GRID CODE – PLANNING CODE

October 2018

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Planning Code

1 Introduction

1.1 **Planning code** specifies the technical and design criteria and procedures to be applied by the **TSO** in the planning and development of the **transmission system**. **Users** shall also take it into account in the planning and development of their own **systems**.

1.2 This **planning code** defines the relationship and responsibilities of the **TSO** and the **users**, including the obligations to transfer data and other information between the **parties**. The **users** comprise **generators** including **generators** connected at voltages below 110 kV, **demand customers** and **DSO**s.

1.3 This **planning code** facilitates investment in new **generation** and **network** facilities to be planned and developed in the most efficient manner.

1.4 Although generation planning is not the responsibility of the **TSO**, the **TSO** is in the best position to monitor the future generation and load balance. The **Planning Code** is therefore addressing monitoring of generation adequacy by the **TSO** as well.

2 Objective

2.1 The objectives of this **planning code** are as detailed in the following paragraphs.

a) To promote discussion and exchange of information between the **TSO** and the **users** regarding their present and future **system** developments and on proposed developments that may impact on the **transmission system**;

b) To provide a framework for the discussion of future developments taking into account the present **system** operation information.

c) To provide for the supply of information to enable the **TSO** in producing the **transmission development plan** and the generation adequacy plan and to plan and develop the **transmission system** so that it can be operated economically, securely and safely.

d) To facilitate the use of the **transmission system** by others and to specify a standard of supply to be provided.

e) To define the flow and supply of information, in particular **system** planning data, between the **TSO** and the **users**.

f) To provide sufficient information for a **user** to assess opportunities for connection and to plan and develop their **system** such as to be compatible with the **transmission system**;

g) To specify the standards that will be used by the **TSO** in the planning and development of the **transmission system**.

2.2 Reference is made in this **planning code** to the **TSO** supplying information or advice to **users**. For the avoidance of doubt, unless the context otherwise requires, such information or advice will be furnished by the **TSO** upon request by the **user** whether during the application for connection process or otherwise.

3 Scope

This **planning code** applies to the following:

a) The **TSO**;

b) **Producers** with **generating units** connected to the **transmission system** and **producers** with **generating units** greater than 5 MW connected to the **distribution system** including **power-generating module** (wind powered generating stations with installed capacity ≥ 5 MW);

c) **DSO**;

d) **Demand customers** directly connected to the **transmission system**;

4 Transmission Planning Standards and Criteria

4.1 The **TSO** shall apply in the planning and development of the system, the design of connections and in the **transmission development plan**, the Transmission System Security and Planning Standards. This document is published on the TSO's web-site.

5 Transmission Development Plan (TDP)

5.1 Preparation of Transmission Development Plan

5.1.1 The **transmission development plan** is a document that describes the current **transmission network** and planned changes, reinforcements, additions and removals so that the **transmission network** will continue to comply with the Transmission System Security and Planning Standards while avoiding unnecessary duplication of facilities and the imposition of unreasonable cost. This document also shows the opportunities for future connections and indicates those parts of the **transmission network** most suited to new connections and to the transport of further quantities of electricity. TDP will assist in encouraging the promotion of competition and the development of the **transmission network** in a non-discriminatory manner.

5.1.2 Each year, the **TSO** shall prepare and submit to the Energy Regulatory Office a ten (10) year network development plan based on demand and actual and forecasted supply after consultation with all relevant stakeholders.

5.1.3 Ten (10) year network development plan in particular:

- Notifies the main market participants for the infrastructure needed to be built or improved over the next ten (10) years;
- It contains all investments that are in development and identifies new investments that will be executed over the next three (3) years;
- Provides a timeline for all investment projects according to the previous paragraph of this Article.

5.2 Contents of the Transmission Development Plan

5.2.1 The following are the key items that will be contained in the **TDP** with both present and forecast data being included:

a) Circuit capacities;

b) Generating capacities;

c) Power flows;

d) Supply point loadings;

e) Short circuit levels for each transmission node;

f) Transmission losses;

g) System capabilities – zonal;

h) Commentary on opportunities to connect;

i) Planned system reinforcements and/or changes in topology;

j) Network configuration

5.2.2 The TDP prepared by the TSO is transparent to all parties. Included in the plan should be the procedures used in its preparation. As a minimum this should include base case data used for system analysis, analysis procedures and results etc.

5.2.3 If a user considers that the information provided in the TDP does not contain sufficient detail for their particular needs, then the user can request additional information from the TSO. In determining what additional information shall be provided, the TSO shall comply with the requirements of its electricity transmission system operator licence. The TSO shall have the right to charge users for the provision of system data additional to that required by the TDP.

5.3 TSO Responsibilities

5.3.1 During the ten (10) year network development plan , the Transmission System Operator shall made reasonable fassumptionsn on the development of generation, supply, consumption and exchanges with other countries, taking into account investment plans for regional networks within Energy Community. or the preparation of the TDP after consultation with other parties.

5.3.2 The draft version of the TDP shall be submitted to the regulator by the end of October for consideration and review. The Regulator shall consult all actual and potential system users about the ten (10) year network development plan in transparent manner and shall publish the results of the consultation process, in particular the needs for potential investment. The comments from the regulator will be submitted by the end of November and once agreement is reached with the regulator, the TSO shall prepare the final version of the TDP and submit it to the regulator for final approval. Once approved the TSO will then publish the TDP on its web-site within 10 working days.

5.4 Electricity Balances

5.4.1 The LongTerm and Annual electricity balances shall be prepared by Transmission System Operator and after receiving the opinion from the respective Ministry, shall be sent for approval to the Regulator.

6 Technical data for planning

6.1 The **TSO** in order to carry out its obligations under its **transmission system operator licence** requires information and data from all **users** of the **transmission system** and will also provide data to **users** and others for the reasons given as in the following paragraphs.

a) Standard planning data and detailed planning data as listed in this **planning code** articles 11 and 12 shall be submitted by each **user** to the **TSO**. This data shall be submitted at the end of March each year and shall cover each of the 10 following years. If from the date of one submission to another, there is no change in the data to be submitted, instead of resubmitting the data, a **user** may submit a written statement confirming that there has been no change from the data submitted previously.

b) Where planning data is included in Appendix B of the relevant **Connection Agreement,** then the **User** may confirm that the data in that Appendix is correct.

c) Any **user** requiring a new or modified **Connection Agreement** shall submit to the **TSO** the preliminary project data as per article 8 with the connection application, and shall submit the standard planning data as per article 11 of this code and the detailed planning data as per article 12 of this code to timescales that shall be specified in the **Connection Agreement.**

7 System Data (provided by the TSO to users)

7.1 To enable **users** to model the equivalent circuit of the **transmission network** in relation to short circuit current contributions, the **TSO** shall provide to **users** the **network** data as per paragraph 7 of this **planning code**. This data will be provided, upon request, within 10 working days, but no **user** may make more than one request for data associated with a single **Connection Point** in a period of 12 months. The **TSO**

shall provide the following data to **users.** The data items refer to values at the **connection point.**

a) Maximum and minimum symmetrical 3 - phase short circuit current infeed at the instant of fault;

b) Maximum and minimum symmetrical 3 - phase short circuit current infeed after the sub-transient fault current contribution has substantially decayed;

c) Maximum and minimum single phase short circuit current infeed at the instant of fault;

d) The zero sequence source resistance and reactance values at the **connection point** consistent with the maximum infeed;

e) The pre fault voltage magnitude at which the maximum fault currents were calculated;

f) The positive sequence x/r ratio at the instant of fault;

g) The negative sequence resistance and reactance values of the **transmission system** seen from the **connection point**;

h) The corresponding zero sequence impedance values;

8 Preliminary Project Planning Data (Provided by Users to the TSO)

8.1 Each **generator** with reference to a **connection application** that it submits to the **TSO** for a new or the modification of an existing **connection**, must provide the following information to facilitate the assessment:

a) name and type of plant;

b) preferred site location (listing any alternatives);

c) power transfer capability of whole plant (maximum MW and/or MVA);

d) expected energy production (MWh per month);

e) expected **demand** of auxiliary **system**;

f) plant type and configuration;

g) nature of any disturbing load;

h) technology of proposed **generating units**;

i) when plant is to be in service;

j) minimum stable **generation** MW;

k) step up transformer's winding arrangement, rated MVA and positive sequence reactance;

8.2 Where the **Power Plant** consists of one or more synchronous **generating units**, the following data should be provided

a) **generating unit's** rated MVA, MW, direct axis transient reactance, Short Circuit Ratio, inertia constant;

b) details of the exciter type and category, for example whether it is a rotating exciter or a static exciter:

9 Generation Adequacy Plan

9.1 Objective

9.1.1 For secure and reliable supply of electricity it is essential that there is sufficient generation capacity to meet the demand. These are key criteria of generation system planning.

9.1.2 The objectives of this generation adequacy plan (GAP) are as follows:

a) To provide, in the short term, an overview of generation adequacy and more generally of supply reliability;

b) To provide, in the medium to long term, information of the generating capacities of new generation or demand side reductions that are required:

9.1.3 This information provides early warning signals to all **parties** and indicates business opportunities for **market participants.**

9.1.4 Generation adequacy plan (GAP) shall be consistent with the **transmission development plan** (TDP).

9.2 Generation Planning Standards and Criteria

9.2.1 In the generation planning process in Kosovo the following issues shall be taken into account:

a) Required reserve ratio – available **generation** capacity to peak load ratio in accordance with the **ENTSO-E** methodology;

b) Probability of maximum **generation** loss (planned and unplanned outages);

c) Maximum forecast generating capacity deficit;

d) Other standards and criteria.

9.3 Contents of the Generation Adequacy Plan

9.3.1 Every 2 years the **TSO** shall produce a Generation Adequacy Plan (GAP). This shall be done in the same year that the long-term energy balance document is produced (see article 5.4). Where relevant, the GAP will use the same data as is used in the energy balance documentations.

9.3.2 The generation adequacy plan (GAP) should cover a period of 10 years and address every year of this period individually. The plan should basically compare whether expected **demand** can be met by the available **generation** capacities options within the required reliability standards and should also define the opportunities for **generation** development projects. The plan addresses the reliance on imports separately.

9.3.3 The following are the main points that will be contained in the generation adequacy plan (GAP) with both present data and forecast data being included:

a) Current and future availability of generations capacities during system peak and load demands in Kosovo in general for special nodes of the load;

b) Expected developments in electricity load consumption based on several economic scenarios (low growth, normal growth and high growth);

c) Impact of daily and seasonal load curves for days/referent time set by **ENTSO-E**;

d) Impact of developments in energy saving and demand side management options;

e) Current and future installed **generation** capacity (type of plant, installed capacity, fuel type, year of commissioning, year of decommissioning);

f) Impact of developments in small power plants (e.g. energy from wind, solar energy, biomass etc.);

g) Impact of import and export opportunities;

h) Impact of possible system constraints;

i) Impact of different scenarios, e.g. development of new production capacities, demand growth scenarios;

j) Choice of primary sources with care for suitable diversification for fuels (and possibly attention for the promotion of renewable resources and environmental conditions).

9.4 System Security Assessment

9.4.1 The GAP should indicate with what reliability the expected **demand** can be supplied with the available **production** and imports options.

9.4.2 The GAP should contain information on **production** surpluses or shortages and should give information on the opportunities for **production** expansion projects. Such information should include the total required capacity per year to meet reliability standards and the prospects for new equipment commissioning, type of power plant, preferred fuel type.

9.4.3 The method to be used for determining generation adequacy should be consistent with the methodology developed by **ENTSO-E**.

9.5 TSO Responsibilities

9.5.1 The **TSO** in its role of **System Operator** shall be responsible for the preparation of the GAP after consultation with the other **parties** involved. Any of the other **parties** may conduct independent assessments to evaluate alternatives.

9.5.2 The **TSO** will be responsible for the quality of the GAP but the **TSO** has no obligation to make sure that any investments in **production** expansion projects are actually carried out. In the event of the **TSO** being unable to operate the **system** to the required standards as a direct result of shortages in available **production** then the **TSO** will take the necessary operational measures to secure the **system.**

9.6 Issue and Publication of the Generation Adequacy Plan (GAP)

The **TSO** shall issue the draft GAP to the **Regulator** by the end of September. The **Regulator** will provide its comments by the end of October and the final version of the GAP, incorporating the comments received from the **Regulator**, will be publish on its website by the end of November.

9.7 Data for GAP

In preparing the GAP the **TSO** will use the planning data of **users** as submitted as per paragraphs 11 and 12 of this **planning code** and any other information that it deems necessary. In taking this action the **TSO** will follow the requirements of information confidentiality as per section 10 of this **planning code**.

10 Confidentiality of Information

Most of the data included in the GAP and in the **TDP** will be provided by independent commercial organisations who will be the **users** (or potential **users**) of the **transmission system**. The data will be commercially sensitive and in view of this, the **user** demand or **generating unit** information will be listed in the plans and will be used to produce the forecast power flows only if a **connection agreement** (**CA**) has been signed between the **TSO** and the **user**. Hypothetical new projects, potential closure of existing plants or other developments that may have been discussed with the relevant **user** will not be included in the plans without the explicit agreement of the **user** or where the impact of omitting the information would adversely affect the accuracy of the plans.

11 Standard Planning Data (Provided by Users to the TSO)

11.1 System Peak and Minimum Data

No later than March of each year, the **TSO** shall provide all **users** with **demand** directly connected to the transmission system with the following data:

a) The expected time and date of system peak demand

b) The expected time and date of system minimum demand

11.2 Total Demand and Active Energy Data Users

11.2.1 The following requirements are applicable to all **users** directly connected to the **transmission system**. **Demand** of **power plants** directly connected to the **transmission system** will be supplied by the **generator** under paragraph 12.1.

11.2.2 All **users** shall provide the **TSO** with its **demand** data (**active power** and **reactive power**) and its **active energy** requirements. In assembling its **demand** and **active energy** requirement forecasts, each **user** must endeavour to avoid duplication with other **users**.

11.2.3 Forecasts of the total demand of **users** (**active power**) and **active energy** are required for:

a) Peak **demand** day on the system of each **user** that in the opinion of the **user** could reasonably be imposed on the **transmission system**;

b) Day of peak **demand** on the **transmission system** (**active power**) specified in article 11.1 (a);

c) Day of the **TSO**'s minimum demand (**active power**) specified in article 11.1 (b);

11.2.4 All forecast **demand** of the **users** of the electricity **system** shall:

a) Be such that the profiles comprise average **active power** levels in MW for each time marked one hour throughout the day;

b) Take into consideration energy output produced by embedded **power plants** and electric installations;

c) Based on average conditions expected for weather:

11.3 Connection Point Demand

11.3.1 Forecast demand (**active power**) and power factor to be met at each **connection point** are required for the following:

a) The maximum **demand** (**active power**) at the **connection point** that in the opinion of the **user** could reasonably be imposed on the **transmission system**;

b) The **demand** at the time of peak **demand** on the **transmission system** as specified in article 11.1 (a);

c) The **demand** at the time of minimum **demand** on the **transmission system** as specified in article 11.1 (b);

11.3.2 All forecast **demand** as specified above shall relate to each **connection point** and be in the form of:

a) One set of demand data where the **user's system** is connected to the **transmission system** via a busbar arrangement that is not normally operated in separate sections;

b) Separate sets of demand data where the **user's system** is connected to the **transmission system** via a busbar arrangement that is or expected to be operated in separate sections:

11.3.3 All of the above forecast **demand** shall:

a) Be that remaining after any deductions reasonably considered by the **user** to take into account the output profile of all embedded **generating units** and such deductions should be separately stated;

b) Based on average weather conditions, unless specified differently;

11.3.4 So that the **TSO** is able to assess the impact on their **transmission system** of the diversified **demand** at various periods throughout the year, each **user** shall provide additional forecast **demand** at times to be specified by the **TSO**. The **TSO** shall not make such a request for additional data more than once in any calendar year.

11.4 Energy Information

11.4.1 The annual **active energy** requirements for each **connection point** must be provided. The energy demand shall be subdivided into the following categories of customer:

a) domestic, farms, commercial, industrial, public lighting and **user** system losses:

11.4.2The following information should be supplied when requested by the **TSO**.

a) Details of any individual loads that have characteristics significantly different from the typical range of Domestic, Commercial or Industrial loads supplied.

b) The sensitivity of the **demand** (**active power** and **reactive power**), to variations in voltage on the **transmission system** at the time of peak **demand**;

c) The average and maximum unbalance of voltages by phases that the **user** would expect its **demand** to impose on the **transmission system**.

d) The maximum harmonic content that the **user** would expect its **demand** to impose on the **transmission system**.

e) Details of all loads that may cause **demand** fluctuations greater than 1 MW at a **connection point**.

11.5 Generating Unit Data

11.5.1 Each **Generator** with **generating units** connected to the **transmission system**, each **producer** with **generating units** of greater than 5 MW connected to the **distribution system**, shall provide the **TSO** with the following current and forecast data each year relevant to the particular plant:

a) The point of **connection** to the **transmission system** in terms of geographical and electrical location and system voltage;

b) Number of **generating units** to which this data applies and type of equipment;

c) Installed capacity in MW;

d) Rated terminal voltage (kV);

e) Rated power factor – minimum leading and lagging;

f) Minimum technical **generation** output in MW;

g) Maximum technical **generation** output in MW;

h) The expected running regime (e.g. base load, medium load, peak load, or reserve plant) at each **power plant** and type of **generating unit** (e.g. steam unit, hydro etc.);

i) Details of the ability of its **generating units** to start and operate without connection to an external power supply and to update this information in the event of any change to this ability:

11.5.2 Where the **Power Plant** consists of synchronous **generating units**, the following data shall be provided:-

a) The **generating unit**'s rated MVA, MW, direct axis transient reactance, Short Circuit Ratio, inertia constant;

b) Details of the exciter type and category, (e.g. whether rotating or static);

11.6 Generating Unit Step-up Transformer

The following **generating unit** step-up transformer parameters shall be provided:

a) Rated MVA

b) Positive sequence reactance (at maximum, minimum and nominal taps);

c) Tap changer: Number of Steps and Step size (if applicable).

11.7 User's System Data

Each **user** connected directly to the **transmission system** shall provide, each year, the **TSO** with data on its **user** system that relates to the **connection point**.

When providing this information the **user** must reflect the effect at the **connection point** of any third party embedded within its own **user** system.

11.8 Single Line Diagram

11.8.1 All **users** shall provide a single line diagram covering their **plant and apparatus** at the **Connection Point.** The single line diagram shall include the following features:

a) Busbar layouts;

b) Electrical circuit (overhead lines, underground cables, transformers, etc.);

c) Vector group for transformers;

d) Earthing arrangements;

e) Switching facilities;

f) Operating voltages;

g) Numbering and nomenclature;

11.8.2 The single line diagram shall also show all connections between the **connection point** and a **generating unit**. The **user** shall also provide a description of the auxiliary supply system.

11.9 Reactive Compensation Equipment

For all reactive compensation equipment connected to the **user** system, other than power factor correction equipment associated directly with customer's **plant and apparatus**, the following information is required:

a) Type of equipment (i.e. fixed or variable);

b) Capacitive and/or inductive rating or its operating range in MVAr;

c) Details of any automatic control logic to enable operating characteristics to be determined;

d) The point of connection to the **user**'s system in terms of electrical location and system voltage;

11.10 Short Circuit Contribution to Transmission System

11.10.1 To allow the **TSO** to model a **user system** with **generating units** and/or motor loads connected to it, a **user** is required to provide data, calculated in accordance with good industry practice.

11.10.2 The data should be provided for the condition of maximum short circuit infeed from that **user** system with all **generating units** synchronised to that **user** system. The **user** must ensure that the pre-fault system conditions reflect a credible system operating arrangement.

11.10.3 The following data regarding the short circuit contribution to the **transmission system** is required. Data should be provided with respect to the **connection point**:

a) symmetrical three phase short circuit current infeed at the instant of fault;

b) symmetrical three phase short circuit current after the sub-transient fault current contribution has substantially decayed;

c) the zero sequence source resistance and reactance values of the user's system as seen from the **connection point** consistent with the maximum infeed above;

d) the positive sequence X/R ratio at the instant of fault;

e) the pre-fault voltage magnitude at which the maximum fault currents were calculated;

f) the negative sequence resistance and reactance values of the **user**'s system seen from the **connection point**;

11.11 Switchgear Data

All **Users** shall provide the following information with respect to switchgear at the **Connection Point**. In addition, **Producers** shall provide this data with respect to all switchgear on the connecting circuits between the **Connection Point** and a **power plant**;

a) Rated voltage (kV);

b) Operating voltage (kV);

c) Rated short circuit breaking current 3 - phase (kA);

d) Rated short circuit breaking current 1 - phase (kA);

e) Rated load breaking current 3 - phase (kA);

f) Rated load breaking current 1 - phase (kA);

g) Rated peak short circuit making current 3 - phase (kA);

h) Rated peak short circuit making current 1 - phase (kA);

i) Breaker operating time.

This information is to be included in Appendix B of the relevant **Connection Agreement**.

11.12 User System Data for Transformers

For transformers between the **transmission system** and the **user** system the following data shall be provided for each transformer:

a) Rated MVA**;**

b) Rated Voltage Ratio;

c) Winding arrangement and vector group;

d) Positive sequence resistance and reactance (max, min and nominal tap);

e) If requested by the **TSO**, zero sequence reactance;

f) Tap changer range and step size;

g) Tap changer type: on load or off;

h) **Earthing** method: direct, through resistance or reactance; and

i) Impedance to earth if not directly earthed.

11.13 Connecting Circuits data

Where the **User**'s part of the circuits connecting the **User** system to the **transmission system** are longer than 100 m in length, the **User** shall supply the following data:

a) Rated voltage (kV);

b) Operating voltage (kV);

c) Positive phase sequence resistance, reactance and susceptance;

d) Where specifically requested by the **TSO**, zero phase sequence resistance, reactance and susceptance.

11.14 Protection data

All **users** shall provide the following information is required which relates only to protection equipment that can trip or intertrip or close any **connection point** circuit breaker:

a) A full description, including estimated settings, for all relays and protection systems installed or to be installed on the **user** system;

b) A full description of any auto-reclosing facilities installed or to be installed on the **user** system, including type and time delays; The fault clearance time for electrical faults on any part of the **user** system directly connected to the **transmission system;**

c) Reach of all protections on transmission lines or cables - % on 100 MVA base;

d) Number of protections on each item;

e) Total fault clearing times for near and remote faults;

f) Line automatic re-closure sequence details;

12 Detailed Planning Data (provided by Users to the TSO)

The Detailed Planning Data described in this article 12 should be provided by all Generators with power plants.

12.1 Energy Demand for In-House Needs

12.1.1 For each **generating unit** that has an associated unit transformer, the value of the demand supplied through this unit transformer when the **generating unit** is at rated MW output is to be provided.

12.1.2 Where the **power plant** has associated **demand** additional to the unit-supplied **demand** that is supplied from the **transmission system** through the station (or starting) transformer, the **producer** shall supply forecasts for each station transformer of:

a) The maximum **demand** that in the opinion of the **producer** could reasonably be imposed on the **transmission system**;

b) The **demand** at the time of the peak **transmission system demand**;

c) The **demand** at the time of minimum **transmission system demand**:

12.2 Power Plant Technical Data

The following data should be provided for the complete **power plant:**

a) Nominal voltage at the **connection point** – kV;

b) Total rated capacity – MW;

c) Largest common mode failure:

12.3 Generating Unit Parameters

The following data should be provided for all synchronous generating units rated at over 10 MW. All reactances should be provided on a saturated/unsaturated basis, and time constants on an open/short circuit basis.

a) Rated terminal volts (kV);

b) Rated MVA;

c) Rated MW;

d) Minimum and maximum production (MW);

e) Auxiliary load (MW);

f) Short circuit ratio;

g) Direct axis synchronous reactance;

h) Direct axis transient reactance;

i) Direct axis sub-transient reactance;

j) Direct axis short-circuit transient time constant.

k) Direct axis short-circuit sub-transient time constant;

l) Quadrature axis synchronous reactance;

m) Quadrature axis sub-transient reactance;

n) Quadrature axis short-circuit sub-transient time constant;

o) Stator time constant;

p) Stator leakage reactance;

q) Armature winding direct-current resistance;

r) Turbo-generator inertia constant (MWs/MVA);

s) The **generation unit** performance chart at the **generating unit**'s stator terminals;

t) Rated field current (A) at rated MW and MVAr output and at rated terminal voltage;

u) Field current (amps) open circuit saturation curve for generating unit terminal voltages ranging from 50% to 120% of rated value in 10% steps as derived from appropriate manufacturers test certificates.

12.4 Generating Unit step-up Transformer

Producers shall provide the following data for all **generating unit** step-up transformers,

a) Rated MVA;

b) Number and arrangement of windings;

c) Rated Voltage ratio;

d) Operating voltage ratio (if different from rated);

e) Positive and negative sequence impedances (at max, min and nominal tap)

f) Zero sequence impedance

g) Vector group;

h) **Earthing** arrangement (Direct, resistance or reactance), with impedance if not directly earthed

i) Transformer tap winding - diagram;

j) Tap changer range;

k) Tap changer step size;

l) Tap changer type (on/off load);

m) Tap change cycle time:

12.5 Generating Unit Reactive Capability (Performance Chart)

The performance chart must include the following data items::

a) lagging **reactive power** at rated MW;

b) lagging **reactive power** at minimum MW;

c) lagging reactive short time capability at rated MW, terminal voltage and speed;

d) leading **reactive power** at rated MW:

e) minimum stability limit

12.6 Excitation System

Each **producer** shall provide an excitation system transfer function block diagram for each **generating unit** showing gains, time constants, limits, rates of change etc. of individual elements including details of:

a) rated field voltage at rated MVA and power factor and rated terminal volts and speed;

b) maximum field voltage;

c) minimum field voltage;

d) maximum rate of change of field voltage (rising and falling);

e) dynamic characteristics of over and under excitation limiter (block diagram);

12.7 Governor and Associated Prime Mover Parameters

12.7.1 Where a **Power Plant** has a governor installed, the following parameters must be provided for each **generating unit.**

A governor system transfer function block diagram showing gains, time constants, limits, rates of change etc of individual elements including details of filters, controllers and convertors. The block diagram shall also show details of the prime mover. The following governor parameters shall be provided:

a) Overall average gain (MW/Hz):

b) Governor time constant (in seconds);

12.7.2 If the prime mover is a steam turbine, the system transfer function block diagram shall include the following:

a) Boilers;

b) HP[1] turbine

i. HP steam extraction range (expressed in terms of the boiler rated output);

ii. HP steam extraction valves;

c) LP[2] turbine;

12.7.3 If the prime mover is a gas turbine unit, the system transfer function block diagram shall include details of the following:

a) Inlet guide vanes;

b) Compressor;

c) Fuel valve;

d) Combustion chamber;

e) Power turbine:

[1] HP – High pressure

[2] LP – Low pressure

12.7.4 If the prime mover is a hydro unit, the system transfer function block diagram shall include details of the following:

a) Guide vane actuator time constant

b) Guide Vane opening limits

c) Guide vane opening and closing rate limits (%/s);

d) Water time constant

12.8 Generating Unit Load Controller

The following data must be provided:

a) Maximum, minimum and normal droop - %;

b) Maximum, minimum and normal frequency deadband – Hz;

c) MW deadband;

a) **Automatic generation control** (**AGC**) capability.

12.9 Governor and Generating Unit Response Capability

The following data must be provided:

a) Sustained response to frequency change - MW/Hz;

b) Non - sustained response to frequency change - MW/Hz;

c) Rate of loading following shutdown (**generating unit** and **power plant**);

d) Block load following synchronising;

e) Rate of de-loading from normal rated MW;

f) Regulating range;

g) Governor time constant (in seconds);

h) Load rejection capability while still synchronised and able to supply load;

i) Fraction of power produced by each stage in a multi - stage steam turbine (HP, IP, LP per unit of max power);

12.10 Equipment Technical Data

The following data must be provided:

a) insulation co-ordination data;

i. rated lightning impulse withstand voltage – kV;

ii. rated short duration power frequency withstand voltage – kV;

iii. circuit maximum current;

iv. rated short time withstand current;

v. ambient conditions under which above current applies;

vi. earthing method and rated current;

vii. insulation pollution performance:

b) Remote data and data transmission arrangements;

12.11 Transient Over-voltage Assessment Data

12.11.1 When undertaking insulation co-ordination studies the TSO will require to conduct transient over-voltage assessments. When requested by the TSO each user is required to submit data with respect to the connection point as follows:

a) Busbar layout, including dimensions and geometry together with electrical parameters of any associated current transformers, voltage transformers, wall bushings, and support insulators;

b) Physical and electrical parameters of lines, cables, transformers, reactors and shunt compensator equipment connected at that busbar or by lines or cables to that busbar. This information is for the purpose of calculating surge impedances;

c) Specification details of all apparatus connected directly or by lines and cables to the busbar including the basic Insulation Levels;

d) Characteristics of over-voltage protection at the busbar and at the termination of lines and cables connected at the busbar;

12.11.2 The following generating unit or power plant transformer data is required:

a) Three or five limb cores or single phase units to be specified;

b) Operating peak flux density at nominal voltage.

12.12 Protection Data

12.12.1 The following information is required which relates only to protection equipment that can trip or intertrip or close any connection point circuit breaker:

a) A full description, including estimated settings, for all relays and protection systems or to be installed on the **generating unit**, genset transformer, station transformer and their associated connections.

12.12.2For **generating units** having (or intended to have) a circuit breaker at the **generating unit** terminal voltage:

a) clearance times for electrical faults within the **generating unit** zone;

12.12.3 **Producers** shall provide the following data for each **generating unit** (The settings of the following protections):

a) under/over excitation;

b) differential;

c) negative phase sequence:

(End of the document)