

# e<sup>3</sup>GRID2012

Data Call for EHV/HV Assets  
(Call X)  
e<sup>3</sup>GRID2012 PROJECT

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[Version 1.13]

## Disclaimer

This is a transmission asset reporting guide for the e<sup>3</sup>GRID2012 project for benchmarking of transmission system operators, first delivered by the authors, Frontier Economics, Sumicsid and Consentec. The latest version of this document is always obtainable at [ramiel.worksmart.net](http://ramiel.worksmart.net)

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## Version history

Ver	Date	Status	Concerns	Auth
1.1	07.02.08	Initial	Basic definition	JD
1.2	19.02.08	Rev	Limited update	JD
1.3	10.03.08	Final		JD/JM
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1.10	02.11.12	Release		ARD
1.11	22.11.12	Release	Updated circuit ends 4.12	CZ
1.12	29.11.12	Release	Updated compensating devices codes (4.20); added some clarifications (4.11, 4.16, 4.17); added description of sheet "lines_conditions" (5.11)	CZ
1.13	03.12.12	Release	Clarification in 3.08 (short circuit current refers to all circuit ends) and 4.11 (what to be counted as circuit end); added adjustable series inductance in 4.23	CZ

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# 1. Introduction

## ***Background***

- 1.01 This e3GRID2012 Asset Reporting Guide is an extension of the e<sup>3</sup>GRID 2008 Asset Reporting Guide (Call X) edited by Frontier Economics, Sumicsid and Consentec, latest version [1.9], including a larger number of (E)HV asset classes.
- 1.02 The deadline for data collection using the Call X data template is **December 10<sup>th</sup>, 2012**.

## ***Principles***

- 1.03 The guide concerns the reporting of the grid assets from the TSO asset registers for use in the e3GRID2012 benchmark. It does not specifically address planned or actual quality in grid operation.
- 1.04 Any benchmarking is an imperfect attempt to create comparability across heterogeneous firms with varying investment profile, asset age, technical standards and accounting principles. As such, the results of the exercise cannot be directly used to inform detailed decisions as to the valuation and maintenance of grid assets. Omission and groupings of specific assets in the definition of the benchmarked grid does not constitute claim of the past or current possibility to operate the organization with the given assets. This disclaimer is important to highlight when using the final or decomposed results from the e3GRID2012 benchmarking in regulation.

## 2. System description

2.01 The following section gives a brief overview over the system description for the TSO's asset base.

### ***Transmission system***

2.02 The transmission system is composed of different network layers characterized by their respective voltages. From interconnection level (380 and 400 kV in Europe), down to sub-transmission network generally being part of the distribution system (in general using voltage under 100 kV). The limits between transmission and distribution activities can be significantly different following the system that is considered. Some transmission systems are characterized by a single functional layer like in England & Wales (made of 400 or 275 kV). Other systems are made of two superimposed layers, in continental Europe this are often made of 380 and 225 kV networks. But transmission systems made of more than two layers also exist. The French system is made of at least four functional layers, most often 380, 225, 90 and 63 kV.

2.03 By default, the installations are considered as being AC operated.

### ***Layer composition***

2.04 Each layer is composed of:

#### 1) Substations

- a) Type open or closed (i.e. outdoor or indoor);
- b) Air insulated or metal clad (gas insulated, i.e. SF<sub>6</sub>);
- c) Bus bars single, double or even triple (further they can be possibly longitudinally sectionalized);

#### 2) Electrical circuits

- a) Overhead lines (single, double, triple, quadruple), all circuits being not necessarily operated at a same voltage level;
- b) Underground or undersea cables;
- c) DC connection (and their converters)<sup>1</sup>;

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<sup>1</sup> Presently, no DC meshed network exists.

- 3) Connections to other layers that are implemented using transformers or auto-transformers
  - a) Presenting 2 or 3 operational windings;
  - b) Equipped with tap changer:
    - In phase (for implementing voltage control)
    - Or in quadrature<sup>2</sup>: phase shifter (for active power control);
    - Or both in a compound device;
  - c) Tap changer operation:
    - Off load;
    - On load: (OLTC, On Load Tap Changer);
- 4) This is completed by specific AC devices:
  - a) Shunt compensation devices:
    - Capacitive;
    - Inductive;
    - Or both in a single compound device;
  - b) Characterized by their control:
    - Continuous (SVC, STACOM, synchronous compensator);
    - Mechanically switched (synchronously operated);
    - Mechanically switched (non synchronously operated);
  - c) Series components:
    - Series inductance for short-circuit limiting;
    - Series capacitors for increased transfer capacity (fixed, on-off, continuously variable);
- 5) Converter stations:
  - a) HVDC (line commutation);
  - b) HVDC (self commutated converters).
- 6) Dispatching Centers:
  - a) Hierarchical organisation, characterised by the number of centers.

2.05 It is worthwhile to indicate here that conceptually systems are roughly developed following two distinct schemes:

- 1) A system based on the reactive compensation scheme. In that case the voltage control in the HV system is mainly implemented using HV reactive compensation;

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<sup>2</sup> Technologically, the series voltage is not necessarily based on a 90° phase shift (“quadrature” booster).

2) An approach based on transformers with OLTC, assuring reactive power transfers between layers while decoupling layers voltages.

2.06 Systems exist where both approaches have been concurrently implemented.

***Treatment of off-shore grids***

2.07 Off-shore grids (i.e. grid components used to connect off-shore wind farms) are rare and case specific and thus excluded from this benchmarking exercise.

2.08 Nevertheless, off-shore grid assets shall be reported for the sake of completeness.

2.09 Off shore grid assets comprise all assets used to connect off shore wind farms (e.g. cables, platforms, converters), ending with and including the circuit end in the first (seen from the perspective of the off-shore wind farm) onshore AC substation.

### 3. Reporting Structure

3.01 Below, we give an overview of the item database structure and the common reporting categories. Whenever applicable, the default reporting option – applied in cases of missing, incomplete or invalidated information – is stated and indicated with grey shading in tables.

#### ***Use of classes***

3.02 For each category, the classes are defined with unit of measurement, definition of measure and limits  $(a,b)$  of the type  $a < x \leq b$ , i.e., the lower limit is exclusive.

#### ***Code key***

3.03 Each item is identified by a code:

**TT|AAA|SSS|V|I|P**

3.04 Where **T** = TSO code  
**A** = Asset type [lines, cables, circuit ends, transformers, compensating devices, series compensation, dispatching centers, other, off-shore]  
**S** = Asset specification [type specific code]  
**V** = Voltage level  
**I** = Current capacity per electrical system (e.g. per circuit)  
**P** = Power per unit (e.g. per transformer)

#### ***Voltage***

3.05 There are six types of voltage ranges defined:

**Table 2-1 Voltage classes.**

V□	Limit L□	Limit H□	UoM□	Definition□
<b>1</b>	-	<=30	kV	nominal
<b>2□</b>	>30	<=70	kV	nominal
<b>3□</b>	>70	<=150	kV	nominal
<b>4□</b>	>150	<=220	kV	nominal
<b>5□</b>	>220	<=350	kV	nominal
<b>6□</b>	>350	-	kV	nominal

3.06 In case of missing, incomplete or incorrect report of the category, the voltage = 30 kV is assumed by default (V=1).

3.07 Note 1: Although no lower limit is defined in the lowest class, the report will explicitly state the lowest represented voltage level and its prevalence in circuit km.

### **Current**

3.08 There are thirteen types of current ranges defined, nine for lines and four for circuit ends:

**Table 2-2 Current classes.**

I□	Limit L□	Limit H□	UoM□	Definition□
Operating current (for lines)				
<b>1</b>	-	<=250	A	nominal
<b>2□</b>	>250	<=500	A	nominal
<b>3□</b>	>500	<=750	A	nominal
<b>4□</b>	>750	<=1000	A	nominal
<b>5□</b>	>1000	<=1500	A	nominal
<b>6</b>	>1500	<=2250	A	nominal
<b>7</b>	>2250	<=3150	A	nominal
<b>8</b>	>3150	<=4000	A	nominal
<b>9</b>	>4000		A	nominal
Short circuit breaking current (for circuit ends)				
<b>1</b>	-	<=30	kA	
<b>2</b>	>30	<=50	kA	
<b>3</b>	>50	<=70	kA	
<b>4</b>	>70		kA	

3.09 In case of missing, incomplete or incorrect report of the category, the current = 250 A is assumed by default (I=1).

- 3.10 The current limit classes (cf. 3.08) that are used for lines (cables) are defined considering nominal values. Deviations between nominal values and operational limits (e.g. due to climatic conditions) are neglected.
- 3.11 The framework conditions assumed for defining the nominal ratings (e.g. standard temperature and wind conditions according to national norms) are also requested.
- 3.12 In case of multiple circuits lines, each circuit must be considered separately. This permits to account for different operational voltages for circuits on a same tower.

### ***Electric Power***

- 3.13 The following power ranges are defined:

**Table 2-3 Power classes.**

<b>P</b>	<b>Limit L</b>	<b>Limit H</b>	<b>UoM</b>	<b>Definition</b>
<b>1</b>	-	<=50	MVA	nominal
<b>2</b>	>50	<=125	MVA	nominal
<b>3</b>	>125	<=350	MVA	nominal
<b>4</b>	>350	<=700	MVA	nominal
<b>5</b>	>700	<=1500	MVA	nominal
<b>6</b>	>1500	<=1750	MVA	nominal
<b>7</b>	>1750	<=2250	MVA	nominal
<b>8</b>	>2250		MVA	nominal

- 3.14 In case of missing, incomplete or incorrect report of the category, the nominal power = 50 MVA is assumed by default (P=1).

## 4. Asset Category Definitions

4.01 Below, we introduce the asset categories in order, drawing if applicable on the previously defined classes of voltage level (V), current capacity (I) and power (P). The main attention is paid to the asset specific positions (SSS). Some comments are given to guide the reporting.

### *Lines*

4.02 An item in the overhead transmission line category is defined as a circuit, operated a certain voltage, installed on a tower equipped with a certain number of circuits and this circuit is characterized by a certain current capacity. The closed form definition is as follows:

Transmission line□	UoM□	Definition□
TT 010 SSS V  0	km	Circuit length

Where

- T** = TSO code
- S** = Asset specification[category specific code]
- V** = Voltage level (cf. 3.05)
- I** = Current capacity of the circuit (cf. 3.08)

4.03 The first position represents the number of circuits per pylon.

SSS□	Limit L□	Limit H□	UoM□	Definition□
1SS□	n/a	n/a	n/a	Single
2SS□	n/a	n/a	n/a	Double
3SS□	n/a	n/a	n/a	Triple
4SS□	n/a	n/a	n/a	Quadruple
5SS	n/a	n/a	n/a	Quintuple or sextuple
6SS	n/a	n/a	n/a	Septuple or above

4.04 Reporting should be based on circuit length, each circuit being part of a single, double, triple, etc. circuit line.

4.05 The technical specifics are based on AC or DC use.

SSS□	Limit L□	Limit H□	UoM□	Definition□
00S□	n/a	n/a	n/a	AC line
09S□	n/a	n/a	n/a	DC line

4.06 The third position indicates the topology of the line as a proxy for the density of towers and operating conditions.

SSS□	Limit L□	Limit H□	UoM□	Definition□
SS0□		default		Average conditions
SS2□		special		Other than average conditions (alpine, urban, coastal, etc.)

### Cables

4.07 An item in the cable category is defined as:

Cable□	UoM□	Definition□
TT 020 SSS V I 0	km	Circuit length

Where

- T** = TSO code
- S** = Asset specification [category specific code]
- V** = Voltage level
- I** = Current capacity (cf. 3.08)

4.08 The specifics are based on land or sea installation.

SSS□	Limit L□	Limit H□	UoM□	Definition□
000□	n/a	n/a	n/a	AC Land cable
009□	n/a	n/a	n/a	AC Sea cable
090□	n/a	n/a	n/a	DC Land cable
099□	n/a	n/a	n/a	DC Sea cable

4.09 The circuit length in km is reported in reported in the column “Circuit Length Asset”.

4.10 Information on cables with particularly costly modes of installation (e.g. cables in tunnels in urban areas) should be provided in the comments field of the cables sheet (including the cost impact relative to ordinary mode of installation) or, alternatively, can be treated via Call Z (special conditions) at a later stage of the analysis.

### Circuit ends

- 4.11 An item in the circuit ends category is generally defined as a bay in a substation. This applies to all types of “primary” devices connected in a substation (e.g. lines, cables, transformers, compensation devices, transverse couplers between bus bars). For example a UHV-HV transformer has two ends (if it is a two windings transformer and both ends are connected to a bus bar), one at UHV level and the other at HV level.

“Auxiliary” devices such as earthing switches or measurement units shall not be counted.

Circuit ends □	UoM □	Definition □
TT 030 SSS V  0	#	Piece count

Where

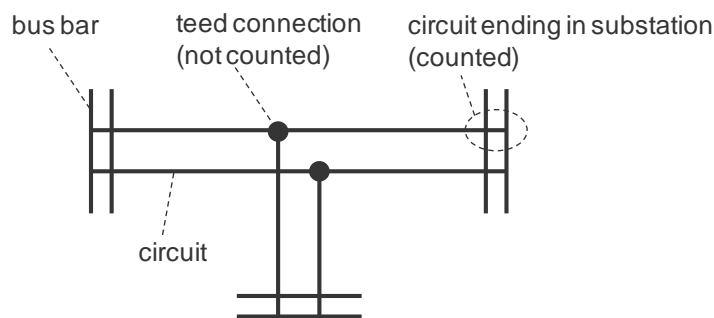
- T** = TSO code
- S** = Asset specification [category specific code]
- V** = Voltage level
- I** = Short-circuit current (cf. 3.08)

- 4.12 The following types of circuit ends are defined:

SSS □	Definition □	Definition □	Definition □
000 □	Single bus bar	Open	Air insulated
001 □	Single bus bar	Open	Metal clad
010 □	Single bus bar	Closed	Air insulated
011 □	Single bus bar	Closed	Metal clad
100 □	Double bus bar	Open	Air insulated
101 □	Double bus bar	Open	Metal clad
110 □	Double bus bar	Closed	Air insulated
111 □	Double bus bar	Closed	Metal clad
200 □	Triple bus bar	Open	Air insulated
201 □	Triple bus bar	Open	Metal clad
210 □	Triple bus bar	Closed	Air insulated
211 □	Triple bus bar	Closed	Metal clad
300	Specific bus bar (1 ½)	Open	Air insulated
301	Specific bus bar (1 ½)	Open	Metal clad
310	Specific bus bar (1 ½)	Closed	Air insulated
311	Specific bus bar (1 ½)	Closed	Metal clad
400	Quadruple bus bar	Open	Air insulated
401	Quadruple bus bar	Open	Metal clad
410	Quadruple bus bar	Closed	Air insulated
411	Quadruple bus bar	Closed	Metal clad

4.13 Circuit ends are only counted if the respective switch gear is within the TSO's property, i.e. also included in the cost base (correspondence principle).

4.14 Note: Teed connections are not specifically taken into account in the present guide. The terminals ending in a substation will only be considered (see figure below). For the calculation of circuit length, the totalized length of the teed structure must be considered, at least when the type of the line is similar. Otherwise the different circuits must be sorted following the type of line. The circuit ends at the connection point on the line is considered as inexistent.



4.15 Note: "True" bus bars are considered (each line of a substation can then be connected to each bus bar 1, 2, 3 or 4), and not "sections". Sections are implicitly considered when evaluating the mean cost of circuit ends, assuming a mean number of lines per substation.

### **Transformers**

4.16 The transformer assets are reported in two ways: as number of installations and as total installed power in each category (cf. 4.17). All types of transformers playing a role in transmission shall be reported.

Transformers supplying substations auxiliaries are excluded. Their costs are implicitly taken into account through circuit ends.

Transformers of HVDC installations are included within the convertors and must not be reported under transformers.

Transformer□	UoM□	Definition□
TT 040 SSS V 0 P	#	Nominal power, piece count
TT 041 SSS V 0 P	MVA	Nominal power, power count

Where    **T**    = TSO code  
           **S**    = Asset specification[category specific code]  
           **V**    = Voltage level (primary voltage)  
           **P**    = Power

4.17        There are eight categories of Transformers defined:

SSS□	Definition□	Definition□	Definition□
000□	Transformer	No OLTC	No phase shift
001□	Transformer	No OLTC	Phase shift <sup>3</sup>
010□	Transformer	OLTC <sup>4</sup>	No phase shift
011□	Transformer	OLTC	Phase shift
100□	Autotransformer	No OLTC	No phase shift
101□	Autotransformer	No OLTC	Phase shift
110□	Autotransformer	OLTC	No phase shift
111□	Autotransformer	OLTC	Phase shift

4.18        Note that no detailed specification over time is necessary for the total installed power class, the aggregate is sufficient.

### **Compensating devices**

4.19        The compensating devices are reported in two ways: as number of installations and as total installed power in each category.

Compensating device□	UoM□	Definition□
TT 050 SSS V 0 0	#	piece count
TT 051 SSS V 0 0	MVA	Nominal power, power count

Where    **T**    = TSO code  
           **S**    = Asset specification[category specific code]  
           **V**    = Voltage level

<sup>3</sup> Phase shift is a type of transformer which permits to implement various phase shifts between two windings, meaning that it becomes possible to change the flow of active power between different paths in the power system (for adjusting the loading of different lines/cables in the system).

<sup>4</sup> OLTC = On-load tap change; with such a transformer it is possible to change, under load, the transformer ratio between two windings of the transformer. This is used for adjusting voltage in the system while allowing for transfer of reactive power. No OLTC means that voltage ration cannot be changed under load, even if often off-load tap changing is possible.

- 4.20 There are discrete (bank) and continuous compensating devices, for banks, single (called: fixed) and multiple steps (called: adjustable):

SSS □	Definition □	Definition □	Definition □
000 □	Bank	Fixed	capacitive
010 □	Bank	Adjustable	capacitive
001 □	Bank	Fixed	inductive
011 □	Bank	Adjustable	inductive
002 □	Banks	Fixed	capacitive and inductive
012 □	Banks	Adjustable	capacitive and inductive
110 □	SVC	Adjustable	capacitive
111 □	SVC	Adjustable	inductive
112 □	SVC	Adjustable	capacitive and inductive
210 □	STATCOM	Adjustable	capacitive
211 □	STATCOM	Adjustable	inductive
212 □	STATCOM	Adjustable	capacitive and inductive
310 □	Synchronous compensator	Adjustable	capacitive
311 □	Synchronous compensator	Adjustable	inductive
312 □	Synchronous compensator	Adjustable	capacitive and inductive

For shunt reactor compensated lines where inductance cannot be disconnected, they are nevertheless supposed to be “fixed”.

- 4.21 For all the items, adjustable, discrete and the continuous compensating devices the number of items should be reported in asset 050. For all the items; adjustable discrete and the continuous compensating devices; the nominal electric power is reported as asset 051. Specification over time is only made for piececount (asset 050), not for nominal electric power.

### **Series compensation**

- 4.22 The series compensations are reported in two ways: as number of installations and as total installed power in each category.

Compensating device □	UoM □	Definition □
TT 060 SSS V 0 0	#	piece count
TT 061 SSS V 0 0	MVA	Nominal power, power count

Where    **T**    = TSO code  
           **S**    = Asset specification[category specific code]  
           **V**    = Voltage level

- 4.23 The series compensation are divided in two categories, inductive (for short-circuit current limiting) on one side and capacitive (for increased transfer capacity) on the other side. Inductive compensation is generally made of fixed components (although some exceptions may

exist, cf. specification 011 in table below), while capacitive series compensation can be made discretely or continuously adjustable. Specification over time is only made for asset 060 (piece count), asset 061 is the aggregate nominal power for fixed and adjustable compensation devices.

SSS □	Definition □	Definition □	Definition □
000 □	Discrete	Fixed	Series capacitors (for increased transfer capacity)
001 □	Discrete	Fixed	Series inductance (for short-circuit limiting)
010 □	Discrete	Adjustable	Adjustable series capacitor
011	Discrete	Adjustable	Adjustable series inductance
110 □	Continuous	Adjustable	Continuously adjustable series capacitor

### **Dispatching Centers**

4.24 Dispatching centers are reported as number of installations.

Compensating device □	UoM □	Definition □
TT 070 SSS 0 0 0	#	piece count

Where **T** = TSO code  
**S** = Asset specification[category specific code]

### **Towers**

4.25 Towers are reported as numbers per voltage level. In case of towers for multiple circuits the highest voltage level (nominal, not operational) is decisive.

Towers □	UoM □	Definition □
TT 080 SSS V 0 0	#	piece count

Where **T** = TSO code  
**S** = Asset specification[category specific code]  
**V** = Voltage level

4.26 Tower categories are differentiated by material, suspension/angle and self-standing/guyed.

SSS□	Definition□	Definition□	Definition□
000	Wood	Suspension	Self-standing
001	Wood	Suspension	Guyed
010	Wood	Angle	Self-standing
011	Wood	Angle	Guyed
100□	Steel	Suspension	Self-standing
101□	Steel	Suspension	Guyed
110□	Steel	Angle	Self-standing
111□	Steel	Angle	Guyed
200	Concrete	Suspension	Self-standing
201	Concrete	Suspension	Guyed
210	Concrete	Angle	Self-standing
211	Concrete	Angle	Guyed

### ***Other installations (except for off-shore grid assets)***

- 4.27 FACTS or HVDC conversion stations are very specific installations. Their number worldwide is less than one hundred. Each constitutes a specific plant. To ensure a correct validation, we suggest that converter stations are reported in a free format, specifying the adequate parameters. Use one line for each station without aggregation, the last digit in the specification field is used to indicate the identity of the installation. Other transmission installations of particular value may also be entered in category 091 after prior authorization by project management.

Other installations□	UoM□	Definition□
TT 090 SSS V 0 0	MVA	Nominal power, power count

T = TSO code  
S = Asset specification [category specific code]  
V = Voltage level

### ***Off-shore grid assets***

- 4.28 Off-shore grid assets are reported for the sake of completeness (but will be excluded from the benchmarking exercise, cf. 2.07).

Off-shore assets□	UoM□	Definition□
TT 100 SSS 0 0 0	# or km	piece count or length, depending on asset category (code SSS)

Where T = TSO code  
S = Asset specification [category specific code]

- 4.29 Platforms, cables and converter stations are reported in aggregated form. Should there be other off-shore grid assets besides the above, please report them in free format, i.e. additional rows with asset specification code 101, 102, 103, etc. Use the description field in these cases to specify the asset(s).

SSS <input type="checkbox"/>	UoM <input type="checkbox"/>	Definition <input type="checkbox"/>
000 <input type="checkbox"/>	#	Off-shore platforms: piece count
001 <input type="checkbox"/>	#	Converter stations (on shore): piece count
002 <input type="checkbox"/>	km	Cables: circuit length
1SS <input type="checkbox"/>		Other: free specification

### ***Landowner agreements***

- 4.30 Additional information will be collected regarding the number of right of way and easement agreements that are in place with landowners.

## 5. Appendix A: Use of the Assets Reporting Templates

### *Introduction*

- 5.01 Obviously the grid assets are one of the major cost determining elements of a TSO. For the sake of objectivity, the benchmarking of the grid related costs will make use of standardised basic costs for different classes of assets, taking into account their general characteristics and their age, but also standardised cost supplements to be added to the basic cost, in order to take account of engineering or other types of specifics (insofar, of course, as these turn out to be relevant, i.e. have a significant impact on the cost).
- 5.02 For the time being, eight different classes of grid related assets have been foreseen, together with a ninth class for assets not foreseen in the eight first ones, and a tenth class for off-shore grid assets. Each of these classes is the subject of a separate Excel sheet, and these will be described in detail hereafter. The only exception is lines, where a second sheet is used to collect a description of the framework conditions assumed for defining the nominal ratings.
- 5.03 Given the fact that the benchmarking will use standardised basic costs and standardised cost supplements (for the specifics), the reporting has to be done by giving the number of units installed and still in operation at the end of the benchmarking period. In other words, no values or amounts have to be reported on the sheets per class of grid asset.
- 5.04 Each type of asset (as determined by its class, and within its class, by its major characteristics) will be identified by a code of 11 digits with (insofar as they are relevant) the following elements :
- the 1st and 2nd digits identify the TSO (see further)
  - the 3rd, 4th and 5th digits identify the class of assets (lines = 010, cables = 020, circuit ends = 030, transformers = 04x, compensating devices = 05x, series compensators = 06x, dispatching centers = 070, towers = 080, other grid related installations = 090, off-shore grid assets = 100)

- the 6<sup>th</sup>, 7<sup>th</sup> and 8<sup>th</sup> digit specify further, within the class, the type of the asset or its working conditions, with the exception and insofar as relevant, of the voltage level (which is determined by the 9<sup>th</sup> digit), the current capacity (determined by the 10<sup>th</sup> digit) and the power level (determined by the 11<sup>th</sup> digit).

5.05 The codes are generated automatically by making the appropriate choice in user friendly drop down menus (see further for details). The templates also include a test to verify that the combinations that are chosen are technically or physically possible or relevant (if this is not the case, the text will appear on a red background).

Generally, the type of field and valid input is indicated in the template: **a yellow background indicates that input is required; whenever an error or inconsistency is detected, this background will turn into red.**

Values on a light blue background are calculated (essentially totals) on the basis of your input.

5.06 Do not delete lines or columns, nor insert columns in the template, as the data files will be automatically validated and consolidated.

### ***Description of the sheets***

□

#### *Sheet «contents»*

5.07 As its name indicates, this sheet gives an overview of the different sheets of the template.

Please start by selecting your country from the drop down menu. In case there is only one TSO, its name and identification number will appear automatically – in the other cases (Germany and the UK), you will have to select your name from the drop down menu that appears.

By clicking on the name of a sheet, you can automatically access it.

#### *Sheet «introduction»*

□.□□ Your name and identification code on this sheet and the next ones will already be filled in (*see sheet «Contents»*).

## Sheet «code key»

- 5.09 This sheet summarizes the different codes and definitions that are used throughout the template :
- the identification number of each TSO, in alphabetical order of the name of the country (1<sup>st</sup> and 2<sup>nd</sup> digit of the asset type code)
  - an overview of the different assets classes (3<sup>rd</sup> to 5<sup>th</sup> digit), and for each of them and insofar as relevant, the working conditions or other specific elements (6<sup>th</sup> to 8<sup>th</sup> code)
  - the voltage levels (if relevant; 9<sup>th</sup> digit) of the grid asset type
  - the current capacity levels (if relevant; 10<sup>th</sup> digit) of the grid asset type
  - the power levels (if relevant; 11<sup>th</sup> digit) of the grid asset type.

Note that when a digit is not relevant, its value is taken to be 0 automatically.

## Sheet «lines»

- 5.10 This sheet is to be used for the reporting of the investments that have been made since 1965 in lines that are still in use at the end of the benchmarking period. As said in the introduction, the data we need are expressed in units, not in value, the unit for lines being the number of km installed. In case old lines have been replaced prior to the beginning of the opex benchmarking period, the length of these old lines is not to be reported anymore, in order to avoid double counting with the lines by which they have been replaced.

The different columns in this sheet contain the following elements (note that the digit codes that follow are either automatically filled in or have to be selected from a drop down menu) :

- the 11 digit code identifying the asset, and which is generated automatically on the basis of the input in the next columns
- the 2 digit code number and the name of the TSO, filled in automatically on the basis of the input on the sheet «contents»
- the 3 digit code number and the name of the asset class «lines», filled in automatically
- the 1 digit code corresponding to the number of circuits per pylon (to be chosen from a drop-down menu)

- the 1 digit code corresponding to the current type (AC or DC) (*idem*)
- the 1 digit code corresponding to the geographic/climatic conditions (*idem*)
- a column describing the combination withheld on the basis of the input already given; if this information appears on a red background, a wrong combination has been given in which needs to be corrected
- a 1 digit code for the voltage level (*idem*)□
- a column describing the voltage level withheld; here too, a value on a red background indicates that a wrong value has been chosen which needs to be corrected
- a 1 digit code for the current capacity (*idem*)□
- a column describing the current capacity withheld; here too, a value on a red background indicates that a wrong value has been chosen which needs to be corrected
- a column named ASSETS that is only useful in case the number of units that will be given in the next yearly columns would add up to a total that does not correspond to the total length of lines actually still in use
- a series of columns where you have to give in, for the year specified, the length of lines installed and that are still in use; lines that have been taken out of use (replaced or not) are not to be reported. Note that the first one of these columns concerns the total length of all the lines that were installed before 1965 and are still in use, whatever the exact year in which they were installed.

#### Sheet «lines\_conditions»

- 5.11 In this sheet the framework conditions assumed for defining the nominal ratings of lines (e.g. standard temperature and wind conditions according to national norms) shall be reported.

#### Sheet «cables»

- 5.12 This sheet basically contains the same columns and hence has to be filled in similarly to the sheet “lines” above. Obviously, the technical or engineering parameters of some elements may be different from the ones used for lines, but the overall reporting principles are the same.

## Sheet «circuit ends»

- 5.13 This sheet basically contains the same columns and hence has to be filled in similarly to the sheets above, but the column with the 1 digit code for the current capacity now refers to the short-circuit breaking current. Furthermore, the reporting unit is, from this class of assets on, the number of units installed and still in use.

## Sheet «transformers»

- 5.14 This sheet basically contains the same columns and hence has to be filled in similarly to the sheets above, but the column with the 1 digit code for the current capacity is replaced by a 1 digit code for the power level. There is, however, an important difference between this sheet and the previous ones : the column ASSETS is split in two, of which the first one is used (as above) to give the actual number of units in use, should this be different from the total obtained by adding up the yearly figures, and the second one is used to specify the total nominal power in use (=asset type 041).

## Sheet «compensating devices»

- 5.15 This sheet basically contains the same columns as the one for the transformers, without, however, the 1 digit column for the power level, but with a split in two of the column ASSETS. The specification over time results in a sum of installations (=asset 050) whereas the power column should give a single value (=asset 051)

## Sheet «series compensation»

- 5.16 This sheet is analogous to the sheet for compensating devices. The specification over time results in a sum of installations (=asset 060) whereas the power column should give a single value (=asset 061)

## Sheet «dispatching centres»

- 5.17 This sheet follows the same reporting principles as the sheets above, but with an important exception : the column DEFINITION is on a yellow background, meaning that you can give in a short technical description for each of the types of dispatching centres you use. This information will be evaluated when deciding which (share of) dispatching centre costs will be included in the benchmarking exercise. Ideally, the description should allow for identifying the proportion of activities related to system operator function (to be excluded) vs. other functions that will be included in the benchmark.

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**Sheet «towers»**

- 5.18 This sheet basically contains the same columns and hence has to be filled in similarly to the sheets above, the column with the 1 digit code referring to the nominal voltage. The reporting unit is the number of towers per type and voltage level that have been installed.

**Sheet «other installations»**

- 5.19 This sheet follows the same principles as the sheet «dispatching centres» above, thus containing a column DEFINITION on a yellow background, meaning that you can give in a short technical description for each of the types of other installations you use.

**Sheet «off-shore»**

- 5.20 This sheet basically contains the same columns and hence has to be filled in similarly to the sheets above. The reporting unit differs according to the asset specification category (piece count or km). The sheet also contains a column DEFINITION\_SPEC on a yellow background. This shall only be used for the asset specification category 1SS (where SS shall be counted up by you), meaning that you can give in a short technical description for each of the types of other off-shore installations (besides platforms, converter stations and cables) you use.

**Sheet «land owners»**

- 5.21 This sheet simply asks for the number of right of way and easement agreements that are in place with landowners.

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