**Documentation**

This document, together with the README file in the same folder will allow a reader to both understand and use the model in this same folder. The README file will focus on allowing a reader to use the model, whereas this document will serve more to provide understanding on how the model works, and why it is made the way it is.

For this model the pandas and pandapower libraries for python are used. Questions concerning their function and use are best answered in these libraries respective documentation,

see:

[pandas documentation — pandas 1.5.2 documentation (pydata.org)](https://pandas.pydata.org/docs/)

and:

[pandapower — pandapower 2.11.1 documentation](https://pandapower.readthedocs.io/en/v2.11.1/)

**General structure of the code**

In order to increase readability the code of this model has been divided into segments. The first segment loads libraries and input data, after that, a segment creates the network busses that external grids are connected to and defines these external grid connections. In this section a series of standard types for different cables are also defined.

The next series of segments define the USP power grid itself, This is itself defined in certain segments at a time in order to increase readability instead of defined all at once. These grid segments are not chosen at random, generally, a segment starts at a specific field of the MV station at the Sorbonnelaan and continues through the grid until a normally open breaker position in the grid is encountered, as indicated on the pdf map of the grid that is enclosed in this same folder. A grid segment is then coded as follows: first all busses in this segment are defined, then all lines, then switches, and then loads.

**Object numbers**

The naming system for objects in this model is based off of the IDs that Stedin assigns to busses/switching installations. Every object in this model is named according to the Stedin ID that applies to the nodes that this object is related to. This is always done in the following format: first a prefix that describes what type of object is defined here (bus, line, switch, etc.), the the object ID, then one or more suffixes giving additional information. All these are separated by the ‘underscore’ sign [\_].

Hence, the bus that represents the fictional network node with Stedin ID ‘1234’ will thus in the code be named [bus\_1234], if the Stedin ID applies to a larger switching installation with multiple busrails then, logically, these are modelled as multiple busses. These busses are then distinguished by adding suffixes 1, 2, 3, etc. For example [bus\_1234\_1] and [bus\_1234\_2].

The line going from node 1234 to node 4321 will be named [line\_1234\_4321], when multiple lines run between the same busses, Stedin distinguishes these with the terms k1, k2, k3, etc. This method is also taken up in the code and would look as follows: [line\_1234\_4321\_k1].

Breakers in grid that are connected to the same node are distinguished by the suffixes 101, 102, 103, etc. And in the case of several busrails falling under the same Stedin ID, the breakers on the second rail are given the suffixes 201, 202, 203, etc. and on the third rail 301, 302, 303, etc. This method of distinguishing breakers has been taken up in the model as well. This means that for example, the first breaker on the second busrail on a Stedin ID, is NOT called [switch\_1234\_2\_101], but instead is called [switch\_1234\_201].

The load connected to node ‘1234’ is named [load\_1234]. A second load connected to this node would be called [load\_1234\_2] (the first load in this case then being named [load\_1234\_1]) hence, to know whether a load called [load\_1234\_2] is the second load connected to bus 1234, or the only load connected to the second rail of bus 1234, one should confirm whether a [load\_1234\_1] exists or not. In the case of multiple suffixes, the first one describes the number of the busrail, and the second one the number of the load. Hence, [load\_1234\_2\_3] would be the third load connected to the second busrail of node 1234.