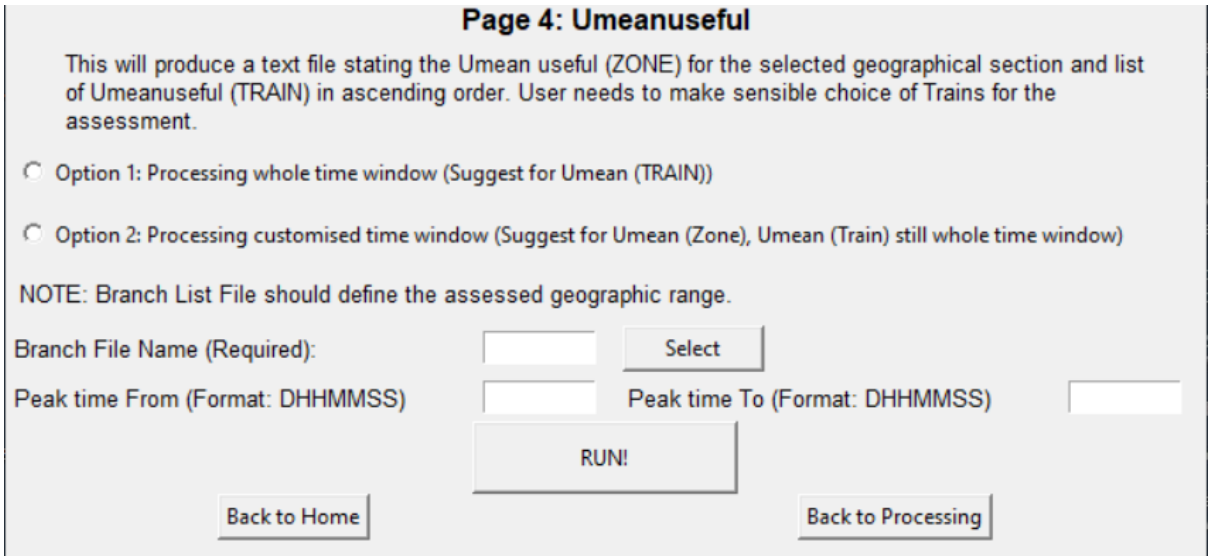
- If the feeder station name is identical for 2 or more feeders the software will aggregate the results to calculate Peak NPS (%) and Maximum Average Apparent Power (MVA) of the feeder station as shown in the table above.

Data: the minimum and maximum voltages of each node in the simulation together with the time they occur are shown in this sheet (see section 7.4). This sheet also provides with all the nodes linked to each supply point.

Oslo feeder name: will generate the Oslo output results such as active power (MW), reactive power (MVAr), voltage (kV) and current (A) at each time increment, average active and reactive powers together with maximum and minimum values within various time windows and average RMS current (A) together with maximum and minimum values within various time windows for each supply node. The power factor at each time increment and within various time windows is also calculated in this sheet.

Supply point: if there are two or more feeders with identical feeder station name the results for the feeder station will be aggregated and represented in this sheet.

8.4 AC: Umean useful



Output file: umeanuseful_result_BRANCHNAME_TIMEWINDOW.csv

The definition, calculation and use of mean useful voltage can be found in Annex B of BS EN 50388-1. This section will generate a csv file containing the mean useful voltage (kV) of a geographical zone in the simulation and a list of mean useful voltages (kV) in ascending order together with the time (s) of all trains (train IDs) running in that zone.

A text file including all Oslo branches in the geographical zone in format shown below is required for this section. The format should follow BranchList.txt (see section 4.2).

The text file name must be then allocated without suffix in the relevant box or select from the 'select' button.

In this section, two options are available.

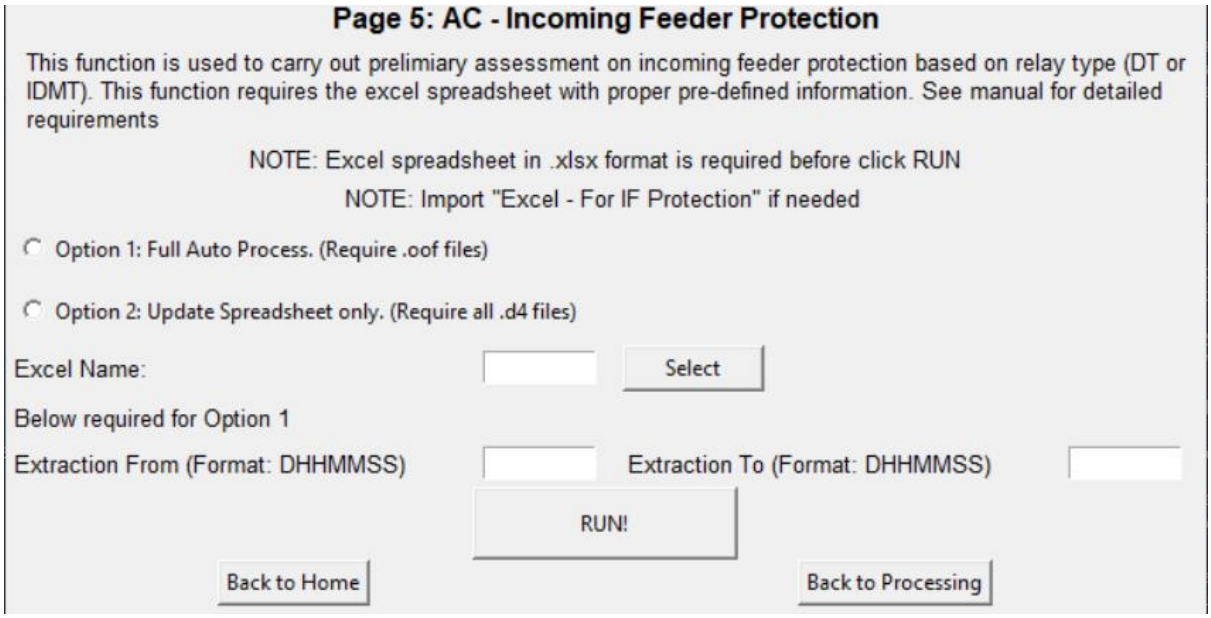
- Option 1: Processing whole time window. This option will provide with the mean useful voltage of the zone and all trains running in that geographical zone across the entire simulation time.
- Option 2: Processing customised time window. The time window can be limited in this option using relevant time boxes in format DHHMMSS. It is important to note the time window will be only restricted for geographical zone mean useful voltage. The time window for calculating the mean useful voltage for trains remains the entire simulation time when they are running in that zone.

Output file:

This output file contains calculated Umeanuseful (Zone) and Umeanuseful (Train) in ascending order. Users need to check the traction time and make sensible judgement whether that is a suitable dimensioning train or not.

Umean useful zone (in kV)		
24.76		
Umean useful train list (in ascending order)		
VISION ID	Umean(train) (kV)	Traction Time (s)
4	24.54	515
2	24.64	890
6	24.66	290
1	24.71	670
3	24.82	445
5	24.92	220
8	24.94	45

8.5 AC: Incoming Feeder Protection



Input & output file: *.xlsx

This section facilitates the analysis of supply point current protection. To utilize this section, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel – For IF Protection' option found in the 'Import' menu. The template, named 'protection_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

Incoming Feeder	OSLO ID	Type (TR/SP)	Protection Type (DT/IDMT)	Pickup Current (A)	Time Multiplier (s)
Gowkthrapple F4	GOW1	SP	DT	1200	0.2
Gowkthrapple F5	GOW2	SP	IDMT	1200	0.2

The necessary information is as follow:

- OSLO ID: identity of the node to which supply point is connected which must be identical to supply point node name in extra.oslo file.
- Type (TR/SP): represents the type of the node (transformer or supply point) for which the current is calculated.
- Protection Type (DT/IDMT): If IDMT is selected the trip current threshold for each time window will be calculated with the following formula. For DT type the trip current threshold will be identical to the pickup current.
  Trip Current Threshold (A) = (((0.14*[time_multiplier]/[time_window])+1)^(1/0.02))*[pickup_current]
- Pickup Current (A): the minimum relay operating current above which the relay starts its operation. This current will be used to calculate the trip current threshold.
- Time Multiplier (s): will be used to calculate the trip current threshold for IDMT type protection relay.

In this section, two options are available.

- Option 1: Full Auto Process. The output data for each sheet is described below. '*.oof' file is required for this option and desired time window should be allocated in format DHHMMSS in the relevant boxes. This will perform supply point extraction (see section 7.8) or transformer extraction (see section 7.10) first, and then analysing the data.
- Option 2: Update Spreadsheet only. Using this option will update supply point data and transformer data of the spreadsheet. All '*.d4' files for the supply points and transformers specified in the spreadsheet is required for this option.

<u>Result</u>: the results in this sheet are as follow:

Trip Current Threshold (A)													
Instantanous	*05 seconds*	*10 seconds*	*15 seconds*	*20 seconds*	*25 seconds*	*30 seconds*	*35 seconds*	*40 seconds*	*60 seconds*	*120 seconds*	*10 min*	*20 min*	*30 min*
1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00	1200.00
1586.52	1586.52	1380.06	1317.28	1286.95	1269.08	1257.30	1248.95	1242.73	1228.32	1214.08	1202.80	1201.40	1200.93

Maximum Incoming Feeder RMS Current (A)													
Instantanous	*05 seconds*	*10 seconds*	*15 seconds*	*20 seconds*	*25 seconds*	*30 seconds*	*35 seconds*	*40 seconds*	*60 seconds*	*120 seconds*	*10 min*	*20 min*	*30 min*
928.30	928.30	925.80	923.67	921.91	920.27	893.37	868.49	849.24	804.78	779.92	671.04	558.35	466.54
1266.20	1266.20	1252.87	1239.59	1216.75	1170.21	1131.52	1108.48	1085.54	1032.56	938.48	670.21	553.92	482.52

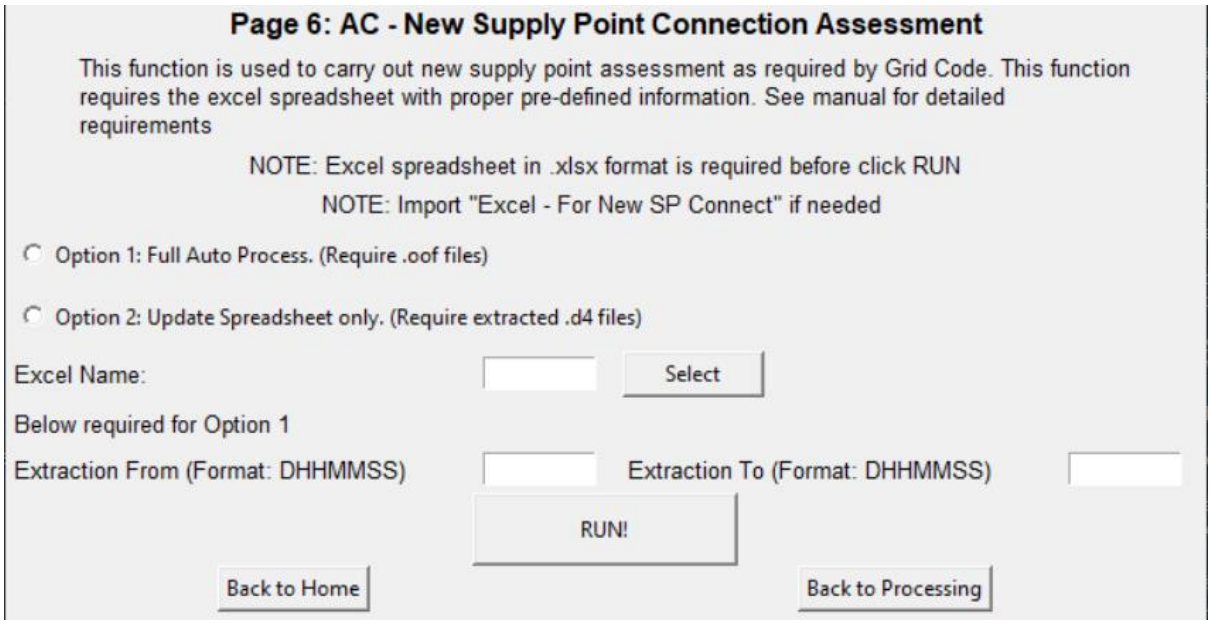
- Trip current threshold (A) for instantaneous (05-sec.), 10-sec., 15-sec., 20-sec., 25-sec., 30-sec., 35-sec., 40-sec., 60-sec., 120-sec., 10-min., 20-min., and 30-min. time windows.

- Maximum RMS current (A) of supply point or transformer assessed against trip current threshold at each time window. The results then are highlighted in green if they are below 80% of threshold, yellow if they are within 20% of threshold, orange if they are within 10% of threshold and red if they exceed the limit.

Plot: the graphs of maximum RMS current compared to protection threshold versus time are available on this sheet.

Supply point: supply points data and transformers data are available on other sheets. For more details refer to section 7.8 (Feeder step output) and section 7.10 (Transformer step output).

8.6 AC: New Supply Point Connection Assessment



Input & output file: *.xlsx

This section enables the analysis of grid connection of a new supply point including operating voltage range, maximum apparent power, maximum reactive power, maximum NPS, maximum step and rapid voltage changes and maximum flicker severity. To utilize this section, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel – For New SP Connect' option found in the 'Import' menu. The template, named 'new_connection_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected from the 'select' button.

Items	Description	Settings	Note
VISION OSLO MODEL	Modelled Supply Point Voltage (kV)	26.25	VO Setting
	Modelled time increament (s)	1	VO Setting
	Supply Point OSLO ID	EMF1	East Midlands Parkway
GRID INFORMATION	Norminal Voltage (kV)	400	Market Harborough Grid
	Max Operating Range (kV) [Grid Code ECC. 6.1.4]	5%	Grid Code
	Min Operating Range (kV) [Grid Code ECC. 6.1.4]	-10%	Grid Code
	Minimum Three Phase Symmetric Fault Level (MVA)	12000	Grid ETYS
GRID BILATERAL AGREEMENT	1-min maximum average loading (MVA) [Appendix F5]	56.3	Power Modelling
	10-min maximum average loading (MVA) [Appendix F5]	38.5	Power Modelling
	30-min maximum average loading (MVA) [Appendix F5]	33.1	Power Modelling
RVC EVENT (USER DEFINED)	Maximum Current (A) at 25 kV - Frequent Event [ECC. 6.1.7]	800	single RS passing NS
	Maximum Current (A) at 25 kV - Infrequent Event [ECC. 6.1.7]	2727	Network Energisation
	Maximum Current (A) at 25 kV - Very infrequent Event [ECC. 6.1.7]	1600	2 RS passing NS

In the Setting column, users should allocate the following necessary information. The other columns are provided for reference purposes only and can be modified as desired.

VISION OSLO MODEL

- Modelled Supply Point Voltage (kV): the supply point nominal voltage (kV) in the simulation which must be identical to supply point voltage specified in extra.oslo file.
- Modelled time increment (s): the time increment (second) specified in V/O simulation parameters.
- Supply Point OSLO ID: identity of the node to which supply point is connected which must be identical to supply point node name in extra.oslo file.

GRID INFORMATION

- Nominal Voltage (kV): the nominal voltage (kV) of the grid at PCC.
- Max. Operating Range (kV): The maximum voltage (kV) of the grid in normal operating condition at PCC which should be in accordance with the Grid Code Clause ECC.6.1.4.
- Min. Operating Range (kV): The minimum voltage (kV) of the grid in normal operating condition at PCC which should be in accordance with the Grid Code Clause ECC.6.1.4.
- Minimum Three Phase Symmetric Fault Level (MVA): the minimum fault level (MVA) of the grid at PCC. This value is required to calculate the maximum source impedance which can be obtained from National Grid Electricity Ten Year Statement Appendix D or Transmission System short circuit and impedance analysis.

GRID BILATERAL AGREEMENT

- 1-min. maximum average loading (MVA): the 01-minute maximum traction demand at PCC which can be obtained from Bilateral Connection Agreement Appendix F5.
- 10-min. maximum average loading (MVA): the 10-minute maximum traction demand at PCC which can be obtained from Bilateral Connection Agreement Appendix F5.
- 30-min. maximum average loading (MVA): the 10-minute maximum traction demand at PCC which can be obtained from Bilateral Connection Agreement Appendix F5.

RVC EVENT (USER DEFINED)

- In this section user is required to define the maximum load current (A) for three different events, based on the maximum number of occurrences of each event. For more information refer to Engineering Recommendation P28 and the Grid Code Clause ECC.6.1.7.

The criteria table on the right is only provided for reference purposes and represents the grid connection assessment criteria in accordance with the relevant standards. The criteria shown in the format below are calculated based on the user-defined setting values allocated in the Setting column. It should be noted that the maximum reactive power (MVAr) criteria for each time window can be obtained from the simple formula below. For more information refer to the Grid Code Clause ECC.6.4.5.1.

Maximum Q (MVAr) = Maximum S (MVA) * 0.9 * 48%

Items	*Criteria*
PCC Maximum Voltage (kV)	420
PCC Minimum Voltage (kV)	360
PCC 1-min Maximum S (MVA) - Apparent	56.30
PCC 10-min Maximum S (MVA) - Apparent	38.50
PCC 30-min Maximum S (MVA) - Apparent	33.10
PCC 1-min Maximum Q (MVAr) - Reactive	24.36
PCC 10-min Maximum Q (MVAr) - Reactive	16.66
PCC 30-min Maximum Q (MVAr) -Reactive	14.32
PCC 1-min Negative Phase Sequence (NPS)	-
PCC 10-min Negative Phase Sequence (NPS)	1.5%
PCC 30-min Negative Phase Sequence (NPS)	1.0%
PCC Step Voltage Change (SVC)	3%
PCC Rapid Voltage Change (RVC) - Frequent Event	6%
PCC RVC - Infrequenty Event	10%
PCC RVC - Very Infrequent Event	12%
Flicker Severity - Short Term RVC with Pst <= 0.5	0.40%
Flicker Severity - Memory Time Technique (S)	600
Flicker Severity - Long Term	Stage 2 Pass

In this section, two options are available.

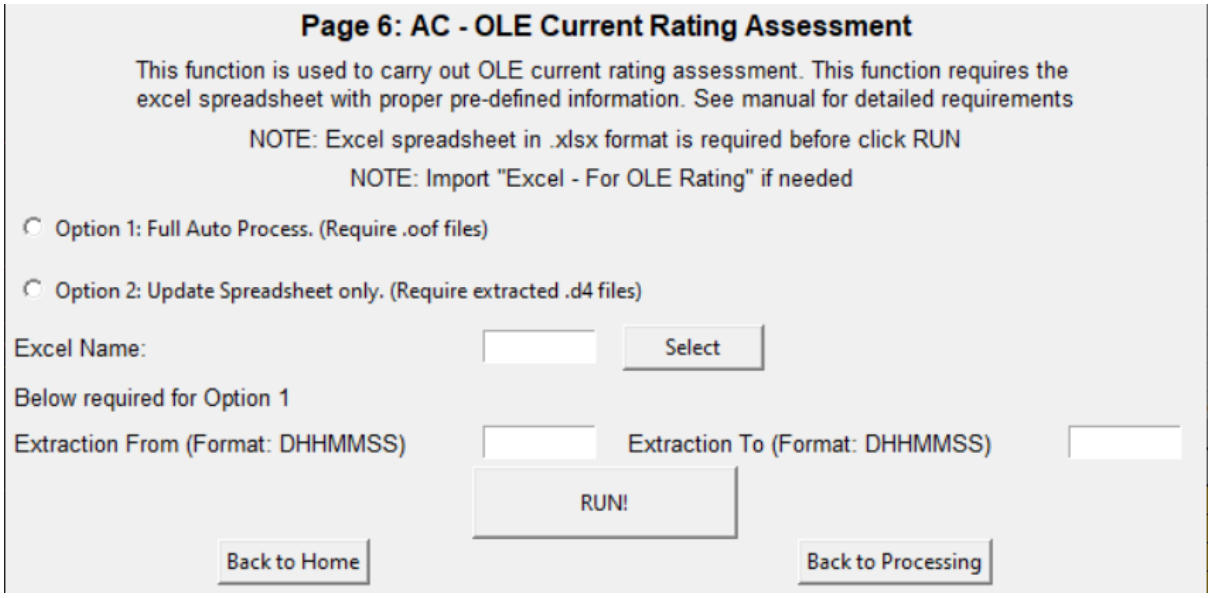
- Option 1: Full Auto Process. The output data for each sheet is described below. '*.oof' file is required for this option and desired time window should be allocated in format DHHMMSS in the relevant boxes. This performs feeder extraction first (see section 7.8) and the do the analysis.
- Option 2: Update Spreadsheet only. Using this option will update supply point data of the spreadsheet. '*.d4' file for the supply point specified in the spreadsheet is required for this option.

Result: this sheet displays the results of grid connection assessments, comparing them to relevant criteria in the format shown below. The results are highlighted in green when they meet the criteria and in red when they fail. This sheet also includes several useful graphs, such as the voltage profile, step voltage change, flicker severity and apparent and reactive power at the point of common coupling.

Assessment Item	Unit	Assessment Criteria	Simulation Result
PCC Maximum Voltage	kV	420	400.32
PCC Minimum Voltage	kV	360	397.87
PCC 1-min Maximum Apparent Load	MVA	56.30	56.86
PCC 10-min Maximum Apparent Load	MVA	38.50	38.80
PCC 30-min Maximum Apparent Load	MVA	33.10	33.37
PCC 1-min Maximum Reactive Load	MVAr	24.36	16.71
PCC 10-min Maximum Reactive Load	MVAr	16.66	4.76
PCC 30-min Maximum Reactive Load	MVAr	14.32	3.00
PCC 1-min Negative Phase Sequence (NPS)	%	-	0.47%
PCC 10-min Negative Phase Sequence (NPS)	%	1.50%	0.32%
PCC 30-min Negative Phase Sequence (NPS)	%	1.00%	0.28%
PCC Step Voltage Change (SVC)	%	3.00%	0.13%
PCC Rapid Voltage Change (RVC) - Frequent Event	%	6.00%	0.33%
PCC Rapid Voltage Change (RVC) - Infrequent Event	%	10.00%	1.14%
PCC Rapid Voltage Change (RVC) - Very Infrequent Event	%	12.00%	0.67%
Flicker Severity - Short Term - RVC with Pst <= 0.5	%	0.40%	0.13%
Flicker Severity - Short Term - Memory Time Technique	s	600	0.27
Flicker Severity - Long Term - Plt	N/A	Pass if Stage 2 Pst pass	PASS

Supply point: this sheet includes the simulation output results of the supply point extracted from V/O at each time increment such as active power (MW) and reactive power (MVAr), voltage (kV) and current (A), together with the results required for grid connection assessment.

8.7 AC: OLE Current Rating Assessment



Input & output file: *.xlsx

This section enables the OLE thermal rating assessment. To utilize this section, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel – (AC) For OLE Rating' option found in the 'Import' menu. The template, named 'new_connection_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected from the 'select' button.

Location	OLE Section	OSLO ID	Type
Substation A	Substation A - Substation B: Up Main Line	005B/E	Mark 1
Substation B	Substation A - Substation B: Down Main Line	007B/S	UKMS 107 CuSn

The necessary information is as follow:

- OSLO ID: This must be in the branch node format of XXXX/S or XXXX/E. This is used to extract branch step output (see section 7.9)
- Type: This contains a drop-down list to be selected from. User must select an existing OLE type. All UK OLE type have been covered in the option. All future new electrification must use UKMS series according to existing Asset Policy. Should a new OLE type be required, user should inform the developer to update this template.
- Location and OLE section is for information only and is good to enter the correct information.

The information table on the right is provided for additional setting but primarily for information only.

NOTE: Adjust settings highlighted in Orange if necessary

OLE Type	Cont. Rating (A)	20min (A)	10min (A)	5min (A)	Note	Enviroment	Source
GEFF	700	-	-	957	700A for nominal, 964A with wind 3 m/s, 957A for 5 min	30 C with wind 0.4 m/s	GEFF System Desciption Manual, Section 3.3
Mark GE	800	-	-	-	800A for nominal, 400A for tramway		NR/L2/ELP/21088
Mark SCS	700	-	-	-	700A for support 0.166 in CW, 800A for support 0.3 in CW	-	MkSCS Equipment Designation
Mark 1	700	-	-	-	800A for compound, 700A for simple, 400A for tramway	-	Mk1 Equipment Designations
BBC	700	-	-	-	700A for nominal	-	NR/L2/ELP/21088
Mark 2	700	-	-	-	700A for nominal	-	NR/L2/ELP/21088
Mark 3	700	-	-	-	700A for nominal, 400A for tramway	-	Mk3 Equipment Designation
Mark 3a	600	-	-	-	600A for nominal, 400A for tramway	-	Mk 3A Equipment Designation
Mark 3b	450	-	-	-	450A for 1 or 2 track or 4 track CS, 370A for 4 track BT	28 C with wind 1 mph	Current Rating of Mark 3B OLE
Mark 3c	600	-	-	-	600A for nominal	-	Mk 3C Equipment Designation
Mark 3d	600	-	-	-	600A for nominal	-	NR/L2/ELP/21088
Mark 5	900	-	-	-	900A for nominal	-	NR/L2/ELP/21088
UK1 - WCML	600	-	-	-	600A for nominal	-	NR/L2/ELP/21088
Sunderland Direct	779	-	-	-	779A for nominal	-	NR/L2/ELP/21088
SICAT OLE	600	-	-	-	600A for nominal	-	NR/L2/ELP/21088
UK Series 1	531	-	-	-	531A for CW, 761A for ATF wire	28 C with wind 1 mph, solar 980 W/m2	MAN001 System Description Manual
UK Series 2	533	-	-	-	533A for CuSn, 551A for CuAg, 590A for CuAg 120	BS EN 50119:2009	Series 2 System Description Manual
UKMS 120 CuAg	430	524	638	798	Refer source - current revision 5	40 C with wind 1 mph	MS/B01/B01/A3 Revision 05
UKMS 107 CuAg	412	494	598	746	Refer source - current revision 5	40 C with wind 1 mph	MS/B01/B01/A3 Revision 05
UKMS 107 CuSn	391	467	565	705	Refer source - current revision 5	40 C with wind 1 mph	MS/B01/B01/A3 Revision 05

This provides rating information /threshold according to various documentation. It should be noted that the thermal assessment will compare the current loading against the current rating presented in this table.

Cont. rating (A) data is required at least for each OLE type and does NOT allow empty cells in that column.

Due to the specific request from the client or change climate in the future, should a specific rating need to be assessed against, user can change the corresponding value according to the specific environment parameter user would like to use for. The calculation of a new thermal rating is outside of the scope of this documentation.

In this section, two options are available.

- Option 1: Full Auto Process. The output data for each sheet is described below. '*.oof' file is required for this option and desired time window should be allocated in format DHHMMSS in the relevant boxes. This performs branch step output extraction first (see section 7.9) and do the analysis.
- Option 2: Update Spreadsheet only. Using this option will update branch step output data of the spreadsheet. '*.d4' file for the branch step output specified in the spreadsheet is required for this option.

Result: this sheet displays the results of OLE rating assessment, comparing them to relevant criteria in the format shown below.

Equipment Rating (A)				Simulation Result: Maximum RMS Current (A)							
Cont.	20min	10min	5min	30min	time at	20min	time at	10min	time at	5min	time at
700.00	-	-	-	94.08	07:54:25	98.54	07:54:25	105.63	07:44:55	122.66	07:46:05
391.00	467.00	565.00	705.00	94.90	07:54:25	96.32	07:55:25	510.00	07:54:25	800.00	07:27:10

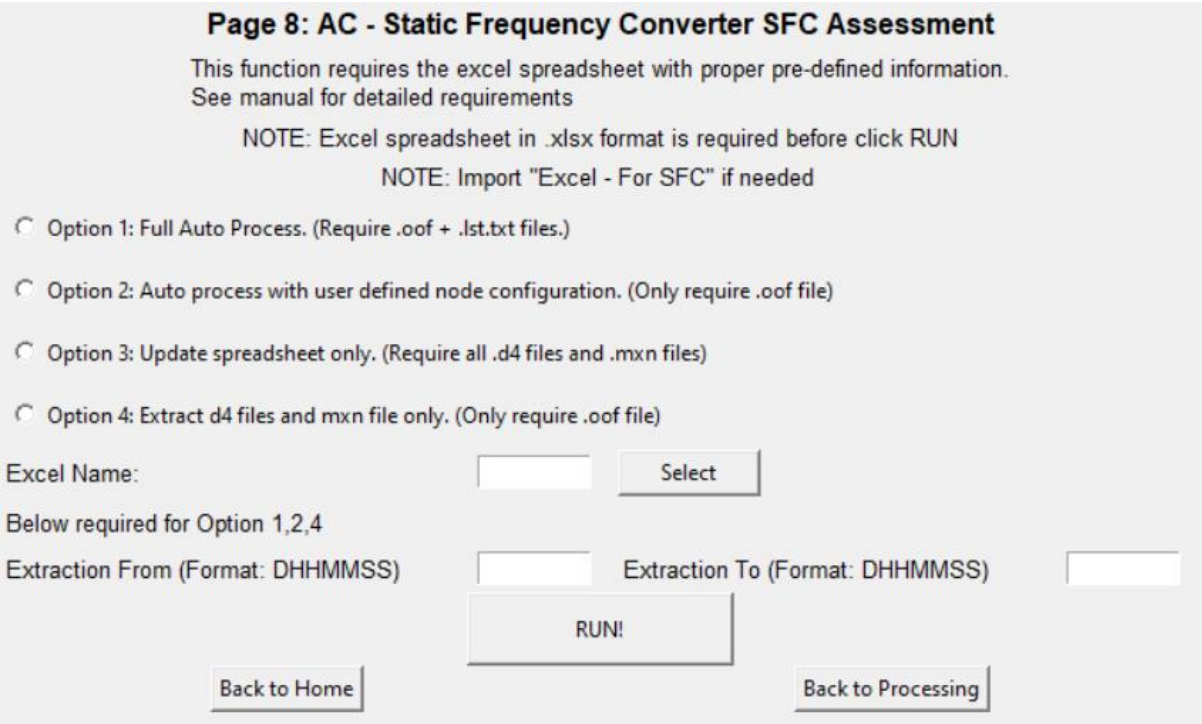
It should be note that if only continuous rating exists, both 20 min RMS result and 30min RMS result will be compared against the continuous rating. This is due to the inconsistent time-windows which used historically and required by NR/L2/ELP/27275. Users need to make sensible judgement which value to use for the assessment.

If both continuous ratings and 20 min ratings are available, the 30min RMS result will be compared against continuous rating, the 20min RMS result will be compared against 20 min rating.

In simulation result, maximum RMS current (A) and corresponding time of each branch node are shown. It should be noted that the time here refers to the end time of a rolling time window. The results then are highlighted in green if they are below 80% of threshold, yellow if they are within 20% of threshold, orange if they are within 10% of threshold and red if they exceed the limit.

Branch Node: this sheet includes the simulation output results of the branch step extracted from V/O at each time increment such as active power (MW) and reactive power (MVAr), voltage (kV) and current (A), together with the relevant RMS calculation.

8.8 AC: Provision for Development



Input & output file: *.xlsx

This section enables SFC assessment. To utilize this section, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel

– For SFC assessment' option found in the 'Import' menu. The template, named 'SFC_assessment_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected from the 'select' button.

NOTE: This spreadsheet is only valid for 5 seconds time-increment.

SFC Supply Points	OSLO feeder name	Incoming Voltage (kV)	Incoming Feeders	Continous Rated Power (MVA)	Instant Rated Current (A)	Instant Overload Capacity	SFC Type
Potteric Carr	PCF1	33	1	27.2	1860	110%	ABB_Potteric_Carr
Hambleton Jcn F1	HMB1	132	1	45	2545	110%	Siemens_Hambleton_Jcn
Hambleton Jcn F2	HMB2	132	1	45	2545	110%	Siemens_Hambleton_Jcn

Individual Feeding Sections

Supply Point	Site name	Node ID	Min Voltage
Potteric Carr	North Muskham	NM2	18.084
	Tuxford	TX	18.348
	Retford	RET1	19.59
	Bawtry	BX1	22.028
	Potter Carr	PC1	24.51
	Doncaster	DR1	24.376
Hambleton Jcn F1	Doncaster	DR2	24.014
	South Kirby	SR1	23.838
	Blane	BB	25.498
	Hambleton	HB1	27.169
Hambleton Jcn F2	Hambleton	HB2	27.17
	Colton	CJ	25.117
	York	YK1	24.377

The necessary information is as follow:

- Supply Point: the desired name of the supply point.
- OSLO feeder name: identity of the node to which supply point is connected which must be identical to supply point node name in extra.oslo file.
- Continuous Rated Power (MVA): This is the power rating at the site, usually limited by transformer 30min power rating.
- Instant Rated Current (A): This is the current rating at the site, usually limited by the IGBT control capability.
- Other fields are only for information.

In this section, four options are available. The option is the same as how to assess a normal supply point. See section 8.3 for detail.

The output data for each sheet is described below.

Result: the results in this sheet are as follow:

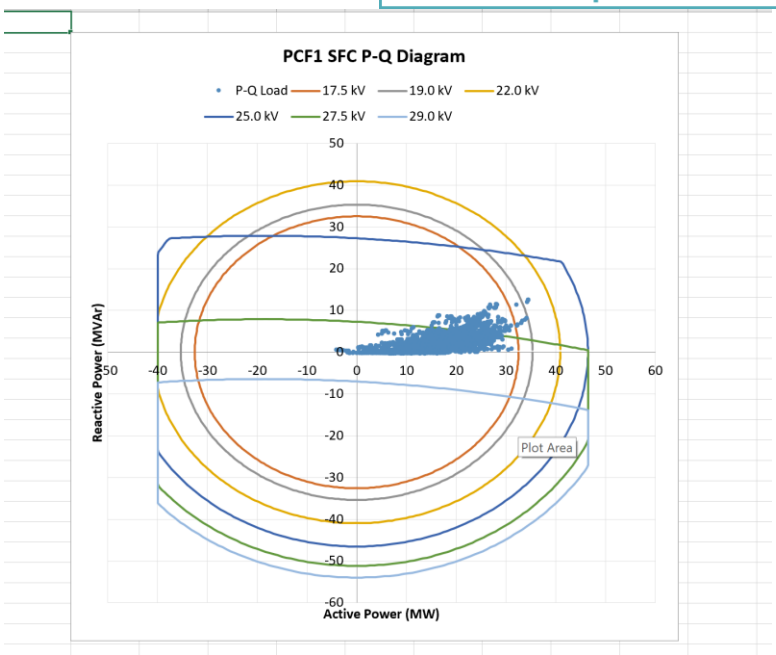
Site Information Summary								Maximum Average Apparent Power (MVA)						Voltage (kV)	
Supply Point Name	OSLO ID	Incoming Voltage (kV)	Incoming Feeder	Continous Rated Power (MVA)	Instant Rated Current (A)	Instant Overload Capacity	SFC Type	Instantaneous	01 Minute	02 Minutes	10 Minutes	20 Minutes	30 Minutes	Minimum	Maximum
Potteric Carr	PCF1	33	1	27.2	1860	110.0%	ABB_Potteric_Carr	36.74	33.45	29.18	23.61	21.91	19.88	18.08	27.76
Hambleton Jcn F1	HMB1	132	1	45	2545	110.0%	Siemens_Hambleton_Jcn	18.90	18.21	15.26	10.26	7.40	7.55	23.84	28.35
Hambleton Jcn F2	HMB2	132	1	45	2545	110.0%	Siemens_Hambleton_Jcn	16.46	14.17	13.01	8.10	6.11	4.94	24.38	28.14

Site Information Summary								Maximum Incoming Feeder RMS Current (A)													
Supply Point Name	OSLO ID	Incoming Voltage (kV)	Incoming Feeder	Continous Rated Power (MVA)	Instant Rated Current (A)	Instant Overload Capacity	SFC Type	Instantaneous	05 seconds	10 seconds	15 seconds	20 seconds	25 seconds	30 seconds	35 seconds	40 seconds	60 seconds	120 seconds	10 min	20 min	30 min
Potteric Carr	PCF1	33	1	27.2	1860	110.0%	ABB_Potteric_Carr	1490.80	1490.80	1490.35	1490.20	1490.05	1489.84	1489.80	1487.48	1474.02	1362.36	1191.12	969.06	900.57	835.07
Hambleton Jcn F1	HMB1	132	1	45	2545	110.0%	Siemens_Hambleton_Jcn	695.10	695.10	688.98	683.46	683.29	683.19	681.19	675.58	671.53	670.06	575.34	392.77	309.36	313.18
Hambleton Jcn F2	HMB2	132	1	45	2545	110.0%	Siemens_Hambleton_Jcn	605.40	605.40	604.60	603.10	600.89	598.20	585.82	575.07	555.66	528.45	489.98	323.57	267.55	238.05

This is the same as provided in section 8.3. NPS information is not provided as not valid for SFC anymore. Site total is not provided as not valid for assessment.

Data: This is the same as provided in section 8.3.

P-Q Diagram Plot: This is the unique feature of SFC assessment. The example is shown below:

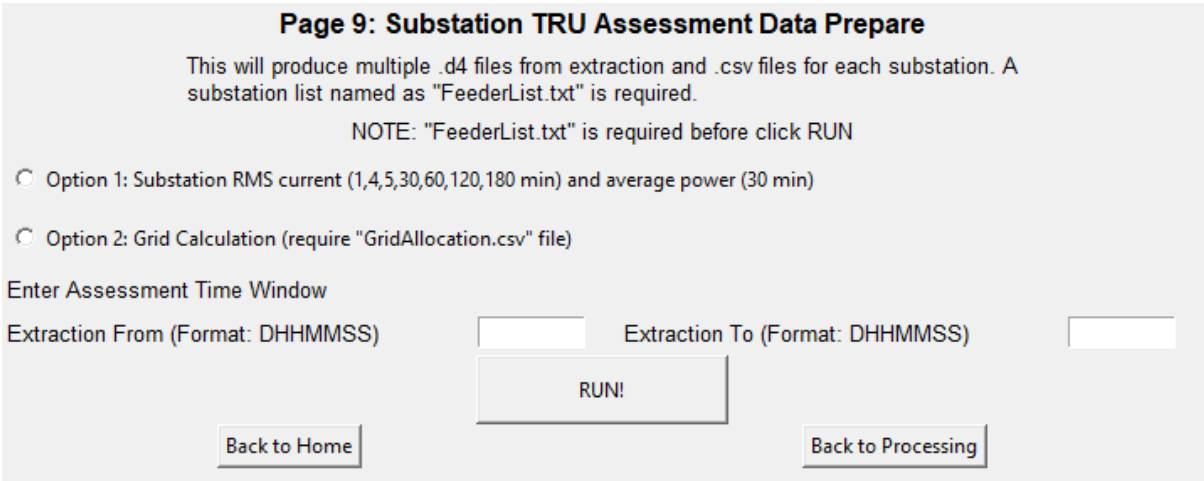


This provides supply point's load P-Q diagram as well as the protection boundary. At the time of the writing, only instant active and reactive power are assessed against the boundary as usually they are the worst-case assessment item.

Oslo feeder name: This is the same as provided in section 8.3.

SFC Type: All used SFC type source data will be provided in a new tab. All these tabs data are imported from the default library where the protection boundary data defined. It should be noted that users cannot import to default library at this stage. But user could adjust the boundary based on any new information available.

8.9 DC: (DATA PREP.) For Grid TRU, Main CB, DC Busbar, Neg ETE, Bonding Assessment



This section extracts the step load outputs at each DC substation and calculates the rolling RMS current and average power.

8.9.1 Option 1 Substation RMS Current

Option 1 provides the data required for option 2 and for the DC assessments in section 8.11.

Name

- BranchNodeList.txt
- DCF321.oof
- FeederList.txt
- oslo_extension.py

To run this tool, the user needs to put the oslo_extension.py in a folder containing the .oof file from VISION/OSLO results. The input text file "FeederList.txt" is also required to filter all substations within the scope that is required for assessment (see section 4.1).

This option performs feeder extraction first (see section 7.8), and then doing data calculation using the tool.

After running the extraction tool, results will be shown in a series of csv files similar to below. Each substation will have a csv file showing all the step loadings and the RMS values.

The ***_RMSCurrent_sum.csv file provides a summary of the maximum RMS current's (and 30min Average Power) at each substation and the corresponding time.

- DCF321_30min_AVEpower_sum.csv
- DCF321_RMSCurrent_Sum.csv
- DCF321_15min_RMScurrent_sum.csv
- DCF321_30min_RMScurrent_sum.csv
- DCF321_60min_RMScurrent_sum.csv
- DCF321_120min_RMScurrent_sum.csv
- DCF321_180min_RMScurrent_sum.csv
- DCF321_1min_RMScurrent_sum.csv
- DCF321_4min_RMScurrent_sum.csv
- DCF321_5min_RMScurrent_sum.csv
- DCF321_MOOR.csv
- DCF321_BOOT.csv
- DCF321_TAPN.csv
- DCF321_BRHS.csv
- DCF321_FREH.csv
- DCF321_LOSW.csv

8.9.2 Option 2 Grid Calculation

Before running option 2 it is required to run option 1 above to generate the substation 30min average power required to do the grid loading calculation.

Option 2 calculates a summary of Grid Loadings based on the substations connected to the grid. The user is required to provide the input file "GridAllocation.csv". The template for this csv file can be generated using the 'CSV - GridAllocation.csv' option found in the 'Import' menu.

Input file: GridAllocation.csv

A	B	C	D	E	F	G
Substation Name	OSLO ID	Grid Feeder				Grid
Winchfield	WNCH	Basingstoke Grid				Basingstoke Grid
Newnham	NEWH	Basingstoke Grid				St Cross Grid
Barton	BART	Basingstoke Grid				Southampton Grid
Worthing Junction	WOJC	Basingstoke Grid				
Oakley	OAKL	Basingstoke Grid				
Waltham	WAHA	Basingstoke Grid				
Micheldever	MICH	St Cross Grid				
Northbrook	NRTH	St Cross Grid				
Kingsworthy	KIGS	St Cross Grid				
Winchester	WSTR	St Cross Grid				
Shawford	SHAW	St Cross Grid				
Eastleigh	ESLI	St Cross Grid				
St Denys	SDYS	Southampton Grid				
Northam A	NORT	Southampton Grid				
Northam B	SOHP	Southampton Grid				
Millbrook	MLBR	Southampton Grid				

This CSV provides information to the programme which Substations are connected to which grid sites, please make sure all grid sites in column C are also entered to the list in column G.

Name	Date modified
DCF312_30min_Grid_Summary.xlsx	05/03/2024 10:06
DCF312_St Cross Grid.csv	05/03/2024 10:06
DCF312_Basingstoke Grid.csv	05/03/2024 10:06
DCF312_Southampton Grid.csv	05/03/2024 10:06
DCF312_30min_AVEpower_sum.csv	26/02/2024 16:47

The programme will output 30min Maximum average power summary in the form of csv for each grid site and a summary excel file.

Grid 30 min Average Power Summary

Grid Name	at Time (hh:mm:ss)	Maximum Power (MW)
Basingstoke Grid	13:23:10	8.76
Southampton Grid	15:24:35	9.89
St Cross Grid	13:43:40	11.48

Detailed 30min Maximum Average Power Summary

Grid Name	Time at Grid Max (hh:mm:ss)	Max Power (MW)	Substation	OSLOID	Sub P at time of Grid Max (MW)	Sub Contribute %	Time at Sub Max (hh:mm:ss)	Max Sub Power (MW)	Power Diff %
Basingstoke Grid	13:23:10	8.76	Winchfield	WNCH	1.38	15.75%	13:16:40	1.49	7.80%
Basingstoke Grid	13:23:10	8.76	Newnham	NEWH	1.34	15.25%	13:07:40	1.40	4.91%
Basingstoke Grid	13:23:10	8.76	Barton	BART	2.13	24.32%	12:57:25	2.63	23.48%
Basingstoke Grid	13:23:10	8.76	Worthing Junction	WOJC	1.18	13.51%	10:50:40	1.33	12.69%
Basingstoke Grid	13:23:10	8.76	Oakley	OAKL	1.39	15.84%	11:18:35	1.71	22.93%
Basingstoke Grid	13:23:10	8.76	Waltham	WAHA	1.34	15.34%	11:16:05	1.63	21.15%
Southampton Grid	15:24:35	9.89	St Denys	SDYS	1.91	19.31%	15:13:15	1.96	2.80%
Southampton Grid	15:24:35	9.89	Northam A	NORT	0.47	4.75%	11:14:00	0.60	28.45%
Southampton Grid	15:24:35	9.89	Northam B	SOHP	1.05	10.66%	15:23:15	1.07	1.14%
Southampton Grid	15:24:35	9.89	Millbrook	MLBR	1.67	16.87%	15:29:35	1.80	7.69%
Southampton Grid	15:24:35	9.89	Redbridge	RBGE	0.83	8.39%	11:58:15	1.02	22.87%
Southampton Grid	15:24:35	9.89	Ashurst	AHUR	0.80	8.04%	12:00:35	0.90	13.70%
Southampton Grid	15:24:35	9.89	Woolston	WOOL	0.78	7.86%	15:27:20	0.85	9.12%
Southampton Grid	15:24:35	9.89	Woodfidley	WODF	0.65	6.61%	15:36:30	0.70	7.49%
Southampton Grid	15:24:35	9.89	Brockenhurst	BRHS	0.61	6.17%	15:33:55	0.68	11.73%
Southampton Grid	15:24:35	9.89	Lower Swanwick	LOSW	0.72	7.30%	15:34:05	0.95	31.94%
Southampton Grid	15:24:35	9.89	Fareham	FREH	0.40	4.06%	15:52:40	0.68	68.92%
St Cross Grid	13:43:40	11.48	Micheldever	MICH	1.57	13.69%	11:13:55	1.77	12.76%
St Cross Grid	13:43:40	11.48	Northbrook	NRTH	1.60	13.91%	13:43:30	1.60	0.13%
St Cross Grid	13:43:40	11.48	Kingsworthy	KIGS	1.38	12.00%	11:26:15	1.66	20.32%
St Cross Grid	13:43:40	11.48	Winchester	WSTR	1.55	13.49%	11:26:45	1.75	13.14%
St Cross Grid	13:43:40	11.48	Shawford	SHAW	1.79	15.58%	13:51:40	1.94	8.45%
St Cross Grid	13:43:40	11.48	Eastleigh	ESLI	2.10	18.32%	11:31:15	2.70	28.53%
St Cross Grid	13:43:40	11.48	South Junction	SJNC	0.58	5.07%	13:51:15	0.64	9.14%
St Cross Grid	13:43:40	11.48	Tapnage	TAPN	0.16	1.39%	15:52:50	0.37	130.65%
St Cross Grid	13:43:40	11.48	Botley	BOOT	0.32	2.79%	15:58:35	0.42	30.28%
St Cross Grid	13:43:40	11.48	Moorgreen	MOOR	0.43	3.75%	15:58:35	0.50	15.38%

The excel file provides all information required to perform HV loading assessment. The generated csv files provide the detailed timestep 30min power data of each substation and the grid site.

Detailed Average Power Summary:

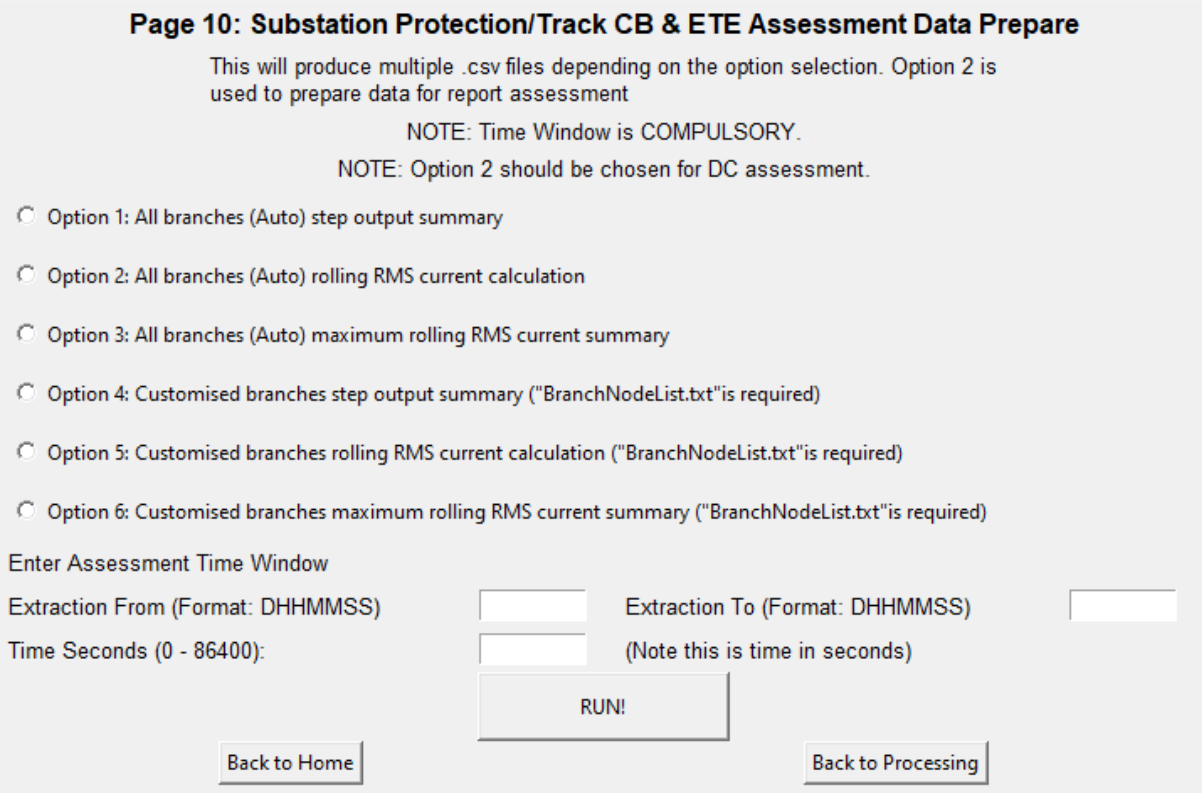
- Maximum Power: the maximum 30-min average grid site power at the grid max time.
- Sub P at time of grid max: the substation power at that time
- Sub Contribute: the contribution is a percentage of this substation power of the total grid site power.
- Max Sub Power: the maximum 30-min power of each substation (at different times which is show in the Time at Sub Max column).
- Power Diff: the percentage difference between the maximum substation power to the substation power recorded during the 30-min period where the grid is the highest power.

8.10 DC: (DATA PREP.) For Track CB, Pos ETE Assessment

This section extracts the current data at each branch nodes and calculates the rolling RMS currents. The result from this section is required for the DC Track CB and Positive ETE assessments in section 8.11.

This option performs list extraction first (see section 7.1), and then doing analysis based on the list data.

Outputs from Option 3 or Option 6; ***_branch_SECONDS_rms_sum_max.csv are required for DC assessments in section 8.11.6 and 8.11.78.11.



There are 6 options in 2 groups. Options 1-3 extract data from all branches in the simulation and will take some time to complete. Option 4-6 extract data from branches specified in the input csv file.

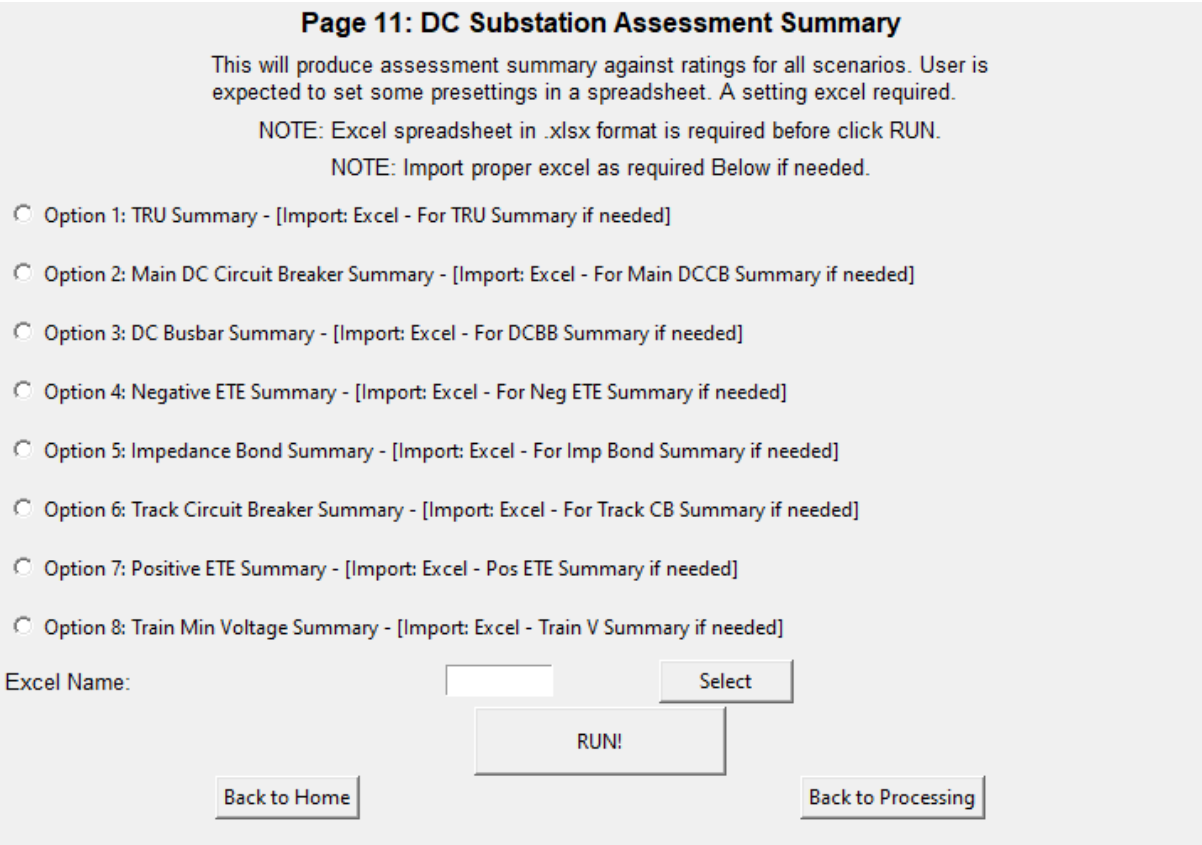
- Option 1 outputs step data for all branches and will not complete an RMS current calculation. Outputs branch_step_sum.csv.
- Option 2 completes the RMS current calculation and outputs the rolling step RMS currents for all branches. Outputs branch_seconds_rms_sum.csv
- Option 3 completes the RMS current calculation but outputs only the maximum recorded currents and the time window only. Outputs branch_seconds_rms_sum_max.csv
- Option 4-6 each correspond to option 1-3 but processes a selected list of branch nodes only. It can be used to reduce the processing time by limiting the number of nodes processed. The user is required to enter the list of required nodes in the input file "BranchNodeList.txt". The template for this txt file can be generated using the 'Text - BranchNodeList.txt' option found in the 'Import' menu (see section 4.3).

For RMS current calculation, the user has to input the time period of calculating the RMS value in seconds.

- 15-min RMS (900 seconds) current used for Track CB assessment.
- 30-min RMS (1800 seconds) current used for Positive ETE assessment.

To get both RMS results the user will be required to run this option twice.

8.11 DC Substation Assessment Summary



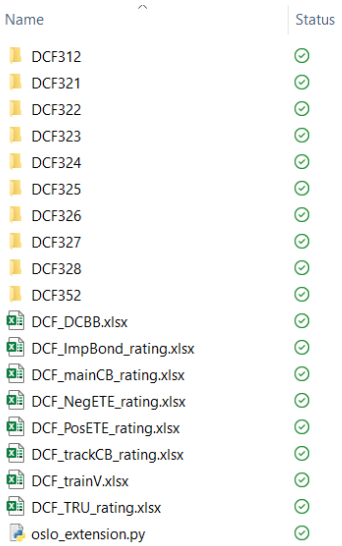
This section performs several DC assessments based on results from section 0 and 8.10 and assessment ratings entered by the user.

This section can combine the results from several N-0 and N-1 scenarios to the summary results sheet for each assessment. Therefore, it is required to copy the oslo_extension.py to outside the simulation folder next to all required simulation folder for this section to work.

The folder structure must be arranged similar to the one below. DCFXXX are all the N-0 and N-1 scenarios to be assessed.

Note that the .xlsx files and oslo_extension.py are located next to these folders. Please make sure that relevant extractions for all specified simulations are completed before using this section.

In this section, results which have exceeded the assessment rating are highlighted as red. Results which are close to exceeding (within 10% or 90% of the assessment rating) are highlighted in amber.



Each assessment option requires a different Excel input file. The relevant input file template could be generated using the 'Import' menu.

Within the excel on the right-hand side there is a table for the simulation folder names and simulation names. This section is the same format across all excel spreadsheets used within this section. An example is shown below. Use outage number 0 for N-0 (no outages) scenario.

ATTENTION: Number 0 is reserved for N-0 scenario.

Outage List			
Outage Number	Simulation Sub-folder	Simulation Name	Note
0	DCF312	DCF312	N-0
1	DCF321	DCF321	N-1
2	DCF322	DCF322	N-1
3	DCF323	DCF323	N-1
4	DCF324	DCF324	N-1
5	DCF325	DCF325	N-1
6	DCF326	DCF326	N-1
7	DCF327	DCF327	N-1
8	DCF328	DCF328	N-1
9	DCF352	DCF352	N-1

8.11.1 Option 1 TRU Summary

This option generates a summary of the TRU results and highlight any rating exceedances in any of the assessed time period from any of the assessed simulation. The user is required to fill in the summary excel with the substation names and ID, their outage number (use 0 if no outages are simulated), and their N-0 and N-1 ratings.

The template for this Excel file can be generated using the 'Excel – (DC) For TRU Summary' option found in the 'Import' menu. The template, named 'TRU_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

					Intact (N-0) Rating									Outage (N-1) Rating								
Substation Name	OSLO ID	Outage Scenario	TRU Rating (MW)	TRU Type	1min	4min	5min	15min	30min	60min	120min	180min	P30min	1min	4min	5min	15min	30min	60min	120min	180min	P30min
Sturt Lane	STUL	0	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Fleet	FLET	0	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Winchfield	WNCH	5	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Newnham	NEWH	1	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Barton	BART	2	3	G	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Worthing Junction	WOJC	3	2	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Oakley	OAKL	4	3	G	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Waltham	WAHA	5	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Micheldever	MICH	1	3	G	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Northbrook	NRTH	2	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Kingsworthy	KIGS	3	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Winchester	WSTR	4	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Shawford	SHAW	5	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Eastleigh	ESLI	1	1.5	SP	19.49	14.21	13.51		8.98	7.66	6.54	5.97		9.75	7.11	6.75		4.49	3.83	3.27	2.98	
St Denys	SDYS	2	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Northam A	NORT	3	3.2	G	49.01	38.40	36.22		25.88	22.72	19.20	18.46		32.67	25.60	24.15		17.25	15.15	12.80	12.31	
Northam B	SOHP	9	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Millbrook	MLBR	4	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Redbridge	RBGE	5	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Ashurst	AHUR	6	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
South Junction	SJNC	6	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Woolston	WOOL	7	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Woodfidley	WODF	0	1	SP	13.00	9.47	9.00		5.98	5.11	4.36	3.98		6.50	4.74	4.50		2.99	2.55	2.18	1.99	
Brockenhurst	BRHS	0	3	G	15.32	12.00	11.32		8.09	7.10	6.00	5.77		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Lower Swanwick	LOSW	8	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Fareham	FREH	0	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Tapnage	TAPN	0	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Botley	BOOT	0	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	
Moorgreen	MOOR	8	1.5	F	6.00	3.13	3.00		2.67	2.40	2.13	2.00		0.00	0.00	0.00		0.00	0.00	0.00	0.00	

The assessment tool will gather the substation RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.9.1 is performed in all simulation folders.

These columns information is essential:

- OSLO ID: Empty cell is NOT allowed.
- Outage Scenario: Allow empty cell which will be assigned to zero automatically.
- Rating section: Allow empty cell which will assume assessment pass.

After running this option, the results will be updated to the same excel file in the form of a results summary page; showing all substations which has exceeded any ratings and results pages for each RMS time period showing results of all assessed substations. Currently N-0 results from the results summary page shows the maximum load at that substation when it is not in outage (adjacent substation could be in outage) N-1 results is the maximum load where that substation is in outage. The tool will be updated to include the maximum loads during a global N-0 scenario at its next update (when all substations are feeding normally).

Summary Title: Failure Substation Summary

OSLO	Substation	1min_N-0	4min_N-0	5min_N-0	15min_N-0	30min_N-0	60min_N-0	120min_N-0	180min_N-0	P30min_N-0	1min_N-1	4min_N-1	5min_N-1	15min_N-1	30min_N-1	60min_N-1	120min_N-1	180min_N-1	P30min_N-1
BART	Barton	174.67%	281.08%	284.96%		189.04%	189.01%	204.15%	214.36%		707.27%	608.05%	589.32%		341.47%	309.36%	291.52%	287.80%	
MICH	Micheldever	109.13%	158.00%	159.95%		118.39%	118.85%	114.73%	118.46%										
OAKL	Oakley	153.37%	242.19%	234.69%		142.96%	141.95%	137.54%	140.23%										

Summary Title 1min TRU Assessment (RMS Current)
Result Failure Substation as Table Below

OSLO	Substation	Outage in Scenario No.	N-0 Rating (kA)	N-1 Rating (kA)	outage_scenario_0	outage_scenario_1	outage_scenario_2	outage_scenario_3	outage_scenario_4	outage_scenario_5	outage_scenario_6	outage_scenario_7	outage_scenario_8	outage_scenario_9
BART	Barton	2	6.00	0.00	8.22	10.00	7.07	10.48	8.42	8.26	8.22	8.22	8.21	8.22
OAKL	Oakley	4	6.00	0.00	7.58	7.05	7.58	9.20		7.86	7.57	7.58	7.57	7.58
MICH	Micheldever	1	6.00	0.00	6.25		6.55	6.28	6.22	6.33	6.26	6.26	6.26	6.25

Summary Title 4min TRU Assessment (RMS Current)
Result Failure Substation as Table Below

OSLO	Substation	Outage in Scenario No.	N-0 Rating (kA)	N-1 Rating (kA)	outage_scenario_0	outage_scenario_1	outage_scenario_2	outage_scenario_3	outage_scenario_4	outage_scenario_5	outage_scenario_6	outage_scenario_7	outage_scenario_8	outage_scenario_9
BART	Barton	2	3.13	0.00	7.02	8.77	6.08	8.79	7.22	7.10	7.02	7.02	7.02	7.02
OAKL	Oakley	4	3.13	0.00	6.19	6.11	6.23	7.57		6.54	6.18	6.19	6.18	6.19
MICH	Micheldever	1	3.13	0.00	4.39		4.93	4.46	4.94	4.63	4.40	4.40	4.39	4.39

Start | Result | 1min | 4min | 5min | 15min | 30min | 60min | 120min | 180min | P30min

8.11.2 Option 2 Main DC Circuit Breaker Summary

This option generates a summary of the Main DC circuit breaker results and highlight any rating exceedances from any of the assessed simulation. The user is required to fill in the summary excel with the substation names and ID, their outage number (use 0 if no outages are simulated), and their N-0 and N-1 ratings.

The template for this Excel file can be generated using the 'Excel – (DC) For MainDCCB Summary' option found in the 'Import' menu. The template, named 'mainCB_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

				Intact	Outage
Substation Name	OSLO ID	Outage Scenario	Main DC CB Type	N-0 Rating (kA)	N-1 Rating (kA)
Sturt Lane	STUL	0	RJR526C	4.00	0.00
Fleet	FLET	0	TN	4.00	0.00
Winchfield	WNCH	5	NDC6	6.00	0.00
Newnham	NEWH	1	TN	4.00	0.00
Barton	BART	2	8MF94	3.00	1.50
Worthing Junction	WOJC	3	TN	1.50	0.00
Oakley	OAKL	4	8MF94	6.00	0.00
Waltham	WAHA	5	TN	3.00	1.50
Micheldever	MICH	1	8MF94	6.00	0.00
Northbrook	NRTH	2	TN	8.00	4.00
Kingsworthy	KIGS	3	TN	8.00	4.00
Winchester	WSTR	4	8MF94	6.00	0.00
Shawford	SHAW	5	TN	8.00	4.00
Eastleigh	ESLI	1	TN	8.00	4.00

These columns information is essential:

- OSLO ID: Empty cell is NOT allowed.
- Outage Scenario: Allow empty cell which will be assigned to zero automatically.
- Rating section: Allow empty cell which will assume assessment pass.

The assessment tool will gather the substation RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.9.1 is performed in all simulation folders. The DC circuit breaker assessment compares the 30min substation current loads to the DC main circuit breaker continuous ratings.

After running this option, the results will be updated to the same excel file in the form of a results summary page; showing all substations which has exceeded any ratings and results pages for 30min RMS current showing results of all assessed substations. Below is an example of the results page showing several substations which have exceeded the assessment rating.

Summary Title:	Failure Substation Summary		
OSLO	*Substation*	*30min_N-0*	*30min_N-1*
BART	Barton	201.88%	272.99%
FLET	Fleet	114.59%	
WAHA	Waltham	148.89%	158.82%
WOJC	Worthing Junction	273.76%	

Summary Title	30min Main DC Circuit Breaker Assessment (RMS Current)														
Result	Failure Substation as Table Below														
OSLO	*Substation*	*Outage in Scenario No.*	*N-0 Rating (kA)*	*N-1 Rating (kA)*	*outage_scenario_0*	*outage_scenario_1*	*outage_scenario_2*	*outage_scenario_3*	*outage_scenario_4*	*outage_scenario_5*	*outage_scenario_6*	*outage_scenario_7*	*outage_scenario_8*	*outage_scenario_9*	
FLET	Fleet	0	4.00	0.00	3.62	3.65	3.61	3.61	3.57	4.58	3.62	3.62	3.62	3.62	
BART	Barton	2	3.00	1.50	4.73	5.84	4.09	6.06	4.87	4.78	4.73	4.73	4.72	4.73	
WOJC	Worthing Junction	3	1.50	0.00	3.18	3.25	3.37		4.11	3.21	3.18	3.18	3.18	3.18	
WAHA	Waltham	5	3.00	1.50	3.03	3.86	3.06	3.20	4.47	2.38	3.03	3.03	3.03	3.03	

8.11.3 Option 3 DC Busbar Summary

This option generates a summary of the DC Busbar Summary results and highlight any rating exceedances from any of the assessed simulation. The user is required to fill in the summary excel with the substation names and ID, their outage number (use 0 if no outages are simulated), and their N-0 and N-1 ratings.

The template for this Excel file can be generated using the 'Excel – (DC) For DCBB Summary' option found in the 'Import' menu. The template, named 'DCBB_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

0					Intact	Outage
1	Substation Name	OSLO ID	Outage Scenario	Main DC Busbar Type - Busbar	N-0 Rating (kA)	N-1 Rating (kA)
2	Sturt Lane	STUL	0	GEC RJR 721E	6.00	6.00
3	Fleet	FLET	0	GEC RJR 721E	8.00	8.00
4	Winchfield	WNCH	5	HSS NDC4	5.50	5.50
5	Newnham	NEWH	1	GEC RJR 721E	4.50	4.50
6	Barton	BART	2	SIEMENS 8MF94 MK1	5.50	5.50
7	Worthing Junction	WOJC	3	BT HSL	5.50	5.50
8	Oakley	OAKL	4	SIEMENS 8MF94 MK1	5.50	5.50
9	Waltham	WAHA	5	BT HSL	5.50	5.50
0	Micheldever	MICH	1	HSS NDC4 SB	8.00	8.00
1	Northbrook	NRTH	2	BT HSL	5.50	5.50
2	Kingsworthy	KIGS	3	BT HSL	5.50	5.50
3	Winchester	WSTR	4	HSS NDC4 SB	6.00	6.00
4	Shawford	SHAW	5	BT HSL	6.00	6.00
5	Eastleigh	ESLI	1	BT HSL	6.00	6.00
6	St Denys	SDYS	2	SECHERON UR36	5.50	5.50

These columns information is essential:

- OSLO ID: Empty cell is NOT allowed.
- Outage Scenario: Allow empty cell which will be assigned to zero automatically.
- Rating section: Allow empty cell which will assume assessment pass.

The assessment tool will gather the substation RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.9.1 is performed in all simulation folders. The DC Busbar assessment compares the 120min substation current loads to the DC busbar continuous ratings. Below is an example of the results page showing several substations which have exceeded the assessment rating.

Summary Title:	Failure Substation Summary		
OSLO	***Substation***	***30min_N-0***	***30min_N-1***
BART	Barton	168.03%	227.65%
FLET	Fleet	91.68%	
WAHA	Waltham	121.18%	136.73%
WOJC	Worthing Junction	218.12%	

Summary Title	30min Main DC Busbar Assessment (RMS Current)													
Result	Failure Substation as Table Below													
OSLO	***Substation***	***Outage in Scenario No.***	***N-0 Rating (kA)***	***N-1 Rating (kA)***	***outage_scenario_0***	***outage_scenario_1***	***outage_scenario_2***	***outage_scenario_3***	***outage_scenario_4***	***outage_scenario_5***	***outage_scenario_6***	***outage_scenario_7***	***outage_scenario_8***	***outage_scenario_9***
FLET	Fleet	0	4.00	0.00	2.89	2.94	2.89	2.88	2.87	3.67	2.89	2.89	2.88	2.89
BART	Barton	2	3.00	1.50	3.94	4.86	3.41	5.04	4.06	4.04	3.94	3.94	3.94	3.94
WOJC	Worthing Junction	3	1.50	0.00	2.51	2.56	2.70		3.27	2.53	2.51	2.51	2.51	2.51
WAHA	Waltham	5	3.00	1.50	2.62	3.41	2.65	2.73	3.64	2.05	2.62	2.62	2.62	2.62

Note that it doesn't take into account the shared load in substations with multiple TRUs. Please check manually if any busbar is over the rating, the program assumes a single TRU situation where all the load if assumed to be fed into one end of the busbar.

8.11.4 Option 4 Negative ETE Summary

This option generates a summary of the Negative ETE (Electrical Traction Equipment) results and highlight any rating exceedances from any of the assessed simulation. The user is required to fill in the summary excel with the substation names and ID, their outage number (use 0 if no outages are simulated), the number of tracks at that substation (which impacts the number of negative return cables at the substation) and their negative ETE assessment ratings (usually at 1.06kA per return cable).

The template for this Excel file can be generated using the 'Excel – (DC) For NegETE Summary' option found in the 'Import' menu. The template, named 'NegETE_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

				Intact
Substation Name	OSLO ID	Outage Scenario	Outgoing Track Number / Near	Rating (kA)
Sturt Lane	STUL	0	4	1.06
Fleet	FLET	0	4	1.06
Winchfield	WNCH	5	4	1.06
Newnham	NEWH	1	4	1.06
Barton	BART	2	4	1.06
Worthing Junction	WOJC	3	4	0.40
Oakley	OAKL	4	2	1.06
Waltham	WAHA	5	2	1.06
Micheldever	MICH	1	2	1.06
Northbrook	NRTH	2	2	0.90
Kingsworthy	KIGS	3	2	0.90
Winchester	WSTR	4	2	1.06

These columns information is essential:

- OSLO ID: Empty cell is NOT allowed.
- Outage Scenario: Allow empty cell which will be assigned to zero automatically.
- Rating section: Allow empty cell which will assume assessment pass.

The assessment tool will gather the substation RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.9.1 is performed in all simulation folders. The Negative ETE uses the 60min substation current loads and divide it using the following formular:

- For N-0 scenario, the value is divided by [number of tracks x 2 – 1] (assuming one return cable in outage)
- For N-1 scenarios, the value is divided by [number of tracks x 2] assuming no outage as another outage make it a N-2 scenario.

Below is an example of the results page showing several substations which have exceeded the assessment rating.

Summary Title	60min Negative Electrical Track Equipment Assessment (RMS Current)													
Result	Failure Substation as Table Below													
OSLO	***Substation***	***Outage in Scenario No.***	***Track Number***	***Rating (kA)***	***outage_scenario_0***	***outage_scenario_1***	***outage_scenario_2***	***outage_scenario_3***	***outage_scenario_4***	***outage_scenario_5***	***outage_scenario_6***	***outage_scenario_7***	***outage_scenario_8***	***outage_scenario_9***
WOJC	Worthing Junction	3	4.00	0.40	0.29	0.29	0.31		0.39	0.29	0.29	0.29	0.29	0.29
NRTH	Northbrook	2	2.00	0.90	0.63	0.95	0.49	0.65	0.66	0.64	0.63	0.63	0.63	0.63
KIGS	Kingsworthy	3	2.00	0.90	0.59	0.62	0.62	0.48	0.90	0.60	0.59	0.59	0.60	0.59

8.11.5 Option 5 Impedance Bond Summary

This option generates a summary of the Impedance Bond results and highlight any rating exceedances from any of the assessed simulation. The user is required to fill in the summary excel with the substation names and ID, their outage number (use 0 if no outages are simulated), the number of tracks at that substation (which impacts the number of impedance bonds at the substation) and their ratings according to the bonding type. The bonding Type column is for information only.

The template for this Excel file can be generated using the 'Excel – (DC) For Imp Bond Summary' option found in the 'Import' menu. The template, named 'ImpBond_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

0						Intact	
1	Substation Name	OSLO ID	Outage Scenario	Outgoing Track Number / Near	Bonding Type	60min Rating (kA)	120min Rating (kA)
2	Sturt Lane	STUL	0	4	Type 2	3.60	
3	Fleet	FLET	0	4	Type 2	3.60	
4	Winchfield	WNCH	5	4	Type 2	0.36	
5	Newnham	NEWH	1	4	Type 2	0.25	
6	Barton	BART	2	4	Type 2	3.60	
7	Worthing Junction	WOJC	3	4	Type 2	3.60	
8	Oakley	OAKL	4	2	Type 2	3.60	
9	Waltham	WAHA	5	2	Type 2	3.60	
0	Micheldever	MICH	1	2	Type 2	3.60	
1	Northbrook	NRTH	2	2	Type 2	3.60	
2	Kingsworthy	KIGS	3	2	Type 2	3.60	
3	Winchester	WSTR	4	2	Type 2	3.60	

These columns information is essential:

- OSLO ID: Empty cell is NOT allowed.
- Outage Scenario: Allow empty cell which will be assigned to zero automatically.
- Rating section: Allow empty cell which will assume assessment pass.

The assessment tool will gather the substation RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.9.1 is performed in all simulation folders. The Negative ETE uses the 60min and 120min substation RMS current loads since different bonding type has ratings in different time periods. The substation load is divided using the following formular:

- For N-0 scenario, the value is divided by [number of tracks x 2 – 1] (assuming one return cable in outage)
- For N-1 scenarios, the value is divided by [number of tracks x 2] assuming no outage as another outage make it a N-2 scenario.

Below is an example of the results page showing several substations which have exceeded the assessment rating.

Summary Title	60min Impedance Bonding Assessment (RMS Current)
Result	Failure Substation as Table Below

OSLO	*Substation*	*Outage in Scenario No.*	*Track Number*	*Bonding Type*	*Rating (kA)*	*outage_scenario_0*	*outage_scenario_1*	*outage_scenario_2*	*outage_scenario_3*	*outage_scenario_4*	*outage_scenario_5*	*outage_scenario_6*	*outage_scenario_7*	*outage_scenario_8*	*outage_scenario_9*
WNCH	Winchfield	5	4	Type 2	0.36	0.30	0.35	0.27	0.27	0.27		0.27	0.27	0.27	0.27
NEWH	Newnham	1	4	Type 2	0.25	0.29		0.27	0.26	0.25	0.34	0.25	0.25	0.25	0.25

Summary Title	120min Impedance Bonding Assessment (RMS Current)
Result	Assessment All Pass

OSLO	*Substation*	*Outage in Scenario No.*	*Track Number*	*Bonding Type*	*Rating (kA)*	*outage_scenario_0*	*outage_scenario_1*	*outage_scenario_2*	*outage_scenario_3*	*outage_scenario_4*	*outage_scenario_5*	*outage_scenario_6*	*outage_scenario_7*	*outage_scenario_8*	*outage_scenario_9*

8.11.6 Option 6 Track Circuit Breaker Summary

This option generates a summary of the Track Circuit Breaker results and highlight any rating exceedances from any of the assessed simulation. The user is required to fill in the summary excel with the substation names, track CB ID, substation OSLO ID, track CB type and their ratings according to the track CB type.

The template for this Excel file can be generated using the 'Excel – (DC) For Track CB Summary' option found in the 'Import' menu. The template, named 'trackCB_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

				15min	Intact
Substation	OSLO Branch ID	Feeder ID	Track CB Type	Standard Rating (kA)	Assessed Rating (kA) (+10%)
Newnham	E22/E	NEWH	GEC RJR 721E	1.17	1.30
Newnham	E24/E	NEWH	GEC RJR 721E	2.30	2.53
Newnham	E23/E	NEWH	GEC RJR 721E	2.30	2.53
Newnham	E21/E	NEWH	GEC RJR 721E	2.30	2.53
Newnham	E26/S	NEWH	GEC RJR 721E	2.30	2.53
Newnham	E28/S	NEWH	GEC RJR 721E	2.3	2.53
Newnham	E27/S	NEWH	GEC RJR 721E	2.3	2.53
Newnham	E25/S	NEWH	GEC RJR 721E	2.3	2.53
Basing TPH	E26/E	BASI	GEC RJR 721E	2.3	2.53
Basing TPH	E28/E	BASI	GEC RJR 721E	2.3	2.53

These columns information is essential:

- OSLO Branch ID: Empty cell is NOT allowed, and the format will be auto-checked once run.
- Assessed Rating (kA) (+10%): Allow empty cell which will assume assessment pass.

The assessment tool will gather the branch 15 min (900 seconds) RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.10 is performed in all simulation folders. The track circuit breaker assessment compares the 15 min branch node current loads to the track circuit breaker continuous ratings.

After running this option, the results will be updated to the same excel file in the form of a results summary page showing all branches which has exceeded any ratings, and results pages for 15 min RMS current showing results of all assessed branches. Below is an example of the results page showing several track circuit breakers which have exceeded the assessment rating.

Summary Title	15min Track Feeder Circuit Breaker Assessment (RMS Current)												
Result	Failure Substation as Table Below												
OSLO	*Substation*	*Track CB Type*	*Rating (kA)*	*outage_ scenario _0*	*outage_ scenario _1*	*outage_ scenario _2*	*outage_ scenario _3*	*outage_ scenario _4*	*outage_ scenario _5*	*outage_ scenario _6*	*outage_ scenario _7*	*outage_ scenario _8*	*outage_ scenario _9*
E22/E		GEC RJR 721E	1.30	1.08	1.00	1.07	1.08	1.08	1.29	1.08	1.08	1.08	1.08
E29/S		GEC RJR 721E	1.00	1.01	0.98	1.01	1.00	1.01	1.00	1.01	1.01	1.01	1.01

8.11.7 Option 7 Positive ETE Summary

This option generates a summary of the Electrical Track Equipment results and highlight any rating exceedances from any of the assessed simulation. The user is required to fill in the summary excel with the substation names, OSLO branch ID, cable number, ETE type and their ratings according to the cable number or ETE type.

The template for this Excel file can be generated using the 'Excel – (DC) For Pos ETE Summary' option found in the 'Import' menu. The template, named 'PosETE_rating_template.xlsx' (which can be

renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

				Intact
Site Location	OSLO Branch ID	Cable Number	Cable / ETE Type	Rating (kA)
Newnham	E22/E	Double	Default	2.60
Newnham	E24/E	Double	Default	2.60
Newnham	E23/E	Double	Default	2.60
Newnham	E21/E	Double	Default	2.60
Newnham	E26/S	Double	Default	2.60
Newnham	E28/S	Double	Default	2.60
Newnham	E27/S	Double	Default	2.60
Newnham	E25/S	Double	Default	2.60
Basing TPH	E26/E	Double	Default	2.60
Basing TPH	E28/E	Double	Default	2.60

These columns information is essential:

- OSLO Branch ID: Empty cell is NOT allowed, and the format will be auto-checked once run.
- Rating (kA): Allow empty cell which will assume assessment pass.

The assessment tool will gather the branch 30 min (1800 seconds) RMS Current summary from all the specified folders to generate a results summary. Please make sure the data extraction in 8.10 is performed in all simulation folders. The track circuit breaker assessment compares the 30 min branch node current loads to the track circuit breaker continuous ratings.

After running this option, the results will be updated to the same excel file in the form of a results summary page showing all branches which has exceeded any ratings, and results pages for 30 min RMS current showing results of all assessed branches. Below is an example of the results page showing several track circuit breakers which have exceeded the assessment rating.

Summary Title	30min Postive Electrical Track Equipment Assessment (RMS Current)
Result	Failure Substation as Table Below

OSLO	*Location*	*Cable Number*	*Rating (kA)*	*outage_ scenario _0*	*outage_ scenario _1*	*outage_ scenario _2*	*outage_ scenario _3*	*outage_ scenario _4*	*outage_ scenario _5*	*outage_ scenario _6*	*outage_ scenario _7*	*outage_ scenario _8*	*outage_ scenario _9*
223a/S	Eastleigh	Single	1.30	1.12	1.62	1.12	1.08	1.11	1.13	0.67	1.08	1.04	1.08
E68/E	Eastleigh	Double	2.60	2.29	2.16	2.34	2.28	2.29	2.24	2.22	2.25	2.24	2.25
208b/S	Woolston	Single	1.30	1.04	1.03	1.03	1.04	1.04	1.04	1.04	0.88	1.29	1.03

8.11.8 Option 8 Train Min Voltage Summary

This option generates a summary of the train's minimum voltage results and highlight any voltage below the voltage threshold. The user is required to fill in the summary excel with the OSLO train No, rolling stock type and the voltage threshold according to the rolling stock type.

The template for this Excel file can be generated using the 'Excel – (DC) For Train V Summary' option found in the 'Import' menu. The template, named 'trainV_rating_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected using the 'select' button.

						Intact
OSLO Train No	HeadCode	Origin	Destination	Depature Time	Rolling Stock	Voltage Threshold
31	"7V12"	WOKINGF	WHATFHH	15:38:00	Class 92 DC 800T	450
35	"4M28"	SOTOMCT	CREWBHN	09:33:00	Class 92 DC 1600T	450
36	"4M55"	SOTOMCT	LWLYSFT	08:57:00	Class 92 DC 1600T	800
38	"4M61"	SOTOMCT	TRFDFLT	12:56:00	Class 92 DC 1600T	450
39	"4M65"	SOTOMCT	LWLYSFT	13:45:00	Class 92 DC 1600T	450
40	"4O51"	WENTLOG	SOTOMCT	09:41:00	Class 92 DC 1475T	450
42	"4O90"	LEEDFLT	SOTOMCT	06:04:00	Class 92 DC 1600T	450
43	"4S59"	SOTOMCT	MOSEDNY	14:57:00	Class 92 DC 1475T	450

These columns information is essential:

- OSLO Train No: Empty cell is NOT allowed.
- Voltage Threshold: Allow empty cell which will assume assessment pass.

The assessment tool will gather the ***.osop.vlt file from all the specified folders to generate a results summary. Please make sure the any data extraction is performed in all simulation folders. The train voltage assessment compares the train's minimum voltage from ***.osop.vlt file against the voltage threshold.

Voltage lower than the threshold will be highlighted in red, voltage lower than 488 V will be highlighted in yellow. Note that 488 is a fixed number hard coded in the tool, the reason of choosing this number is outside the scope of this document and user could refer any DC traction power modelling report for understanding.

After running this option, the results will be updated to the same excel file in the form of a results summary page showing all trains that fails the initial assessment, and results pages for train minimum voltage summary showing results of all assessed trains. Below is an example of the results page showing several track circuit breakers which have exceeded the assessment rating.

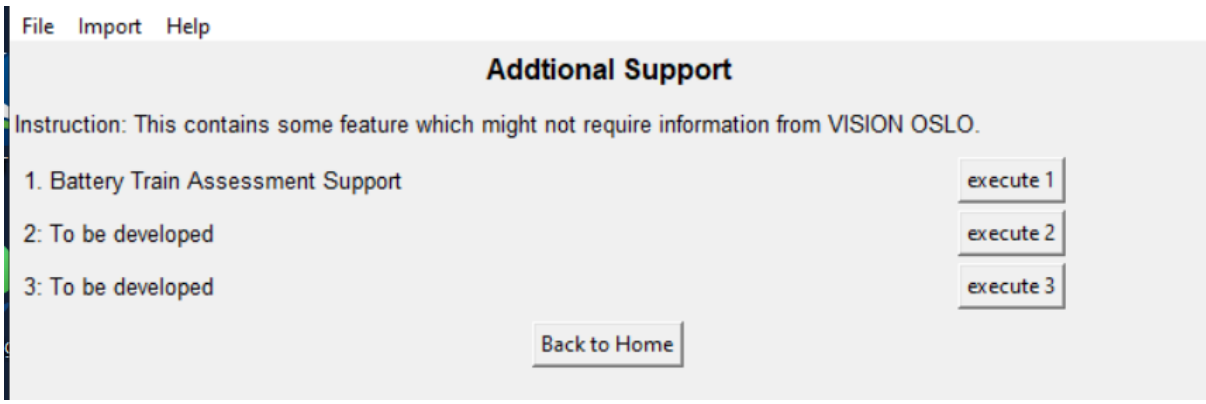
Summary Title	MinV Minimum Voltage Assessment (RMS Current)
Result	Failure Substation as Table Below

OSLO	*HeadCode*	*Origin*	*Destination*	*Departure Time*	*Rolling Stock*	*Voltage Threshold (V)*	*outage_scenario_0*	*outage_scenario_1*	*outage_scenario_2*	*outage_scenario_3*	*outage_scenario_4*	*outage_scenario_5*	*outage_scenario_6*	*outage_scenario_7*	*outage_scenario_8*	*outage_scenario_9*
35	"4M28"	SOTOMCT	CREWBHN	09:33:00	Class 92 DC 1600T	450.00	527.00	517.00	506.00	504.00	448.00	526.00	527.00	527.00	527.00	527.00
36	"4M55"	SOTOMCT	LWLYSFT	08:57:00	Class 92 DC 1600T	800.00	515.00	499.00	511.00	489.00	477.00	517.00	515.00	515.00	515.00	515.00
38	"4M61"	SOTOMCT	TRFDFLT	12:56:00	Class 92 DC 1600T	450.00	516.00	502.00	495.00	515.00	410.00	508.00	515.00	515.00	516.00	515.00
40	"4O51"	WENTLOG	SOTOMCT	09:41:00	Class 92 DC 1475T	450.00	502.00	504.00	480.00	493.00	491.00	509.00	500.00	501.00	502.00	501.00

8.12 DC: Provision for Development

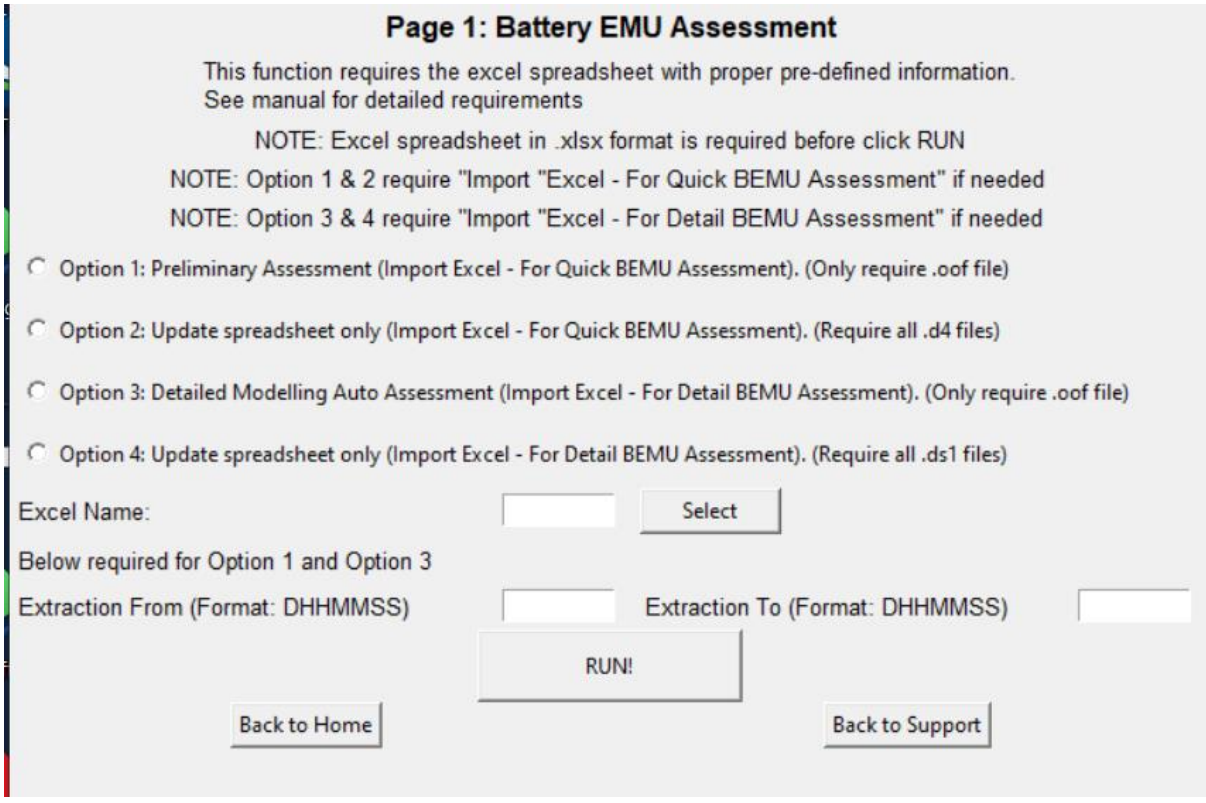
This section is provision for development.

9 Additional Support



This option provides additional support that might not need data from VISION OSLO.

9.1 Battery EMU Assessment Support



In this section, four options are available as follows. Option 1 and Option 2 use the same excel file, while Option 3 and Option 4 uses a different one. The latest results will be automatically updated in the Excel file. This will be further explained below.

The desired time period must be allocated for Option 1 and 3 in format DHHMMSS.

9.1.1 Option 1 & 2

Input & output file: *.xlsx

Option 1 and Option 2 are to support the supply point's capacity to support the BEMU operation. It utilise the feeder station raw data from VISION OSLO output and calculate the maximum number of BEMU that can be support within a feeder area. For further details please refer to document [5].

To utilize this option, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel – For Quick BEMU Assessment' option found in the 'Import' menu. The template, named BEMU_support_capacity.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected from the 'select' button.

NOTE: This spreadsheet is only valid for 5 seconds time-increment.

Supply Point Name	OSLO ID	Source Resistance (Ω)	Source Reactance (Ω)	OLE Paralleled Section	Fault Level (MVA)	Incoming Feeder Overcurrent (A)	MISL (MVA)	Instant Charging Limit (A)	Charging Limit (MW)	Expected Site Usage (%)	OLE Continous Rating (A)
Essendine Feeder 1	BOF1	0.2251	4.79	8	1000	2100	40	80	2	80%	300
Welwyn Feeder 1	SUF1	0.2251	4.79	8	1000	2100	40	80	2	80%	300

The necessary information is as follow:

- Supply Point Name: This is the user defined name of a supply point / feeder station.
- OSLO ID: This is corresponding OSLO ID.
- Source Resistance: This is the source resistance from extra.oslo (including grid transformer).
- Source Reactance: This is the source reactance from extra.oslo (including grid transformer).
- OLE Paralleled Section: This is the all paralleled path that the current could flow. This figure was used to estimate the current split between various conductors.
- Fault Level: at the moment, this value is not used for assessment.
- Incoming Feeder Overcurrent: This is the IF O/C protection setting. Instant current threshold.
- MISL: Minimum Infrastructure Site Limit.
- Instant Charging Limit: This is the maximum instant charging limit of a single battery EMU.
- Charing Limit: This is the continuous maximum charging power of a single battery EMU. This is usually referred as the charging rating.
- Expected Site Usage: This is the value that will be used to calculate the headroom of a site. This is the percentage value that a supply point will NOT exceed.
- OLE continuous rating: this is the OLE rating that user do not want to exceed.

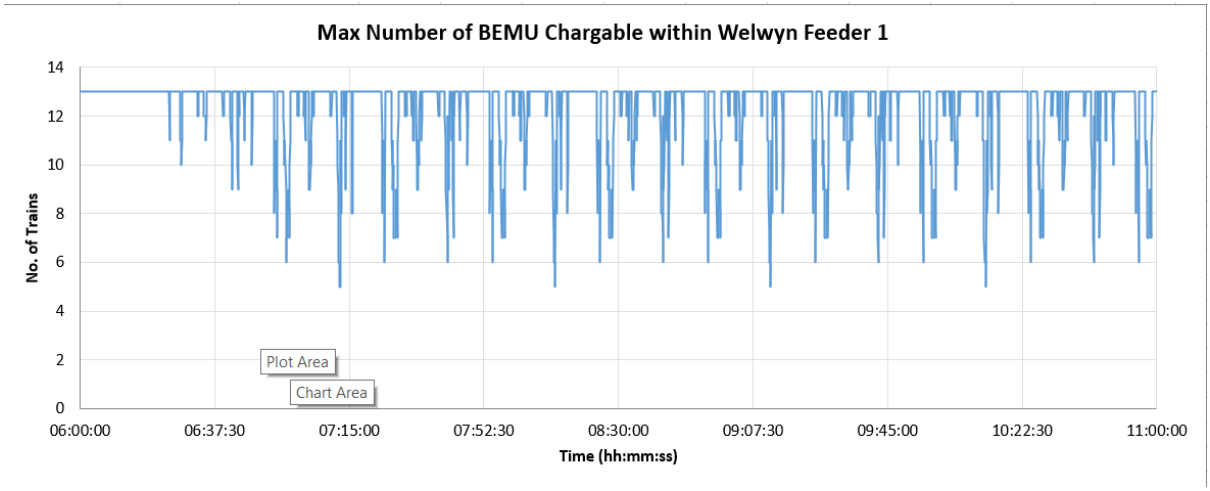
Due to the high simplification of this assessment procedure. All these setting will be available to adjust after the processing as the result was written in a way using excel formula.

The output data will be the assessment calculation for each supply point / feeder station.

Each sheet will follow the following format:

Source Impedance	4.795286228	0.2251	4.79
Expected Usage	80.0%		
MISL (MVA)	40		
MISL Limit (MVA)	32		
IF O/C (A)	2100		
IF O/C Limit(A)	1680		
OLE Section	8		
BEMU Limit (A)	80		
BEMU Limit (MW)	2		
OLE Rating (A)	300		

There will be setting configuration summary on the top left corner. User could change the values here to dynamic adjust the final result if needed.



A plot of maximum number of BEMU can be charged within a feeder area will be shown. The setting change will adjust this plot dynamically. It should be noted that there is no sensible check of this result as users are expected to do the design check, i.e., the maximum number could be negative if the supply point has little capacity to support any operation.

NOTE: Calculation from Column W should is trackable from the formula
NOTE: You can adjust the settings above to manipulate the plot
Support for Column 'AC' Charging Headroom calculation as follows:
Considering the source energy consumption --> VI + I^2 R = MISL --> RI^2+VI-MISL = 0
I could be sorted using standard 2nd order equation solution
I = [-V + sqrt(V^2 - 4 R MISL)] / 2 R

SupplyID	Type	Time	P_inst	Q_inst	Voltage	V_angle	Current	I_angle	S_inst	P_20min	Q_20min	S_20min	P_30min	Q_30min	S_30min	I_inst	I_1200s_RMS	I_1800s_RMS	New_C_1	New_C_2	New_C_3	Excel_Time	Inst Current Headroom (A)	Instat Max Train	New_C_4	MISL Headroom (MVA)	MISL Current (A)	Charging Headroom (A)	Charging per OLE (A)	30 min Average (A)
SUF1	SP	06:00:05	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:05	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:10	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:10	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:15	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:15	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:20	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:20	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:25	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:25	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:30	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:30	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:35	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:35	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:40	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:40	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:45	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:45	1673.3	20		25.3	963.773	1026.52	128.314	
SUF1	SP	06:00:50	0.104	-0.14	26.251	0	6.7	53.3	0.1744							6.7						06:00:50	1673.3	20		25.3	963.773	1026.52	128.314	

Train step output raw data will be available below. The default modelling calculate is not changeable as it should come from simulation output directly. However, all assessment related calculation (i.e., from Column W to right) is calculated using the excel formula. User could do their own sensible check and adjust the calculation to support specific needs if needed.

The calculation will not be shown here but the meaning of headings is further explained.

- Instant Current Headroom: this is the total current headroom available based on existing substation usage.
- Instant Max Train: this is the maximum number of train that can be run without breaking the instant protection setting.
- MISL Headroom: this is the total power headroom available based on existing site usage.
- MISL Current: this is the equivalent current under MISL headroom at that time sample.
- Charing Headroom: this is the maximum total charging current considering the energy consumption on the source due to the constant charging current.
- Charing per OLE: this is the equivalent maximum charging headroom for each OLE section.
- 30 min Average: This is the 30 min average value of maximum charging per OLE.
- 30 min Current Headroom for Charging: this is the charging limit considering both OLE rating and MISL.

- 30 min Equivalent Power: This is the equivalent power.
- 30 min Max Train: this is the maximum number of train that can be run without exceeding MISL and OLE limit.
- Max train: this is the minimum value between Instant Max Train and 30 min Max Train.

9.1.2 Option 3 & 4 Detailed Assessment Spreadsheet

Input & output file: *.xlsx

Option 3 and Option 4 are to support battery EMU modelling methodology adopted at the time of writing. User needs to have a working BEMU modelling successfully finished and the model needs to be set up as required in the existing battery EMU modelling procedures. For further detail please refer to document [5].

To utilize this option, user needs an Excel file containing necessary pre-defined information. The template for this Excel file can be generated using the 'Excel – For Detail BEMU Assessment' option found in the 'Import' menu. The template, named battery_train_template.xlsx' (which can be renamed as desired), follows the format shown below. After allocating the necessary information in the file, user must save and close it. Then, the file name (without suffix) should be entered into the relevant box or selected from the 'select' button.

NOTE: This spreadsheet is only valid for 5 seconds time-increment.				NOTE: This is BHTPBANK withOUT battery charging performance.						
Train Journey	Train ID in Section	Section	On/Off Wire	Base Traction Profile	Link Previous (NA or Train ID)	Jounery Start Battery Level (%)	Auxiliary Power (kW)	Charging Efficiency (%)	Discharging Efficiency (%)	Battery Size (kWh)
Borders Railway BEMU	1027	Edinburgh to Newcraighall	On	BEMU4C00	NA	50%	203	80%	80%	1050
Borders Railway BEMU	1028	Newcraighall to Galashiels	Off	BEMU4C02	1027	-	203	80%	80%	1050
Borders Railway BEMU	1029	Galashiels to Tweebank	On	BEMU4C00	1028	-	203	80%	80%	1050
Borders Railway BEMU	1030	Tweedbank Station - Charging	On	BEMU4C03	1029	-	203	80%	80%	1050
Borders Railway BEMU	1031	Tweedbank to Galashiels	On	BEMU4C00	1030	-	203	80%	80%	1050
Borders Railway BEMU	1032	Galashiels to Newcraighall	Off	BEMU4C02	1031	-	203	80%	80%	1050
Borders Railway BEMU	1033	Newcraighall to Edinburgh	On	BEMU4C00	1032	-	203	80%	80%	1050

The necessary information is as follow:

- Train Journey: This is the user defined name of a train route containing different sections. It should be noted that a unique route name is required for each different route.
- Train ID in Section: Train VISION ID that is used to represent the section.
- Section: The section name. Note that this will be used in plot analysis.
- On/Off Wire: User can ONLY enter 'On' representing the train will be charged on wire. Or 'Off' representing the train will NOT be charged on wire, running in battery mode only.
- Base Traction Profile: This is the BHTPBANK file that does NOT consider battery charging performance under opportunity charging. Note that this is NOT the BHTPBANK that the train actually use. But for stationary charging or battery mode, it is the BHTPABANK that the train actually use.
- Link Previous (NA or Train ID): User can only enter 'NA' or a train VISION ID that the services linked from. This link flow will be analysed.
- Journey Start Battery Level (%): User must enter a value if this is the first section (i.e., Link Previous is NA. Other train sections do not require a battery level.
- Auxiliary Power (kW): Adding information required.
- Charging Efficiency: This is the efficiency between the energy to the battery cell and the energy actually charged to the battery.
- Discharging efficiency: This is the efficiency between the energy discharged from the battery and the energy before distributing to auxiliary and traction.
- Battery Size: This should be the maximum battery size including contingency part.

In the control panel,

- Option 2: Full Auto Process. This option will only required .oof file. It will extraction train step output using the train list provided in the excel. And then do the battery analysis as Option 3 will do.
- Option 3: Update spreadsheet only. This option will update the spreadsheet based upon the existing ds1 file located within the working folder. It will do comprehensive battery analysis by manipulating excel file only.

The output data for each sheet is described below.

Result: the results in this sheet are as follow:

Simulation Results					
Battery Charged in Section (kWh)	*Start Battery Level (kWh)*	*End Battery Level (kWh)*	*Battery Charged in Section (%)*	*Start SoC (%)*	*End SoC (%)*
166.80	500.00	666.80	16.68%	50.00%	66.68%
-543.05	666.80	123.74	-54.31%	66.68%	12.37%
64.82	123.74	188.56	6.48%	12.37%	18.86%
449.34	188.56	637.90	44.93%	18.86%	63.79%
78.64	637.90	716.55	7.86%	63.79%	71.65%
-447.26	716.55	269.29	-44.73%	71.65%	26.93%
170.64	269.29	439.93	17.06%	26.93%	43.99%

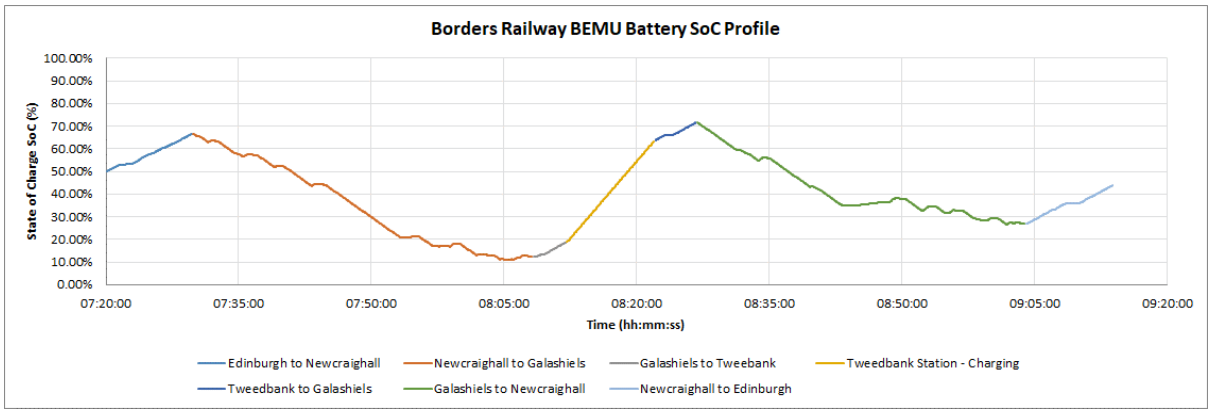
The information provided contains the battery level at the start and the end of each train section in both absolute value (kWh) and percentage value (%). At the moment, no conditional formatting is applied due to the assessment criteria is not clear.

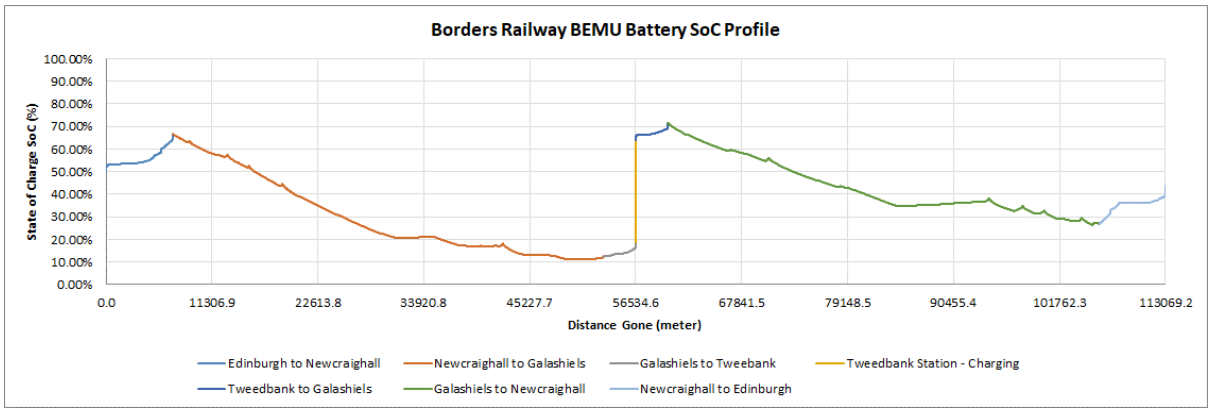
Train ID: will generate the OSLO single train step output results between column “Train ID” and “REF2”. The following column are calculated using the formula below:

- Inst Speed (km/h): convert from column “Instant Speed” in mph. (mph – kmh)
- Average Speed (m/s): convert from column “Average Speed” in mph. (mph – m/s)
- Effort for Traction (kN): If the braking effort < 0 and braking used = 100%, then this is calculated using the instant speed and pantograph voltage. It finds out the linear interpolation of the tractive effort under that speed and voltage. Otherwise, it convert from column “TE/BE used” in lbf. (lbf – kN)
- Mechanical Egy Used (kWh): This is calculated using the Effort for Traction (kN) * Average Speed (m/s) * 5 / 3600
- Electrical Egy Used (kWh): This is calculated using the column ‘Active Power (kW)’ and times 5 and then divide 3600.
- Traction Egy Used (kWh): This is calculated using the mechanical energy and linear interpolation of the traction efficiency by mechanical energy / efficiency for traction, mechanical energy * efficiency for regenerative braking.
- Auxiliary Egy Used (kWh): This is using the user defined auxiliary load * 5 / 3600.

- Battery Egy Used (kWh): This is calculated as (electrical energy – traction energy – auxiliary energy) under 'On' wire charging, calculated as (– electrical energy) under "Off" wire running.
- Battery Egy (dis)charging (kWh): This is calculated as (battery energy * charging efficiency) under 'On' wire charring, calculated as (battery energy / discharging efficiency) under 'Off' wire braking.
- Excel_Time: Time in excel format.
- Excel_Position: This is the absolute distance gone from the start of the "route" (i.e., first train section starts). And covert from yards to meter. (yard - meter)
- Excel_Battery: This is the absolute battery level in (kWh) from the start of the "route" (i.e., first train section starts).
- Excel_SoC: This is the percentage battery level in (SoC %) from the start of the "route" (i.e., first train section starts).

Route: Each route will have a new tab for its route journey energy level plotting.





This sheet gives two plotting. Battery EMU's battery level / SoC (%) against time. And the battery EMU's battery level / SoC (%) against the distance gone.

10 Reference

1. 182786-NRD-REP-MAN-000002, VISION-OSLO Extension Guidance for Developers, Engineering Services.
2. User Guide for Computer Program 'OSLO', Copy No 2, R.J. Phillips & F. Waterland, Mathematical Modelling Unit.
3. Introduction to OSLO, issue 1.1, AEA Technology Rail.
4. 182786-NRD-REP-MAN-000006, Static Frequency Converter Modelling in VISION OSLO, Engineering Services.
5. 182786-NRD-REP-MAN-000007, Battery Train Modelling in VISION OSLO, Engineering Services.

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