|  |
| --- |
| Micro Grid Test Configuration |
| Version 2 |
| CGMES 2.4.15 |
| 3 October 2017 |

Contents

[Contents 2](#_Toc495325237)

[1. Introduction 3](#_Toc495325238)

[2. Usage and content of the test configuration 3](#_Toc495325239)

[3. Micro Grid Base Case 5](#_Toc495325240)

[3.1. General information 5](#_Toc495325241)

[3.2. Network topology and data 5](#_Toc495325242)

[3.3. Load flow and short-circuit calculation information 8](#_Toc495325243)

[3.4. CIMdesk validation report for BE MAS 8](#_Toc495325244)

[3.5. CIMdesk validation report for NL MAS 9](#_Toc495325245)

[3.6. CIMdesk validation report for BD MAS 9](#_Toc495325246)

[3.7. CIMdesk validation report for Assembled model 9](#_Toc495325247)

[4. Micro Grid Type 1 10](#_Toc495325248)

[4.1. General information 10](#_Toc495325249)

[4.2. Network topology and data 10](#_Toc495325250)

[4.3. Load flow and short-circuit calculation information 12](#_Toc495325251)

[4.4. CIMdesk validation report for Assembled model 12](#_Toc495325252)

[5. Micro Grid Type 2 12](#_Toc495325253)

[5.1. General information 12](#_Toc495325254)

[5.2. Network topology and data 13](#_Toc495325255)

[5.3. Load flow and short-circuit calculation information 14](#_Toc495325256)

[5.4. CIMdesk validation report for Assembled model 14](#_Toc495325257)

[6. Micro Grid Type 3 15](#_Toc495325258)

[6.1. General information 15](#_Toc495325259)

[6.2. Network topology and data 15](#_Toc495325260)

[6.3. Load flow and short-circuit calculation information 16](#_Toc495325261)

[6.4. CIMdesk validation report for Assembled model 16](#_Toc495325262)

[7. Micro Grid Type 4 17](#_Toc495325263)

[7.1. General information 17](#_Toc495325264)

[7.2. Network topology and data 17](#_Toc495325265)

[7.3. Load flow and short-circuit calculation information 20](#_Toc495325266)

[7.4. CIMdesk validation report for Assembled model 20](#_Toc495325267)

[8. Single line diagrams 21](#_Toc495325268)

1. Introduction

This document is providing an overview of the Micro Grid Test Configuration applicable for the ENTSO-E Common Grid Model Exchange Specification (CGMES) Conformity Assessment Framework 2.0, hereafter referred as “the Framework”.

Versioning of the document is following the rules specified in the Chapter 6.1 of IEC 61970-600-1, 1st Edition.

**Disclaimer**

The Test Configurations (test models) are owned by ENTSO-E and are provided by ENTSO-E “as it is”. To the fullest extent permitted by law, ENTSO-E shall not be liable for any damages of any kind arising out of the use of the models (including any of their subsequent modifications). ENTSO-E neither warrants, nor represents that the use of the models will not infringe the rights of third parties. Any use of the models shall include a reference to ENTSO-E. ENTSO-E web site is the only official source of information related to these models.

1. Usage and content of the test configuration

Micro grid type of cases represents the smallest possible data set for focusing on the syntax, connectivity, file management (MAS, zip). It also allows testing different concepts of CGMES with a model which is small enough to debug.

The Micro Grid Base Case (MGBC) is created based on the current ENTSO-E 16 nodes model used in the ENTSO-E IOP July 2013. This model contains three Model Authority Sets (MAS) – 2 MAS representing TSO type of model and 1 Boundary MAS. The Boundary MAS contains equipment (EQ) and topology (TP) instance files. Each TSO kind of MAS contains EQ, TP, SSH, SV (state variables), DL (diagram layout), GL (geographical location) and DY (dynamics) instance files.

The EQ, TP and SSH files can be used without SV. In this case if calculation is performed on EQ+TP+SSH the same results as in SV should be achieved. In case of the node breaker variant it is also not necessary to use TP files. For each configuration, a final (complete) model is provided, but also Difference files to move from one model to another are included.

Since only one boundary file is used for all Micro Grid Configurations, it is plausible to combine different types of models. Consequently, since in same cases not all of the nodes from Boundary are used it is plausible to receive some warnings concerning the boundary nodes during the import.

The folder structure for Micro Grid test configuration is the following:

* Documentation folder which contains:
  + WORD document which explains the MicroGrid test configuration including base case and all variations
  + EXCEL file which contains all the calculation results for the base case and for the four types.
* BaseCase\_BC contains 4 zip containers:
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BD\_v2.zip (Boundary set)
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BC\_NL\_v2.zip (Base Case Netherlands)
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BC\_BE\_v2.zip (Base Case Belgium)
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BC\_Assembled\_v2.zip (BL+NL+BD)
* Type1\_T1 contains 6 zip containers:
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T1\_NL\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T1\_BE\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T1\_Assembled\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BD\_v2.zip
  + T1\_NL\_Difference\_v2.zip
  + T1\_BE\_Difference\_v2.zip
* Type2\_T2 contains 6 zip containers:
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T2\_BE\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T2\_NL\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T2\_Assembled\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BD\_v2.zip
  + T2\_BE\_Difference\_v2.zip
  + T2\_NL\_Difference\_v2.zip
* Type3\_T3 contains 6 zip containers:
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T3\_BE\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T3\_NL\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T3\_Assembled\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BD\_v2.zip
  + T3\_BE\_Difference\_v2.zip
  + T3\_NL\_Difference\_v2.zip
* Type4\_T4 contains 11 zip containers:
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_BD\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T4\_Assembled\_BB\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T4\_Assembled\_NB\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T4\_BE\_BB\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T4\_BE\_NB\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T4\_NL\_BB\_Complete\_v2.zip
  + CGMES\_v2.4.15\_MicroGridTestConfiguration\_T4\_NL\_NB\_Complete\_v2.zip
  + T4\_BE\_BB\_Difference\_v2.zip
  + T4\_NL\_BB\_Difference\_v2.zip
  + T4\_BE\_NB\_Difference\_v2.zip
  + T4\_NL\_NB\_Difference\_v2.zip
* Type5\_EDD which contains a complete energy delivery day (24 timestamps)

For all Micro Grid configurations, the same Boundary file is used.

Example of applying difference files for switching from one model to another is illustrated in Figure 1. Similar reasoning is valid for all other models.

MG Base Case (BC)

MAS BE+NL+BD

Bus-Branch

MG Type 1

Node Breaker

+ Type\_1

Diff 1 Files

MG Type 1

With Petersen Coil (BE) and

Thermal Unit (NL)

+ Type\_4

NB Diff Files

+ Type\_1

Diff 3-5 Files

MG Type 1

Node Breaker

Complete

MG Type 4

Bus -Branch

+ Type\_4

BB Diff Files

+ Type\_1

Diff 2 Files

MG Type 4

Node Breaker

Figure 1Bus Branch to Node Breaker

1. Micro Grid Base Case
   1. General information

The Base Case model consists of 3 MAS regions, BE, NL and BD (boundary). The separate models are available for each of the MAS-s and also an assembled model is included. This model is Bus-Branch model. All generators are intentionally represented by GeneratingUnits.

* 1. Network topology and data

The number and types of the elements in the Micro Grid Base Case model is indicated in Table 1.

Table 1

| **Class** | **# of Objects** |
| --- | --- |
| ACLineSegment | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [168](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [207](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [346](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam0 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [39](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [14](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [49](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [24](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [16](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [79](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [17](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

The number and types of the elements in the Micro Grid Base Case: MAS BE model is indicated in Table 2.

Table 2

| **Class** | **# of Objects** |
| --- | --- |
| ACLineSegment | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [100](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [108](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [183](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam0 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [23](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [29](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [45](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

The number and types of the elements in the Micro Grid Base Case: MAS NL model is indicated in Table 3.

Table 3

| **Class** | **# of Objects** |
| --- | --- |
| ACLineSegment | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [68](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [104](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [173](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [16](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [20](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [35](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

* 1. Load flow and short-circuit calculation information

The single line diagrams for the Micro Grid Base Case is illustrated in Figure 2. The load flow results are included in a file MicroGrid.xls. (Tabs BC\_NO\_AREA\_CONTROL and BC\_AREA\_CONTROL\_ON).

For the purpose of calculation, the Extended Full Newton Raphson method has been used. The maximum number of iterations has been set to 50 while required accuracy is 0.0001. Reactive power limits have not been considered. All shunt control has been disabled. For the slack, NL-G1 generator has been used with voltage angle of 0 degrees and voltage of 16.5kV.

Additionally, phase to ground short circuit has been simulated on Busbar\_NL\_4, obtained results are illustrated in Figure 4.

* 1. CIMdesk validation report for BE MAS

CIMdesk validation report (validation against Base profiles) on the assembled mode BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | SubGeographicalRegion | [1/3](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [1/12](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [5/7](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | TopologicalNode | [1/12](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |
| Warning | PowerTransformerEnd | [2/9](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* ACLineSegment is allowed to connect nodes with different BaseVoltages
* PowerTransformerEnd is data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.
  1. CIMdesk validation report for NL MAS

CIMdesk validation report (validation against Base profiles) on the assembled mode NL MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | BaseVoltage | [2/5](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltage doesn't contain any child instances (or is not referenced by other instances). |
| Warning | SubGeographicalRegion | [1/2](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [1/11](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [1/5](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | TopologicalNode | [1/11](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* BaseVoltage - it is data issue as there is unused element in the instance file, which is allowed
* ACLineSegment is data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.
  1. CIMdesk validation report for BD MAS

CIMdesk validation report (validation against Base profiles) on the boundary EQ and TP instance file does not return errors or warnings.

* 1. CIMdesk validation report for Assembled model

CIMdesk validation report (validation against Base profiles) on the assembled mode NL MAS, BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | SubGeographicalRegion | [1/4](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [1/17](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [1/12](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | ACLineSegment | [5/12](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | TopologicalNode | [1/17](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |
| Warning | PowerTransformerEnd | [2/15](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* ACLineSegment is allowed to connect nodes with different BaseVoltages
* PowerTransformerEnd, ACLineSegmant are data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.

1. Micro Grid Type 1
   1. General information

The Type 1 model is used for testing interoperability to ensure that tools can handle:

* node-breaker configuration;
* asymmetrical data - positive, negative, zero sequence impedances;
* difference files.

This model is built on top of the MGBC. The following modifications are available:

* Difference files of EQ, TP, GL, DY, files (bus-branch configuration). Node-breaker configuration of the model is available in two variants – separate full EQ, TP, SSH, SV, DI, DY and difference files of EQ, TP, GL and DY to transform bus-branch to node-breaker model.
* Difference files for addition PetersenCoil and other grounding classes/attributes on top of bus-branch variant and node-breaker variant
* Difference files that include additional details on limits for both bus-branch and node-breaker variants
* Difference files to place a boundary point in a substation, i.e. in cases where the boundary point is a ConnectivityNode
* Difference files to change types of generation i.e. a GeneratingUnit becomes ThermalGeneratingUnit.
* Difference files to introduce or replace GeneratingUnit by EnergySource.
* Difference files to introduce changes or replace ReactiveCapabilityCurve.
* Difference files to introduce conform and non-conform loads.
  1. Network topology and data

Micro Grid Type 1 uses the same starting topology as Base Case, by applying difference models, above mentioned changes can be performed on the model.

The number and types of the elements in the assembled model is indicated in Table 4.

Table 4

| **Class** | **# of Objects** |
| --- | --- |
| ACLineSegment | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [26](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [41](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [170](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [401](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [692](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySource | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| FossilFuel | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [39](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| PetersenCoil | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [49](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [24](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [16](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [130](http://localhost:8080/CIMSpy/contents/javascript) |
| ThermalGeneratingUnit | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [17](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

**NOTE**: EnergySource model used in load flow slightly differs from the official CGMES. The EnergySource is modelled using the VoltageAngle and VoltageMagnitude as the values at the terminals of the energy source and not as the open circuit values as suggested in the CGMES. This might be discussed how should be solved in the future. CGMES issue is recorded on this.

* 1. Load flow and short-circuit calculation information

The single line diagrams for the Micro Grid Type is illustrated in Figure 5. The load flow results for complete configuration are included in a file MicroGrid.xls, tab Type\_1.

For the purpose of calculation, the Extended Full Newton Raphson method has been used. The maximum number of iterations has been set to 50 while required accuracy is 0.0001. Reactive power limits have not been considered. All shunt control has been disabled. For the slack, NL-G1 generator has been used with voltage angle of 0 degrees and voltage of 16.5kV.

* 1. CIMdesk validation report for Assembled model

CIMdesk validation report (validation against Base profiles) on the assembled mode NL MAS, BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | SubGeographicalRegion | [1/4](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [1/17](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [1/12](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | ACLineSegment | [5/12](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | TopologicalNode | [1/17](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |
| Warning | PowerTransformerEnd | [2/15](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* ACLineSegment is allowed to connect nodes with different BaseVoltages
* PowerTransformerEnd, ACLineSegment are data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.

1. Micro Grid Type 2
   1. General information

Included are:

* Difference files to replace one of the tie-lines as HVDC line for bus-branch configuration. The HVDC should be type VSC (MAS BE)
* Difference files to replace one of the tie-lines as HVDC line for node-breaker configuration. The HVDC should be type VSC (MAS NL)
* Assembled complete model in NB configuration

The difference models are applied on Base Case model. For MAS BE (Bus-Branch), the difference files can be applied directly on BC model, while for MAS NL (Node Breaker) first Difference (Diff 1) models from Type 1 configuration must be applied in order to transform MAS NL to Node-Breaker configuration.

* 1. Network topology and data

Micro Grid Type 2 is based on Base Case configuration. Two HVDC Systems are introduced in the network. One HVDC system is integrated part of MAS BE, while the other is modelled and exported as a separate MAS.

The number and types of the elements in the assembled model is indicated in Table 5.

Table 5

| **Class** | **# of Objects** |
| --- | --- |
| ACDCConverterDCTerminal | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| ACLineSegment | [16](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [26](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [49](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [506](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DCConverterUnit | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| DCGround | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| DCLine | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| DCLineSegment | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| DCNode | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| DCSeriesDevice | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| DCTerminal | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| DCTopologicalNode | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [578](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [1012](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam0 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [22](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [55](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [50](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [23](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [26](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [25](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [151](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [25](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| VsConverter | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

* 1. Load flow and short-circuit calculation information

The single line diagrams for the Micro Grid Type 2 is illustrated in Figure 6. The load flow results are included in a file MicroGrid.xls, tab Type\_2.

For the purpose of calculation, the Extended Full Newton Raphson method has been used. The maximum number of iterations has been set to 50 while required accuracy is 0.0001. Reactive power limits have not been considered. All shunt control has been disabled. For the slack, NL-G1 generator has been used with voltage angle of 0 degrees and voltage of 16.5kV.

* 1. CIMdesk validation report for Assembled model

CIMdesk validation report (validation against Base profiles) on the assembled mode NL MAS, BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | OperationalLimitType | [3/15](http://localhost:8080/CIMSpy/contents/javascript) | The OperationalLimitType doesn't contain any child instances (or is not referenced by other instances). |
| Warning | SubGeographicalRegion | [1/5](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | ACLineSegment | [1/16](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | ACLineSegment | [5/16](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | PowerTransformerEnd | [2/23](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |
| Warning | ACLineSegment | [5/16](http://localhost:8080/CIMSpy/contents/javascript) | No Locations are associated with ACLineSegment. |
| Warning | DCLineSegment | [2/2](http://localhost:8080/CIMSpy/contents/javascript) | No Locations are associated with DCLineSegment. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* ACLineSegment is allowed to connect nodes with different BaseVoltages
* PowerTransformerEnd, ACLineSegment, OperationalLimitType are data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.
* The last 2 warnings inform that there are no GL coordinates assigned for these elements.

1. Micro Grid Type 3
   1. General information

Included are:

* Difference files to replace one of the internal AC lines by HVDC Classic (CSC) line for bus-branch configuration.
* Difference files to replace one of the internal AC lines by HVDC Classic (CSC) line for node-breaker configuration.
* Assembled complete model in NB configuration
  1. Network topology and data

The number and types of the elements in the model is indicated in Table 6.

Table 6

| **Class** | **# of Objects** |
| --- | --- |
| ACDCConverterDCTerminal | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| ACLineSegment | [16](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [26](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [49](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| CsConverter | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [358](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DCConverterUnit | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| DCGround | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| DCLine | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| DCLineSegment | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| DCNode | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| DCTerminal | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| DCTopologicalNode | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [557](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [976](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam0 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [22](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [16](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [55](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [52](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [23](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [28](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [24](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [153](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [25](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

* 1. Load flow and short-circuit calculation information

The single line diagram of the base case Micro Grid 2 network is illustrated in Figure 7 while the load flow results are included in a file MicroGrid.xls, Tab Type\_3.

* 1. CIMdesk validation report for Assembled model

CIMdesk validation report (validation against Base profiles) on the assembled mode NL MAS, BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | OperationalLimitType | [2/10](http://localhost:8080/CIMSpy/contents/javascript) | The OperationalLimitType doesn't contain any child instances (or is not referenced by other instances). |
| Warning | SubGeographicalRegion | [1/4](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [1/25](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [1/16](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | ACLineSegment | [5/16](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | TopologicalNode | [1/25](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |
| Warning | PowerTransformerEnd | [2/23](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |
| Warning | ACLineSegment | [3/16](http://localhost:8080/CIMSpy/contents/javascript) | No Locations are associated with ACLineSegment. |
| Warning | DCLineSegment | [2/2](http://localhost:8080/CIMSpy/contents/javascript) | No Locations are associated with DCLineSegment. |
| Warning | Substation | [4/7](http://localhost:8080/CIMSpy/contents/javascript) | No Locations are associated with Substation. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* ACLineSegment is allowed to connect nodes with different BaseVoltages
* PowerTransformerEnd, ACLineSegment are data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.
* The last 3 warnings inform that there are no GL coordinates assigned for these elements.

1. Micro Grid Type 4
   1. General information

This model is used to test interoperability of transformers and shunt/series compensators.

This model is built on top of the MGBC. The following modifications are available as difference files and complete (full) instance files:

* Model transformers that use the following classes should be added: RatioTapChanger, RatioTapChangerTable, RatioTapChangerTablePoint, TapChangerTablePoint, PhaseTapChangerTablePoint, PhaseTapChangerTabular, PhaseTapChangerTable, PhaseTapChangerSymmertical, PhaseTapChangerAsymmetrical, PhaseTapChangerLinear.
* Model shunt compensators that LinearShuntCompensator, NonlinearShuntCompensator, NonlinearShuntCompensatorPoint.
* Model StaticVarCompensator.
* Model SeriesCompensator.

Difference and complete instance files are available for bus-branch and node-breaker type of models.

It should be noted that based on the parameters and setpoints of the Static Var Compensator (SVC), the SVC will run into the reactive power limit (10Mvar). This has been done intentionally to make it easier to achieve same results between tools since otherwise tools could have different results depending on which control they chose to follow (VoltageSetPoint or RegulatingControl). Additionally, obtaining the correct reactive limit shows that parameters of the SVC are correctly interpreted.

* 1. Network topology and data

Micro Grid Type 4 configuration is based on MG Base Case model. Various TapChangers have been added to the transformer models, also, Series Compensator SVC are included. The number and types of the elements in the bus-branch model is indicated in Table 7; for node-breaker version – Table 8.

Table 7

| **Class** | **# of Objects** |
| --- | --- |
| ACLineSegment | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [278](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [213](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [356](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam0 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| NonlinearShuntCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| NonlinearShuntCompensatorPoint | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [39](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerLinear | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerSymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerTable | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerTablePoint | [34](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerTabular | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [49](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChangerTable | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChangerTablePoint | [31](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| SeriesCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| StaticVarCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [25](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [17](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [82](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

Table 8

| **Class** | **# of Objects** |
| --- | --- |
| ACLineSegment | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| BaseVoltage | [8](http://localhost:8080/CIMSpy/contents/javascript) |
| Breaker | [26](http://localhost:8080/CIMSpy/contents/javascript) |
| BusbarSection | [13](http://localhost:8080/CIMSpy/contents/javascript) |
| ConnectivityNode | [42](http://localhost:8080/CIMSpy/contents/javascript) |
| CoordinateSystem | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| CurrentLimit | [278](http://localhost:8080/CIMSpy/contents/javascript) |
| CurveData | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| Diagram | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObject | [411](http://localhost:8080/CIMSpy/contents/javascript) |
| DiagramObjectPoint | [706](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergyConsumer | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| EquivalentInjection | [10](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC1A | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEAC4A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| ExcIEEEST1A | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GeneratingUnit | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| GeographicalRegion | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro1 | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| GovHydro2 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam0 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| GovSteam1 | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Junction | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| Line | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| LinearShuntCompensator | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadAggregate | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadResponseCharacteristic | [2](http://localhost:8080/CIMSpy/contents/javascript) |
| LoadStatic | [6](http://localhost:8080/CIMSpy/contents/javascript) |
| Location | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| NonlinearShuntCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| NonlinearShuntCompensatorPoint | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitSet | [39](http://localhost:8080/CIMSpy/contents/javascript) |
| OperationalLimitType | [12](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerAsymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerLinear | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerSymmetrical | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerTable | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerTablePoint | [34](http://localhost:8080/CIMSpy/contents/javascript) |
| PhaseTapChangerTabular | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| PositionPoint | [49](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformer | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| PowerTransformerEnd | [15](http://localhost:8080/CIMSpy/contents/javascript) |
| Pss2B | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChanger | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChangerTable | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RatioTapChangerTablePoint | [31](http://localhost:8080/CIMSpy/contents/javascript) |
| ReactiveCapabilityCurve | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| RegulatingControl | [9](http://localhost:8080/CIMSpy/contents/javascript) |
| SeriesCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| StaticVarCompensator | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| SubGeographicalRegion | [4](http://localhost:8080/CIMSpy/contents/javascript) |
| Substation | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvPowerFlow | [25](http://localhost:8080/CIMSpy/contents/javascript) |
| SvShuntCompensatorSections | [3](http://localhost:8080/CIMSpy/contents/javascript) |
| SvTapStep | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| SvVoltage | [17](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachine | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| SynchronousMachineTimeConstantReactance | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| TapChangerControl | [7](http://localhost:8080/CIMSpy/contents/javascript) |
| Terminal | [132](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalIsland | [1](http://localhost:8080/CIMSpy/contents/javascript) |
| TopologicalNode | [18](http://localhost:8080/CIMSpy/contents/javascript) |
| VCompIEEEType1 | [5](http://localhost:8080/CIMSpy/contents/javascript) |
| VoltageLevel | [11](http://localhost:8080/CIMSpy/contents/javascript) |
| EnergySchedulingType | [6](http://localhost:8080/CIMSpy/contents/javascript) |

* 1. Load flow and short-circuit calculation information

The single line diagram of the base case Micro Grid 4 network is illustrated in Figure 8 while the load flow results are included in a file MicroGrid.xls, Tab Type\_4.

For the purpose of calculation, the Extended Newton Raphson method has been used. The maximum number of iterations has been set to 50 while required accuracy is 0.0001. Reactive power limits have not been considered. All shunt control has been disabled. For the slack, NL-G1 generator has been used with voltage angle of 0 degrees and voltage of 16.5kV.

* 1. CIMdesk validation report for Assembled model

CIMdesk validation report (validation against Base profiles) on the assembled model (bus-branch variant): NL MAS, BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | SubGeographicalRegion | [1/4](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [2/18](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [1/12](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | SeriesCompensator | [1/1](http://localhost:8080/CIMSpy/contents/javascript) | Attribute SeriesCompensator.r0 is less than or equal to Attribute SeriesCompensator.r. |
| Warning | ACLineSegment | [5/12](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | TopologicalNode | [1/18](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |
| Warning | PowerTransformerEnd | [2/15](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |

The above errors and warnings should be ignored as:

* SubGeographicalRegion warning is related to the CGMES requirement that there are no substations defined in the boundary.
* ACLineSegment is allowed to connect nodes with different BaseVoltages
* PowerTransformerEnd, SeriesCompensator, ACLineSegment are data issue which is highlighted by CIMdesk to make users check for potential error. In this case that data is fine.

CIMdesk validation report (validation against Operation profiles) on the assembled model (node-breaker variant): NL MAS, BE MAS and boundary MAS is the following:

| **Type** | **Class** | **Recurrence** | **Description** |
| --- | --- | --- | --- |
| Warning | ConnectivityNode | [2/42](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with ConnectivityNode via Association Terminal.ConnectivityNode, expecting at least 2. |
| Warning | SubGeographicalRegion | [1/4](http://localhost:8080/CIMSpy/contents/javascript) | No Substations are associated with SubGeographicalRegion via Association Substation.Region, expecting at least 1. |
| Warning | TopologicalNode | [2/18](http://localhost:8080/CIMSpy/contents/javascript) | No Terminals are associated with TopologicalNode via Association Terminal.TopologicalNode, expecting at least 2. |
| Warning | ACLineSegment | [1/12](http://localhost:8080/CIMSpy/contents/javascript) | Attribute ACLineSegment.r0 is less than Attribute ACLineSegment.r. |
| Warning | SeriesCompensator | [1/1](http://localhost:8080/CIMSpy/contents/javascript) | Attribute SeriesCompensator.r0 is less than or equal to Attribute SeriesCompensator.r. |
| Warning | ACLineSegment | [5/12](http://localhost:8080/CIMSpy/contents/javascript) | The BaseVoltages of the two connected nodes are not the same. |
| Warning | TopologicalNode | [1/18](http://localhost:8080/CIMSpy/contents/javascript) | The TopologicalNode is an island without Terminals connected or with all of the associated Terminals disconnected. |
| Warning | PowerTransformerEnd | [2/15](http://localhost:8080/CIMSpy/contents/javascript) | The rated voltage doesn't match the nominal voltage of the connected node. |

1. Single line diagrams

On the following pages, single line diagrams of all the models are illustrated. All diagrams contain valid load flow or short circuit calculation results.



Figure 2 Base case – assembled NO AREA CONTROL



Figure 3Base case – assembled NO AREA CONTROL, NO TRAFO REGULATION



Figure 4 Base case – assembled AREA CONTROL ON



Figure 5BC Short Circuit (NL\_Busbar\_4)



Figure 6 Type 1 – assembled complete



Figure 7 Type 1 – assembled complete NoTrafo Regulation



Figure 8 Type 2 – assembled



Figure 9 Type 2 – assembled NO TRAFO REGULATION



Figure 10 Type 3 – assembled



Figure 11 Type 3 – assembled NO TRAFO REGULATION



Figure 12 – Type 4 – assembled



Figure 13– Type 4 – assembled NO TRAFO CONTROL



Figure 14 Geographical illustration