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10 years 2000-2010

Power Tranmission Grid (PTG) Perspective Plan Period 2008-2012 and 2017 as a guide

- August 2009 -

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Acronyms

ANRE	National Energy Regulatory Authority
CBT	Cross Border Trade (cross-border electricity trade)
CHPP	Central Heating and Power Plant
HPP	Hydroelectric Power Plant
SPHPP	Storage Pump-Hydroelectric Power Plant
NPP	Nuclear Power Plant
OTC	Own Technical Consumption (losses, overheads, internal service consumptions)
SPP	Steam Power Plant
NED	National Electricity Dispatcher
TED	Territorial Electricity Dispatcher
EMS/SCADA	Energy management system / supervisory control and data acquisition system
ETSO	European Transmission System Operators
FDFEE	Electricity Distribution and Generation Subsidiary
GNV	Summer night low consumption
NIS	National Institute for Statistics
ITI	Internal Technical Instructions
OHL	Over-Head Lines
OMEPA	„Operator for Metering the Electricity Transited in the Wholesale Market" Branch
OPCOM	Commercial Operator
TSO	Transmission System Operator
GEO	Government Energy Ordinance
EG	Energy Guidelines
OP	Operational Procedure
RAR	Automatic Reset
RARM	Monophase RAR
RD	Reference design regime
EDG	Electricity Distribution Grid
PTG	Power Transmission Grid
RK	Capital repair
RMB	Basic Average Regime
RTU	Remote Terminal Unit
SDFEE	Electricity Distribution and Supply Branch
NPS	National Power System
SETSO	South-European Transmission and System Operators
ST	Subsidiary of Transmission
TSS	Technical system services
UCTE	Union for the Co-ordination of Transmission of Electricity
EU	European Union
UNO-DEN	NED Operating Unit
WMP	Winter Morning Peak
WEP	Winter Evening Peak

1. Purposes and Objectives of PTG Perspective Plan

"Transelectrica" the National Company for Power Transmission elaborates the development plans of PTG based on its responsibilities and competencies set forth in the Electricity Law no. 13/2007, PTG Technical Code and the Licence for Power Transmission, with due consideration of the current situation and future evolution of power consumption and availability, including electricity imports and exports.

PTG development planning is carried out in compliance with the national energy strategy and policy.

Development of PTG needs to be correlated with the evolution of NPS as a whole, considering that NPS is expected to cover electricity consumption in conditions of economic and energetic safety and efficiency.

To this end Transelectrica elaborates every two years a perspective plan for the following consecutive 10 years, plan which becomes a public document after its endorsement by the competent authority and applicable regulatory ministry.

The main objectives of PTG Perspective Plan are:

- Provision at minimum possible costs of an optimum adequacy of the transmission grid in safe conditions and observing the government energy policy and programme, as established in the Electricity Law no. 13/2007 and other applicable strategic documents in force;
- Correlation between TSO and market participants of actions related to any service requested which might affect safety performance characteristics of NPS;
- Correlation between TSO and market participants of actions related to average and long term investment plans;
- Presentation of regional opportunities for connection of PTG and use of PTG, subject to consumption forecasts and requirements for new energy generation capacities, aiming at ensuring an efficient and safe operation;
- Identification and presentation of opportunities for development of interconnection grids supporting development of international electricity markets.

Planning of PTG development shall consist of:

- elaboration of a programme for PTG investments and major maintenance works needed for the period under analysis;
- identification of opportunities for arrangement of new electric power generation capacities and development of electricity consumption areas;
- identification of resources required for development and operation of PTG in safe operation conditions, manner of acquiring such resources and establishment of rates following to be detailed and specified in the business plan;
-

2. Legislative and regulatory framework

Legislative framework. European Directives and Community Acquis implementation status

The legislative framework regulating the energy sector in Romania has passed through significant changes according to the progress of sector reform process, whose direction was given by the European Union accession negotiations in the last years. On January the 1st, 2009, Romania was accepted as member state of the European Union and the EU legislation and regulations in the field are assimilated into Romanian legislation and the energy sector recorded significant changes in the last years, out of which we mention:

- Alteration of electricity market model by adopting a new Commercial Code of the wholesale market which modified the trading rules and led to Day Ahead Market establishment, Balancing Market, Centralized Market for Bilateral Contracts and Market for Green Certificates
- Starting from 2004 and carrying on with 2005 developments, new private players appeared in the electricity transmission sector as a result of privatization of 4 out of 8 regional transmission subsidiaries
- Electricity generation activity is directly influenced in terms of input costs by the increase of degree of the natural gas market liberalization and through privatization of transmission companies such as Distrigaz Sud, Distrigaz Nord as well as the National Oil Company Petrom S.A.
- Electricity generation activity was reorganized by establishment of Rovinari, Turceni and Craiova Power Plants
- During 2006, Transelectrica attracted private capital through initial public offer, which represented an increase in company's share capital by 10%. Also, the state transferred 15% of its shares in favour of the Property Fund and by operation of law 10/2001, 10% of shares are going to be offered to natural persons who must be compensated for loss of properties during communist period..;
- In 2005, Romania signed the Treaty establishing the Energy Community setting forth the rules for organization and establishment of the regional electricity and natural gas market in South-Easterd Europe providing the legal framework for promoting the investments made in energy infrastructure installations of regional interest, a very important role being played by the interconnection installation from power transmission networks.
- In compliance with the commitments undertaken by Romania through EU Accession Treaty, the assurance of medium-term operation and sustainable development of the energy sector remains a priority, through rehabilitation and improvement programmes and stimulation of new investments.

The main measures taken by Romania for the fulfilment of obligations set forth in commitments undertaken through the above mentioned documents refer to the transition from the centralized, monopolistic and vertically integrated system to a descentralised system. The distortions related to the crossed subsidies were eliminated, and the prices were lined up with the production costs. A relevant independent regulatory authority was established and the gradual market liberalisation process was initiated.

Although energetic efficiency strategies were approved and a Governmental Agency for Energy Preservation is organized and operates, no significant progresses were recorded in this field, a much more alarming fact as the energetic intensity of the Romanian economy is very high (approximately seven times higher than the EU average, according to the values included in the Energy Roadmap of Romania).

After Romania's accession to EU, our country may benefit from important amounts granted from the EU financial support programmes through the mechanism of structural and cohesion funds.

The Management Authority for Increase of Competitiveness is established and operates within MEF, and within MA operates the Intermediary Body for energy which manages the programmes financed from structural funds and regional development funds intended for the energetic efficiency increase projects and for development of the exploitation of renewable energy sources projects.

The electric energy and natural gas market was completely opened for all consumers on July the 1st 2007.

An independent regulatory authority of the electric energy and natural gas sector was established.

A current priority of the European Union is the reduction of carbon emissions and encouragement of renewable energy consumption. The legislative package on climate changes and renewable energies, published on 23.01.2008 sets on covering 20% of the community consumption from renewable sources until 2020.

In Romania, the Law no. 220/27.10.2008 „Law for establishing the promotion system for energy production from renewable energy sources" :

- extends the validity of the mandatory quotas (until 2020);
- differentially allots the green certificates (e.g.: 4 GCs for 1MWh of solar energy, 3 GCs for biomass, 2 GCs for eolian energy, etc.);
- provides for the increase of price limits on the competitive market of green certificates (minimum value 27 EUR/GC, maximum value 55 EUR/GC);
- stipulates principles to be applied on supporting connection costs between relevant producers, TSO and/or power distribution operators.

2.1.1. Primary legislation

The primary legal framework regulating the energy sector has passed through significant changes according to the progress of sector reform process.

The main normative acts governing this energy sector in Romania and having a major impact on the development of PTG, Law no. 13/2007 – "Law of electric energy", amended and supplemented by GEO no. 172/19 November 2008, Law no. 220/27.10.2008 "Law for establishing the promotion system for energy production from renewable energy sources", as well as the Regulation on users' connection to public electric networks, approved by GD no. 90/2008.

The national power transmission grid is considered to be of strategic significance and, as such a great part of its component assets is publicly owned by the state. The legal framework regulating the status of the public patrimony and concession conditions of hereof is embodied by the Law 213/1998 on public property and its regime – with further amendments – and respectively Law 219/1998 on regime of concessions.

2.1.2. Secondary legislation

Secondary legislation includes those mandatory regulatory instruments for the actors in energy sector so it would operate coordinately and synchronized. In recent years, ANRE prepared and enacted various instruments of the secondary legislation, among which the following regulations with impact on the PTG development and exploitation:

- PTG Technical Code – Revision I, approved by ANRE Order no. 20/2004, amended and supplemented by ANRE Order no. 35/2004;
- Technical Code of Electric Distribution Networks – approved by Decision ANRE no. 101 /2000
- Commercial Code of wholesale market of electric energy, approved by ANRE Order no. 25/2004;
- Licenses and Authorisations; activity of CNTEE “Transelectrica” - S.A. is carried out based ob the Conditions related to License no.161/2000, Revision 2/2005;
- Codul de măsurare a energiei electrice - aprobat prin Ordin ANRE nr. 17/2002;
- Performance standard for power transport and system services, approved by ANRE Order no. 17/2007;
- Performance standard for power distribution service, approved by ANRE Order no. 28 /2007;
- Orders and decisions for regulation of tariffs for monopoly activities (transport and distribution) as well as for the produced power on the regulated market;
- Methodology for establishing the tariffs for power transport service, approved by Order no. 60/ 13 December 2007 of ANRE president;
- Methodology for establishing the tariffs for system service, approved by Order no. 20/ 13 July 2007 of ANRE President;
- Order no. 42/ 16.10.2007 of ANRE president – on the enforcement of operational procedure “Mechanism of counterbalancing the effects of using electric transmission networks for electric energy transits between transport and system operators “.

3. Principles, methodologies and calculation programs used for preparation of PTG Perspective Plan

3.1. Principles underlying the preparation of Perspective Plan

The PTG Perspective Plan has been prepared starting from the need to meet the users’ requirements under the conditions of maintaining the quality of transmission and system service and the operational safety of the national electroenergetic system, in compliance with the regulations in force and the standards required by an interconnected operation with UCTE.

The elements which underlay the Plan preparation were the following:

- Strategic directions of CNTEE “Transelectrica” - S.A.;
- PTG technical characteristics;
- The needs of the NPS users;
- Assurance of infrastructure required for Government’s energy strategy and policy;
- The ferm contracts and commitments of the company upon programme preparation;
- Available funds of the company
- Integration on the European electricity market.

The strategic directions of development which were considered in preparation of programme and setting forth the technical solutions, in compliance with the mission and objectives of CNTEE “Transelectrica” S.A., are the following:

- To carry out the maintenance, improvement and development of PTG and interconnection capacities in order to maintain the safety of the overall NPS operation, in compliance with the License no. 161/2000, rev.2/2005;
- Introduce the most performant technologies existing worldwide;
- Promote the remote control of the installations in PTG stations;
- Obtain a major role on regional and European electricity market;
- Increase the capacity of interconnection with neighbouring systems;
- Increase the volume of transmitted power;
- Promote the solutions leading to PTG loss reduction;
- Reduce PTG congestions.

The minimum cost development and operation of PTG is based on the principle of optimal development and usage of transmission system. This desideratum is also supported by the signals sent through regional tariff on:

- Placement of the new consumers, preferably, in the excess areas of the system;
- Placement of the new producers, preferably in the deficit areas of the system;
- Most efficient usage of existing transmission capacities;
- Integration on the European electricity market.

3.2. Applied methodologies and calculation programs

The preparation of the PTG Perspective Plan implies running through the following analzsis stages based on the specific methodologies, respectively:

- Forecast of electricity and heat energy demand (urban district heating and industrial consumption) on the NPS assembly for the analysed period;
- Forecast of power consumption and levels of electric power (active and reactive) on specific plateaus in the territorial load curves (load peak and no load in winter and summer seasons);
- Forecasts of electric energy and power import/export/transit;
- Assessment of the current technical condition of the electric (and heat) energy production capacities, of the PTG (and distribution) facilities and interconnection facilities with neighboring power systems;
- Establish the availability of production capacities, considering the dismantling, rehabilitations and new installed power – development scenarios;
- Assessment of the system services necessary for NPS and their assurance method;
- Assessment of the balances of active and reactive powers on the PTG nodes and NPS power areas to the specific plateaus in the load curves;
- PTG functional characteristic analysis in the reference period;
    - The power flows at the specific plateaus of the load curve;
    - Power losses on the specific plateaus of the load curve and annual electricity losses in PTG;
    - Admissible voltage level and its adjustable control in PTG nodes;
    - Protection, automation systems;
    - Level of short-circuit powers in PTG nodes;

- o Steady-state and transient stability conditions of the NPS operation;

- Current performance analysis and establishing the necessary PTG-related infrastructure modernization/development programmes;
- Determine the investments needed for complying with the technical requirements required by interconnected operation of NPS with UCTE network and for the contribution to regional electricity exchanges;
- Set the measures required to reduce the PTG impact on the environment;
- Forecast of transmission tarrifs according to the content of the PTG Perspective Plan and company's Business Plan;
- Identify opportunities for the new users to connect to PTG: major consumers directly connected to the very high voltage networks and electricity producers;
- Identify electricity import/export opportunities.

The detailed presentation of the calculation prerequisites and used methodologies for the main stages listed in this chapter is provided in Annex A.

The PTG reference design analysis according to various forecast horizons was carried aut in compliance with the provisions of the Normative for Romanian power system design (PE026/1992).

As the mentioned document has been prepared several years ago, it does not include provisions for wind-power stations. Under such circumstances and being aware of the special particularity of these stations, we consider necessary for the provisions of PE 026/92 to be supplemented as follows:

- In BAR the existing wind-power stations (already included in the model) will be considered producing maximum 50% of the installed power..
- În SR the following changes will be operated in relation to BAR:
  - Ø The production of wind-power stations from the analysed area will be increased from 50% (standard level in BAR) to 100%. Loading of the wind-power stations from other geographic regions will remain as in BAR.
  - Ø The wind-power station subject to analysis will be considered (included in the model) of 100% of the installed power under the regimes with „N" elements in operation..
  - Ø The wind-power station subject to analysis and the wind-power stations from the region will be considered (included in the model) of 70 % of the installed power under the regimes with "N-1" elements in operation (upon inspection of "N-1" criteria fulfilment).

We point out that these values are established based on the information acquired from the professional literature and as a result of the discussions held by the company specialists with the representatives of companies operating significant volumes of wind-power stations, as currently we have no operational wind-power stations in Romania, which would be able to provide sufficient guiding marks on their loading level and related probability.

Following the commissioning of a relevant volume of wind-power stations in NPS, CNTEE "Transelectrica" S.A. intends to update the values set forth based on the statistic analysis of measurements.

The detailed presentation of the calculation prerequisites and used methodologies for the main stages listed in this chapter is provided in Annex A.

3.3. Calculation programs used in preparation of PTG Perspective Plan

Calculation programs are used in preparation of PTG Perspective Plan in order to:

- Determine the development programs with minimum costs, the electricity generation capacities - PowrSym3;
- Detailed simulation of the operation of all consumption and production capacities and the transmission capacitiy in NPS (Load Flow NIL and Power Systems Simulator / Engineers – PSS/E);
- Forecast of the electricity required on entire NPS assembly and in territorial allotment (ConStat);
- PowrSym3 interface – Load Flow NIL and PSS/E – ConStat;
- Determine the zonal transmission tariff (STT – Simplified Transmission Tariff).

4. Current technical characteristics (2008) of PTG within NPS

4.1. Electricity generation capacities

Within NPS operate four types of electricity generation technologies and their related four categories of power generator sets: hydroelectric, thermo-electric (of condensation and central heating), nuclear power and wind-power. Therefore:

- The largest power generator sets in the system are the 707 MW nuclear units from Cernavoda (the second unit was installed in August 2007);
- The hydro-power generating units with unit powers from values lower than 1 MW until 194,4 MW (the installed power after the rehabilitation of the units in HPP Portile de Fier I);
- The classic thermo-electric power generating units with a wide range of the installed unit power variation: from few MW, for some units of the selfproducers, to 330 MW, the unit power of the lignite-fired power units in Rovinari and Turceni thermal power plants.
- Wind-power generating units with unit powers lower than 1 MW.

The total installed power of the power plants, available for the System Operator on 31.12.2007 (Table 4.1.1) was 20380 MW, out of which 32% in hydroelectric power plant, 7% în centrale nucleare şi 61% in thermoelectric power plants.

Table 4.1.1 [MW]

Installed power	**Installed power***	**Maximum net power available ****
TOTAL	20380	16160
Hydroelectric power plants	6377	5859
Nuclear power plants	1413	1300
Conventional thermoelectric power plants	12582	8994
Condensed steam	8262	5524
Central heating	4320	3470
Wind-power plants	8	7

Note: * The installed power includes also decommissioned units for rehabilitation, preservation and cassation respectively.

** According to the UCTE methodology the maximum net available power does not include the permanent reductions of power nor the own technological consumption of the power plants. For the hydroelectric power plants, the net power was considered (exclusive of OTC of the power plants) without the hydraulicity-related unavailabilities.

It can be observed from Table 4.1.2 that, in terms of system adequacy, estimated as per UCTE methodology, the capacity installed in NPS was sufficient to cover the load peak (crest) in December and the export, under NPS operational safety conditions. The value of excess power in December represented 20% of the net installed power in NPS.

Table 4.1.2.

	Maximum net power available in NPS - the 3rd Wednesday of December - hours 12 (hours 11 CET)	[MW]
1	Hydroelectric power plants	5859
2	Nuclear power plants	1300
3	Conventional thermoelectric power plants	9016
4	Other renewable power sources	7
5	Other power plants	0
6	**Installed power in NPS [6=1+2+3+4+5]**	**16182**
7	Unavailable power (Permanent + temporary reduction)	1395
8	Power related to planned maintenance	847
9	Power related to unscheduled repairs (after breakdown)	1137
10	Power reserve for system services	838
11	**Available power [11=6-(7+8+9+10)]**	**11965**
12	**Internal consumption**	**8179**
13	**Internal consumption deviation in relation to the monthly maximum consumption**	**502**
14	**The residual power without considering power exchanges [14=11-12]**	**3786**
	Power exchange	
15	Import	352
16	Export	945
17	**Balance Import-Export [17 = 15 - 16]**	**-593**
18	**The residual power with power exchanges included [18 = 14 + 17]**	**3193**

4.2. Statistical analysis of the electric power consumption in the last 5 years (2003 – 2007)

4.2.1. Evolution of Electric Power Consumption in the Territory between 2003-2007

The evolution of power consumption between 2003–2007 in the power stations for consumer supply and at SDFEE level is described in Annex B-1 and Annex B-2.

As a result of electric power consumption evolution analysis at SDFEE and FDFEE level for 2005 – 2007 period, the following data can be determined:

- An increase in consumption within most SDFEEs except for SDFEE Suceava, Cluj, Tulcea, Gorj and Mureş, was recorded after 2005;
- In case of the other SDFEEs, a consumption decrease trend is recorded in 2007 compared with 2006

4.2.2. Consumption curves per types of consumers, seasons and specific days

The categories of economic activities, according to NACE classification, wherefore the consumption curves are determined are the following:

- Coal industry;
- Oil industry;
- Ferrous metallurgy industry;
- Non-ferrous metallurgy industry;
- Machine manufacturing industry;
- Chemical industry;
- Building materials industry;
- Cellulose and paper industry;
- Light industry;
- Food industry;
- Wood industry;
- Other industrial activities;
- Building industry;
- transport and telecommunications;
- agriculture;
- tertiary;
- domestic.

The consumption curves per consumer types are determined for the winter and summer seasons for the following specific days:

- working day (Tuesday, Wednesday, Thursday, Friday);
- holiday (Sunday and other legal holidays);
- day before holiday (Saturday and any day before a holiday);
- day after holiday (Monday and any other day after a holiday), based on the calculation method applied to a representative sample of consumers for each consumer type.

The analysis of the consumption curves showed that they can be classified according to the daily variation indicators in:

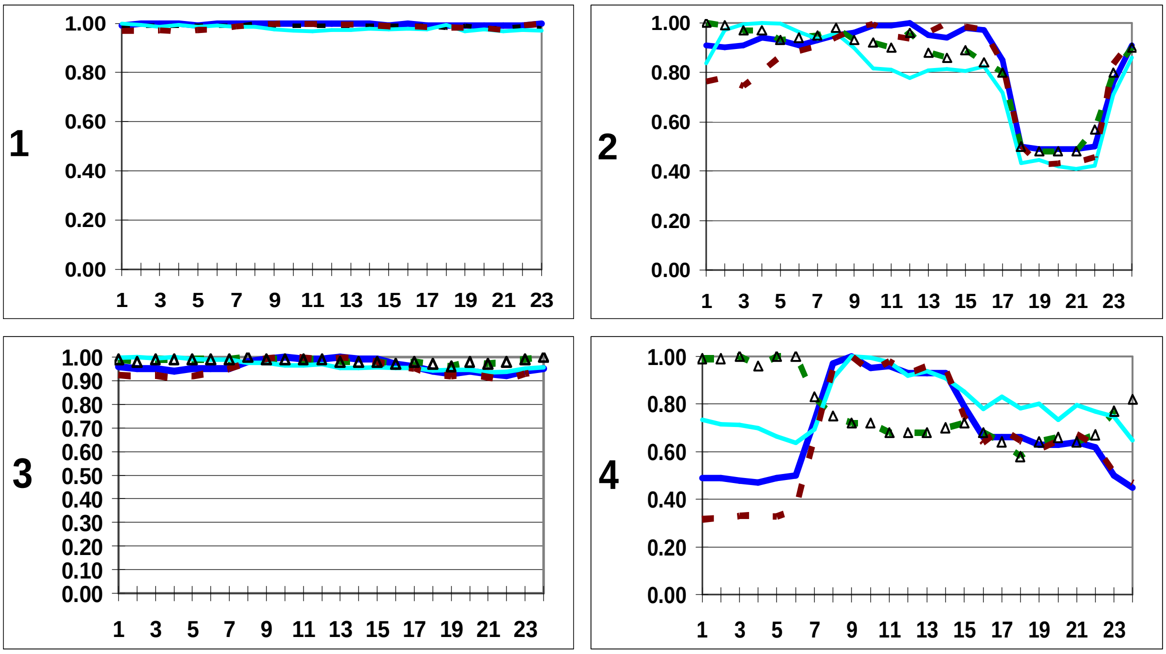
- smooth curves
- slightly modulated curves
- very modulated curves
- curves sensitive to tariff

For illustrative purposes, the figure 4.2.1 describes the consumption curves related to winter seasons for the branches:

– Non-ferrous metallurgy industry (smooth curve);
– Building materials industry (curve sensitive to tarif);
– Chemical industry (slightly modulated curve);
– Wood industry (very modulated curve).

Figure 4.2.1 Consumption curves for winter season, for the following activity fields

1. Non-ferrous metallurgy industry (smooth curve)
2. Building materials industry (curve sensitive to tarif
3. Chemical industry (slightly modulated curve)
4. Wood industry (very modulated curve)



Considering the relative stability of the specific consumption curves per consumer types, as well as the lack of more updated studies on the structure of electric energy consumption per fields of application and economic activity categories, this paper applies the determinations achieved for period 2002-2004.

The Annex B-3 shows the charts of the relative specific curves of consumption (related to the maximum consumption for the repective day type) per consumption categories for the specific days in the winter and summer seasons.

Consumption forecast error

The forecast of net consumption (final consumption + network losses) – peak power and annual power – used in Perspective Plans for periods 2004-2008-2014, 2006-2010-2016 and 2008-2012-2017 and the values achieved in NPS are presented in tables 4.2.1, 4.2.2, 4.2.3:

Table 4.2.1

Forecast		2004	2006	2008	2010	2012	2014	2016	2017
net Peak consumption - power	**[MW]**								
2004-2008-2014 Plan		8044	8480	9124	9817	10311	10830		
2006-2010-2016 Plan			8415	9024	9678	10443	11268	12158	
2008-2012-2017 Plan				8501	9675	10253	10937	11332	12065
Net annual consumption - energy	**[TWh]**								
2004-2008-2014 Plan		50.68	52.90	55.82	58.90	61.87	64.98		
2006-2010-2016 Plan			52.85	56.09	59.52	63.70	68.17	72.95	
2008-2012-2017 Plan				54.27	59.50	62.53	66.12	70.10	72.05

Table 4.2.2

Net realized consumption – average power at peak hour* [MWh/h]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
2006	7976	7762	7633	7209	6686	6795	6679	6625	6956	7594	7827	**8151**

* Maximum hourly average value in relevant month
The values of the net hourly realized consumption are available starting from 2005.

Table 4.2.3

	2004	2006	2008
Net annual realized energy consumption [TWh]	50.75	53.02	55.22

Fig. 4.2.2

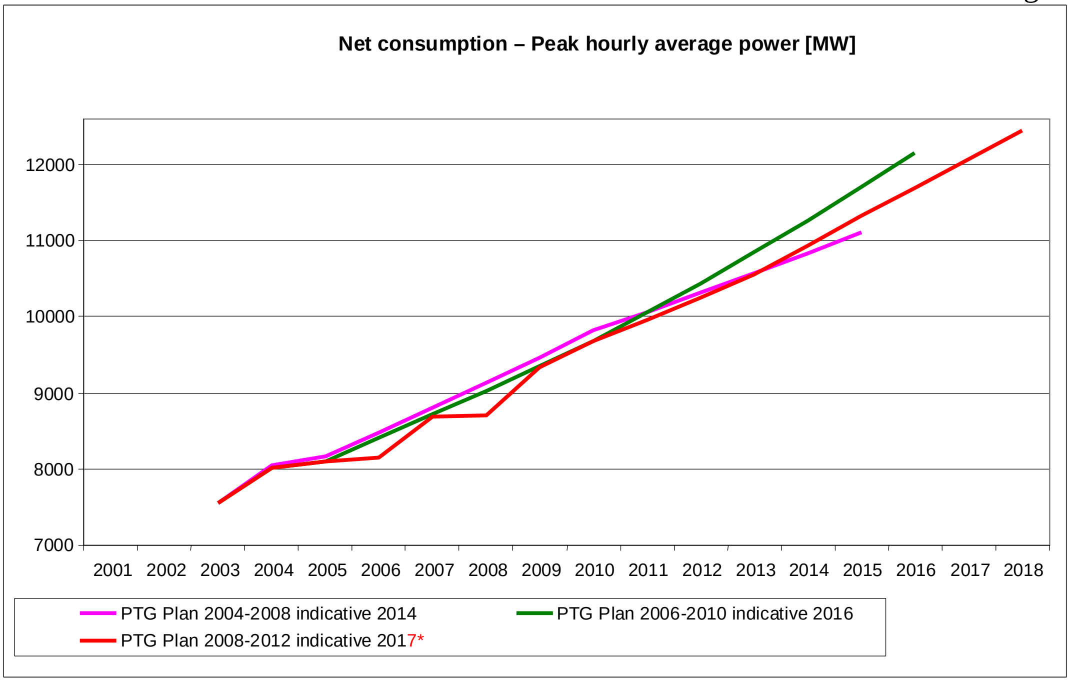
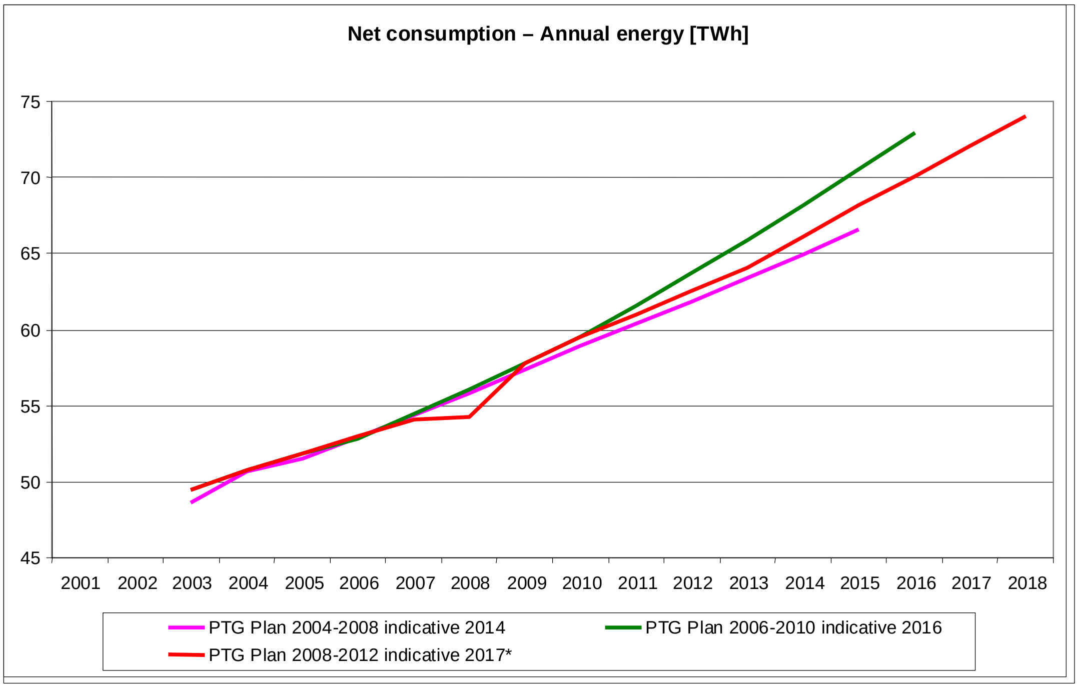


Fig. 4.2.3



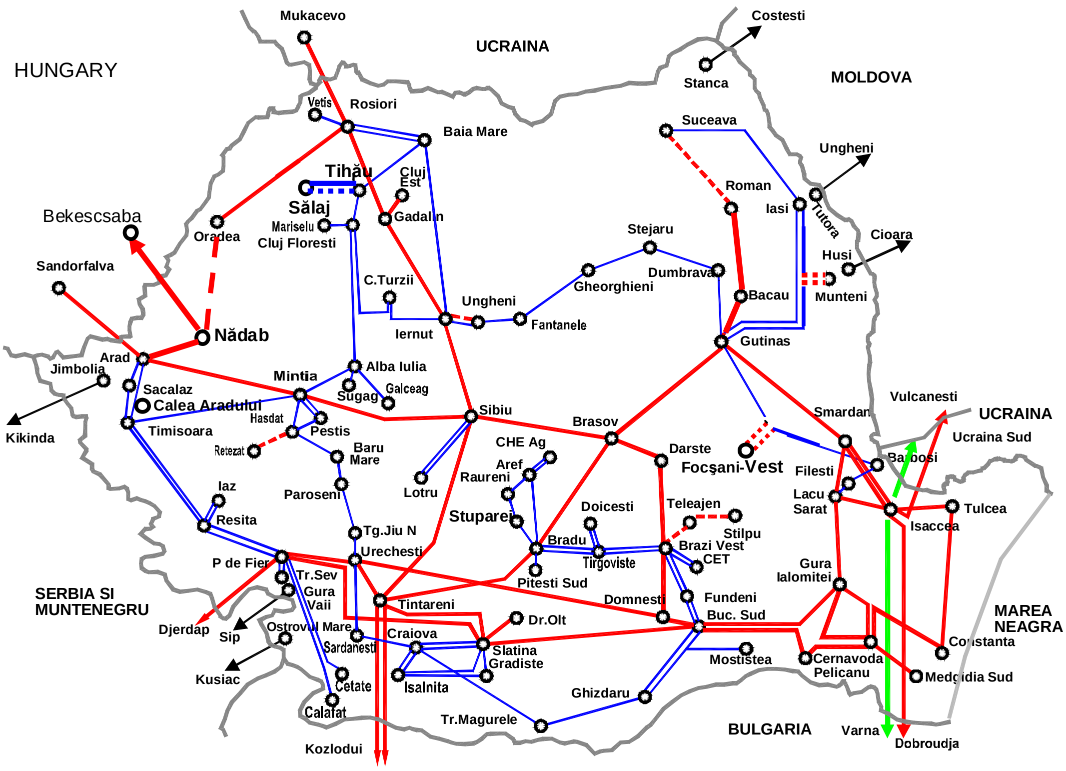
* The values prior to the first forecast year (2008) represent achieved values

From the comparative analysis of the forecast and achieved consumption values, presented in fig 4.2.2 and fig. 4.2.3, it was observed that the value achieved in 2006 was below forecast by 264 MW, the forecast error being of 3.2% of the achieved value.

4.3. Electricity Transmission Internal Capacities and Interconnections

The Power Transmission Grid is defined as the electric grid of national and strategic interest with a rated voltage higher than 110 kV.

Figure 4.3. Power Transmission Grid



<u>CAPTION</u>:

- 110 kV OHL: ▬▬▬
- 220 kV OHL: ▬▬▬ (······· : operates at 110 kV)
- 400 kV OHL: ▬▬▬ (‒ ‒ ‒ : operates at 220 kV; 400kV OHL Nădab – Oradea under completion)
- 750 kV OHL: ▬▬▬

The Table 4.3.1. and Annex B-4 (Tables 3, 4 and 5) PTG elements are detailed: lines, transformers, coils and operating characteristics of the electric lines (thermic limits and current regulations of the maximal protections) assigned to Transelectrica S.A. by Power Transmission License.

Table 4.3.1 PTG facilities

Voltage (kV)	Power transforming substation			OHL lengths according to constructive voltage (km)
	Sub stati ons	Transforming units (T, AT)*	Apparent rated power T,AT	
	nr.	nr.	MVA	
750	1	2	1250	154,6**)
400	34	2 20 25	500 400 250	4740,3
220	42	2 1 80	400 100 200	4095,9
110	0			38
Total number of substations	77			
TOTAL LENGTH of OHL (km)				9028,8
TOTAL transforming units (T, AT)		132	34.650	

*) T = transformers; AT = autotransformers

**) 750kV Ucraina Sud-Isaccea OHL is not available within Ukraine territory and 750kV Isaccea -Varna OHL was switched to the 400kV operational voltage, the 400kV cell being uncompleted in Varna (Bulgaria).

The electric lines and substations constituting the national transmission system were built mostly during 1960 – 1970, according to the technology level of respective decade. As a consequence, PTG technical condition was defined by a excessively long period of operation set forth by the legislation of the 60s – 70s, and the use of low quality materials, considering the importance of such equipments and their normal period of service.

The overhead power lines of 220 kV and 400 kV from the national transmission system are almost as old as the normal period of service (40 years – as per GD 2139/2004), approximately two thirds of them already reaching their normal period of service.

It is though to be pointed out that the actual technical condition of the facilities is maintained to an appropriate level as a result of carrying out a rigorous maintenance program and of enforcing a sustained program for retrofitting and modernization of facilities and equipment.

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The modernization / retrofitting works which were initiated and carried out with a sustained pace in the last years shared a common element, that is the adoption of state-of-the-art technical solutions in regard to selection of equipment to be used and consequently the selection of optimal connection schemes, simplified for the power substations. The new transformers and autotransformers which were installed in the retrofitted substations is characterized by improved operational parameters, constructive solutions without adjustmen units or monophase units, which reduces the adverse environmental impact and the grid losses.

Such transformers / autotransformers were commissioned in the last five years in the following substations:

- AT 1, 2 500 MVA 400/220 kV Porțile de Fier, replacing AT 1,2 400 MVA (2003, 2004);
- AT 3400 MVA 400/220 kV Brazi Vest, replacing AT 3 400 MVA with adjustment unit (2005);
- AT 1,2 200 MVA 220/110 kV Brazi Vest, replacing AT 1,2 200 MVA (2006, 2007);
- AT 200 MVA 220/110 kV Arefu, replacing AT 100 MVA (2006);
- AT 4 400 400/220 kV MVA Mintia, replacing AT4 400 MVA with adjustment unit (2006);
- T4 250 MVA 400/110 kV Sibiu Sud, replacing AT 1,2 200 MVA (2006);
- AT 1,2 400 MVA 400/220 kV Slatina, replacing AT 1,2 400 MVA with adjustment unit (2006);
- AT 400 MVA 400/220 kV Roşiori, replacing AT 400 MVA with adjustment unit (2006);
- AT 1,2 400 MVA 220/110 kV Fundeni, replacing AT 1,2,3 200 MVA (2007);
- AT 3,4 400 MVA 400/220 kV Sibiu Sud, replacing AT 3,4 400 MVA with adjustment unit (2007);
- AT 3,4 400 MVA 400/220 kV Bucureşti Sud, replacing AT 3,4 400 MVA with adjustment unit (2007);
- AT 200 MVA 220/110 kV Paroşeni, replacing AT 125 MVA (2007);
- AT 3 200 MVA 220/110 kV Iernut, replacing AT 3 200 MVA with monophase units (2007);
- AT 1 400 MVA 400/220 kV Iernut, replacing AT 1 400 MVA with monophase units (2007);
- AT 5,6 400 MVA 400/220 kV Gutinaş, replacing AT 5,6 400 MVA with adjustment unit (2007, 2008);
- AT 3,4 200 MVA 220/110 kV Gutinaş, replacing AT 3,4 200 MVA (2007, 2008);
- AT 1,2 200 MVA 220/110 kV Bucureşti Sud, replacing AT 1,2 200 MVA with adjustment unit (2008).
- T 250 MVA 400/110kV Bacău S, replacing AT 200 MVA
- T 250 MVA 400/110kV Roman N, replacing AT 200 MVA

Until today, the following project have been completed: electric substations: Porțile de Fier, Urecheşti 400 kV and 220 kV, Țânțăreni, Arad 400 kV, Oradea Sud, Drăgăneşti Olt 400 kV, Rosiori, Gutinas 400 kV and 220 kV, Slatina, Brazi Vest 400kV and 220 kV, Bucureşti Sud 400kV and 220 kV, Fântanele 110kV, Baia Mare 110kV, Vetiş, Piteşti Sud, Constanța Nord, Iernut, Sibiu Sud, Fundeni, Salaj, Paroseni

Concerning OHL, approximately 4700 km of optical fiber have been installed on the protective conductors and 120 km optical fiber in urban areas.

In order to increase the transmission capacity and reduce the grid power losses, the operational voltage was increased from 220kV to 400 kV for some lines measured by project to 400 kV. Thus, Roşiori – Oradea Sud OHL and Gutinaş - Bacău S – Roman N OHL were switched over to 400 kV operational voltage (from 220 kV) and the new 400 kV Bacau S and Roman N substations were commissioned. The works on Roman N – Suceava OHL for switching over to 400 kV (from 220 kV) are in progress, and the construction works of the 400kV Suceava substation as well.

In 2004, the 400 kV Vulcăneşti – Dobrudjea OHL connection in the 400 kV Isaccea substation was completed, which led to the occurrence of two new interconnection lines in NPS: 400 kV Isaccea – Dobrudjea (Bulgaria) OHL and 400 kV Isaccea –Vulcăneşti (Moldavian Republic) OHL.

In 2008, the second interconnection line Romania – Hungary was commissioned: 400 kV Nădab – Bekescsaba (Hungary) and 400 kV Arad – Nădab (new line) OHL. 400 kV Oradea – Nădab (new line) OHL is going to be commissioned, whose completion was delayed by the difficulties encountered in obtaining the property right over the required land.

As the scheduling of the modernization / retrofitting works will cover a long period of time, as a result of the high value of these works and necessity to mobilize the required financial resources, a part of PTG facilities will maintain the current technical level for a certain period of time.

The technical condition of the Power Transmission Grid is also reflected in the statistics of the incidents occurred in the its component equipments. The table 4.3.2. shows the evolution of the incident number. The general decreasing trend of the incident number is observed from year to year.

In general, the incidents occurred PTG have not affected the continuous supply to consumers and the quality of the delivered power.

Table 4.3.2. Number of incidents

Facilities	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
OHL	82	69	60	59	35	54
Substations	841	699	569	683	640	489
Total PTG	**923**	**768**	**629**	**742**	**675**	**543**

4.4 Loading factor of PTG elements

The analysis of the load factor of PTG elements is carried out on a reference regime for the relevant period, regime defined by consumption coverage with a probable production structure and considering the planned long-term decommissionings in the grid and the new elements planned to go into service within same period.

It is to be mentioned that the grid elements' loads vary in service, due to the permanent change of the consumption and generation level and structure and due to decommissionings for planned and accidental repair purposes. This may lead to very different loads on the grid elements.

Furthermore, PTG operational particularity is that the load limits of the PTG elements are also determined by an analysis in terms of static stability in NPS operation. The detailed presentation of these aspects are provided in section 4.8

4.4.1 Summer 2008

The analysis of the load factor of the PTG equipments is carried out for summer 2008, on a grid where:

- regarding the progress of retrofitting works for 400kV Bacau Sud-Roman Nord-Suceava axis, the 400kV Roman Nord and 400kV Bacau Sud substations are in service. In *Suceava* substation:

  - T 400/110kV Suceava is commissioned
  - 400kV Suceava-Roman Nord line is commissioned
  - 220kV Suceava-FAI line is disconnected
  - AT1 220/110kV Suceava-FAI is disconnected
  - Suceava synchronous compensator is definitvely decommissioned

- In *Cernavoda* substation the 400kV Cernavoda-Gura Ialomitei line, circuit 1 is decommissioned

- In *Isalnita* substation the AT1,2 220/110kV Isalnita are decommissioned.

Also:

- the 110kV Făgăras-Hoghiz and Copsa Mică-Medias lines and 110 kV Sibiu bus bar coupling device operate connected, since there is a single 400/110kV transformer in Sibiu substation;

- Tarnaveni bus bar coupling device is connected, while the 110kV Tarnaveni-Medias line is disconnected;

- The consumption of the passive island from 110kV Smardan area is considered absorbed in NPS, and power supplied by the 400kV Vulcanesti-Isaccea line.

In stationary regimes, the power flows through PTG equipments (400kV, 220kV lines, AT 400/220kV, T 400/110kV, AT 220/110kV) are below the thermal limits of the conductors or below the rated power of the transformers and are shown in Annex B-5, Tables D1 - D5, Diagrams 1-5.

From the point of view of line loading in relation to impedance-tailored rated power, the following may be observed:

- In analysed stationary regimes, all 400 kV OHLs are loaded below impedance-tailored rated power (Pnat = 450-570MW), except for the interconnection line Tantareni-Koslodui (one circuit), Cernavoda-Gura Ialomitei-c2 lines (due to decommission of the other circuit), Sibiu-Brasov line.
- In analysed stationary regimes, 220 kV OHLs are loaded below impedance-tailored rated power (Pnat = 120-150MW) approximately 90% of OHL total. The lines Fantanele-Ungheni, Bradu-Targoviste-c2, Bucuresti Sud – Fundeni - circuit 1 and circuit 2,

Fantanele -Gheorghieni, Iernut-Ungheni - circuit 1, Turnu Magurele - Craiova are loaded close to or above impedance-tailored rated power.

AT and T loading (percents from Sn) is synthetically shown in Table 4.4.1.

Table 4.4.1

(%Sn)

Regime	AT 400/220 kV loading		AT 220/110 kV loading		T 400/110 kV loading	
	maximum	average	maximum	average	maximum	average
MSP 2008	64	38	54	22	56	27

PTG use is low in relation to the transmission capacity at thermal limit of component elements.

4.4.2 Winter 2008-2009

PTG equipment load factor analysis is carried out **for the winter 2008/2009**, on a grid where:

- *In Suceava* substation the 400kV substation is commissioned, with:

- 400 kV Roman N.-Suceava line
- 400/110 kV Suceava transformer

- In Suceava substation the 220 kV Suceava-FAI and AT1220/110 kV are removed. The synchronous compensator is definitvely decommissioned.

- *In Cernavoda substation* the retrofitting works are carried on. It remaines decommissioned:

- 400kV Cernavoda-Pelicanu line

- *In Isalnita substation* 220kV Gradiste line is relocated from the old substation (bus bar A) to the new substation (bus bar B);

- 220 kV bus bar coupling device is disconnected;
- AT1 220/110 kV is commissioned in the new substation (bus bar B)

AT2 220/110 kV Isalnita is decommissioned.

- *In Darste substation* the T 400/110kV Darste is unavailable.

- *In Gheorghieni substation* AT2 220/110kV Gheorghieni is disconnected

- *In Pestis substation* the RK works and control and protection system installation works are continued which imply the operation with the two long lines:

- 220kV Mintia - (Pestis) – Hasdat line, consisting of 220kV Mintia-Pestis line circ. 1 shunted to L 220 kV Pestis-Hasdat

- 220 kV Mintia - (Pestis) - Otelarie Hunedoara line, consisting of 220kV Mintia-Pestis line, circ. 2 shunted to 220kV Pestis-Otelarie Hunedoara line.

- *In Nadab substation* 400kV Nadab-Arad line is considered completed and commissioned. 400kV Nadab-Oradea line is not completed yet.

- *In Oradea substation* T 400/110kV Oradea is unavailable.

Also:

- 110 kV Fagaras-Hoghiz and Copsa Mica-Medias lines as well as the 110kV Sibiu bus bar coupling device are connected, since there is a single 400/110kV transformer in Sibiu substation;

- 110 kV Bus bar coupling device from Tarnaveni is connected, as the 110 kV Tarnaveni-Medias is disconnected;

- The passive island from Smardan 110kV area is running, supplied by the 400kV Vulcanesti-Isaccea line;

- The compensation coil connected in 110 kV Fundeni substation is unavailable, because its cell is used by a 110kV/mt transformer;

- The compensation coil connected in 400 kV Domnesti substation is unavailable, as it is requested for decommissioning by ST Bucuresti.

In stationary regimes, the power flows through PTG equipments (400kV, 220kV lines, AT 400/220kV, T 400/110kV, AT 220/110kV) are below the thermal limits of the conductors or below the rated power of the transformers and are shown in Annex B-6, Tables D1 - D5, Diagrams 1-5.

From the point of view of line loading in relation to impedance-tailored rated power, the following may be observed:

- In analysed stationary regimes, all 400 kV OHLs are loaded below impedance-tailored rated power (Pnat = 450-570 MW) except for the interconnection lines Portile de Fier-Djerdap, Tantareni-Koslodui (one circuit) and Rosiori-Mukacevo.
- In analysed stationary regimes, the 220 kV OHL are loaded below impedance-tailored rated power (Pnat = 120-150 MW) approximately 85 % from total OHL. The power lines Slatina-Craiova, Isalnita-Craiova-c2, Turnu Magurele-Craiova, Bucuresti Sud-Fundeni-circuits 1 and 2, Bradu-Targoviste-circuit 2, Fantanele-Ungheni, Iernut-Ungheni- circuit 1 are loaded close to or above impedance-tailored rated power value.

AT şi T loading (percents from Sn) is shown synthetically in Table 4.4.2.

Table 4.4.2 (%Sn)

Regime	AT 400/220 kV loading		AT 220/110 kV loading		T 400/110 kV loading	
	maximum	average	maximum	average	maximum	average
WEP 2008/2009	68	38	52	25	60	33

PTG use is low in relation to the transmission capacity at thermal limit of component elements.

4.4.3 Loaded lines over the impedance-tailored rated power during 2006-2008

Winter 2006-2007

Lines 400kV

				P [MW]	I [A]
14	200	PFER4	XPF_DJ11	565,49	805,9
19	29	TINTRN4B	TURC5678	515,26	721,4
11	17	TINTRN4A	BRADU4	468,49	655
7	15	DOMNEST4	URECH 4	460,18	669,3

Lines 220kV

				P [MW]	I [A]
54	83	TMAGUR2	CRAIOV22	178,02	465,5
32	93	BUC SD2	FUNDN 2B	169,39	421
38	72	LSARAT12	TBRAILA2	162,14	407,5
48	83	ISALN 2A	CRAIOV22	161,74	407,8
75	119	FINTIN.2	UNGHEN2	154,26	387,8
75	88	FINTIN.2	GHEORG 2	153,97	382,3
47	49	CRAIOV12	ISALN 2B	152,89	386,7
24	57	PFER12	RESITA 2	152,15	374,5
34	57	PFER22	RESITA 2	152,09	374,3
47	83	CRAIOV12	CRAIOV22	146,44	369,7
48	197	ISALN 2A	GRAD2	135,66	342,7
37	67	BRADU2	TIRGOV2B	133,03	330,9
30	83	SLATINA2	CRAIOV22	132,56	336,5
52	397	BARBOSI2	FOCSANI2	129,72	324,7
102	119	TIERNUT2	UNGHEN2	126,93	325,1
43	77	CLUJ 2	AIULIA2	125,58	319,2

The unavailable equipments and the network changes compared to summer 2006

The unavailable elements

- In Gutinas substation:
  - AT 6 400/220 kV is withdrawn for 400 kV substation retrofitting purposes;
- 220 kV Paroseni substation was withdrawn for planned retrofitting between ***October – February***, and the 220 kV Targu Jiu-Baru Mare power line was in operation, a line created by connecting together the power lines Tg. Jiu-Paroseni and Paroseni-Baru Mare.
- In Bucuresti Sud substation:
  - AT3 400/220 kV withdrawn for 400 kV Bucuresti Sud substation planned retrofitting between ***October - March***;
  - 400kV Bucuresti Sud-Slatina and Bucuresti Sud - Gura Ialomitei lines withdrawn for 400 kV Bucuresti Sud substation planned retrofitting between ***November-January***;
  - 400 kV Bucuresti Sud - Domnesti and Bucuresti Sud – Pelicanu lines withdrawn for 400 kV Bucuresti Sud substation planned retrofitting between ***February-March***;
- In Fundeni substation:
  - 220 kV transversal coupler disconnected due to lack of coating;
  - During the works related to Brazi Vest 1+2 and Bucuresti Sud 1+2 a shunt was executed to the pole 1 between the line 220kV Brazi Vest 1 interconnected with Bucuresti Sud 2.
- In Sibiu substation:
  - T4 400/110 kV withdrawn for planned retrofitting of 110 kV substation between ***October-15th of December***;
  - AT1 220/110kV definitively decommissioned as from ***16th of December***;

  Obs: In both periods, considering that there is a single injection in 110 kV Sibiu substation, the 110kV Copsa Mica-Medias and Fagaras-Hoghiz lines are operating and connected to the section coupling 110 kV Sibiu.

In 220-400kV network – CC1 and CC2 bus bar coupling devices are disconnected in 220 kV Mintia substation, in order to reduce the short-circuit powers on the bus bars and CT in Gutinas 220 kV substation, in order to increase the operational safety of the Moldova region.

Summer2007(flows per npp unit)

Lines 400kV

				P [MW]	I [A]
11	19	TINTRN4A	TINTRN4B	688,35	971,5
19	97	TINTRN4B	XKO_TI11	500,56	705,8
6	8	SIBIU 4	BRASOV 4	454,59	642,7

Lines 220kV

				P [MW]	I [A]
28	45	SIBIU 2	LOTRU 2	180,29	449,4
28	45	SIBIU 2	LOTRU 2	180,29	449,4
37	67	BRADU2	TIRGOV2B	165,85	415,6
47	83	CRAIOV12	CRAIOV22	143,78	367,1
75	119	FINTIN.2	UNGHEN2	143,03	360,2
43	78	CLUJ 2	MARISEL2	137,25	341,1
75	88	FINTIN.2	GHEORG 2	135,76	340,5
38	70	LSARAT12	FILESTI2	131,31	353,4
54	83	TMAGUR2	CRAIOV22	129,12	343,5
37	68	BRADU2	TIRGOV2A	127,01	317,8
52	70	BARBOSI2	FILESTI2	126,68	335,5
80	90	BRAZI 2A	BRAZI 2B	123,48	316,4

The unavailable equipments and the network changes compared to winter 2006-2007

- In Gutinas substation:
  - AT5 400/220 kV withdrawn for planned retrofitting of the 220 kV substation between 2006 – August 2007;
  - AT3 220/110kV withdrawn for planned retrofitting of the 220 kV substation between May – August 2007;
- In Bucuresti Sud substation:
  - AT3 400/220 kV withdrawn for planned retrofitting of the 400 kV Bucuresti Sud substation between *March – October 2007*;
  - The cells of the 400kV Bucuresti Sud - Pelicanu and Bucuresti Sud – Domnesti lines in the 400 kV Bucuresti Sud substation, withdrawn for planned retrofitting of 400 kV Bucuresti Sud substation between *March – November*; during such period – shunt between the two lines, operating on the temporary line 400 kV Domnesti – Pelicanu;
- In Fundeni substation:
  - CL 220 kV disconnected;
  - Line Brazi Vest, circuits 1 and 2 and line Bucuresti Sud circuits 1 si 2 in operation, the retrofitting works being completed;
- In Sibiu substation:
  - T4 400/110 kV in operation;
  - AT1 220/110 kV definitively decommissioned as from *16th of December 2006*;

  Obs: There is only one injection in Sibiu 110kV substation and it is operated on the lines 110 kV Copsa Mica-Medias and Fagaras-Hoghiz, connected to the 110kV Sibiu section coupling.
- In Salaj substation:
  - line 220 kV and AT 220/110 kV are in service.

In 220-400kV network, the CC1 and CC2 bus bar coupling devices are disconnected in 220 kV Mintia substation, in order to reduce the short-circuit powers on the bus bars and CT in Gutinas 220 kV substation, in order to increase the operational safety of the Moldova region.

Winter 2007-2008

Lines 400kV

				P [MW]	I [A]
14	200	PFER4	XPF_DJ11	535,29	768,6
11	19	TINTRN4A	TINTRN4B	504,14	722,2
19	98	TINTRN4B	XKO_TI12	455,88	678,5

Lines 220kV

				P [MW]	I [A]
32	53	BUC SD2	FUNDN 2A	214,22	558,8
30	83	SLATINA2	CRAIOV22	199,66	506
48	197	ISALN 2A	GRAD2	186,25	469,8
32	93	BUC SD2	FUNDN 2B	179,97	498,7
38	72	LSARAT12	TBRAILA2	164,94	409,4
48	83	ISALN 2A	CRAIOV22	161,89	405,8
47	49	CRAIOV12	ISALN 2B	153,35	385,4
47	83	CRAIOV12	CRAIOV22	151,1	380,4
75	119	FINTIN.2	UNGHEN2	149,68	374,7
102	119	TIERNUT2	UNGHEN2	134,84	336,4
75	88	FINTIN.2	GHEORG 2	131,86	328,8
24	57	PFER12	RESITA 2	125,84	313,2
34	57	PFER22	RESITA 2	125,78	313,1

The unavailable equipments and the network changes compared to summer 2007:

Unavailable equipment:

- In Bacau Sud substation are considered as definitively decommissioned, as per the project for conversion to 400 kV of axis Gutinas-Bacau-Roman N – Suceava:
  - line 220 kV Bacau Sud-Gutinas;
  - line 220 kV Bacau Sud-Roman Nord;
  - AT 220/110 kV Bacau Sud;
- In Suceava substation:
  - AT2 220/110kV is definitively decommissioned;
- In Isalnita substation, primary circuits modernization works are in progress, thus being disconnected:
  - AT1 and AT2 220/110 kV; the line 220 kV Gradiste is in operation on the circuit breaker JB of TA7 Isalnita.

Retrofitting works completed for the following equipments:

- In Buc. Sud substation:
  - Operation on the 400 kV Bucuresti Sud - Pelicanu and Bucuresti Sud - Domnesti line cells and on AT3 400/220 kV; the temporary line 400kV Domnesti-Pelicanu is removed;
- In Gutinas substation:
  - Operation on a new substation Gutinas 400/220 kV with AT5, AT6 400/220 kV;
- In Iernut substation:
  - § Operation on the new substation Iernut 400/220 kV;

It is operated on the 110kV Fagaras - Hoghiz and Copsa Mica - Medias lines and connected bus bar coupling device 110 kV Sibiu, since there is only one 400/110 kV transformer in Sibiu substation.

The operation of a passive island in 110 kV area was taken into account, an island supplied by the 400kV Vulcanesti-Isaccea line.

4.4.4 Conclusions

- It is determined the high loading, in the proximity of impedance-tailored rated power of the circuits 1 and 2 of the 220 kV Bucuresti Sud – Fundeni line, due to the large consumption in Bucharest, both during summer and winter season;

- The large consumption in Bucharest (both in the summer and winter), under production conditions at the priority level, leads to congestions, especially in the westeen side of Bucharest, but in the southern as well;

  * in the western area, the congestions occur upon trippings both in transmission grid and in 110 kV grid and consist in exceeding the admissible limits both on T 400/110kV Domnesti, and on the 110 kV Bujoreni – Grozavesti axis.

  * in southern area, the congestions occur upon tripping of one of the autotransformers 220/110 kV from Bucuresti Sud substation.

  It is to be mentioned that total shut-down of the power generating units is performed during summer for annual revision purposes in the central heating-and-power plants;

- in order to comply with the N-1 criterion in full diagram, the 110 kV loops are closed between the Ghizdaru and Domnesti areas;

- The low power factor of the Feral Tulcea requires for its consumed reactive power compensation up to the value of the neutral power factor;

- the radial operation of the 110 kV supply network of the Bucharest city is maintained in order to split its supply from 3 different points of the transmission grid: Domnesti, Bucuresti Sud and Fundeni substations;

- the high loading of the interconnection lines is determined, particularly of the 400kV Portile de Fier-Djerdap line, but also of the other lines, due to the Romanian export and the parallel flows due to the transactions between foreign partners;

- The loading value close to impedance-tailored rated power of the 220kV Iernut-Ungheni-Fantanele axis is determined, due to the supply of the deficit S5 section (Moldova);

- Due to the fact that there is only one transformer 400/110 kV in Sibiu Sud substation, it is necessary to operate on the connected 110 kV Fagaras - Hoghiz and Copsa Mica – Medias lines and 110 kV Sibiu bus bar coupling device in order to reserve the area supply;

- Keeping in operation the current-controlled automation (800A/0.6 s) on OHL220 kV double circuit Lotru – Sibiu in order to avoid limiting the production in CHE Lotru and Bradisor:

  a) in any two–circuit scheme L220kV Lotru - Sibiu in operation to avoid overloading of a circuit upon tripping of the other one;

  b) in the 400kv Sibiu busbar decommissioning scheme to avoid overloading a 220kV Lotru-Sibiu circuit upon tripping of the other400kV Sibiu busbar;

c) in the decommission schemes additional to the ones described in b);

- When operating with two units in NPP Cernavoda, problems related to generated power delivery occur, in case of long term decommissioning of some 400 kV lines in Dobrogea, concurrently with shorter-term decommissionings in the same area, for N-1 criterion compliance purposes. Under such circumstances, both looping is required in 110 kV grid and consumption decrease in Dobrogea or production decrease in NPP Cernavoda;

- The consumption increase in Dobrogea region leads to difficulties in observance of the N-1 criterion in case of long-term decommissioning of some 400 kV lines in Dobrogea, concurrently with shorter-term decommissionings in the same area. Beside the looping of the 110 kV grid from the area, it is also required a superior limitation of the deficit in the area Constanta – Medgidia - Tulcea;

- In Pelicanu substation, upon long-term decommissioning of a 400 kV line or a 400/110 kV transformer and tripping of another equipment, line or transformer, the N-1 criterion is not complied with. It is to be mentioned that the 110 kV bus bar coupling device from Pelicanu substation cannot be connected between B1 and B2, as it would disturb by flicker effect the operation of the other consumers from SC Donasid and from the area. It is recommended to install a DAS-U in Donasid, in order to include the post-event regime in the normal values of power and voltage and to implement the technical measures for removal of flicker effect in SC Donasid;

- In Barbosi substation the N-1 criterion is not complied with in regard to the power supply to the Iron and Steel Complex of Galati upon decommissioning of a 220kV line existing on the Lacu Sarat – Filesti – Barbosi - Focsani Vest axis;

- In Bradu substation, when decommissioning a 220 kV busbar, a loop is created on the 110 kV grid from the Stuparei – Raureni and Arefu – Bradu – Pitesti area in order to create supply reserves for the areas upon activating the other busbar but it must be considered also the limitation of power exchange between this area and the rest of the NPS to 200 MW maximum – power delivery and maximum 150MW - shortage;

- The retrofitting of Gutinas substation and its conversion to a substation with 1 and ½ circuit breakers led to compliance with the N-1 criterion in case of a 220kV busbar decommissioning, when the other one is triped;

- To avoid the loop in 110 kV grid and to avoid applying the congestion management mechanism by charging over the market price certain productions in HPP Remeti, Munteni or Lugasu, upon decommissioning a 400 kV equipment, line or transformer, in Oradea substation, under low production conditions in CHPP Oradea Vest, it is recommended to ensure an additional transforming unit in Oradea substation.

- During the works in Isalnita substation, special measures must be taken to ensure the generated power delivery in CHPP Isalnita in case of short-term decommissioning in the area.

4.4.5 Total and bilateral transfer capacities on borders

4.4.5.1 Calculated / estimated net exchange capacities

In the management of congestions generated by cross-border exchanges, Transelectrica calculates and provides the following types of net transfer capacities (NTC) for the market.

a) Non-guaranteed maximum annual NTC

In the UCTE work group "Network models and forecast tools" (NMFT), the seasonal net transfer capacities (NTC) are calculated in NPS synchronous interconnection interface for the following season, under normal operation and considering favourable transfer scenarios.
The annual maximum NTC values for the next year are calculated according to the winter season model.
The calculations are made for normal topology and favourable transfer scenarios, considering also the commissionings significant for NTC value which are going to take place in relevant period.

There are calculated:
- bilateral net transfer capacities additionable to partial interfaces RO/RS+BG, RO+BG/RS, RO/UA+HU, HU/RO+RS;
- total net transfer capacities between Romania and UCTE network.

N-1 criterion will be verified and the limits required by the equipments and adjustments of protections / automations in use will be determined, taking into account the common use of interconnection interfaces and considering preventive / post-failure measures.

A transmission reliability margin (TRM) of 100MW/border is considered for the partially additionable capacities, 200MW/partial interface and export/import TRM in Romania's interface of 300/400MW for calculation of additionable coordinated capacities in Romania's interface.

The bilateral values are harmonized with the partners. These values are **indicative, non-guaranteed** and are used to estimate the maximum possible transfer volume and to define the ceilings of the monthly allocation.

b) Fixed annual and monthly NTC

According to the bilateral agreements concluded with the interconnection partners (MAVIR, EMS, ESO EAD), TRANSELECTRICA provides fixed bilateral NTC for commercial use, which can be used simultaneously in the same export/import direction, with transfer reliability margins (TRM) agreed in bilateral agreements, without endangering the system security:

- fixed annual NTC, guaranteed for all annual coordinated repair programs agreed in NPS and interconnection;

- fixed monthly NTC, guaranteed for monthly planned repair programs in NPS and interconnection.

Considering:
- the necessity to supply fixed annual NTC prior to the preparation of NPS' annual decommissioning plan and coordinated decommissioning plans in interconnection
- the reschedule of decommissionings along the year,
- uncertainties related to the key points production forecast affecting the NTC values (HPP Portile de Fier+Djerdap, etc) and related to the meeting of commissioning deadlines.

Fixed annual NTC are estimated by considering:
§ Current and previous year experience on simulatenous repair programs carried out on

interconnection and the transfer possibilities: the lowest fixed monthly NTC values achieved**;**

§ Additional calculations, performed only if scheduled:

- retrofittin programs in the next year that may lead to lower fixed NTC values;
- significant commissionings (interconnection lines and substations, etc) in the period between annual NTC estimation and the beginning of the next year, which may lead to NTC value increase.

Fixed monthly NTC on borders are calculated on a monthly basis applying the calculation methodology developed in SPO/DEN based on the UCTE-ETSO recommendations on the interdependent transfers in looped networks: bilateral NTCs are determined coordinatedly by calculating composite NTC in NPS interconnection interface and other interfaces jointly used with partners, a principle agreed with all partners.

For each month, SPO/DEN calculates and provides the power market, in previous month, with fixed NTC values on borders and such values are simultaneously exploitable in the entire NPS interconnection interface under safety conditions, considering:

- the forecasted transfers, fixed annual NTC, netting elimination, joint use of interfaces;
- repair programs for relevant month; production and consumption forecast;
- status of automations, preventive / post-failure operative measures.

Should significant changes in maintenance program occur after the monthly auctions are carried out, thus enabling the increase of NTC values for a monthly subperiod, the NTC values are re-assessed for such subperiod and recommended for harmonization with partners and provided to the market, including the relevant month, if there is enough time to hold auctions for allocating the additional capacities at least 3 days prior to the relevant subperiod.

4.4.5.2 Maximum net transfer capacities in 2005-2008

	Year				
	2005	**2006**	**2007**	2008	2009
Maximum non-guaranteed NTC (forecast)					
RO export	**1650**	**1900**	**1750**	**1750**	**1950**
RO import	**1750**	**1100**[Rosiori]	**1800**	**1500**	**1700**
RO->HU		400	600	600	800
HU->RO		400	400	500	600
RO->RS		800[P-D1700A]	800 [P-D1700A]	700[P-D1600A]	650[P-D1500A]

RS->RO		400	400	700	500
RO->BG		800	600	750	750
BG->RO		800	600	750	750
RO->UA		200	200	200	400 (100*)
UA->RO		400	400	500	400
Harmonized fixed maximum NTC (monthly)					
RO export	**1350**	**1370**	**1250**	**1200**	
RO import	**1100**	**1350**	**1020**	**950**	
RO->HU	400	400	400	350	
HU->RO	300	350	400	400	
RO->RS	750	720	600	500	
RS->RO	300	350	150	300	
RO->BG	850	300	500	550	
BG->RO	500	350	200	200	
RO->UA	0	50	50	50	
UA->RO	50	350	500	350	

* UA value for import; for transit, contract with operator is required.

The following factors have significantly influenced the values of the annual maximum transfer capacities in NPS:

- Disconnection of the automatic control of powers on c1+2 400kV Tantareni-Kozlodui in May 2005, with positive impact on export capacity.

- Increase of current limit enforced by the TC of Sandorfalva on L400kV Arad-Sandorfalva-Subotica from 800A to 1600A in April 2006, with positive impact on NPS export capacity

- Alteration of current limit on L400kV Portile de Fier-Djerdap:
  - in Djerdap from 1500A to 1800A in December 2005 (overload protection - 95% was considered admissible in 2006), with positive impact on export capacity;
  - in Portile de Fier from 1700A (thermal limit) on 1600A (TC in Portile de Fier) in January 2007 and in Djerdap to 1500A (TC in Djerdap) in November 2008, with adverse impact on export capacity;

- Operation with 2 units in Cernavoda as from August 2007, which increased the contribution of OHL 400kV Isaccea-Dobrudja to export, with positive impact on the NPS export capacity;

- Development of retrofitting programs in Rosiori (2005-2006) and Iernut, with reduction in NPS import capacity.

- Reduction in Bulgaria's export as a result of shutting down several units from NPP Kozlodui in 2007, which determined:
  - the increase by 100-200MW of parallel flows from North to South, generated by the transactions in the rest of UCTE,

- the increase of flows on RO-BG border,

- increase the export quota from Romania to Greece and from transits through Romania, focusing the export flows on the Romanian border with Serbia and Bulgaria,

adversely affecting both import NTC on the borders with Ukraine, Hungary and Bulgaria and export NTC on the borders with Hungary, Serbia and Bulgaria and determining the change of NTC distribution on the borders with Serbia and Bulgaria.

- Commissioning of substation 400kV Nadab, leading to the increase of import and export capacity on the border RO-HU and NPS interface.

4.4.5.3 Seasonal and monthly evolution of net transfer capacities

NTC values in Romania's interface may vary along the year between 20-100%, subject to the influence of certain factors such as:

- Decommissioning of some interconnection power lines and domestic lines influencing the NTC values.
- Seasonal temperature difference leading to:

- conversion to summer adjustments reduced by approximately 25% for overload protections in Serbia between April – October, with adverse impact on export NTC;

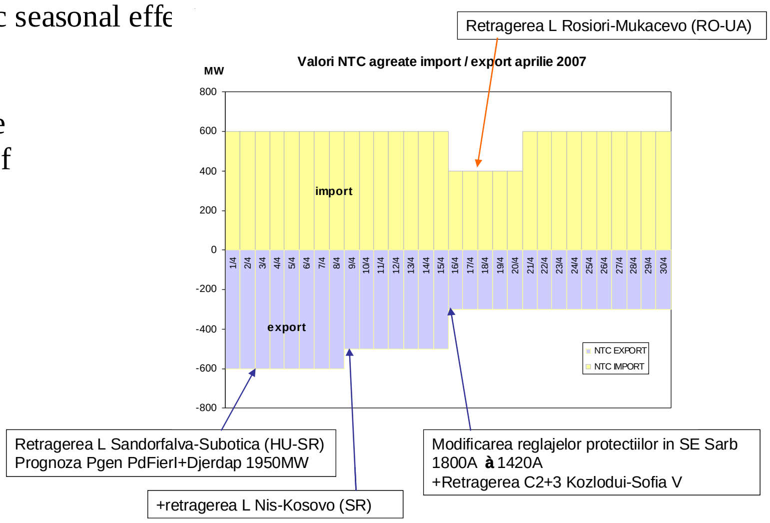
- higher admissible thermal limit currents on various lines in NPS which influence positively the values of import and export NTC in November – February.

- Production in HPP Portile de Fier and Djerdap, especially in summer time

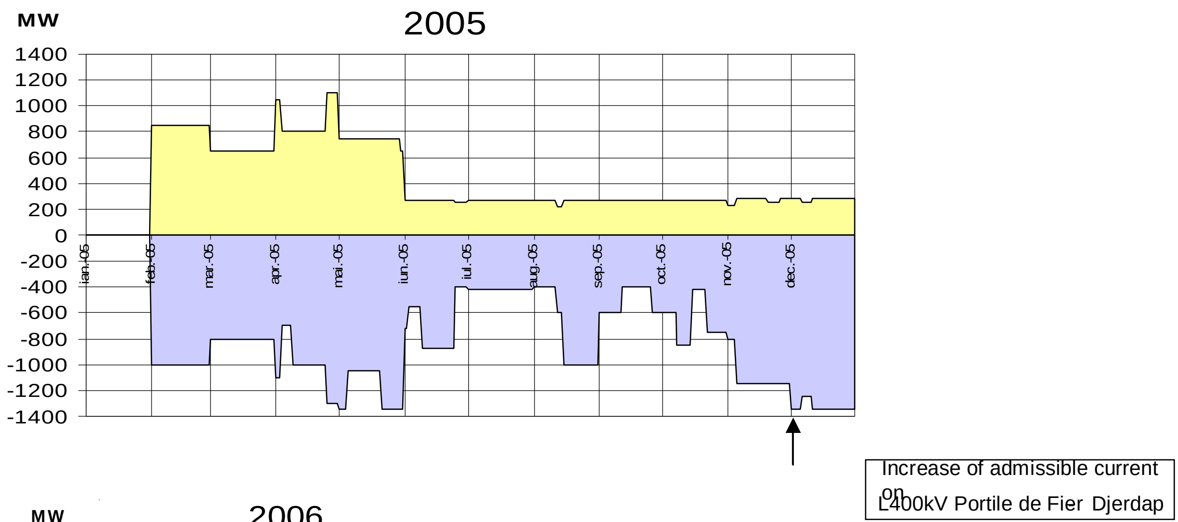
In 2008, other factors were added to there above:

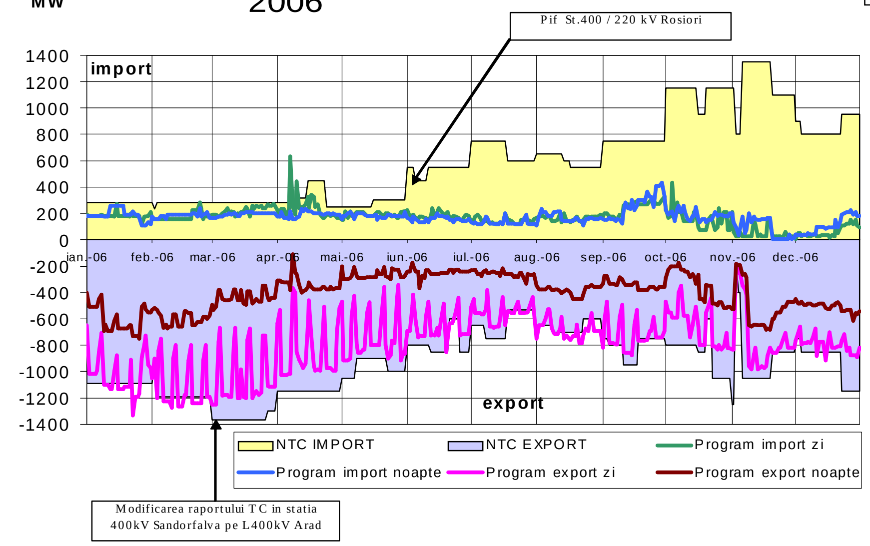
- Serbia reduced the admissible current in summer season and on OHL 400 kV Portile de Fier-Djerdap, adversely affecting the export NTC;
- Energy market's limiting effect on the TSO's use of redispatching for NTC increase;
- Greece increased the DASP regulation on OHL Blagoevgrad-Thessaloniki and accepted NTC values which were assured by the post-event corrective action of DASP in N-1, leading to the increase of transfer capacity through export interface Romania – Bulgaria;
- Long-term decommissioning of TH5 Portile de Fier I, which reduced the maximum power in HPP Portile de Fier I, with a benefic seasonal effe

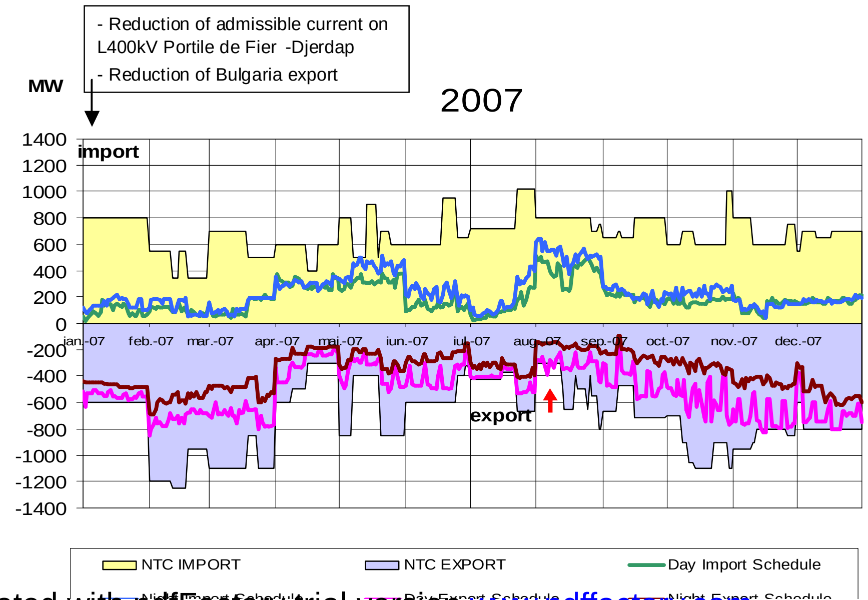
The figure herein illustrates the necessity for a monthly profile to be defined and the influence of some of these factors:

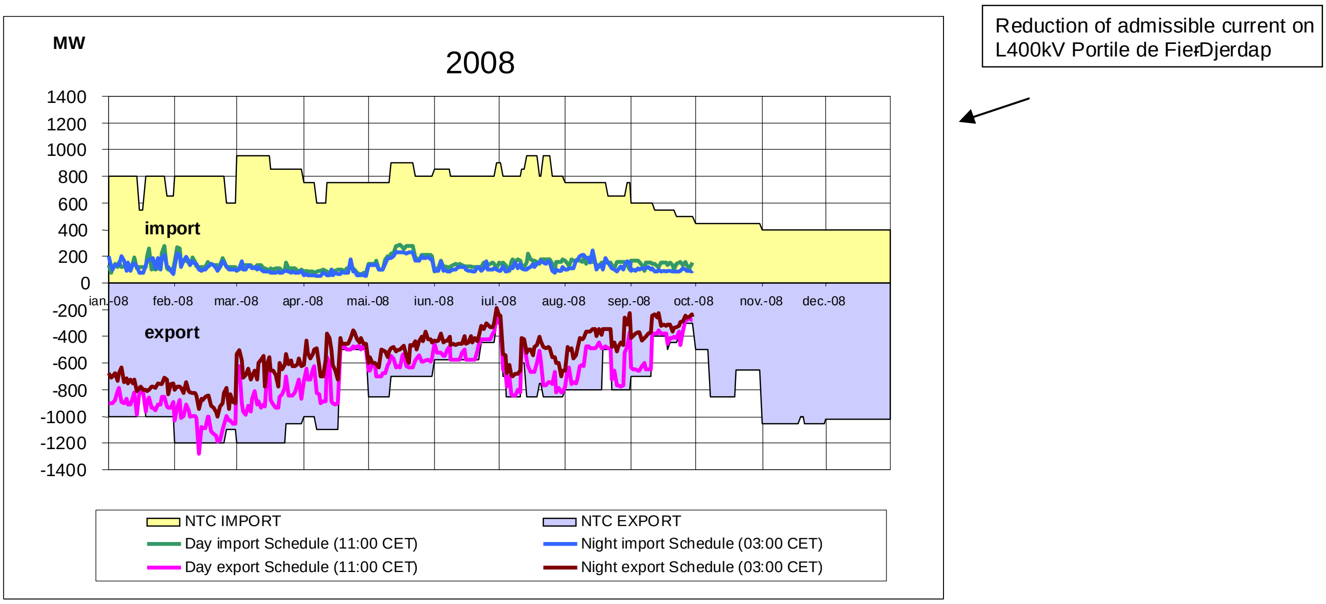


Hereinafter NTC profiles in NPS interface may be seen, harmonized with the partners, and the transfer schedules for 2005-2008.





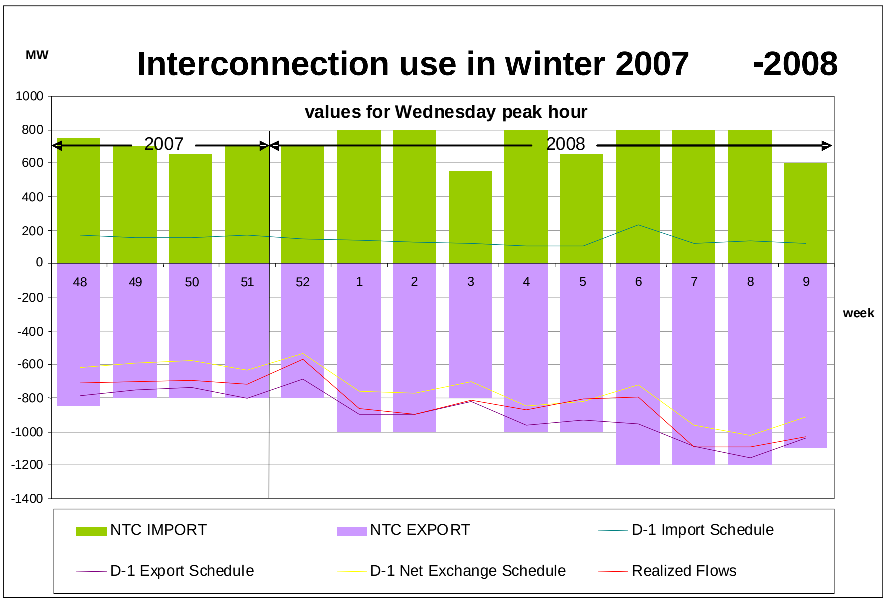




There have been determined:

- Occasionally, export or import transfer schedules over NTC value, due to TRM use for emergency assistance (winter 2005-2006) and limited acceptance of netting;
- Increase of the participants' number and competition on each border
- Increase the actual degree of use of the available transfer capacity in 2008 compared to 2007.

During winter 2007-2008, the peak load flows through Romania's interconnection interface during working days, represented 66-**101.4**% of NTC, with a 3-winter month average of 86% of export NTC, as shown in the following figure.



4.5 The admissible limit of voltage level, voltage control in PTG nodes, reactive power compensation, voltage quality.

Transelectrica calculates/schedules on a half-year basis the voltage ranges from the power stations of the transmission grid which represent the voltage control nodes. The purpose is to maintain normal voltage levels in all grid nodes, to maintain the steady-state stability of operation and to reduce the grid losses. In Annex B-7, the voltage ranges in PTG control nodes for summer 2008 are shown.

The discharged operation of the power grid leads to relatively high voltage levels in NPS's 400 kV network, 220 kV network respectively (Annex B-8, Annex B-9 respectively). In order to maintain the voltages within the range of admissible values, it is necessary to connect a reduced number of reactive coils in case of peak regimes. In off-load regimes, it is necessary for the all the available coils to be connected. Furthermore, it is necessary to use also other control tools in voltage control: change of plots in transforming units, capacitive operation of some generating units and disconnection of some OHL 400 kV with a low load.

Table 4.5.1. shows the active and reactive power quantities (balanced) which are transited PTG – EDG, determined on the 110 kV bus bar of the autotransformers 220/110 kV and transformers 400/110 kV.

Table 4.5.1

Regime		Balanced transit PTG –EDG	
		P MW	Q MVAr
Winter 07/08	WEP	4202	1158

The consumers supplied from EDG represent approximately 94-95% of total consumption, both in terms of active power and reactive power. Their required reactive power is covered in the ratio of 40-50% from local sources. It can be observed that approx. 55% of consumers' demand for reactive power corresponding to the impedance-tailored rated power factor is covered from transit from PTG to EDG (this demand represents approx. 95% of total consumption of reactive power).

Means of voltage control in PTG – Changes in the last 5 years

- Commissioning of the compensation coil - A 100 MVAr in substation 400 kV Tantareni, on 23.12.2005

- Compensation coil 100 MVAr Arad was decommissioned on 16.01.2006, in order to be relocated in substation 400/110 kV Darste, where was commissioned on 08.02.2006.

- Synchronous compensator in Arad was definitively decommissioned on.

- In substation 400 kV Gutinas, the compensation coil 100 MVAr was commissioned on 20.06.2006.

- In substation 110 kV Fundeni was commissioned the compensation coil 100 MVAr connected to 110 kV on 26.07.2007, and later was decommissioned for making available its own cell of 110 kV, in order to be used by the transformer 5 110/mt.

- In substation 400 kV Bucuresti Sud the compensation coil 100MVAr was commissioned on 19.12.2007.

- In substation 400 kV Arad the compensation coil 100MVAr was commissioned on 01.10.2008, after the repair works of the former compensation coil 100MVAr from Darste substation were executed.

Voltage quality in PTG

As from September 2007 the "Performance standard for electricity transmission and system services" prepared by ANRE came into force.

Current Romanian regulations (Performance standard and PTG Code) require the Transmission and System Operator to monitor the compliance with the electricity quality within own grid, being envisaged that ANRE will prepare a discount/penalty system in the following years.

Under such conditions, Transelectrica is preparing a procedure for evaluation and compliance with the requirements of Electricity Quality within own substations and for identification of the disturbing sources. As per CEER (Council of European Energy Regulators - 2001) and EURELECTRIC (2006), the aspects related to electricity quality classify as follows:

- *Voltage quality* – with regard to the technical characteristics of voltage;
- *Continuity of power supply* – with regard to the continuity of supply to consumers;
- *Commercial quality* – with regard to the commercial relations between suppliers, between distributors and users respectively, in terms of providing the various services

In respect to voltage quality monitoring in PTG nodes, the system performance reporting procedure based on the Performance Standard and a strategy for electricity quality supervision are already applied both through a system of fixed analyzers managed by OMEPA and via a program for monitoring voltage curve quality in Transelectrica substations, using mobile analyzers. For the first time, in 2007, simultaneous quality measurements were performed in several electrically adjacent substations, in order to determine the disturbing consumer and vulnerability area.

These types of measurements will be continued in the next years.

Furthermore, Transelectrica plans to:

- Introduce certain requirements and penalties related to compliance with voltage curve quality requirements in the technical approvals of connection /contracts/operation agreements;
- Perform measurements before and after the connection of major consumers and possibly disturbing consumers connected to the substations 110 kV Transelectrica or to PTG;

- Perform area measurements in the substations where electricity quality limit deviations were determined, in order to establish the disturbing user
- Exclusive use of dedicated measurement equipments which are certified as class A;
- Extend the nodes with permanent monitoring – a measurement integration system based on class A equipments;
- Re-analyze the performance standard based on the one-year experience in enforcement the provisions;
- Re-update the PTG Code and include herein certain specific requirements for PTG users, such as the introduction of flicker admissible limits;
- Permanently install class A analyzers in the points where major deviations from electricity quality were detected. An example is substation 400/110 kV Pelicanu, for Donasid user.

4.6 Power losses on the specific plateaus of the load curve and annual electricity in PTG

The power losses consist of Joule losses in electric conductors of the lines and in copper for transformers and reactor windings, capacitive losses in insulations, losses in iron (caused by Foucault and hysteresis currents) and losses from corona phenomenon.

The volume and structure of losses continuously change, along with the generation and consumption in each NPS point, along with grid configuration modifications as a result of maintenance works or grid incidents and along with the voltage level change in substations.

The structure of PTG losses, determined for WEP 2008 specific plateau, is shown in Table 4.6.1, distributed on grid elements and related to the total sources delivering to PTG ($P_{intr.PTG}$).

Table 4.6.1

			ΔP_{PTG}					
Year	Plateau	ΔP_{total} (400-110kV)	ΔP_{PTG}	ΔP_{OHL} Joule	ΔP_{OHL} Corona	ΔP_{trafo}	$\Delta P_{reactors}$	ΔP_{PTG} /$P_{intr.PTG}$
		MW	MW	MW	MW	MW	MW	%
Winter 2008/ 2009	WEP	247	183	100	50	22	11	3.15

For the same specific plateau, the structure of the power transmitted through PTG is shown in the Table 4.6.2., distributed on the sources delivering directly in PTG, the import from neighbouring systems and power injected from PDG.

Table 4.6.2.

Year	Plateau	$P_{entered\ in\ PTG}$		$P_{intr.\ interconnec}$	$P_{generat.\ in\ PTG}$		Input $_{PDG\text{->}PTG}$		$P_{gen.\ PTG}$ / $P_{gen.\ NPS}$
		MW	$\%P_{intr.RET}$	MW	MW	$\%P_{intr.PTG}$	MW	$\%P_{intr.PTG}$	%
2008/2009	VSI	6504	100	460	5702	87.67	342	5.26	57.65

The predominance of sources directly delivering in PTG (87.67%) is determined compared to the power input from PDG representing (5,26%).

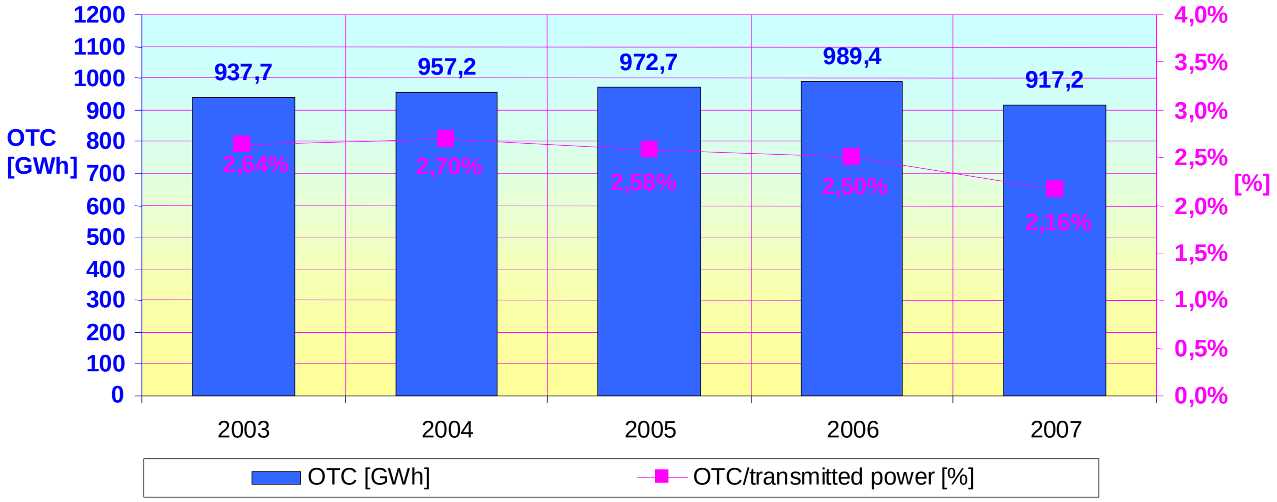
The losses increase along with the volume of transmitted electricity, distance between power generation facilities and consumption sites and decrease along with the increase of grid voltage level

Transelectrica S.A. constantly aims at the loss reducing starting from the grid design stage, real time operation and exploitation scheduling.

The measures applied during design stage are the following: different regional tariffs in order to encourage through market mechanisms the reduction of distance between power generation facilities and consumption sites, increase of grid voltage level and purchase of modern high-performance equipment in terms of specific losses. The actions completed to this effect in the last 5 years are illustrated in the sub-chapter 4.3.

As a result of the taken measures, the evolution of grid losses in the last 5 years is characterized by a continuously decreasing trend. In figure 4.6, the evolution of annual values of own technological consumption in PTG is shown, together with the dominant component consisting of losses and the commercial component represented by measurement errors, invoicing and data processing errors and own consumptions for electric substations operation.

Annual evolution of OTC and its related share in transmitted power



4.7 Level of short circuit currents in PTG nodes

The values of the maximum three-phase, one-phase and double-phase short-circuit currents with earth connection in 220-400 kV PTG nodes in NPS are calculated according to the PE 134/1995 “Normative on method to calculate short-circuit currents in power grids of voltage over 1 kV”, edition which had as objective the classification of this regulation under the CEI provisions.

The values of the short-circuit currents in PTG nodes are used to:

- Examine the existing facilities and determine the stage where their performances could be exceeded;
- Adjust the new facilities to dynamic and thermal requirements that may occur in the grid;
- Determine the protection controls by relays and system automations;
- Determine the influence of the high voltage lines on the telecommunication lines and currents through substation socket outlet;
- Recommendations for PTG-related measures in order to maintain the short-circuit demands below the values admitted by the existing facilities;
- Set the performances of the equipments and apparatus which are to be assimilated in the future.

The design calculation of the equipment and apparatus from power facilities, of the earth outlets and protections of telecommunication lines is made for the maximum operation.

The calculation hypotheses, according to the revised PE 134/95 and UCTE recommendations on the calculation of short-circuit currents under maximum regime, underlying the calculation of the maximum short-circuit currents, are as follows:

- All lines and bus-bar couplings 400 kV, 220 kV and 110 kV from NPS are connected;
- All 400 kV interconnection lines between NPS and neighbouring power systems are connected;
- All transformers, autotransformers with high voltage of 400 kV, 220 kV, 110 kV are in use on median plot and their neutral is rigidly earthed;
- All units in operation;
- All compensation coils and synchronous compensators are in operation;
- Previous permanent conditions are not taken into account;
- Consumers' loads are not taken into consideration at any voltage level;
- Under initial conditions, the system is perfectly balanced;
- Transient phenomena are disregarded.

These hypotheses are established in OP "Computation and communicating the results of short-circuit calculations" – code: TEL – 07.III RS-DN–186.

Annex B-10 shows the values of the short circuit currents in the 220 kV and 400kV grid at the 2008 level.

The values of the short circuit currents range between: 4,36 kA (Calafat and Suceava 220 kV) - 31,24 kA (Ţânţăreni 400 kV).

At 220kV voltage, out of 80 nodes:

- 62 (81%) have short-circuit power lower than 6000MVA
- 13(14%) have short-circuit power between 6000 and 10000MVA
- 4(5%) have short-circuit power between 10000 and 12000MVA
- 1 node (Porţile de Fier) has a short-circuit power higher than 12000MVA, the substation being retrofitted however

At 400kV voltage, out of 32 nodes:

- 19 (59%) have short-circuit power lower than 10000MVA
- 12(37%) have short-circuit power between 10000 and 17000MVA
- 1 node (Ţânţăreni) has short-circuit power higher than 20000MVA, the substation being retrofitted however

The substation Mintia 220 kV has a level of short-circuit currents exceeding the admitted ceiling. Therefore, restrictions on the operation scheme were introduced in this substation, recorded in the valid ITI C11.1 “Conditions regarding the connection of CC1 and CC2 220 kV Mintia in order for the interrupting ratings of the breakers not to be exceeded”. After the procurement of breakers with a 40 kA level of the symmetrical rated short-circuit-breaking current, during 220 kV Mintia substation retrofitting, the restriction will be removed and the mentioned instruction will be withdrawn and annulled.

4.8 PTG inspection in steady-state and transient stability conditions

4.8.1.PTG inspection in steady-state stability condition

For all the sections, the interconnected operation of NPS with UCTE was considered.

Calculations were made for schemes with N, N-1 elements in operation under the balance hypothesis 1 (winter peak), maximum period calculation scheme from the analysed time interval (relevant semester), with N-1 criterion confirmation. For each of these schemes, the steady-state stability was verified in the duration scheme in case of tripping an element from the area affecting the section, and compliance with the safety criterion.

Under the regimes where the rated reserve is met in the section but grid voltages or current flows on the grid elements were outside the rated limits, the admissible power Padm in section is established under the last regime where restrictions related to voltage level and grid element loading limits are complied with. For the scenarios where a line tripping leads to the substantial variation of the grid losses, there were given values for the admissible power through the section under the regime following the tripping (a) and under the regime before the tripping of an element (b), as a / b.

The set values correspond to the cases of unavailabilities described for each regime and to a structure of units forecasted for the relevant period. These values modify in case additional line unavailabilities occur within NPS or the system operated on a different distribution of generated powers. The changes are analysed on regime scheduling.

4.8.1.1. Calculation assumptions

According to PE 026/92, the inter-zonal power transmission grid must ensure a steady-state stability reserve of minimum 20% within a configuration of N elements in operation and of minimum 8% with N-1 elements in operation.

Presently, there are the following regions in NPS, designated as characteristic sections, in terms of steady-state stability, Figure 4.8.:

- Section S1 – Oltenia region, delimited by the following electric lines:
    - OHL 400 kV Slatina-Bucureşti Sud;
    - OHL 400 kV Urecheşti-Domneşti;

- OHL 400 kV Ţânţăreni-Bradu;
- OHL 400 kV Ţânţăreni-Sibiu;
- OHL 400 kV Ţânţăreni-Kozlodui (d.c.);
- OHL 400 kV Porţile de Fier-Djerdap;
- OHL 220 kV Porţile de Fier-Reşiţa (d.c.);
- OHL 220 kV Târgu Jiu-Urechesti;
- OHL 220 kV Craiova-Turnu Măgurele.

– Section S2 (to the east of axis Iernut-Sibiu, Ţânţăreni-Slatina), delimited by the following electric lines:
  - OHL 400 kV Urecheşti-Domneşti;
  - OHL 400 kV Slatina-Bucureşti Sud;
  - OHL 400 kV Braşov-Sibiu;
  - OHL 400 kV Ţânţăreni-Bradu;
  - OHL 400 kV Isaccea-Dobrudja;
  - OHL 220 kV Iernut-Ungheni (d.c.);
  - OHL 220 kV Craiova-Turnu Măgurele;
  - OHL 110 kV Iernut-CIC (d.c);
  - OHL 110 kV Iernut-Târnăveni (d.c)
  - OHL 110 kV Sibiu – Copsa Mica;
  - OHL 110 kV Fagaras – Hoghiz.

– Section S3 – region of Moldova, Dobrogea and a part of Muntenia, delimited by the following electric lines:
  - OHL 400 kV Braşov-Gutinaş;
  - OHL 400 kV Bucureşti Sud-Pelicanu;
  - OHL 400 kV Bucureşti Sud-Gura Ialomiţei;
  - OHL 400 kV Dobrudja-Isaccea;
  - OHL 220 kV Gheorghieni-Stejaru;
  - OHL 110 kV Dragoş Vodă-Slobozia Sud.

– Section S4 – Northern Transilvania region, delimited by the following electric lines:
  - OHL 400 kV Sibiu-Iernut;
  - OHL 400 kV Roşiori-Mukacevo;
  - OHL 220 kV Gheorghieni-Stejaru;
  - OHL 220 kV Cluj Floreşti-Alba Iulia;
  - OHL 400kV Oradea-Bekescsaba (for the stages 2009-2014).

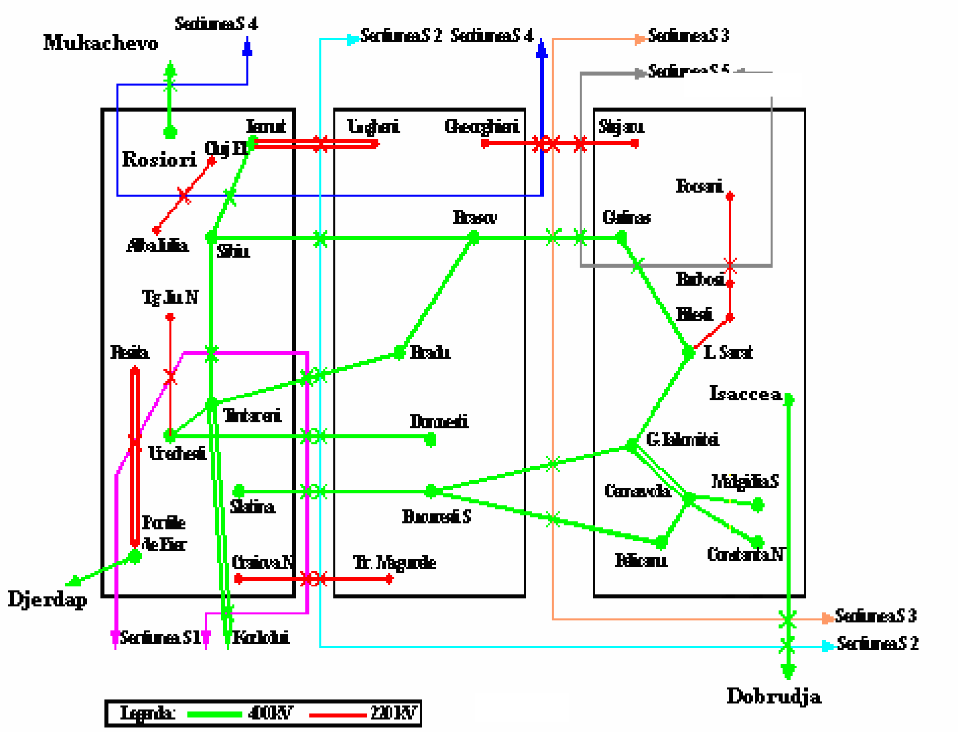
– Section S5 – Moldova region, delimited by the following electric lines:
  - OHL 400 kV Braşov-Gutinaş;
  - OHL 400 kV Smârdan-Gutinaş;
  - OHL 220 kV Barboşi-Focşani;
  - OHL 220 kV Gheorghieni-Stejaru

The calculation for all sections was made in the basic regime, with the following configuration:

- L 400 kV Cernavoda – Gura Ialomitei decommissioned;
- L220 kV Suceava – FAI decommissioned;
- AT1 and AT2 200 MVA Isalnita decommissioned;

- AT2 200 MVA Suceava definitively decommissioned;

Figure 4.8. Characteristic sections for the NPS steady-state stability analyses



4.8.1.2 Results of steady-state stability analyses

The summary of analysis results is shown in Table 4.8.1. and Table 4.8.2. for the 2008 summer level, 2008-2009 winter level respectively.

Table 4.8.1.

Ref. no.	Section	Excess [MW]		Deficit [MW]		The element which generated the limit value
		$P_{rez\ st.\ st}$	P_{adm}	$P_{rez\ st.\ st.}$	P_{adm}	
1	S 1	4090	3750	-	-	Tripping of OHL 400kV Tantareni-Bradu.
2	S 2	-	-	2520	2160	Tripping of OHL 400 kV Sibiu – Brasov.
3	S 3	-	-	960	90	Tripping of OHL 400 kV Constanta Nord – Cernavoda
4	S 4	-	-	1220	870	Tripping of OHL 400 kV – Mukacevo-Rosiori
5	S 5	-	-	900	730	Tripping of OHL 400 kV Smardan – Gutinas

Table 4.8.2.

Ref. no.	Section	Excess [MW]		Deficit [MW]		The element which generated the limit value
		$P_{rez\ st.\ st}$	P_{adm}	$P_{rez\ st.\ st.}$	P_{adm}	
1	S 1	4860	3760	-	-	Tripping of OHL 400kV Tantareni- Sibiu.
2	S 2	-	-	2940	2420	Tripping of OHL 400 kV Urechesti –

						Domnesti.
3	S 3	-	-	780	250	Tripping of OHL 400 kV Constanta – Cernavoda
4	S 4	-	-	1210	810	AT 400/110 kV Rosiori
5	S 5	-	-	840	720	Tripping of OHL 400 kV Brasov- Gutinaş

The admitted limit flows on PTG elements must range between deficits/excesses determined by the steady-state stability calculation.

4.8.1.3. Analysis of NPS characteristic sections in terms of steady-state stability conditions.

Section S1

The results' analysis shows that the value with rated reserve is 4090 MW (determined in summer regime), and the value of minimum admissible power related to the section (S1 Oltenia) is 3750 MW (determined in summer regime). Limits are recorded upon tripping of OHL 400 kV Ţânţăreni-Bradu (the most restrictive case) and OHL 400 kV Ţânţăreni-Sibiu, respectively. For a transit over 3750 MW, the maximum admissible current is exceeded TC L220 kV Paroseni-Targu Jiu.

Section S2

Rated reserve power in S2, corresponding to grid voltages and current flows on grid elements beyond the rated limits, is approximately up to 2420 MW (determined in winter regime) and the value of minimum admissible power is up to 2160 MW (determined in summer regime), a value over which the rated voltage is exceeded. The limits are recorded on tripping of OHL 400 kV Urechesti – Domnesti and OHL 400 kV Sibiu – Brasov respectively.

Section S3

Rated reserve power in S3 is approximately 960 MW (determined in summer regime), 780 MW respectively (determined in winter regime). Both limits are recorded upon tripping of OHL 400 kV Constanta – Cernavoda.

The values of minimum admissible powers corresponding to grid voltages and current flows on grid elements within the rated limits are 90 MW (determined in summer regime), and 250 MW respectively (determined in winter regime). Both values are low because they are limited by the value of thermal current on L110 kV Basarabi – Megidia Sud d.c. upon power delivery from NPP Cernavoda (two units) and the deficit from sub-zones Constanta and Tulcea, after tripping OHL 400kV Constanta – Cernavoda. The deficit is accentuated in summer period due the fact that during this period there are no units operating in CHPP Palas and thermal overloads on OHL are considered at 30^0 C.

It is urgently required the construction of a new line and reorganization of 400 kV network in Dobrogea area.

Section S4

Rated reserve power in S4 corresponding to grid voltages and current flows on grid elements beyond the rated limits is of approximately 1210 MW (determined in winter regime), and the value of minimum admissible power is 810 MW (determined in winter regime). Both limits are recorded when tripping AT 400/110 kV Rosiori.

For summer regime, the value of minimum admissible power is 1100 MW and coincides with tripping of OHL 400kV Iernut-Sibiu.

Section S5

The most restrictive value of the rated reserve power was 840 MW (determined in winter regime), achieved on tripping OHL 400 kV Smardan – Gutinas .

The value of minimum admissible power is 720 MW (determined in winter regime) coinciding with tripping OHL 400 kV Brasov- Gutinaş, and the rated voltage is exceeded over such value.

Weak points in PTG in terms of steady-state stability.

- In **section S3** congestions occur:

  - upon tripping Constanta - NPP determined by overload on L 110kV d.c. Basarabi – Medgidia Sud;
  - upon decommissioning L400kV Isaccea-Dobrudja, determined by overload on L110kV d.c. Basarabi – Medgidia Sud;
  - upon decommissioning L400kV Brasov-Gutinas , determined by overload on L 220kV Fintinele - Gheorghieni;
  - upon decommissioning L400kV Bucuresti Sud – Pelicanu determined by overload on L 110kV d.c. Basarabi – Medgidia Sud;
  - upon decommissioning Constanta - HPP determined by overload on L 110kV d.c. Basarabi – Medgidia Sud;

- In **section S4** congestions occur:

  - upon tripping L220 kV Alba Iulia – Cluj Fl determined by overload on T250 MVA from Cluj Est substation;
  - upon tripping L220 kV Stejaru – Gheorghieni determined by overload on T250 MVA from Oradea substation;
  - upon tripping L220 kV Stejaru – Gheorghieni determined by overload on T250 MVA from Oradea substation;
  - upon tripping L400 kV Sibiu - Iernut determined by overload on L 110kV Sibiu – Copsa Mica;
  - upon decommissioning L400 kV Sibiu – Iernut determined by overload on L 110kV Mintia – Brad;
  - upon decommissioning L400 kV Rosiori - Mukacevo determined by overload on L 110kV Mintia – Brad ;
  - upon decommissioning L220 kV Alba Iulia – Cluj Fl. determined by overload on L 110kV Mintia – Brad ;

- In **section S5** congestions occur:

  - upon tripping an AT 400/220kV Gutinas determined by overload on the other AT 400/220kV Gutinas;

-upon decommissioning L400 kV Smardan – Gutinas determined by overload on L220kV Barbosi – Filesti;

- The congestions due to the decrease of voltages within transmission grid and in 110 kV system below the values set forth in PTG Code are much numerous and depend on the local voltage and reactive power control.

The congestions caused as a result of steady-state stability inspection lead to imposing admissible powers through the characteristic sections below the rated reserve power for steady-state stability which is $P_{8\%}$ or $P_{20\%}$.

4.8.2 Transient stability and possible protection measures in PTG nodes

4.8.2.1 Methodology and calculation hypotheses

The operational planning of NPS included transient stability analyses which monitored:
- the inspection of transient stability in areas with large power plants, which may affect the stability and integrity of NPS and interconnection (Portile de Fier, Cernavoda, Turceni, Rovinari);
- identification of dangerous fault points and scenarios; identification of decommissionings significant to area stability, NPS and interconnection stability; identification of simultaneous decommissionings which require restrictions, etc.;
- determination of restrictions and conditionings required to ensure the NPS and interconnection's stability and integrity conditions, including the ones regarding the coordination of decommissioning schedules and preventive operative measures in interconnected system;
- inspection of dispatching, logics and effectiveness of system automations;
- inspection of stability of the regions affected by retrofitting programs (Iernut, Lotru, Isalnita, Bucuresti Sud, Gutinas, Cernavoda, etc.); determination of production limit and other restrictions and conditionings required for region stability preservation;
- inspection of stability in NPS's characteristic sections and in temporary critical sections, under conditions of simultaneous retrofitting programs deployment within NPS;
- inspection of stability in the NPS interconnection section and determination of stability limits and limits for activating the automations;
- inspection / adjustments optimization of control systems of the new and retrofitted units (Portile de Fier, U2 Cernavoda, etc);
- calculation of short circuit critical times, in order to substantiate the determination of equipment performances required in the substations;
- substantiation / inspection of protection controls (safety for asynchronous operation on the interconnection lines or units, the selective/non-selective drive in I-st stage of distance protection on bus bar coupling devices, etc.).

Inspection of transient stability and automations has been made for the NPS interconnected operation with UCTE system and Western Ukraine, on the L400KV Portile de Fier-Djerdap, 1c 400kV Tantareni-Kozlodui, L400kV Isaccea-Dobrudja, Arad-Sandorfalva, Rosiori-Mukacevo; in the studies related to summer 2008 and winter of 2008-2009, also Nadab substation with 400kV Nadab-Bekecsaba and a domestic L400kV were considered in operation.

The stability for load peak in winter and summer respectively was studied.

The inspection of transient stability was carried out on the grids which included the decommissionings included in PAR, which are required by the retrofitting works in NPS from the relevant period.
NPS dynamic model included the last data on substation retrofitting programs, the modernization of unit control systems and commissioning of new or retrofitted units.

The model of the external systems was made based on the data supplied in the work group UCTE M&FT. It is to be noticed the forecast of a synchronous import of 1000-1300 MW in Greece+Albania+Macedonia and a low balance (0-400MW) in Bulgaria after closing 230MW units in Kozlodui (January 2007).
The power generating units from Serbia+Montenegro, Bulgaria, Ukraine, Burshtyn Island, Macedonia, Greece, Albania, Slovakia, Bosnia-Herzegovina, Slovenia and Croatia were dynamically modelled.

The dynamic models for external systems were re-updated based on the collected data in the work group WG2 within the "IPSUPS Interconnection to UCTE" project" (2005-2008).

According to the purpose of analyses, simulations were made for:
- maximum number of units in operation in the power plants located in analysed area, loaded to maximum; various different variants of units and loadings;
- long term operation scheme; various schemes with 1-3 line decommissionings in NPS and interconnection (Portile de Fier area); specific retrofitting and transfer between an old and a new substation schemes (Sibiu, Gutinas, Isalnita); schemes including the decommissioning of a bus bar in substations with 1.5 breakers per element (Iernut, Gutinas, Sibiu); etc.
- various hypotheses on the exchanges between NPS and interconnection.

According to the purpose of analyses, various fault scenarios were taken into consideration:
- metallic three-phase short circuit on a bus bar, isolated by:
  - Different bus bar protection, or
  - stage II of distance protections on connected elements;
- metallic three-phase short circuit at a line or a (auto)transformer, isolated:
  - by correct actuation of protections and breakers, by distance protections, with teleprotection, if any, differentiated protection of (auto)transformer) respectively, or
  - by temporary unavailable teleprotection and actuation of stage II distance protection actuation, or
  - by breaker refusal and isolation of a bus bar through DRRI (or stage II of distance protection if there is no DRRI);
- double-phase or one-phase short circuits, isolated as above.

AR was considered where applicable.

Calculations were made without / with actuation of automations.

Total times for activating the protections, times which were considered in calculations for 400-220KV system, are as follows:
- in new and retrofitted substations (Portile de Fier, Tantareni, Urechesti, Slatina, Iernut, Sibiu, Rosiori, Gutinas, Cernavoda, Constanta Nord, Bucuresti Sud) : ZI, PDT, PDB 0.1s; DRRI 0.23-0.24s;
- in other substations: ZI, PDT 0.12-0.16s; DRRI 0.42s.

- ZII 0.5-0.52s / 0.9-0.92s on L400kV (with no teleprotection);

Additionally, for the new or retrofitted units (U2 Cernavoda, Portile de Fier, TA3 Mintia) dynamic simulations were made on test models for generating unit connected to an infinite power node.

There were generated load variations generating oscillation frequencies within the 0.25-1.5 Hz range for inspection / optimization of PSS

The EUROSTAG 4.2dynamic simulation program was used.

4.8.2.2 Analyses and results

Transient stability analyses were made within the NPS operational planning studies for winter 2007-2008, summer 2008, winter 2008-2009, including:
- Inspection of Portile de Fier area and interconnection stability; inspection of automations;
- Stability of TPP Iernut and HPP Lotru, including during conversion stages in new substation Sibiu 400kV;
- Stability of Cernavoda area during 2-unit operation;
- Stability of Bucuresti Sud and Domnesti-Bucuresti Vest areas; etc

Inspection of transient stability was carried out on the grids including the decommissionings included in PAR, required by the retrofitting works in NPS during relevant period (AT1,2 in Isalnita, Gutinas-Bacau Sud-Roman axis during winter 2007-2008 and Bacau-Roman-Suceava axis during summer 2008, consecutive decommissioning of L 400kV Cernavoda-Medgidia and of a L Cernavoda-Gura Ialomitei during summer 2008, decommissioning L400kV Cernavoda-Pelicanu during winter 2008-2009, etc.), as well as the operation including the consumption island on L400kV Isaccea-Vulkanesti.
The NPS interconnected operation with UCTE system and Western Ukraine was modelled, on L400KV Portile de Fier-Djerdap, 1 circuit 400kV Tantareni-Kozlodui, L400kV Isaccea-Dobrudja, Arad-Sandorfalva, Rosiori-Mukacevo; for the summer 2008, the possibility to commission the Nadab substation with L400kV Nadab-Bekecsaba and Nadab-Oradea was also considered, and for the winter 2008-2009, the commissioning of Nadab substation with L400kV Nadab-Bekecsaba and Arad-Nadab was considered.
The analyses were performed for average load peak and a synchronous interconnection balance of 700MW export on L400kV and a balance of 530MW export for summer 2008.

4.8.2.2.1 Stability of Portile de Fier area and interconnection; inspection of automations

Calculation assumptions and scenarios

The inspection of stability of Portile de Fier area and interconnection and the re-updating of actuation logic of automation system in Portile de Fier were made for the winter 2007-2008, summer 2008, winter 2008-2009.
Maximum 6 units were considered in operation in HPP Portile de Fier during winter 2007-2008 and summer 2008, respectively 5 units during winter 2008-2009, and 6 units in HPP Djerdap, with maximum loadings 6x194MW (5x194MW) , 6x175MW respectively.

It has been studied:
- short-term and medium-term transient stability of Portile de Fier area, of NPS and interconnection, including the risk of separating some interconnection areas by activating protections / automations;

- identification of decommissionings relevant for stability of Portile de Fier area and integrity of interconnection and restrictions related to their planning;
- the effect of operation with L400kV Oradea/Arad-Nadab-Bekescsaba on area stability;
- logic and control of automations from Portile de Fier.
- Identification of stability limits in NPS's interconnection section.

Calculations were made for the normal operation scheme and for schemes including 1-5 unavailable elements in the area Portile de Fier+Djerdap, in NPS and in interconnected grid. Transient regimes were calculated which were determined by metallic three-phase short circuits on L400kV from Portile de Fier+Djerdap or from interconnection loops, isolated through correct actuation of protection and breakers.
Calculations were made without / with actuation of automations in order to determine the necessity and actuation logic.

Calculation results

- The normal operation scheme was set in substation Portile de Fier 400/220kV:

CT220kV Portile de Fier connected, AT3 (400MVA) +2 generating units on the bus bar 1 220kV and AT1,2 (2x500MVA) + 3-4 units on bus bar 2, L220kV Portile de Fier symmetrically distributed on the 2 bus bars;

- The dispatching and logic of automations' operation from Portile de Fier were established for the summer and winter periods;

- There were identified the significant decommissionings in Portile de Fier +Djerdap area and in interconnection, the measures for stability preservation and the restrictions on simultaneous planning of line decommissionings in Portile de Fier +Djerdap area and in interconnection, including the limitation of excess in Portile de Fier node or coordinated limitation of excess in Portile de Fier+Djerdap.
- It has been recommended to avoid the planning of the next simultaneous decommissionings under production regimes in HPP Portile de Fier and Djerdap, exceeding the values in the table below:

Period / Decommissionings	Summer 2008 (6g PdFier I)	Winter 2008-2009 (5g PdFier I)
	Limit excess (MW)	
1L400kV PdFier	PdFier+Djerdap 2200	-
2L400kV PdFier	PdFier 850	PdFier 850
L400kV PdFier-Urech./ Slatina+ c1+2 220kV PdFier-Resita	PdFier 850/ 1150 PdFier+Djerdap 1700	PdFier 850/ 1150 PdFier+Djerdap 1850
L400kV PdFier-Djerdap+ c1+2 220kV PdFier-Resita	PdFier 1050	PdFier 1050
1L400kV PdFier + 1L400kV Djerdap or Bor-Nis	PdFier+Djerdap 1500	PdFier+Djerdap 1600
c1+2 220kV PdFier-Resita + 1L400kV Djerdap,	PdFier+Djerdap 1950	PdFier+Djerdap 1950
c1+2 Tantareni-Kozlodui + L400kV Djerdap-Drmno/ Bor,	PdFier+Djerdap 2000 Export RO+Djerdap 1450	PdFier+Djerdap 1900 Export RO+Djerdap 1100*
L400kV Arad-Sandorfalva+	PdFier+Djerdap 2200	Export RO+BG+Djerdap

+L400kV Nadab-Bekecsaba 1L400kV Djerdap	Export RO+BG+Djerdap 2000	1400**

* automation limit on L400kV Isaccea-Dobrudja
** medium-term stability limit

Both circuits Tantareni-Kozlodui will be connected upon decommissioning of L400kV Arad-Sandorfalva simultaneously with an L400kV Djerdap.

- The commissioning of L400kV Nadab-Bekecsaba significantly improves the attenuation of oscillations and increases the medium-term stability limit in the Romania+Bulgaria interface in case of decommissioning of L400kV Arad-Sandorfalva simultaneously with an L400kV Djerdap and in case of tripping the second line in Djerdap.

In case of decommissioning of c1+2 400kV Tantareni-Kozlodui simultaneously with an L400kV Djerdap, the commissioning of L400kV Nadab-Bekecsaba has a positive effect on the oscillation attenuation and increases the stability limit and the limit of risk for activating the automation in NPS interface with approx. 50MW.

- During winter 2008-2009, the effect of deficit increase south of Romania can be observed, under a zero balance condition in Bulgaria; the intensification of parallel flows North->South through NPS due to the transactions between other partners lead to the reduction of automation actuation limit on interconnection lines (*) and of the stability limit (**) in NPS interconnection interface and RO+BG interface.

4.8.2.2.2 Inspection of Cernavoda area stability

The dynamic behaviour of Cernavoda area was studied for an operation with 1-2 units in Cernavoda (1-2x710MW) and without teleprotection in use on L400kV Bucuresti Sud-Pelicanu and Bucuresti Sud-Gura Ialomitei (until the completion of suitable works in the substations adjacent to Bucuresti Sud substation); the possibility to decommission more than one L400kV in the area was assessed, the PSS efficiency was verified.

For the winter period 2007-2008, various schemes with decommissioned 1-2 L400kV; for the summer period 2008, schemes with long-term planned decommissioning of L400kV Cernavoda-Medgidia, L1 400KV Cernavoda- Gura Ialomitei respectively were considered, and the additional decommissioning of a line 400kV in Cernavoda or in the area; for the winter period 2008-2009, schemes with long-term planned decommissioning of L400kV Cernavoda-Pelicanu were considered and additional decommissioning of a line 400kV in Cernavoda or area

Transient regimes determined by metallic three-phase short circuits on L400kV from Cernavoda and from the area were calculated, isolated through:
- correct actuation of protections and breakers;
- breaker refusal and DRRI in Cernavoda or in substations from the area.

Calculation results

- The analysis examined the efficiency of PSS2A of unit 2 Cernavoda in attenuation of oscillations within a 0.23-0.8Hz range.

- A three-phase short-circuit on a L400kV from Gura Ialomitei, isolated with breaker refusal and DRRI in Gura Ialomitei, may lead to stability loss in NPP and in the area while operating with 1-2 units, even for a normal topology in the area; the retrofitting of 400kV Gura Ialomitei substation must be considered a priority.

- In case of simultaneous decommissioning of 2 lines in the area, it is necessary to limit the production in NPP in order to ensure the preservation of transient stability on isolated faults with breaker refusal and DRRI, and in some cases on isolated faults with accurate actuation of protections and breakers.

<u>For summer period 2008:</u>

- If only the risk of isolated short-circuit with correct actuation of protections and breakers is considered in assessment of additional decommissioning acceptability and the risk of breaker refusal in Cernavoda or adjacent substations is neglected and if conditions to complete a post-failure regime can be assured without current excess and normal voltages, there are acceptable for operation with units loaded to rated power:
- L400kV Cernavoda-Medgidia decommissioning and additional decommissioning of one of L400kV from Cernavoda or Gura Ialomitei, except for L400kV Cernavoda-Pelicanu;
- L1 400kV Cernavoda-Gura Ialomitei decommissioning and additional decommissioning of one of L400kV Cernavoda-Medgidia, Cernavoda-Constanta Nord, Gura Ialomitei-Lacu Sarat

- If the DRRI risk is also considered, the additional decommissionings schemes which require the lowest reductions in production of NPP (1350MW), are schemes with L400kV Cernavoda-Medgidia decommissioning and the additional decommissioning of L400kV Cernavoda-Pelicanu or L400kV Cernavoda-Constanta Nord

<u>For winter period 2008-2009:</u>

- The additional decommissioning of one L400kV Cernavoda-Medgidia, Isaccea-Lacu Sarat, Isaccea-Smardan c2 (c1 in island), Lacu Sarat-Smardan, Bucuresti-Pelicanu does not significantly modify the conclusions on NPP stability.

- The following cases of additional decommissionings require the diminution of production in NPP in order to maintain the stability:

Additional decommissioning	Limit a) required by sc. on	Limits NPP (MW)	
		a)	b)
L Cernavoda-Constanta N		-	1400
C1 Cernavoda-G.Ialomitei	C2 Cernavoda-G.Ialomitei	1350	1150
L Buc.S.-G.Ialomitei	L Isaccea-Tulcea +ZII	650 / 1250	
L G.Ialomitei-L.Sarat	L Buc.S.-G.Ialomitei +ZII	1300	
L Isaccea-Dobrudja		1350	
L Gutinas-Smardan		1380	
TIF L G.Ialomitei-L.Sarat	L G.Ialomitei-L.Sarat +ZII	1380	-

a) correct actuation of protections and breakers
b) breaker refusal and DRRI (except DRRI in Gura Ialomitei)

4.8.2.2.3 Inspection of TPP Iernut and HPP Lotru stability

For the winter period 2007-2008, the transient stability of TPP Iernut and HPP Lotru was analysed, while operating with 400-600MW in TPP Iernut and 170-510MW in HPP Lotru, considering:
- the normal configuration of the grid and configurations including a decommissioned element in Iernut 400/220kV, Sibiu 400kV substations or in 400kV Gadalin-Rosiori-Mukacevo axis;
- configurations corresponding to the transfer stages from old substation Sibiu 400kV to retrofitted substation.

Three-phase short-circuits eliminated by correct actuation of existing protections and breakers were simulated on:
- L400kV from Iernut, AT400/220kV Iernut, L220kV Iernut, L220kV Fantanele-Ungheni;
- L400kv from Sibiu, L220kV Lotru-Sibiu.

The following case was also considered:
- operation with 600MW in Iernut 220kV and 220kV Iernut bus bar decommissioning;
- tripping the other busbar on isolated three-phase short-circuit by differential protection of bus bars, determining some pair of elements connected via the median breaker to keep operating:: G5 Iernut+c1 220kV Iernut-Ungheni; G6 Iernut +c2 220kV Iernut-Ungheni, G1+2 + L220kV Iernut-Campia Turzei, AT1 400/220kV Iernut+ L220kV Iernut-Baia Mare.

Calculation results

- the limits of transient stability were determined in TPP Iernut and HPP Lotru for various operation schemes, with/without teleprotection on L400kV Iernut-Sibiu :

Decommissionings	Stability limit in TPP Iernut 220kV		
	100+200 MW	2x200 MW	100+2x200
-	300	400/ 380	500/ 480
L400kV Iernut-Gadalin	300/ 280	400/ 360	500/ 460
L400kV Gadalin-Rosiori			
L400kV Rosiori-Mukacevo	300/ 260	400/ 320	500/ 430
L400kV Iernut-Sibiu or s2)	270	340	430
L400kV Sibiu-Mintia (s1)	300	380	480
L400kV Sibiu-Tantareni or s5)			
L400kV Sibiu-Brasov	300	370	470
s3)	290	380	480
s4)	280	370	470
AT 400/220kV Iernut	240	300	380
c1+2 220kV Iernut-Ungheni	300/ 280	380/ 360	470/ 450
L 220kV Iernut-Campia Turzii	290/280	360	450

Decommissionings	Stability limit in HPP Lotru 220kV		
	170 MW	2x170 MW	3x170 MV
-	170/160	330/ 290	390
1(AT Sibiu+L220kV Lotru-Sibiu)	160/150	260/ 220	-
L400kV on the axis Iernut-Mukacevo	170/160	300/ 290	390
L400kV Iernut-Sibiu	150	270	360
L400kV Sibiu-Mintia (s1)	140/130	260/ 240	360/330
L400kV Sibiu-Tantareni or s5)	150/130	270/ 240	360/340
L400kV Sibiu-Brasov	170/130	300/ 230	360/310
s2) [+2 (AT Sibiu+L Lotru)]	80 [90]	150 [180]	210 [250]
s3)	170	310	390
s4) [+2 (AT Sibiu+L Lotru)]	110 [130] / 60 [80]	190 [230] / 110 [150]	300 [-] / 190 [

- It is recommended to provide the units from HPP Lotru with a performant excitation control system with PSS2A, which would ensure a good attenuation of oscillations and increase of short-term and medium-term stability limit.

4.8.2.2.4 Inspection of Bucuresti Sud area stability

There were determined the critical times for isolating the metallic three-phase short-circuit on the bus bars 110kV Bucuresti Sud and on elements connected on bus bars (AT 220/110kV, L110kV, as support for defining the required performances of the equipment in retrofitting of 110kV Bucuresti Sud substation, for the normal operation scheme and with 1 decommissioned AT 220/110kV.

Calculation results

Fault scenario Sc.3f on	Decommissioning	Tcritical [sec.]	For:
B 110kV Bucuresti Sud	-	0.34-0.42	PDB and DRRI
AT 220/110kV Bucuresti Sud	-	0.25	PDL
L 110kV Bucuresti Sud-UMGB, ZI	-	0.23-0.26	ZI
L 110kV Bucuresti Sud-UMGB, ZII	-	0.40	ZII

- It is recommended to provide the bus bars 110kV Bucuresti Sud with the differential protection with disconnection without time delay and performant DRRI with time delay of 0.2-0.25s, and fitting the L 110kV from Bucuresti Sud with teleprotection.

4.8.2.2.5 Inspection of Domnesti-Bucuresti Vest area stability

The combined unit commissioning effect on the area stability in summer 2008 was analysed, and area stability during operation with maximum number of units, including the combined cycle unit, during winter 2008-2009.

The area transient stability for normal operation scheme including a decommissioning was verified, including the effect of radicalization of bus bars Grozavesti and Bujoreni and the effect of un-looping the 110kV grid.

Calculation results

- The commissioning of the combined cycle unit will determine a decrease in critical times on bus bars 110kV Domnesti and on L110kV Domnesti-Bujoreni, due to the generating block-steam turbine of the combined cycle, which has a low inertia constant:

Sc.3f on	Critical time [sec.]	
	TA2 Buc.V TA1,2 Grozav.	+CC TG3 in Bujoreni1 TA4 in Bujoreni2
B1 110kV Domnesti	0.41	0.24*-0.26
B2 110kV Domnesti	0.27	0.17-0.18 (0.25**)
L2 110kV Domnesti-Bujoreni	>0.2	0.18

* for TG3 146MW >Pn
** stability lost only in TA4; TA2 stays synchronous.

- In order to improve the area stability, it is necessary to commission the differential protection of bus bars in Domnesti with non-delayed tripping of elements or with maximum delay of 0.1s, to retrofit the Domnesti substation and to fit such substation with performant DRRI with low time delay 0.15s.

- Radial operation of the units in Bujoreni and Grozavesti, achieved by disconnection of C110kV Grozavesti and of L110kV Crangasi-Bujoreni, leads to the loss of a small number of units during an incident, but with higher frequency; the post-failure regime creates problems easier to solve.

Fault scenario	Instability or insulation of units	
	Present scheme	Radial scheme
Sc.3f on B1 110kV Domnesti isolated with ZII	Instability Buc.V+ Groz. +Progresu 520MW	Insulation of unit TA2+TA4 Buc.V+G2 Groz. +instability TG3 +G1 Groz. 420MW
Sc.3f on B2 110kV Domnesti isolated with ZII Sc.3f on L 110kV Domnesti isolated with DRRI		Insulation of unit TA2+TA4 Buc.V+G2 Groz. or TG3+G1 Groz. max.230MW
Fault on L110kV Domnesti-Bujoreni +tripping	-	Insulation of unit 1B Buj.+1B Groz
Fault on L110kV Bujoreni-Militari-Grozavesti +tripping	-	Insulation of unit 1B Groz
Sc.3f on L110kV, isolated with ZI,ZII: L2 110kV Domnesti-Chitila, Domnesti-IFA , Domnesti-heavy engineering	-	Instability TG3 +G1 Groz.

-The separation of the Alexandria area from Giurgiu-Ghizdaru area does not affect significantly the stability of CHPP Bucuresti Vest and Grozavesti.

4.8.2.3 Weak points in PTG in terms of transient stability

- 400kV Gura Ialomitei substation:
An isolated three-phase short-circuit with DRRI in Gura Ialomitei is dangerous for the NPP stability even within the scheme with no decommissionings in Cernavoda and in the area, regardless of the number of units in operation in NPP. The substation retrofitting is required;

- Temporary operation without teleprotection on L400kV Bucuresti Sud-Gura Ialomitei and Bucuresti Sud-Pelicanu:
It requires power restrictions in operation with 2 units in NPP and schemes including 2 line decommissionings in Cernavoda and in the area, in terms of transient stability.
It is necessary for the suitable equipment to be installed in the Pelicanu and Gura Ialomitei substations.

- Dobrogea grid:
It requires power restrictions in operation with 2 units in NPP and schemes including 2 line decommissionings in Cernavoda and in the area, in terms of transient stability and post-failure regime admissibility. The development and systematization of Dobrogea grid is required;

- lack of teleprotection on L400kV Sibiu-Iernut and Sibiu-Brasov:
It entailed power restrictions in TPP Iernut and HPP Lotru; solved in 2007 (commissioning of new 400kV Sibiu substation + teleprotection on L400kV Iernut-Sibiu) and 2008 (commissioning of teleprotection on L400kV Sibiu-Brasov).

- HPP Lotru:
The medium-term behaviour of HPP Lotru aggravated in the new configuration from Sibiu.
Tripping of an AT Sibiu +1c Lotru block requires a limit of oscillation attenuation of 390MW.
The Lotru units fitting with an excitation control system with performant PSS is necessary; PSS2A is recommended.

- Domnesti substation:
On commissioning of combined cycle unit, the critical time on bus bars 110kV Domnesti decreases.
Domnesti substation retrofitting is required.

- Portile de Fier+Djerdap:
There are schemes including 2 simultaneous decommissionings in Portile de Fier+Djerdap and interconnection, and some fault scenarios may be dangerous for such schemes in terms of area and interconnection stability and necessitate the coordination of decommissionings with production in Portile de Fier and Djerdap and excess in interconnection sections.

Measures:

- Commissioning 400 kV Arad-Nădab-Bekecsaba OHL;
- Completion of 400kV Porțile de Fier-Reşița-Timişoara-Arad axis;
- Completion of a new 400 kV OHL for interconnection with Serbia.

- 220 kV Alba Iulia substation:
The stability of generating units from HPP Galceag, HPP Susag and TPP Mintia is lost at short-circuits in neighbouring grid
Measures:

- The 220 kV Alba Iulia substation is provided with performant commutation and protection equipment
- The following lines are provided with teletransmission installations:
  - 220 kV Alba Iulia – Cluj Floreşti OHL
  - 220 kV Alba Iulia – Mintia OHL
  - 220 kV Alba Iulia – Gâlceag OHL
  - 220 kV Alba Iulia – Şugag OHL

- 400 kV Smardan substation:
The stability of generating units from CHPP Galati is lost at short-circuits in neighbouring grid

Measures:

- 400 kV Smardan substation is provided with performant commutation and protection equipment;
- The following lines are provided with teletransmission installations:
  - 400kV d.c. Smârdan – Isaccea OHL;
  - 400kV s.c. Smârdan – Lacu Sărat OHL.

4.9. Continuity of Power Transmission Services

The continuity in operation represents one of the quality parameters of transmission and system services. The assessment of safety level in assurance of service provided in a certain PTG point, under normal operation, is an important prerequisite in assuring performant transmission services by Transelectrica S.A. and for the good operation of market itself.

In terms of continuity of supply, the performance indicators, as defined in current PTG Code, are reported to ANRE and MEF until now. These indicators are summarized in the following table, for the 2004-2007 periods. Their improvement trend in the last years can be observed.

Table 4.9: Performance indicators for PTG

Year	2004	2005	2006	2007
Average time of interruption	2.98	4.434	1,187	0.857
Severity indicator	0.175	0.369	0,044	0.035
System minutes indicator	1.694	2.606	0,782	0.555

In order to evaluate the service continuity indicators in a certain PTG point, it is necessary to determine the safety indicators calculated for each PTG node. By this concept it is understood the service continuity level that PTG may provide, at the level of substation bus bars pertaining to PTG from relevant area. The Technical Grid Code requires the calculation of the following indicators for each PTG node:

(a) Average duration of interruption;

(b) Average number of interruptions followed by repairs;

(c) Average number of interruptions followed by manoeuvres.

Knowing the service continuity indicators on PTG bus bars, the indicators of continuity in user delimitation points can be calculated, by taking into consideration the reliability indicators related to the connection of each user (client) which defines the continuity in operation provided by the electric grids connecting the PTG substations and the actual connection point.

The calculation of safety indicators enables both the grid operator and the users to assess the influence of relevant node connection to PTG (by determination of related safety level), as well as the influence of own connection of the node and of reliability parameters of the equipment (by determination of inherent safety level). These elements are used during the stage of establishing the optimal solutions for grid development and connection to grid.

Annex B-11 shows the safety indicators for all 400 kV 220 kV nodes in PTG and for 110 kV nodes from the substations with high voltage of 400 or 220 kV.

Following the comparison of values before and after substation retrofitting, it results that the investments of Transelectrica within last years led to the improvement of safety indicators for retrofitted substations and for neighbouring substations in most cases, particularly by reduction of interruptions and average duration of failure.

In terms of continuity in service provision, it is to be specified that, for the unmodernized substations, keeping the indicators near to the values required by European standards is achieved with increased costs related to preventive and corrective maintenance. The indicators will be improved, especially in terms of interruption duration (average and maximum), by retrofitting the lines and substations and by reduction of fault remedy duration using high performance management technologies and systems.

4.10. The operative dispatching management system - EMS/SCADA

EMS/SCADA is designed and implemented by AREVA company using Windows 2003 Server operating system as basic software, at the level of dispatching management system of the National Power System.

The system acquires the information from translators and concentrates it through RTUs (network terminals) into RTU concentrating equipment which forwards information on the EMS/SCADA infrastructure to the central servers where information is processed. The servers transmit replicas for visualisation / command / control to TEDs.

There are from 300 to 1000 data acquisition points in each substation, approximately 100 of these being equipped with analog translators. The translators are not back-uped for the measurement of the same parameter.

The total data volume on EMS/SCADA infrastructure is approximately STM-4 on its start. Current traffic is of approximately 2Mb requiring a cover band of 10Mb.

The system is centralized, collecting data on a national level through the above described Transelectrica infrastructure and concentrates such data in Bucharest, where system servers process received information and forward them to TED/NED in order to achieve the real time image of the local and national energetic status.

All RTU programs are stored in the permanent reprogrammable memory (EPROM).

RTU processor accepts the parameters' loading from a remote control centre. Each RTU has a local GPS system for RTU synchronization. The central processor unit includes a real time clock (RTC).

RTU are scanned by SCADA system of the control centre for the data concerning the status, analog data and regarding the accumulator.

The system architecture is performed through dedicated servers: SCADA server, network application server, administration server, system operator server (market applications), communications server and network terminal concentrator server:

- SCADA server implements the functional blocks of SCADA and power applications
- Network application server includes the real-time grid analysis and security functions and study mode
- Administration server performs the data base administration functions, historical storage, planning and forecast
- System operator server executes the functions required by the system operator tasks under market conditions
- Communication server includes the data link communication protocols and network terminal concentrators and basic functions for data collection

Each system has a redundant server for each of the configuration servers. In hot stand-by redundancy, the functions operate and data are updated simultaneously in stand-by and primary server. The data integrity is also guaranteed in reserve redundancy. The system equipment, the servers and the concentrators are synchronized through GPS clock. Each system has two GPS clocks connected to primary and secondary LAN. The servers are synchronized through LAN with NTP protocol. The network terminals are synchronized from concentrator in case of GPS system failure to RTU.

The system has access control and system security mechanisms.

The EMS/SCADA telemanagement system provides the acquisition and real-time processing of all significant data regarding the conditions of operation of National Power System. At the same time, it enables the remote management of all components of National Power System under safety conditions. EMS/SCADA is multi-level structured and ensured the real-time command and control of the 350 energy units, of all power transmission substations, performed by Central Energy Dispatcher and the five centres of Territorial Energy Dispatchers.

The EMS/SCADA tele-command system uses functions including those for energy market administration, in a modular hardware and software concept. Transelectrica, as transmission system operator, develops the mechanisms of the electricity competitive market and improves the reliability of national power system to meet the standards of the European interconnected electricity network (UCTE).

This tele-command system ultimately depends on performant and safe telecommunication infrastructures, based on a national optical fiber network. CN Transelectrica SA spares no effort in implementing a telecommunication infrastructure, based on the optical fiber installations in protection conductors of the over-head lines of 220 kV and 400 kV and of the related telecommunication equipment.

The infrastructure related to the EMS/SCADA system is the following:

EMS/SCADA system components	Detailed description
SCADA	Represents the system of information acquisition from NPS substations and major power plants at TED/CED for NPS management under safety conditions
Data acquisition from RTU and command – control - protection system	Represents the information and telecontrol acquisition in NPS transmission substations at substation level for NPS management under safety conditions
EMS	Provided the safety functions of the national power system and the dispatchers' training functions
Frequency – power control (AGC)	The system ensures the closed loop frequency control function and the control of transfers with the interconnected power systems
ETSO node	It represents the system whereby the data exchanges with UCTE power systems are carried out
Balancing market system	The systems which ensures the operation of balancing market, as per Commercial Code, within the energy market
Video wall projection systems	Graphic Information display systems using large screens, as support in decision-making process of the operational management.

4.11. Technical system services (STS)

According to the provisions of Technical Grid Code, the system technical services suppliers are qualified by Transelectrica through specific procedures. These procedures include also the possibilities to grant limited exceptions in order to comply with qualification requirements.
PTG users which were qualified to this effect may conclude supply contracts for system technical services.

The status of groups and supplier qualification for execution of system technical services for 2008 is shown in Annex B-12.

In order to ensure the quality requirements of the transmission and system services, Transelectrica SA purchases system technical services from qualified suppliers, pursuant to the conditions regulated by ANRE.

As of 01.08.2006, ANRE regulates the quantities and procurement prices of STS, and the differences will be purchased on competitive market.

ANRE introduced a new system service – capacity reserve – which was purchased by Transelectrica S.A. on capacity market established on 01.08.2007, in order to ensure the adequacy of existing production capacities in NPS to consumption demand.

Due to the insufficient competition on TSS market and its non-stimulative character, the situation worsened in 2006 and 2007 as to the TSS (power reserves) acquirement by Transelectrica S.A., TSS required by a NPS operation within rated safety limits. The volume purchased was below requirements and the fulfilment level of contracted services was unsatisfactory.

The status of purchase and fulfilment of system technical services in the last 5 years is shown below:

Technical system services - 2003 (hMW)

	contract	achieved	%
	[hMW]	[hMW]	
Secondary regulation range	2603282	2524653	97.0%
Fast tertiary regulation reserve	3503600	3529760	100.7%
Slow tertiary regulation reserve	2452520	2054564	83.8%

Technical system services - 2003 (hMW/h)

	contract	achieved	%
	[hMW/h]	[hMW]	
Secondary regulation range	297	288	97.0%
Fast tertiary regulation reserve	400	403	100.7%
Slow tertiary regulation reserve	280	235	83.8%

Technical system services - 2004 (hMW)

	contract	achieved	%
	[hMW]	[hMW]	
Secondary regulation range	2788920	2427844	87.1%
Fast tertiary reserve	6723431	6483506	96.4%
Slow tertiary reserve	4204800	3832000	91.1%

Technical system services - 2004 (hMW/h)

	contract	achieved	%
	[hMW/h]	[hMW/h]	
Secondary regulation range	318	276	87.1%
Fast tertiary reserve	765	738	96.4%
Slow tertiary reserve	479	436	91.1%

Technical system services - 2005 (hMW)

	contract	achieved	%
	[hMW]	[hMW]	
Secondary regulation range	3277200	2698245	97.0%
Fast tertiary regulation reserve	6955255	6486762	100.7%
Slow tertiary regulation reserve	6497430	6047170	83.8%

Technical system services - 2005 (hMW/h)

	contract	achieved	%
	[hMW/h]	[hMW/h]	
Secondary regulation range	374	308	82.3%
Fast tertiary regulation reserve	794	740	93.3%
Slow tertiary regulation reserve	742	690	93.1%

Technical system services - 2006 (hMW)

	Required by UNO-DEN	regulated	contracted	achieved	%	
	[hMW]	[hMW]	[hMW]	[hMW]	Contract [%]	Required [%]
Secondary regulation range	4029600	2015963	3224369	2231526	69.2%	55.4%
Fast tertiary reserve	7008000	4865393	6557383	6205201	94.6%	88.5%
Slow tertiary reserve	6132000	2080951	5155848	4516401	87.6%	73.7%

Technical system services - 2006 (hMW/h)

	Required by UNO-DEN	regulated	contracted	achieved	%	
	[hMW/h]	[hMW/h]	[hMW/h]	[hMW/h]	Contract [%]	Required [%]
Secondary regulation range	460	230	368	255	69.2%	55.4%
Fast tertiary reserve	800	555	749	708	94.6%	88.5%
Slow tertiary reserve	700	238	589	516	87.6%	73.7%

As from 01.08.2006, ANRE regulates the capacities and procurement prices of TSS and the differences are going to be purchased on competitive market.

Technical system services - 2007

	Required by UNO-DEN	regulated	contracted	achieved	%	
	[hMW]	[hMW]	[hMW]	[hMW]	Contract [%]	Required [%]
Secondary regulation range	3528100	2029021	2457926	2450230	99.7%	69.4%
Fast tertiary reserve	7008000	5665274	5998741	5965331	99.4%	85.1%
Slow tertiary reserve	5697700	4145758	4654343	4605878	99.0%	80.8%

4.12. Metering system

The "Metering and assembling metered data operator" work within Transelectrica S.A. is performed by OMEPA and addresses the following components:

- Tele-metering of "A"-category metering points (according to the Electricity Metering Code) through the system executed under the contract between Transelectrica S.A. and Landis & Gyr company, Switzerland. This project was completed 100% during 2007, being installed new voltage and current transformers in the electrical substations of Transelectrica and new teletransmission meters in the "A"-category metering points from NPS, as well as in the Transelectrica points of interest (exchange points between STs, own services of the electrical substations). The completed system fully meets the requirements of the "Electricity Metering Code" for Transelectrica S.A. substations and only partially for the third parties substations (the metering transformers do not comply with). It is mentioned that 170 electrical substations are covered in NPS, adding together approximately 1000 current-meters and 568 metering transformers, including also the interconnection lines of 110-220-400kV, previously metered by a separate system ("Energy Exchange Acquisition System" – EEAS). The system ensures the teletransmission (using the Transelectrica optical fiber as transmission environment, for the 58 electrical substations and GSM for the rest of them) of the metering data to the Metering Data Management System (MDMS), where data are processed and the results are provided to the qualified entities. The system supplies metering horary data and it is used in horary settlement on the electricity wholesale market;

- back-up tele-metering of interconnection lines (110-220-400kV) performed automatically and centralized through a separate systems (in compliance with UCTE requests);

- local metering of metering points for balance check on voltage levels within electrical substations is carried out on a monthly basis by local reading in substations, inspection and centralization in OMEPA workshops, centralization in OMEPA Bucharest, reporting to CD, UnO-DEN, ST. It is specified that this work mode is obsolete being time-consuming and providing indicative results. By retrofitting some electrical substations, local metering systems are implemented which perform the balance and OTC calculation functions, with the possibility to teletransmit at OMEPA Workshop level, where such systems are also monitored. Such retrofitted substations are Fundeni, Bucuresti Sud, Slatina, Gutinas, Cernavoda, Iernut, Brazi Vest, Paroseni, being retrofitted the Bacau Sud, Roman, Suceava, Lacu Sarat substations and others according to the NPS modernization plan.
- The assembly of metering data for electricity wholesale market. Pursuant to the Commercial Code of the Electricity Wholesale Market (entered into force on 01.10.2005), Transelectrica through OMEPA Branch collects the horary data which are metered or pre-assembled by other metering operators (Electrica, Hidroelectrica, etc.) for the metering points of the wholesale market participants which are not directly metered by OMEPA (by data file import in XML format), performs the final assembly of all metering data from this market (including the data telemetered by OMEPA) and communicates the results (for dispatchable groups and Balance Responsible Parties) to

TSO and OPCOM. Furthermore, OMEPA provides the market participants with own metering and assembly data for their validation purposes;

- Data validation for metering points where Transelectrica is transfer partner (market participant transfers in PTG points) and agreement on the data for replacement of incorrect metered values.
- OMEPA also performs the participants' administration function for energy wholesale market for the purpose of their registration for metering points and own assembly formulas with their mutual confirmation.

OMEPA also carries out the related activities of periodical inspections of facilities and metrologic inspections for meters (own and third parties'). OMEPA Branch currently has portable instrument sets for installation inspection (in all 8 OMEPA Centres) and three authorized laboratories for metrologic inspections of the meters, which operate within OMEPA Centres from Sibiu, Timisoara and Craiova. This activity is really useful, considering the large number of meters managed by OMEPA, and it increases the efficiency and reduces the related operating costs.

OMEPA also has specialized equipment and personnel certified for measuring the power quality parameters. Thus, OMEPA retains 5 portable equipments for power quality analysis, also manages 2 independent systems for power quality monitoring, one for Sibiu area and the other for large consumers in PTG. Measurements on power quality in Transelectrica substations were made in order to verify the parameter compliance with the accepted values in Technical Grid Code and standards in force.

4.13. Telecommunication system

For every company, telecommunication network is the basic element of the information system, where IT services and applications can be implemented and developed, to serve the final users. Therefore, the concept and implementation of a proper design of telecommunication network determines the network capacity to support the implementation of various services and applications required by the activities developed within the company.

As to communication infrastructure, Transelectrica holds one of the largest national optical fiber networks (approximately 5000 km) with a huge transmission capacity (currently maximum STM-16, a limitation given by the transmission equipment, except for the segments with DWDM).

The optical fiber infrastructure is executed on the power transmission infrastructure, the fiber cable using the ground wire between power-line towers. The nodes of optical fiber network are the Transelectrica substations, in fact most of these substations are connected on this infrastructure.

The locations on the primary nodes of the fiber rings are on-grid locations. The off-grid locations are the radial ones.

The present telecommunication system is based on an own infrastructure and one rented from communication services providers.

The own infrastructure consists of:

- Carrier current systems, analog systems or controlled by microprocessor;
- Telecommunication equipments;
- 4000km of optical fiber on the electrical lines of 220, 400kV

Below, the infrastructure related to telecommunication system is described:

Telecommunication system components	Detailed description
National optical backbone network, including the internal optical network OPGW, optical interconnections with electricity companies of Hungary, Bulgaria, Serbia, metropolitan optical connections and optical connections with other domestic companies/operators	It represents the communication physical support for all critical services addressed to the Transelectrica company, UCTE, ETSO and state government entities.
Microwave infrastructure in 7 Ghz, 13 GHz and 23 GHz	It ensures the data-voice operative communications for the system operator, for metering operator and for balancing market
Backbone DWDM-SDH systems	It ensures the operation of all applications and systems required by the company's basic activities through complex routing and protection mechanisms
Carrier current systems installed on electrical transmission lines; Dedicated channel systems WT	It ensures the low frequency communications related to the transmissions of equipment for process data acquisition from substations and thermal/hydro/nuclear power plants, teleprotection signals on transmission lines and interfacing the Company's private telecommunication system with public systems of other operators.
Data transmission systems Hotline and commutated telephone systems Video/teleconference systems	It ensures the information transmissions for system operator It ensures the critical vocal communications for dispatching activity and for transmission operator locations It ensures the periodical communications for transmission and system operator locations

The infrastructure of EMS/SCADA and telecommunication system is shown in fig. 4.13

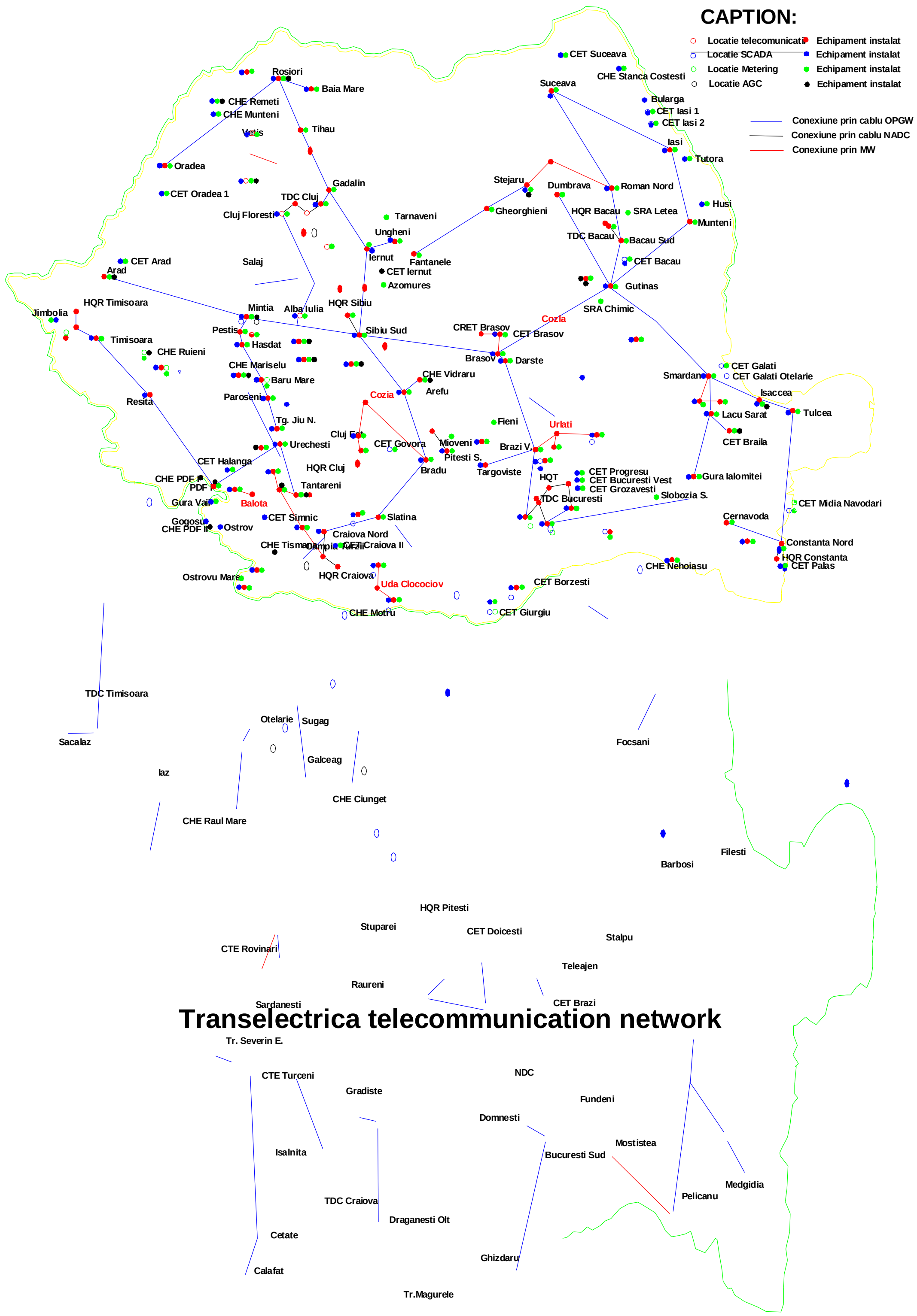


Figure 4.13. Telecommunications and EMS/SCADA system infrastructure

5. Protection of Installations and Crisis Management

In the current international context marked by an escalation of terrorism, in particular the EU Member democratic states, and given the prospective accession of Romania to the European structures, Romania's country risk – from the national protection perspective – as potential target of terrorism attacks is significantly increasing. The effects a terrorist attack may have on the Transelectrica S.A. objectives, from the shutdown of power supply of small areas (remote localities) to the disturbance of the entire NPS with disastrous effects on the population, and the economy in general, the PTG installations operated by Transelectrica S.A are a target for possible terrorist attacks. Also the Romanian society has witnessed an increase in crimes, both theft, and unauthorized entries in IT networks.

In light of the above, Transelectrica S.A has created in its organizational structure the Protection and Crisis Management Department that primarily aims at the protection of the PTG installations and related IT systems against terrorist or criminal threats, as well as a response structure in case of natural calamities.

5.1. Current Situation

CSMSU is run by the Installation Protection Manager who is directly subordinated to the General Manager of Transelectrica S.A.

The primary missions of the Department are:

- provide a protection level for installations that is appropriate for NPS requirements and threats;
- provide a Company's defence capacity against physical or IT disturbing factors;
- organize and coordinate the crisis management activity (civil protection and fire prevention and extinction);
- organize and carry out classified information protection;
- organize and coordinate the military recording activity;
- implement physical and computer specific investment projects;

At present, the physical protection of the Transelectrica S.A. is primarily done via protection services by specialized companies.

Also, for improved protection conditions, Transelectrica S.A. entered into collaboration protocols with the State's competent authorities. In the event of unforeseen events (disasters, natural calamities etc.), Transelectrica S.A. recently revised the "Disaster Defence Plan".

In terms of information protection, Transelectrica S.A. applies the „need-to-know" principle, giving access rights depending on staff position and skill level. The access to the Transelectrica S.A IT network is done based on username and password, which makes it possible to view certain areas only and the applications required for good performance of the staff's tasks.

5.2. Perspectives

For safe and stable NPS operation purposes, Transelectrica is considering an increase in the protection level of objectives, depending both on the patrimonial value of assets, and their functional importance.

The Transelectrica strategy on providing an appropriate objective protection level, with minimum costs, includes a set of own tasks conducted on Company level:

1. Assess vulnerabilities and risk management: this task identifies the critical goals for task performance, and their vulnerability level.
2. Continuous improvement of the capacity to respond to threats: it stands for the level of staff preparation to cope with a most varied range of physical and IT threats.
3. Crisis management: makes sure the system as a whole is ready to respond to physical and IT threats.
4. Drafting process continuance plans: consider aspects related to a long-term reduction in probable malfunctions and the increase in prompt recovery of the initial status.
5. Communication development: provides for coherence of response capacity-related tasks, crisis management and recovery plans. An important aspect is the connections with the authorities.
6. Increase in the physical protection level: pursues a reduction in system inner and outer threats.
7. Increase in IT protection: ensures a reduction in the risk level of command and control systems, data procurement and tele-protection;
8. Staff protection measures: should lead to a decrease in threats inside the system and consider employment and periodical checking of staff involved in critical tasks.
9. Information protection: for a reduction of availability of critical, classified or non-classified, information to potential aggressors.

In implementing the aforementioned measures, Transelectrica aims at setting up and operating a protection management framework as an integral part of the Company's management system.

The primary goals of the Transelectrica protection management system are as follows:

a. Physical protection: Provide for prevention, detection and response measures with a view to diminishing protection risks of the Company's installations and goals, based on subsidiarity, complementarity and proportionality principles.
Measures to include resources assignment for investments and/or use of specialized services based on an assessment of vulnerability and risk analysis.

b. Information protection: Provide for measures to diminish IT risks based on a classification of IT resources and resource assignment proportionality. To consider the identification of critical IT resources and an assessment of the risks they incur and the priority application of risk tackling programmes for said resources.

c. Staff protection: Increased attention shall be paid to inner threats, as well as the improvement of the staff's information on protection issues, and the roles and responsibilities of each staff member in connection with protection-related aspects.

d. Business continuity: Make sure within reason that abnormal conditions and events that may be foreseen should not affect the Company's mission more than acceptably and for a limited period of time. For such situations, provide for an organization framework for crisis response and management and recovery after incidents.

e. Legal protection: To provide for compliance with the legal provisions for all Company responsibilities related to protection aspects:
- classified information protection
- fire protection
- civil protection
- personal data protection
- privileged data protection.

f. Critical infrastructure protection: As a critical infrastructure operator, we aim at increasing the Company information level, the active participation in identifying and assessing critical infrastructure designation criteria in the power sector, Company asset vulnerability and interdependence analysis methods, as well as the cooperation with third parties and within UCTE. To constantly act for ensuring conformity with regulations on critical infrastructure protection in its various aspects (including critical IT infrastructure protection) based on subsidiarity, complementarity, proportionality and confidentiality principles.

g. Provide for core protection conditions for third party relations: In third party collaboration relations, to primarily consider an indication of protection requirements and risk diminishing measures, outlining protection requirement fulfillment monitoring matrices, mechanisms of audit, control, responsibility and sanctions in case protection-related incidents.

Some protection-related tasks may be, as applicable, outsourced upon compliance with the appropriate Company task protection requirements.

5.3. Physical Protection Programme Implementation

The physical protection system Transelectrica intends to achieve shall comply with the protection principles required to systems of size and complexity similar to those of the Company, i.e.:

- possible dispatching of protection incidents
- possible definition of increased protection areas depending on objective importance and various areas on the objective territory
- capacity to extend to all Company objectives
- unique identification of access requesting staff
- authentication of persons approving access requests
- transmission of requests and approvals in secured, unified and accessible electronic format
- creation of databases to provide for access traceability within critical infrastructure-related strategic goals
- possible granting and revocation of operative access.

As concerns the implementation of the physical protection programme, the breakdown by years is as follows:

1. In 2008 to complete the integrated protection systems in 11 objectives.
2. In 2009 to complete the integrated protection systems in 20 objectives
   In 2010 to complete the integrated protection systems in 45 objectives

6. Environment Protection related to PTG

6.1. Impact of Transmission Grids on the Environment

The transmission power networks have a certain negative impact on the environment during their entire lifetime, starting with the „construction and mounting” stage (Table 6-1), further to the „operation and maintenance stage (Table 6-2), to the final „shutdown” stage.

Table 6-1 PTG impact during construction and mounting

Type of impact	Manifestations (effects)
Physical	open new access routes, soil uncovering and excavations impact on flora (by deforestation) and wild life habitat land occupation with site organization activities, including warehouses waste deposits and material surplus from work locations
Chemical	Use of various chemical products (paints, solvents, reagents etc.) air emissions from heating installations or transmission means
Sound	noise made by transmission means
Social and economic	disturbance of social activities

Table 6-2 PTG impact during operation and maintenance

Type of impact	Manifestations (effects)
Physical	land occupation with OHL routes and substation perimeters systematic deforestation impact on wild life habitat obstacles in bird routes possible accidents resulting in burns or electrocution
Electromagnetic	sound and luminous effects of the corona phenomenon disturbances of radio and television systems influences on telecom installations or other electric networks when crossing each other or vicinity of each other effects of the electromagnetic field on living beings
Visual	impact on the landscape
Sound	noises made by the PTG element operation and vibration noises made by the corona phenomenon (in very high voltage OHL) or electric transformers
Mental	fear induced by the PTG vicinity and its visual and sound effects
Chemical	soil and water pollution by accidental spillage of oil and other chemical substances air pollution by emissions from thermal substations, motor vehicles, batteries generation of ozone and azote oxides by the corona high voltage effect

Mechanical	possible danger of collision with aircrafts danger of fall near or crossing of roads, railroads, buildings etc. fire danger as a result of insulation deterioration or accidental contact of conductors with objects or dry vegetation

6.2 Legislation Requirements for the New and Existing Facilities

The primary national regulations on the PTG applicable environmental protection are:

- Law No. 107/1996 – Law of Waters (amended and supplemented by Laws No. 310/2004 and No. 112 / 2006);
- Law No. 655/2001 – Atmosphere Protection (approves the Government's Emergency Ordinance No. 243/2000);
- Law No. 426/2001 – Waste Status (approves the Government's Ordinance No.78/2000, amended and supplemented by Law No. 61 / 2006 and Law No. 27/2007);
- Law No. 360 / 2003 on the status of hazardous chemical substances and preparations;
- Law No. 265/2006 for the approval of the Government's Emergency Ordinance No. 195/2005 on environment protection;
- Law No. 292 / 2007 for the amendment of the Government's Emergency Ordinance No. 196/2005 on the environment fund;
- The Romanian Government's Decision 536/1997 Hygiene standards and recommendations on the population living environment (changed and supplemented in 2007);
- The Government's Decision No. 173/2000 – Regulations on control and management of phenochlors and other similar compounds (amended and supplemented until 2007);
- The Government's Decision No. 235/2007– Used oil management;
- The Government's Decision No. 1.057/2001 – Status of batteries and accumulators with a hazardous substance content;
- The Government's Decision No nr. 118/2002 – Norms on the terms of wastewater disposal in waterways (updated and supplemented until 2005);
- The Government's Decision No. 856/2002 – Records of waste management and list of waste, including hazardous waste;
- The Government's Decision No. 124/2003 Prevention, reduction and control of asbestos environment pollution;
- The Government's Decision No. nr. 804 / 2007 on the control of activities that incur major threats of accidents involving hazardous substances;
- The Government's Decision No. 170 / 2004 - Used tire management;
- The Government's Decision No. 349/2005 – Waste storage;
- The Government's Decision No. 448 / 2005 – Electric and electronic equipment waste;
- The Government's Decision No. 992 / 2005 – Limitation of use of certain hazardous substances in electric and electronic equipment;
- The Government's Decision No. 321/2005 on the evaluation and management of outdoor noise (amended and supplemented until 2007);
- The Government's Decision No. 621 /2005 – Management of packages and package waste;

- The Government’s Decision No. 1.213 / 2006 on the establishment of the framework procedure for the evaluation of the environment impact of certain public and private projects;
- The Government’s Decision No. 1.403 / 2007 on the recovery of areas where the soil, subsoil and terrestrial ecosystems were adversely affected;
- The Government’s Decision No. 1.408 / 2007 on means to investigate and evaluate soil and subsoil pollution;
- Order of the Ministry of Water and Environment No. 462 / 1993 for the approval of the Technical Conditions for atmosphere protection and Methodological Standards on determination of atmospheric polluting agent emissions generated by steady-state sources;
- Order of the Ministry of Environment (MAPPM) No. 278 / 1997 Framework methodology on the elaboration of plans to prevent and fight against accidental pollution on using potentially polluting water usage;
- The Government’s Emergency Ordinance No. 89 / 1999 – The commercial system and introduction of restrictions on use of perhalocarbons that have a destructive effect on the ozone layer;
- The Government’s Emergency Ordinance No. 243 / 2000 on atmosphere protection;
- The Government’s Emergency Ordinance No. 16/ 2001 (republished-updated until 2003) – Management of recyclable industrial waste;
- Order of the Ministry of Water and Environment No. 1.144 / 2002 – Registry of polluting agents issued by the activities under art. 3 par. (1) lett. g) and h) of the Government’s Emergency Ordinance No. 34/2002 on the prevention, reduction and integrated control of pollution and pollution reporting
- Order of the Ministry of Water and Environment No. 592/2002 for the approval of the Standards on defining limits, threshold values, criteria and evaluation methods of sulphur dioxide and azote oxides, suspension powders [PM(10) and PM(2,5)], lead, benzene, carbon monoxide and ozone in the air;
- Order of the Ministry of Public Health No. 1.193 / 2006 for the approval of the Standards on the limited exposure of the general population to electromagnetic fields from 0 Hz to 300 GHz .
- Order of the Ministry of Water and Environment No. 860/2002 – Evaluation procedure on the environment impact and environment agreement issue;
- Order of the Ministry of Water and Environment No. 863/2002 – Approval of methodological guides applicable to the stages of the framework procedure for the evaluation of environment impact;
- Order of the Ministry of Agriculture, Forests, Water and Environment No. 210 / 2004 on the amendment of Order of the Ministry of Agriculture, Forests, Water and Environment No. 860/2002 for the approval of the environment impact and environment agreement issue;
- Order of the Ministry of Economy No. 175/13.04.2005 on the procedure to report data concerning the environmental protection by industrial companies;
- Order of the Ministry of the Environment and Water Management No. 1037/2005 – Amendment of the Ministry of the Environment and Water Management No. 860 / 2002 for the approval of the environment impact and environment agreement issue;
- Order of the Ministry of the Environment and Water Management No. 927/2005 –on the procedure to report data on packages and package waste;

- Order of the Ministry of the Environment and Water Management No. 1001/2005 on reporting procedures by companies, data and information on chemical substances and preparations;
- The Government's Emergency Ordinance No. 195 / 2005 – Environmental Protection**;**
- The Government's Emergency Ordinance No. 196 / 2005 – Environment Fund;
- Order of the Ministry of the Environment and Water Management No. 662 / 2006 on the Procedure approval, approval issue competences and water management authorizations;
- Order of the Ministry of Environment No. 1.798 / 2007 for the approval of the environment authorization issue procedure;
- Standards of the environment management system in series: ISO 14000 and 19000;

Pursuant to the national environment legislation harmonized with the EU legislation, the operation of the transmission power network is allowed only upon environment and water management permits. An "environment permit" and a „water management permit" are required for new objectives or change of the existing ones via construction and mounting works that change the objective specifications or capacity. Both document categories are issued by the environment authorities based on the substantiation documentation issued by the beneficiary.

The "environment permit" task was completed 100% at the end of 2007.

In 2008 – 2012, given Romania's accession to EU and the PTG interconnected operation with the UCTE similar systems, it is very likely that additional measures to reduce the negative environmental impact should be necessary within Transelectrica S.A. branches in order to obtain a renewal of environment and water management permits.

6.3 Steps Taken to Reduce PTG Impact on the Environment

- In 2008 – 2012, and probably 2018, the steps established by the environmental protection authorities must be implemented as a priority, both the ones in the "conformity programmes" that set up environment/water management permit issue requirements and those resulting following the periodical checking done in branches;
- All documentations on maintenance works and retrofitting will include a special chapter on environmental protection steps/actions to be outlined physically and value wise;
- For works of new objectives, as well as retrofitting/modernization, the "Environment Management Plan" will be drafted that will include environment impact reducing and environment factor monitoring actions both during demolition, construction, operation/maintenance, as well as shutdown. An estimation of the necessary funds will be made for each single action and the necessary recordings will be mentioned.
- Legal environmental protection requirements and environment management standard requirements will be considered on evaluating the Transelectrica S.A. service and work providers;
- The management of all waste resulting from the Company's activities will be improved;
- Special attention will be paid to improving oil management by drafting an oil report per substation, as well as the safe collection and use of used oils;
- In 2008 – 2012, to continue monitoring the wastewater in substations and to start corrective actions for compliance of their parameters within the maximum limits on disposal;

- In 2008 – 2012, to continue monitoring the electromagnetic field parameters, in particular in OHL, in adjacent populated areas and noise measurement/monitoring at substation boundaries;
- It is necessary to maintain the operation and improvement of the environment management system pursuant to ISO 14001/2004, including international recognition;
- In 2008 – 2012, to pursue certification of the environment management system according to EMAS ;
- To annual edit the Company's "Environmental Report" to ensure external communication in the field and to organize the annual environment symposium;
- To use all possibility of information and experience exchange in the field of environment protection with EU partners and others for the continuous improvement of the Company's environment performances.

7. Current Situation – Synopsis

The estimated adequacy of the system pursuant to the UCTE methodology was ensured on the 3rd Wednesday of December – 12 o'clock (11 o'clock CET), the installed capacity in the substations being sufficient to cover the load peak of December and export in safe operation conditions of NPS.

Owing to the insufficient competition on the TSS market and its lack of stimulation, in 2006 and 2007, the situation got worse from the perspective of Transelectrica S.A. obtaining of TSS– power reserves – necessary for the NPS functioning within safe standardized limits. The purchased volume was below the necessary value, and the contracted service provision level was unsatisfactory.

After 2005 increased consumption in most SDFEE's was recorded.

In production conditions at priority level, the high consumption in Bucharest (both wintertime and summertime) leads to blockages, in particular in the western and eastern area of Bucharest;

* in the western area, blockages occur on tripping both in the transmission network, and the 110 kV one and consist of exceeding acceptable limits both on T 400/110 kV Domneşti, and the 110 kV Bujoreni – Grozăveşti axis;

* in the southern area, blockages occur on tripping of one of the AT's 220/110 kV in the Bucuresti Sud substation.

There is also a high load noted, near the impedance-tailored rated power, of circuits 1 and 2 of the 220 kV Bucuresti Sud – Fundeni line caused by the high consumption in Bucharest, both in summertime and wintertime.

It is worth mentioning that in summertime total shutdown is done for annual overhauling in thermal stations.

The electric power lines and substations that make up the national transmission systems were mostly built in 1960-1970, at that decade's technological level. Hence, the PTG technical status was characterized by an excessively long operation time defined by the 60's-70's legislation, and the use of poor quality at the time, given the importance of the equipment and their normal lifetime.

The air 220 kV and 400 kV electric lines in the national transmission system are as old as their standardized lifetime (40 years – as per the Government's Decision 2139/2004), approx. two thirds of them having already reached the end of their normal lifetime.

The increasing consumption dynamics will justify the transfer from the 220kV to the 400kV voltage within a quite long period of time as concerns an important part of the 220kV network. This is done selectively, as they continue to provide for a required function of transmission, a series of 220 kV substations entered the retrofitting programme. Development project for this voltage will be avoided as much as possible.

From the perspective of the line load as to impedance-tailored rated power, they are noted to have a comparatively low load, and values over the impedance-tailored rated power are registered on OHL 400 kV Urecheşti-Domneşti, Tânțăreni-Bradu, Sibiu – Braşov, Porțile de Fier-Djerdap, Tânțăreni- Kozlodui and OHL 220 kV Porțile de Fier –Reşița (dc), Bradu-Târgovişte (1 circuit), Gheorghieni - Fântânele – Ungheni, Bucureşti Sud-Fundeni (dc), Işalnița – Craiova (d.c.), Barboşi - Focşani.

The high load of interconnection lines is noted, in particular the 400kV line of Portile de Fier-Djerdap, and also the others, owing both to Romania's export, and the parallel circulations owed to transactions between external partners.

The Iernut-Ungheni-Fântânele de 220kV axis is also loaded near the impedance-tailored rated power owing to the deficient supply of section S5 (Moldova).

In the NPS transmission network, there are 3 areas non-compliant with the N-1 reference design criterion, i.e.:

– the Portile de Fier area, where certain automations are commissioned under decommissioning programming, with tripping of units in HPP Portile de Fier 1 correlated with simultaneous interconnection;
– the HPP Lotru area for the two circuits of OHL 220 kV Lotru – Sibiu for power disposal;
– the Barboşi area, on decommissioning of one 220kV OHL of the two in the Barboşi 220Kv substation;

Occasionally, depending on the power consumed by Feroaliaje Tulcea, the N-1 criterion is not complied with on decommissioning of one OHL 400kV of two in the Tulcea 400kV substation.

Owing to the existence of only 400/110kV T or the specificity of the PTG scheme, on decommissioning of elements from PTG, for compliance with the N-1 criterion, looping measures and/or use of the blockage management mechanism in the Sibiu Sud, Oradea, Bradu areas, are necessary.

On operation with two units in NPP Cernavodă, there appear produced power disposal problems if several 400 kV lines are withdrawn for a long period of time, simultaneously with short-term decommissionings for compliance with the N-1 criterion. In these situations, both node measures in the 110 kV network, and steps for consumption reduction in Dobrogea or production reduction in NPP Cernavoda are required.

The increase in consumption in the Dobrogea leads to difficulties of compliance with the N-1 criterion in the event of long-term decommissioning of 400 kV lines in Dobrogea, simultaneously with short-term decommissionings in the same area. Except for node measures for the 110kV network, it is also necessary to establish the upper limit of deficit in the Constanța – Medgidia – Tulcea area.

In the Pelicanu substation, on the long-term decommissioning of a 400kV line or a T 400/110 kV and the tripping of another piece of equipment, line or transformer, the N-1 criterion is not complied with. It is mentioned a 110 kV bus bar coupling connection is not possible in the Pelicanu substation, between B1 and B2, as this would disturb, because of the flicker effect, the operation of the other consumers in the SC Donasid and the area. It is necessary to take steps in Donasid for compliance of the status within the standardized current and voltage thresholds and the implementation of technical steps to remove the flicker effect at SC Donasid.

The retrofitting of the Gutinaş substation and its transformation into a substation with 1½ breakers along the circuit has led to compliance with the N-1 criterion in the event of a 220kV bar decommissioning when the other one is started.

The unloaded operation of the electric network leads to comparatively high voltage levels in PTG. To maintain voltages within the acceptance range it is necessary to connect a small number of reactive coils for peak conditions. In the off-load operational regime, it is necessary to connect all available coils. Also, on voltage adjustment, it is required to use other adjustment means as well: changes of plates in transformation units, capacitive operation of generators and disconnection of weakly loaded OHL 400 kV.

The NTC values in the Romanian interface may vary all year long between 20-100% under the influence of factors like:

- Decommissioning of interconnection electric lines and internal lines influencing the NTC values;
- Seasonal temperature difference;
- Production in HPP Portile de Fier and Djerdap, in particular in summertime;
- The limiting effect of the power market on the use by TSO of re-dispatching for the NTC increase.

The following were noted:

- Occasionally, export or import exchange programmes over the NTC value owing to the TRM use for emergency assistance (winter 2005-2006) and limited acceptance of liquidation;
- Increase in participants' numbers and competition per border;
- Increased level of actual use of the exchange capacity available in 2008 as compared to 2007.

In the winter of 2007-2008, Romania's circulations via the interconnection interface at load peak, business days, accounted for 66-101.4% of NTC, with an average of 86% of the export NTC for the 3 winter months.

As a result of the enforcement of viability-based maintenance principles and introduction of modern state-of-the-art equipment via retrofitting actions, one can note a tendency to improve the transmission service performance indices during the latest years in terms of supply continuity.

As a result of the measures taken in the design, scheduling and operative implementation stages, the progress of network loss evolution in the latest 5 years is characterized by a decreasing tendency from 2.64% in 2003 to 2.16% in 2007.

The outcome analysis results in the conclusion that, in the 2008 stage, the level of short circuit currents in the 400 and 220kV substations is under the value of switch breaking currents.

The exception is the Mintia 220kV substation where the operation is required to take place with a disconnected bus bar coupling device in the scheme of all commissioning equipment (including all generators). In the decommissioning and/or shutdown generator scheme the connection of the bus bar coupling device is conditionally allowed. The 220kV Mintia substation is included in the retrofitting plan.

When connecting all bus bar coupling devices to 110 kV, in some 110 kV substations, the value of short circuit one-phase currents exceeds 31.5 kA – the current capacity of the equipment, which requires limitations of acceptable operation schemes.

It is noted that the acceptable power in the PTG typical sections is determined, in most cases, by the thermal limitations of the equipment or reaching minimum acceptable values of the voltage and not reaching steady-state stability limits.

The analysis concerning the NPS transient stability conditions, assuming interconnected operation, resulted in that the transient stability is generally ensured with the current equipment, with some exceptions.

In order solve the above issue, the retrofitting of the following substations is necessary: 400 kV Gura Ialomitei, 220 kV Alba Iulia, 400 kV Smardan, Domnesti, Pelicanu.

Also, tele-protection equipment installations are necessary to be done on OHL 220 kV Alba Iulia – Cluj Floreşti, Alba Iulia – Mintia, Alba Iulia – Gâlceag, Alba Iulia – Şugag.

The Dobrogea network requires power limitations on operation with 2 units in NPP and schemes with 2 line decommissionings in the area in terms of transient stability and post-damage status acceptability. The development of the Dobrogea network is necessary;

To stabilize the Portile de Fier+Djerdap area and the interconnection, the following are necessary:

- Commissioning of OHL 400 kV Arad-Nadab-Bekecsaba;
- Execution of the 400kV Portile de Fier-Resita-Timisoara-Arad axis;
- Execution of a new OHL 400 kV for interconnection with Serbia.

In 2007, Transelectrica completed the tele-metering system for A class measuring points (according to the “Electrical Power Measuring Code”), used in the hourly reimbursement on the electric power wholesale market. New voltage and current transformers were installed in the Transelectrica substations and new teletransmission meters in all A class measuring points in NPS. The system covers 170 electric substations, amounting to a total of approx. 1000 meters and 568 transformers. The system provides for data teletransmission to the Tele-Metering Data Management System (MMS), with Transelectrica optic fiber as transmission medium for 58 substations and GSM for the remaining substations.

8. Electric Power Consumption Forecast for 2008 – 2018

8.1. NPS Electric Power Consumption Forecast correlated to GDP Evolution

The electric power consumption forecast in 2008 – 2017 takes into account the document called “Romania’s Power Strategy for 2007- 2020” elaborated by MEF and approved by a Government’s Decision No. 1069/2007 and the information and forecasts received from distribution operators, with its primary goal of the power sector sustainable development and the integration of the power industry in the European structures.

For 2008 – 2017, the forecast annual average GDP increased pace and the final electric power consumption is 5.7%, and 3.2% respectively.

To highlight the evolution of the electric power consumption, a baseline scenario and two alternative scenarios have been envisaged, a minimal and a maximal one. The primary elements of these scenarios are provided in table 8.1.

Table 8.1

[TWh]

	2008	2013	2018
Minimum scenario			
net production	**56.5**	**64.8**	**70.9**
gross internal consumption	54.3	61,8	67.9
annual pace %		2.6	1.9
Basic scenario			
net production	**56.5**	**67.1**	**77.1**
gross internal consumption	54.3	64.1	74.1
annual pace %		*3.4*	*2.9*
Maximum scenario			
net production	56.5	70.0	81.3
gross internal consumption	54.3	67.0	78.3
annual pace %		*4.3*	*3.2*

In the basic scenario the evolution of the energy and electric power consumption and the main specific parameters in 2008– 2017 are provided in Table 8.2.

The net peak power of the internal consumption increases from 8501 MW in 2008 to 12065 MW in 2017.

Table 8.2

	2007	**2008**	**2012**	**2017**
Final consumption (at the final electric power consumer) [TWh]	47.94	48.40	57.32	66.22
Net internal electric power consumption (including network losses) [TWh]	54.14	54.27	64.10	74.05
Electric network losses [TWh]	6.2	5.8	6.7	7.8
Electric power net production [TWh]	56.37	56.46	67,10	77.05

Net internal consumption (including network losses) – peak power [MW]	8681	8501	10253	12065
Use duration of maximum power [h/year]	6236	6056	6073	5948

8.2 Evolution of Electric Power and Energy Consumption in the Territory in 2008, 2012 and 2018 as a guide – Basic scenario

A basic constituent of the territorial consumption forecast should have been the consumption forecasts by substations done by the distribution operators and provided to Transelectrica S.A. in compliance with the provisions of the PTG Technical Code. Among the eight major NPS distribution operators, only ENEL Distribuție Dobrogea and EON Distribuție Moldova provided the requested forecasts.

Hence, in terms of the territorial consumption distribution forecast, by consumption centres, the starting point was the readings done at the 110, 220 and 400 kV substations on calendar days in year 2006: January 18th, 4 and 10 o'clock, July 18th and 19th, 4, 10 and 22 o'clock and the global country consumption increase coefficient was applied. The outcome was thus the forecast of consumed power on the calendar levels of the load curve, for winter evening peak consumption (WEP), summer morning peak consumptions (SMP) and summer night low consumption (GNV).

In some urban centres (Bucharest, Braşov, Cluj, Timişoara, Constanța, Tulcea), a marked increase in consumption over the national increased pace was considered as announced by some distribution operators and by requests of connection technical approvals.

In Bucharest, the consumption increase rate is higher than the country average rate. 8% consumption increases were recorded in 2006 as compared to 2005, 18% in 2007 as compared to 2006, and ENEL Distribuție Muntenia Sud forecasts in 2012 an 87% increase as compared to 2006 and a 115% increase in 2017. This forecast was included in the basic scenario used in the Perspective Plan in order to define the necessary level of the Capital City supply network consolidation.

At the same time, for areas in the country that consumption forecasts have not been ordered for from distribution operators, the country average increase percentage was applied.

In the Constanța-Black Sea seaside area, a 52% increase is forecast as compared to 2006 in 2012 and an 85% increase in 2017.

Information from distribution operators on large consumer consumption increase was also considered:

- FERAL Tulcea – requests consumption increase to 185MW (at present, it has an approval from ENEL Dobrogea for 170MW; such consumption, alongside with the ALUM consumption - 32 MW and that of the Tulcea city - 108 MW, exceeds on consumption peak the capacity of a T 400/110kV 250 MVA in Tulcea, on the start of the second one).
- SC ATON Transilvania – a new consumer that is considered connected to the 220kV network in the Calea Aradului substation, with a possibility to transfer to 400kV, requests connection for a 100MW consumption;
- CEFIN POLO (40MW) and Park Industrial Dragomireşti (40MW) – request supply from OHL 110 kV Domneşti – Chitila;

- Donasid (45MW) and Saint Gobain (149MW) – request supply from the Pelicanu 110kV substation;
- In the Braşov area, there is the new consumer, Parc Industrial S.C. ICCO S.R.L., radial connected to the 110kV ICA Ghimbav substation, Pconsum = 10 MW in 2008 (15 MW after 2009) and S.C. Graells&Llonch Invest SRL – Parc industrial Prejmer connected to the two circuits of OHL 110kV Braşov- Sfântu Gheorghe, Pconsum = 30 MW in 2008 (42MW after 2009) ;
- In the Cluj area (the Jucu commune) the connection of new consumers is requested - Parc Industrial Tetarom III (100 MVA - 2015).

The net power, with no network loss, consumed at winter evening peak consumption (WEP), measured for 2006* and envisaged in calculations for years 2008, 2012 and 2017, by distribution branches and total NPS are provided in Tables 8.3 and Figure 8.1.

Table 8.3 **[MW]**

	MOLDOVA	MUNTENIA NORD	DOBROGEA	MUNTENIA SUD	OLTENIA	BANAT	TRANSILVANIA Nord	TRANSILVANIA Sud	TOTAL NPS
Measured 2006	**872**	**1080**	**765.3**	**991**	**1724**	**768.6**	**756.1**	**802.6**	**7760**
Forecast 2008	**911.1**	**1108.6**	**828.5**	**1562.9**	**1812.2**	**846.5**	**794.8**	**833.7**	**8698.3**
[%] readings 2006	104	103	108	158	105	110	105	104	112
Measured 2012	**1031.7**	**1215**	**992.7**	**1857.9**	**2240.3**	**1014.2**	**956.8**	**973.9**	**10282.6**
[%] readings 2006	118	113	130	187	130	132	127	121	133
[%] 2008	113	110	120	119	124	120	120	117	118
Forecast 2017	**1260.9**	**1432.6**	**1146**	**2126.1**	**2582.7**	**1215.9**	**1156**	**1190.8**	**12111**
[%] readings 2006	145	133	150	215	150	158	153	148	156
[%] 2012	122	118	115	114	115	120	121	122	118

* Measurements on January 18th, 2006, 18:00

Figure 8.1

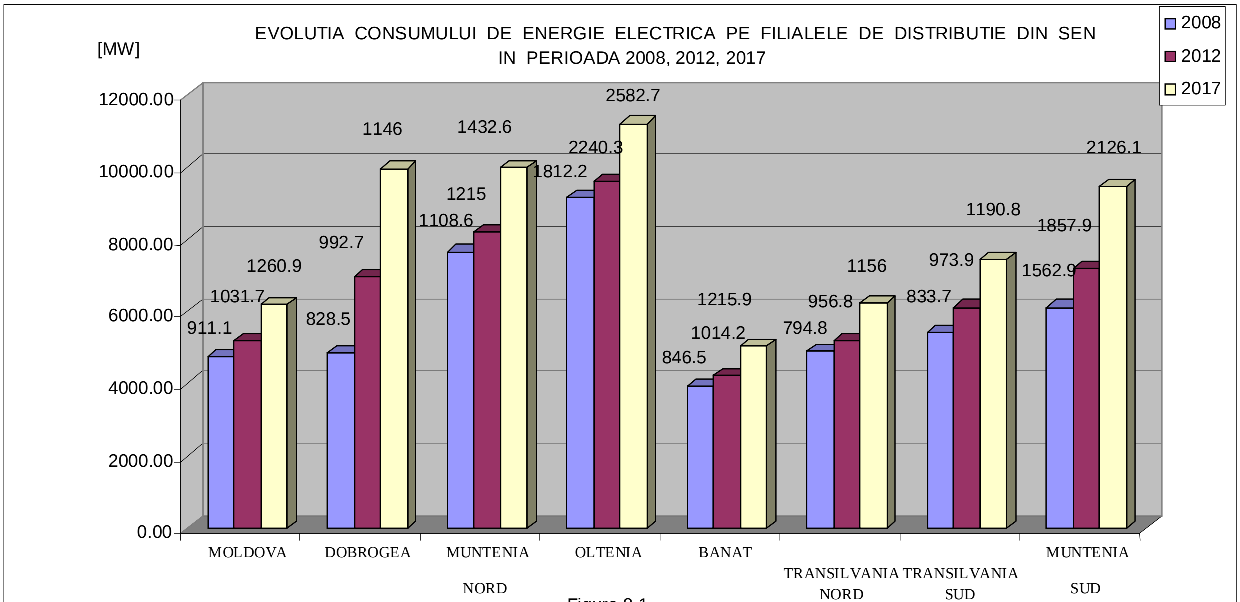


Figura 8.1

Annexes C-1-1 and C-1-2 provide a forecast of the electric power consumption in 2008, 2012 and 2017 by substations and SDFEE's.

In view of more remote time intervals (2012 and 2017), higher or lower consumption rates were considered, resulting into three scenarios: average, minimum and maximum. As the network is sized for the maximum NPS consumption, recorded at winter evening consumption peak, three scenarios for the winter evening consumption peak (WEP min, WEP average and WEP max), and an average scenario for the summer morning consumption peak (SMP) and evening summer holiday low consumption (GNS) were used. The consumption values for these levels are provided in Table 8.4 and the substation-by-substation breakdown in Annex C-1-1.

Table 8.4

	Net consumption [MW]	**No loss net consumption [MW]**	**Losses in modelled networks [MW]**
2008			
WEP average	8962.0	8698.0	264.0
SMP	7419.3	7169	250.3
GNV	4145.3	4002	143.3
2012			
WEP medium	10563.4	10283	280.4
WEP min	10052.8	9783	269.8
WEP maximum	11110.0	10805	305
SMP	9025.1	8777	248.1

GNV	4257.5	4141	116.5
2017			
WEP medium	12475	12111	364
WEP min	11243	10913	330
WEP maxim	13228	12850	378
SMP	10685	10363	322
GNV	5145	5018	127

9. Production Required to Cover Electric Power Consumption in the period 2008 – 2017

9.1. Forecast of Production Facilities Evolution

The information from producers was considered as concerns the retrofitting plans, replacement or quashing of certain groups (Annex C-2).

In 2008 ÷ 2017 a program of final decommissionings from operation was announced on reaching the end of their lifetime or because of very low efficiency. The decision to shutdown certain groups should take into account, besides the old age and their market place, aspects related to the NPS safe operation. The power installed in the groups to be quashed amounts to a total of 2520 MW of which 1290 MW in 2016.

In 2008-2017 retrofitting is forecast for groups amounting to 3700 MW, and the primary goal is the compliance with the European environment protection requirements.

The total installed power of the groups proposed for final decommissioning from operation in 2008 ÷ 2013 is 712 MW and in 2014 ÷ 2018 it is 1808 MW. Under there circumstances, the net production capacity of the substation group is reduced from 15853 MW in 2008 to 13816 MW in 2018, and the net capacity available in the NPS load peak level from 13502 MW to 11466 MW (Annex D - 1).

The information collected from producers outlined the fact that they did not project the shutdown of expired or low performance groups. The decision to withdraw these groups would certainly influence negatively the available power surplus/deficit in the analyzed period.

9.2. New Electric Power Required to Meet Electric Power Demands

In order to cover the electric power demand and the peak power in safe conditions, the power system requires a certain level of the total power reserve, defined as the difference between the available power and the peak power. This reserve level depends on the structure of the generating sets and the viability indices in the system and should cover the following power categories:

- the power necessary to cover the planned repairs;
- reserve for unplanned repairs.

The total power reserve necessary to cover the power demand under safe circumstances has a tendency to reduce in time (as a percentage of the peak power) while the viability indices of the system available groups improve by quashing of old outdated groups or by rehabilitating existing groups and installing new high performance groups. Thus, the power reserve necessary level will decrease from approx. 33% of the peak power in 2007 to approx. 27% in 2018. (Annex D - 1).

In 2008, the power demand and the peak power are safely coverable with the existing substations, with an available net power surplus of approx. 1590 MW (Annex D - 1).

By reducing the power related to the existing groups as a result of lifetime expiry and via the increased power consumption, this surplus reduces in time, and the power deficit starts in 2013 and continues to increase up to approx. 5000 MW in 2018 (Annex D - 1). To compensate this deficit, a group rehabilitation programme was envisaged alongside with the commissioning of new groups with superior performance and characteristics (Annex D - 2).

The rehabilitation projects and the new groups that were considered in the analyzed period are:

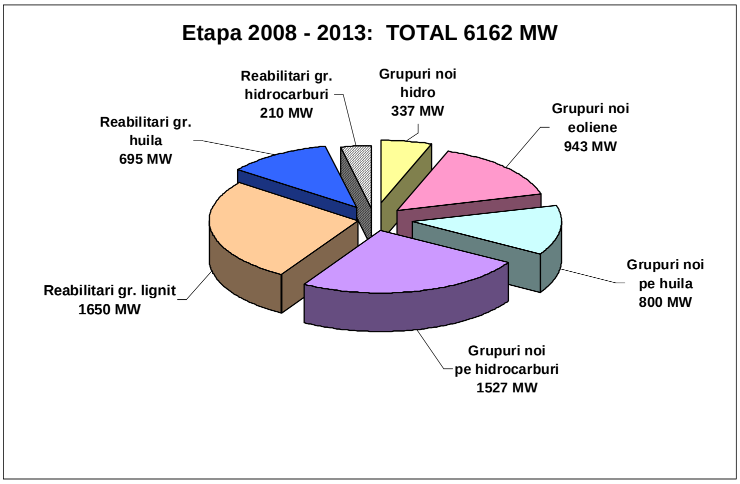
- rehabilitation of brown coal, pit coal or hydrocarbon– fuelled 330 MW or 210 MW thermal and condensation electric power units, for lifetime extension and compliance with the environment requirements in Order No. 859 as of 29.09.2005 of the Ministry of Administration and Interior that approved the “National Programme for the reduction of emissions of sulphur dioxide, azote oxide and powders from large burning substations”;
- completion of hydroelectric substations in various execution stages and installation of the pump storage hydroelectric substation with 4 250MW groups;
- completion of groups 3 and 4 in NPP Cernavodă;
- installation of new condensation electric power units (mixed natural gas-fuelled cycle and clean pit coal technology groups);
- natural gas-fuelled groups with heat recovery gas turbines.

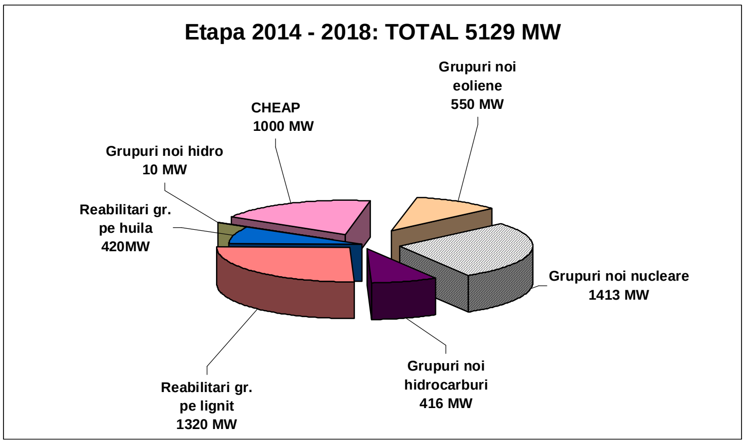
INSTALLED REHABILITATED AND NEW CAPACITY PROGRAMME

Stage 2008: Total 6162 MW

Pit coal group rehabilitation: 695 MW
Brown coal group rehabilitation: 1650 MW
New hydrocarbon groups: 1527 MW
New pit coal groups: 800 MW
New wind groups: 943 MW
New hydro groups: 337 MW
Hydrocarbon group rehabilitation: 210 MW

PROGRAM DE CAPACITATI REABILITATE SI NOI INSTALATE





Stage 2014-2018: Total 5129 MW
New hydro units: 10 MW
Pit coal unit rehabilitation: 420 MW
Brown coal unit rehabilitation: 1320 MW
New hydrocarbon power units: 416 MW
New nuclear power units: 1413 MW
New wind power units: 550 MW
SPHPP: 1000 MW

Under these circumstances, the power deficit is eliminated, the net production capacity reaching 18844 MW in 2013 and 20754 MW in 2018, with an available net capacity at the load peak of approx. 15530 MW in 2013 and approx. 16951 MW in 2018 (Annex D - 3).

Mention must be made of the increasing interest in the efficient use of new and renewable power resources: wind, solar, geothermal, biogas, biomass, waves, as well as the hydro power in installations of less tan 10 MW power. For the time being and in the near future, the hydro power in installations with less than 10 MW power and wind power may have a more significant contribution to the country's power balance. Their contribution will be higher for electric power production and lesser for ensuring power levels guaranteed for consumption peak coverage.

9.3. Methodologies Applied for Scenarios Used for Analysis of PTG Suitability

For calculation and system analysis purposes 6 databases were created that correspond to 2 total energy line specific points: winter evening peak consumption (WEP) and summer night holiday low consumption (GNV), for each of the 3 forecast intervals: 2008, 2012 and 2017. Each of these databases corresponds to a condition called Basic Average Regime – RMB.

If an electric substation connection to a network is analyzed, the specialists performing the analyses have to (according to PE 026/1992), starting from RMB, elaborate another database called: reference design regime – RD.

The elaboration rules for both RMB, and RD are set forth in PE 026/1992.

As the aforementioned document was elaborated several years ago, it does not provide for wind power units. Given the circumstances and knowing the unique specificity of these substations, we believe it is necessary to supplement the provisions of PE 026/1992 as follows:

- In RMB the existing wind power units (already included in the model) will be considered with a production of maximum 50 % of the installed power.
- In RD the following changes will be operated as to the RMB:
    - Ø The production of wind power units in the analyzed area will increase from 50% (standard level in RMB) to 70%. Loading of wind power units in the other geographical area will stay like in RMB.
    - Ø The wind power unit that is analyzed will be considered (included in the model) with 100 % of the installed power in "N" operating element conditions.
    - Ø The wind power units that are analyzed and the wind power units in the area will be considered (included in the model) with 70% of the power installed in the "N-1" operating element conditions (on checking compliance with the "N-1" criterion).

Mention must be made that these values are defined based on information from the specialized literature and following discussions with the company's specialists, representatives of companies operating significant wind power unit volumes as at present there are no operating wind power unit in Romania that can provide enough references on their loading levels and associated probability.

After the commissioning of a relevant volume of wind power units in NPS, CNTEE "Transelectrica" S.A. is considering an update of the values stated based on the measurement statistic analysis.

9.4. Scenarios Used for Analysis of PTG Suitability – 2008 ÷ 2017

On defining production scenarios, programmes for the rehabilitation and quashing of certain groups communicated by producers were considered. Also projects for the installation of new groups were considered which intentions for connection were expressed for by submittal of connections or requests for connection solution studies:

- The nuclear units 3 and 4 in Cernavodă – 2x700 MW, forecast according to the Government's power strategy in 2015, with the solution study and the feasibility study under preparation;
- SPHPP Tarnița Lăpuşteşti – 1000 MW (4 groups, with a 256MW unitary power as generator set and as 270MW pump), that is strictly necessary for a production/consumption balance in NPS, in the context of the two nuclear substations, the basic condition operating thermal and electric substations and wind power units with priority operation;
- Traditional thermal and electric high power substations:
    - OMV Petrom - 925 MW – forecast in 2010;
    - Turnu Măgurele – 1320 MW - forecast in 2013;
    - Sărdăneşti – 700 MW- forecast in 2013;
    - Galați - 800 MW - forecast in 2013;
    - Brăila – 800 MW ;
- Wind power units amounting to a significant installed power given the implementation of the Government's strategy for the stimulation of renewable power sources.

The scenarios were intended to check the PTG suitability in various network development situations, given the foreseen consumption and production structure.

1) For the 2008 stage, the typical consumptions levels were considered for winter evening peak consumption (WEP), summer morning peak consumption (SMP), summer holiday night no – load (GNS).

Table 9.4.1

	Net generated power (MW)	**No-loss consumed power (MW)**	**Balance (MW)**	**Losses (MW)**	**Net consumed power (MW)**
Average WEP 2008	9212	8698	250	264.0	8962.0
SMP 2008	7670	7169	250	250.3	7419.3
GNS 2008	4396	4002	250	143.3	4145.3

Annex D-4-page 1 breaks down, for each specific level in table 9.4.1, the values of the total net power produced in NPS, by types of primary resources and groups in thermal electric substations, as projected in scenarios.

2) For the 2012 reference stage, specific consumption levels were considered, i.e. winter evening peak consumption (WEP), summer morning peak consumption (SMP), summer holiday night low consumption (GNS). Three production-consumption scenarios were considered for the WEP level (Table 9.4.2):

Table 9.4.2

	Net generated power (MW)	No-loss consumed power (MW)	Balance (MW)	Losses (MW)	Net consumed power (MW)
Average WEP 2012	11109	10283	545	280.4	10563.4
Average WEP 2012	11655	10805	545	305	11110
Average WEP 2012	10599	9783	545	269.8	10052.8
SMP 2012	9275	8777	250	248.1	9025.1
GNS 2012	4507	4141	250	116.5	4257.5

Annex D-4 breaks down, for each specific level in table 9.4.2-page 2, the values of the total net power produced in NPS, by types of primary resources and groups in thermal electric substations, as projected in scenarios.

The high power traditional thermal electric substations included in the 2012 reference stage are:

- OMV Petrom Brazi - 925 MW:
    - On the 400kV bars of the Brazi Vest substation – a 305MW gas turbine (TG) and a 315MW steam turbine (TA);
    - On the 220kV bars of the Brazi Vest substation - a 305MW TG;
- A 800MW group in Brăila or Galați. The calculation models considered Brăila, connected to the 400kV substation bars in Lacu Sărat;
- Mixed-cycle group substation in the 110 kV Bucureşi Vest substation: 1TGx155MW (15 kV at the generator's terminals) and 1TGx55MW (10.5kV at terminals);
- SPP Turnu Măgurele 2x660 MW – one group connected to the 220 kV Turnu Magurele substation (temporary solution);
- 1027 MW in the wind electric units (CEE), based on the technical connection approvals issued so far by CNTEE "Transelectrica" S.A. and the distribution operators. The 1027 MW were considered already installed as follows:
    - 600 MW at the 400 kV Tariverde substation;
    - 112 MW in the Vaslui county: Falciu Berezeni, Roşieşti, Vetrişoaia;
    - 105 MW in the Tulcea county: Baia and Corugea-Cişmeaua Nouă;
    - 90 MW in the Medgidia Sud area: Peştera;
    - 120 MW in the Medgidia Nord area: Târguşor and Siliştea.

In the basic average regime (RMB) 50% of the power installed in CEE was considered operational (see chapter 9.3).

Owing to the high uncertainty level considering the commissioning of a new traditional electric substation, sensitivity analyses were considered for:

- Sărdăneşti – 2x350 MW – connection in a new 400kV substation in Sărdaneşti;
- Galați - 800 MW connection via OHL d.c. in the 400kV Smârdan substation;
- Ungheni - 350MW: Substation in the Republic of Moldova that transfers power into NPS via OHL 220 (equipped with 400) kV Ungheni - FAI;
- Groups in Moldavskaya Gress – 400 MW, radial connected in the 400kV Isaccea substation via OHL 400 kV Isaccea – Vulcaneşti.

3) For the 2017 reference stage, the characteristic consumption levels were considered, i.e. winter evening consumption peak (WEP), summer morning consumption peak (SMP), summer night holiday low consumption (GNS), and for the WEP level 3 forecast-consumption scenarios (Table 9.4.3) were considered: average scenario, maximum scenario and minimum scenario.

Table 9.4.3

	Net generated power (MW)	No-loss net consumed power (MW)	Balance (MW)	Losses (MW)	Net consumed power (MW)
Average WEP 2017	13953	12111	1500	364	12475
Max. WEP 2017	14829	12850	1600	378	13228
Min. WEP 2017	12425	10913	1200	330	11243
SMP 2017	11682	10363	1000	322	10685
GNV 2017	5944	5018	800	127	5145

Annex D-4-page 3 breaks down, for each specific level in table 9.4.3, the values of the total net power produced in NPS, by types of primary resources and groups in thermal electric substations, as projected in scenarios.

The nuclear units 3 and 4 in Cernavodă were considered – 2x700 MW, foreseen to start their commercial operation according to the Government's Power Strategy in 2015.

The traditional high power thermal electric substations foreseen to appear in 2012÷2017 and included in the 2017 reference stage analysis are:

- Turnu Măgurele - 2x660 MW connected in the 400 kV Turnu Măgurele substation.

SPHPP Tarnița-Lăpuşteşti with 4 groups was considered, each having 256 MW unitary power as generator and 270MW pump power.

Also, based on the technical approvals so far issued by CNTEE "Transelectrica" S.A., approx. 3000 MW installed in CEE were considered as follows:

- 1700 MW in the 400kV Tariverde substation;
- 600MW in the Vânt substation;
- 354MW in Moldova: Fălciu Berezeni, Roşieşti, Vetrişoaia, CEE in the Smârdan-Gutinaş area;
- 105MW in the Tulcea county: Baia and Corugea-Cişmeaua Nouă;
- 90MW in the Medgidia Sud area: Peştera;
- 120MW in the Medgidia Nord area: Târguşor and Siliştea.

In the basic average regime (RMB) 50% of the power installed in CEE was considered operational.

The following were envisaged as sensitivity analyses:

- Sărdăneşti – 2x350 MW connected in the new 400kV Sărdaneşti substation;
- Galați - 800 MW connected on the bars of the 400kV Smârdan substation;
- Ungheni - 350MW: Substation in the Republic of Moldova that transfer power to NPS via OHL 220 kV (equipped with 400) Ungheni - FAI;

- Groups in Moldavskaya Gress - 400MW, radial connected in the 400kV Isaccea substation via OHL 400 kV Isaccea – Vulcaneşti.

10. Analysis of PTG Operation Characteristics (2012 and 2017)

The PTG characteristics analyzed in this work are as follows:

- the load level of the PTG elements in the N and N-1 element configuration (lines, transformers, autotransformers);
- the voltage levels in the PTG nodes in the N and N-1 element configuration and the compensation level of reactive power;
- the level of active power loss in PTG;
- level of short-circuit power in the PTG nodes.

The PTG characteristics were analyzed by a stimulation of the PTG operation in NPS via steady-state conditions at extreme levels (maximum–winter evening peak consumption –WEP, summer morning pea consumptions - SMP and minimum – summer night low consumption – GNVs) of the load curve.

The basic data on consumption and the electric power production of generating sets that operate at peak and low consumption hours are substantiated in chapters 8 and 9.

The values of the total net generated powers for these levels are provided in Annex D-5.

The configuration of the 400 kV – 220 kV – 110 kV electric network modelled for the 2008 stage is consistent with the studies elaborated by UNO-DEN. For the 2012 and 2017 stages, the achievement of the objectives substantiated in the development studies drafted by Transelectrica S.A. and consultants was foreseen in addition to the current stage (2008):

Stage 2012:

- the 220/110kV Cetate substation, 1×200MVA;
- the 220/110kV Porțile de Fier II (Ostrovu Mare) substation, 2×200MVA;
- OHL 220kV s.c. Porțile de Fier II (Ostrovu Mare) – Cetate;
- OHL 220kV s.c. Porțile de Fier II (Ostrovu Mare) – Porțile de Fier I;
- OHL 400 kV Arad – Nădab – Oradea;
- OHL 400 kV Nădab – Bekescsaba;
- transfer to 400kV of the Reşita -Timişoara electric highway;
  - doubling 250MVA T 400/110kV in the Arad substation and giving up the 400MVA AT 400/220kV in the Arad substation;
  - Reşița:
    - the Reşița 400/220kV substation, 1×400MVA;
    - the Reşița 400/110kV substation, 1×250MVA;
    - new OHL 400kV Porțile de Fier I – Reşița;
  - Timişoara:
    - the Timişoara 1Trafo 400/110kV substation, 1×250 MVA and one 200MVA AT 220/110kV;

- The 400/110kV Tariverde substation:
    - Incoming-outgoing in the 400kV Tariverde substation on OHL 400kV Tulcea-Constanța and OHL 400kV Isaccea- Varna;

- The Medgidia substation:
    - Incoming-outgoing in the 400kV Medgidia on OHL 400kV Isaccea-Varna;

- doubling 250MVA T 400/110kV in the Oradea substation;
- doubling 250MVA T 400/110kV in the Dârste substation;
- the third 250MVA T 400/110kV in the Domneşti substation;
- 2x100MVAr reactive power shunt reactor in the Grozăveşti 400kV substation;
- The third 250MVA T400/110kV in the Tulcea substation;
- Conductor replacement in OHL d.c. 220kV Bucureşti Sud-Fundeni: 50% increase in capacity
- the Constanța Sud 400/110kV substation:
    1. 1Trafo 250MVA 400/110kV;
- OHL 400kV new Medgidia-Constanta Sud;
- OHL 400kV new Constanta Sud-Constanta Nord;
- transfer to 400kV of the Gutinaş-Bacău-Roman-Suceava electric highway
    - the 400/110kV Suceava substation, 2×250MVA;
    - the 400/110kV Roman substation, 1×250MVA;
    - the 400/110kV Bacău substation, 1×250MVA;

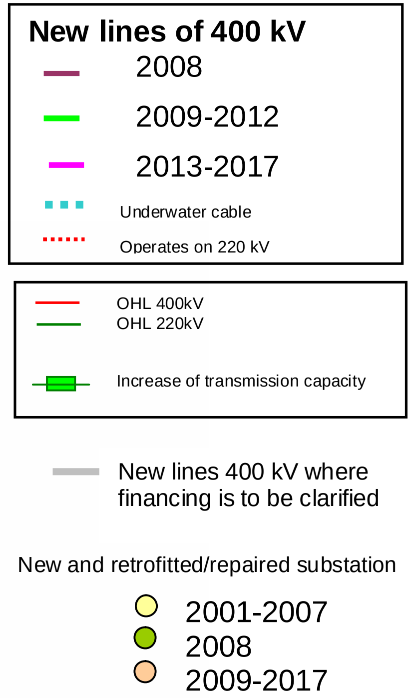
The 2017 stage:

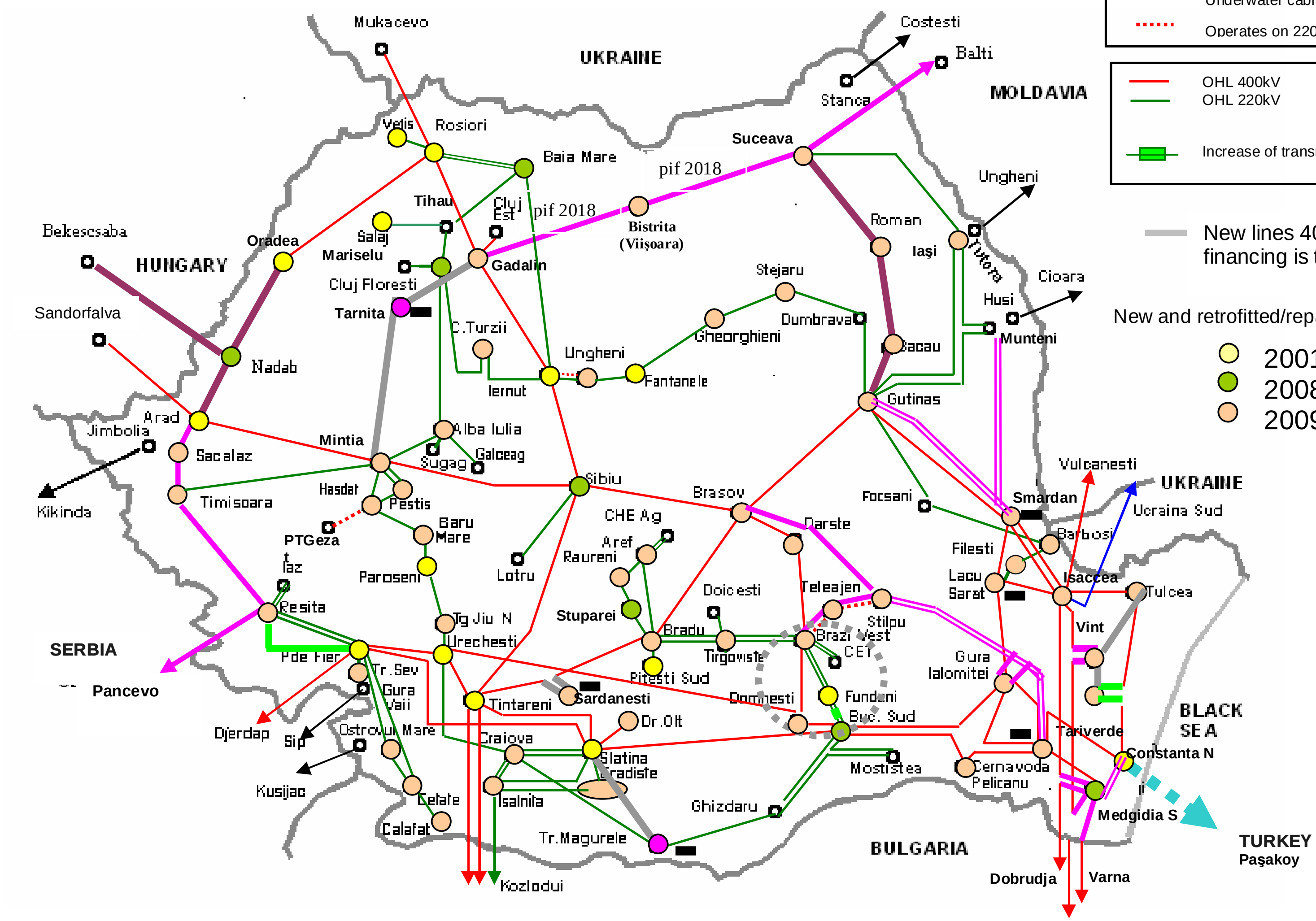
- OHL 400kV d.c. NPP Cernavodă - Sâlpu with an incoming-outgoing circuit in the 400kV G.Ialomitei substation;
- incoming-outgoing from the 400kV Medgidia substation on OHL 400kV Isaccea-Dobrudja;
- Săcălaz:
    - the Săcălaz 400/110kV substation, 1×250 MVA;
- OHL 400kV Timişoara –Săcălaz;
- OHL 400kV Săcălaz-Calea Aradului;
- Calea Aradului:
    - the Calea Aradului 400/110kV substation;
- OHL 400kV Arad-Calea Aradului;
- OHL 400kV Romania (Săcălaz or Reşița)- Serbia (Pancevo or Novi Sad);
    - Sărdăneşti:
        - the Sărdăneşti 400/110kV substation, Trafo 400/100kV de 250 MVA;
        - incoming-outgoing on OHL 400kV Tănțăreni-Bradu;
        - shutdown of the 220kV Sărdăneşti substation and 200MVA AT220/110kV
        - OHL 220kV Urecheşti-Sărdăneşti and OHL 220kV Sărdăneşti-Craiova Nord becomes OHL 220kV Urecheşti-Craiova Nord;
- Tarnița:
    - the Tarnița 400kV substation;
    - 4 Trafo 400/15.75kV, 4×280MVA;
    - new OHL 400kV d.c. Tarnița-Mintia;

    - new OHL 400kV s.c. Tarniţa-Gădălin.
- Vânt:
    - the Vânt 400kV/110kV substation;
    - new OHL 400kV d.c. Vânt-Tariverde;
    - Incoming-outgoing on OHL 400kV Isaccea-Medgidia-Varna;
- Turnu Măgurele:
    - the Turnu Magurele 400/220kV substation;
    - 2 Trafo bloc 400/20kV de 2x400MVA;
    - 2 AT 400/220kV de 2x400MVA;
    - new OHL 400kV d.c. Slatina-Turnu Măgurele;
- Pipera/ Otopeni:
    - the Pipera/Otopeni 400/110kV substation - 2 T 400/110kV , 2x400MVA;
    - new OHL 400kV s.c. Pipera/ Otopeni -Bucureşti Sud;
    - new UPL +OHL 400kV s.c. Pipera/ Otopeni –Brazi V;
- Grozăveşti:
    - the Grozăveşti 400/110kV substation - 2 T 400/110kV de 2x250MVA;
    - new OHL 400kV d.c. Grozăveşti-Domneşti;

- the 400/110kV Teleajen substation, (replaces the current 220/110kV substation), 2 T 400/110kV de 2x250MVA;
- the 400/110kV Stâlpu substation (replaces the current 220/110kV substation), 250MVA 1T 400/110kV;
- transfer to 400kV of OHL operating at 220 kV Brazi Vest-Teleajen-Stâlpu.

Figura 10-1 Forecast PTG configuration for analyzed period





The calculus of steady-state conditions for checking the PTG reference design were done according to PE 026/92 (Standard on the Principles, criteria and methods for the substantiation of the NPS development strategy and the determination of PTG development programmes) upon modelling of NPS interconnected operation.

A list of coils deemed still operational is provided in Annex E, Table 1.

The power circulations in the analyzed steady-state conditions are provided in brief in Annex E, schemes 1÷4.

10.1. Analysis of Steady State Conditions

Checking was performed on the PTG reference design via calculus of steady-state conditions with N and N-1 operating network elements.

10.1.1. Stage 2012

Section S1

Section S1, the Oltenia area, is defined in the 2012 stage by the following lines:

- OHL 400kV Slatina – Bucureşti Sud;
- OHL 400kV Urecheşti – Domneşti;
- OHL 400kV Ţânţăreni – Bradu;
- OHL 400kV Ţânţăreni – Sibiu;
- OHL 400kV Porţile de Fier – Djerdap;
- OHL 400kV d.c. Ţânţăreni – Kozlodui;
- OHL 220kV Urecheşti – Tg.Jiu;
- OHL 220kV d.c. Porţile de Fier – Reşiţa;
- OHL 220kV Craiova – Turnu Măgurele;
- OHL 400kV Porţile de Fier – Reşiţa

This area is redundant in the 2012 stage in the reference design regime and the redundancy is approx. 2900 MW.

N-element configuration

The resulting condition was acceptable, with the characteristics parameters (loading of network elements, bar voltages) within acceptable limits.

The most loaded lines in the area are Ţânţăreni – Bradu, carrying a 616A current = 36% Ilim (Ilim = 1700A) and Timişoara – Reşiţa with a 726A current = 36% Ilim (Ilim = 1994A), 43% Ilim (Ilim = 1700A)

The remaining NPS most loaded lines are the 2 circuits of OHL 220kV Bucureşti Sud – Fundeni:

- circuit 1: 685A = 47% Ilim (Ilim = 1460A), 78% Ilim (Ilim = 875A)
- circuit 2: 720A = 49% Ilim (Ilim = 1460A), 82% Ilim (Ilim = 875A)

On OHL 400kV Porţile de Fier – Djerdap 212MW are transmitted to the Serbian network, which a 321A current corresponds to.

N-1 element configurations

The steady-state conditions were calculated for the N-1 configurations given the unavailability of the 2 above-mentioned more loaded lines.

The N-1 element configuration, with unavailable OHL Țânțăreni – Bradu

The condition is acceptable, with the characteristics parameters within acceptable limits, wherein the most loaded lines in the area are:

- OHL 400kV Timişoara – Reşița I = 764A = 38% Ilim (Ilim = 1994A), 45% Ilim (Ilim = 1700A)
- OHL 400kV Urecheşti – Domneşti I = 709A = 42% Ilim (Ilim = 1700A)

The N-1 element configuration, with unavailable OHL 400kV Timişoara – Reşița

This condition is acceptable too, with the specific parameters within acceptable limits, wherein the most loaded lines in the area are:

- OHL 400kV Porțile de Fier – Djerdap I = 676A = 40% Ilim (Ilim = 1700A)
- OHL 400kV Țânțăreni – Bradu I = 660A = 39% Ilim (Ilim = 1700A)
- OHL 400kV Porțile de Fier – Slatina I = 643A = 38% Ilim (Ilim = 1700A)
- OHL 400kV Urecheşti – Domneşti I = 638A = 37% Ilim (Ilim = 1700A)

Section S2

Section S2 (east of the Iernut – Sibiu – Țânțăreni – Slatina axis) is delimited by the following lines:

- OHL 400kV Isaccea – Dobrudja;
- OHL 400kV Slatina – Bucureşti Sud;
- OHL 400kV Sibiu – Braşov;
- OHL 400kV Țânțăreni – Bradu;
- OHL 400kV Isaccea – Dobrudja;
- OHL 220kV d.c. Iernut – Ungheni;
- OHL 220kV Craiova – Turnu Măgurele;
- OHL 110kV Iernut – CIC (d.c.);
- OHL 110kV Iernut – Târnăveni (d.c.),
- To add in 2017 OHL 400kV Gădălin - Bistrița.

An analysis of this section's balance for the 2012 resulting in the following:

- assuming all wind electric units (CEE) in the area produce merely 50% of their installed power, at this stage, the area has an approx. 215MW deficit;

- assuming these CEE produce 70% of their installed power, the area becomes redundant, with an approx. 210MW redundancy.

This deficit, and redundancy respectively, is transmitted via 5 400kV lines, with a 220kV double-circuit line, one 220kV simple-circuit line and 2 double-circuit 110kV line, all these lines being poorly loaded, and transmission is not an important problem in terms of stability.

Hence, this section is no longer relevant for the NPS operation. The proposal is to give up pursuing it further on.

Section S3

Section S3 is delimited by the following lines:

- OHL 400kV Gutinaş – Braşov;
- OHL 400kV Pelicanu – Bucureşti Sud;
- OHL 400kV Gura Ialomiței – Bucureşti Sud;
- OHL 400kV Isaccea – Dobrudja;
- OHL 220kV Stejaru – Gheorghieni;
- OHL 110kV Slobozia – Dragoş Vodă.

Owing to the power situation in NPS, i.e. new power sources appear in south-eastern NPS, mainly wind power units, and not only, section S3 (Moldova + Dobrogea) no longer represents a relevant section either and should not be further monitored.

Indeed, starting the 2012 stage, as a result of new power sources in the south-eastern NPS, the area delimited by lines:

- OHL 400kV Smârdan – Gutinaş
- OHL 220kV Barboşi – Focşani
- OHL 400kV Isaccea – Dobrudja
- OHL 400kV G.Ialomiței – Bucureşti Sud
- OHL 400kV Pelicanu – Bucureşti Sud
- OHL 110kV Slobozia – Dragoş Vodă

added, in the 2017 stage, OHL 400kV NPP – Stâlpu (section proposed to be named "section S6") becomes excessively redundant, having in the said stage an approx. 2080MW redundancy (also considering the new 800MW generator in CHPP Galați Free Area).

As a result, section 3, traditionally deficient, which includes section S5 (Moldova) with an approx. 450MW deficit, becomes redundant (however, its redundancy is less than that of Section S6), hence, monitoring this area is no longer necessary.

This is the reason why we suggest disregarding this section and analyzing/monitoring section 6 above instead.

Section S4

The analysis was conducted without taking into account the 400kV electric highway of Gădălin – Bistrița – Suceava in the 2012 stage.

Given this assumption, section S4 is delimited by the following lines:

- OHL 400kV Sibiu – Iernut;
- OHL 220kV Gheorghieni – Stejaru;
- OHL 220kV Cluj Floreşti – Alba Iulia;
- OHL 400kV Roşiori – Mukacevo;
- OHL 400kV Oradea – Nădab.

The area is deficient, and its deficit is approx. 940MW in the reference design regime.

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limits.

The most loaded line is OHL 400kV Sibiu – Iernut that carries to Section S4 a 382MW power, and a 551A current respectively = 32% Ilim.

On OHL 400kV Mukacevo – Roşiori some 190MW power enters S4, alongside with a 278A current = 16% Ilim (Ilim = 1700A).

N-1 element configurations

Steady-state conditions were calculated for the N-1 configurations corresponding to the unavailability of the following lines:

The N-1 element configuration, with unavailable OHL 400kV Sibiu – Iernut

The condition is acceptable, with the specific parameters within acceptable limits.

The most loaded line is OHL 400kV Nădab – Oradea that transmits a 320MW power and a 464A current = 27% Ilim (Ilim = 1700A).

The N-1 element configuration, with unavailable OHL 400kV Nădab – Oradea

The condition is acceptable, with the specific parameters within acceptable limits.

The most loaded line is OHL 400kV Sibiu-Iernut that transmits an approx. 445MW power and a 645A current = 38% Ilim (Ilim = 1700A).

Section S5

The analysis was conducted without taking into account the 400kV line of Gădălin – Bistrița – Suceava in the 2012 stage

Given this assumption, section S5 is delimited by the following lines:

- OHL 400kV Gutinaş – Braşov;
- OHL 400kV Gutinaş – Smârdan;
- OHL 220kV Focşani – Barboşi;
- OHL 220kV Stejaru – Gheorghieni.

The area is deficient, and its deficit is approx. 476MW in the reference design regime.

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limits.

The most loaded line is OHL 400kV Smârdan – Gutinaş, that transmits to S5 a 620MW power and a 907A current = 53% Ilim (Ilim = 1700A).

N-1 element configurations

Steady-state conditions were calculated for the N-1 configurations according to the unavailability of the most important lines for area operation.

The N-1 element configuration, with unavailable OHL 400kV Smârdan – Gutinaş

The steady-state condition where S5 stays connected to the remaining NPS via 3 lines only, had an acceptable result, with the specific parameters within acceptable limits.

The most loaded line is OHL 220kV Focşani – Barboşi that transmits a 296MWpower and a 779A current = 53% Ilim (Ilim = 1462A), 97% Ilim (Ilim = 805A)

The other important operating line, OHL 400kV Braşov – Gutinaş, transmits a 238MW power and a 348A current = 20% Ilim, (Ilim = 1700A)

The N-1 element configuration, with unavailable OHL 400kV Braşov – Gutinaş

The condition is acceptable, and the most loaded NPS connection lines of the area are:

- OHL 400kV Smârdan – Gutinaş that transmits a 493MW power and a 712A current = 42% Ilim; (Ilim = 1700A)
- OHL 220kV Stejaru – Gheorghieni that evacuates from S5 a 123MW power and a 325A current = 40% Ilim (Ilim = 805A)

Section S6

As shown above, this area is redundant. In the 2012 stage, in the reference design regime, the redundancy is approx. 2360MW.

The N-element configuration

The resulting condition is acceptable, with its specific parameters (loading of network elements, voltages of the bars in the area) within acceptable limits.

The most loaded line in the area is OHL 400 kV Smârdan – Gutinaş, that transmits a 1035 A current = 61% Ilim (Ilim = 1700 A). On OHL 400 kV Isaccea – Dobrudja 471 MW are transmitted to the Bulgarian network, and a 690 A current corresponds to it.

The N-1 element configuration, with unavailable OHL Smârdan-Gutinaş

The condition is acceptable, with the specific parameters within acceptable limits, if the conductors of OHL 220kV Focşani – Barboşi (Ilim = 1200 A) are replaced and unacceptable if the current line conductors are preserved (Ilim = 805 A); in this condition, the most loaded lines are:

- OHL 220 kV Focşani-Barboşi I = 852 A = 71% Ilim (Ilim = 1200 A), 106% (Ilim = 805 A)
- OHL 400 kV Pelicanu-CNE I = 1129 A = 66% Ilim (Ilim = 1700 A)
- OHL 400 kV Bucureşti-Gura Ialomiței I = 1165 A = 68% Ilim (Ilim = 1700 A)

On OHL Isaccea – Dobrudja 635 MW are evacuated, corresponding to a 918 A current.

The N-1 element configuration, with other important lines unavailable for the area:

- with OHL Bucureşti-Gura Ialomiței unavailable:
  - OHL Pelicanu-CNE I = 1346 A = 79% Ilim (Ilim = 1700 A)
  - OHL Smârdan-Gutinaş I = 1223 A = 72% Ilim (Ilim = 1700 A)
- with OHL Bucureşti-Pelicanu unavailable:
  - OHL Smârdan-Gutinaş I = 1145 A = 67% Ilim(Ilim = 1700 A)
  - OHL Bucureşti-Gura Ialomiței I = 1244 A = 73% Ilim (Ilim = 1700 A)

The N-2 element configuration, with unavailable OHL Pelicanu-CNE and CNE-Gura Ialomiței (1 circuit)

As NPP Cernavodă supplied from the area, according PE026/92, the N-2 reference design criterion should be checked, and the steady-state condition with 2 unavailable NPP connection lines should be calculated.

In this respect, the steady-state condition was calculated, with the relevant lines disconnected, which unavailability (in this stage) leads to the most difficult N-2 configuration condition.

In this condition, the most difficult of the ones calculated for this stage, for section S6, the specific parameters are, however, within acceptable limits.

Hence:

- the lowest voltage value of the bars in the area is recorded at the Pelicanu substation, i.e. 385.5 kV;
- the most loaded lines are:
  - OHL Bucureşti-Gura Ialomiței I = 1281 A = 75% Ilim (Ilim = 1700 A)
  - The circuit still on operation of OHL d.c. CNE-Gura Ialomiței I = 1561 A = 92% Ilim (Ilim = 1700 A)
  - OHL Smârdan-Gutinaş I = 1200 A = 70% Ilim(Ilim = 1700 A)

The above indicates that, in the 2012 stage, given the assumptions (2 units in NPP Cernavoda and a wind power production in S6 with an installed power of 2098MW producing 70% and interconnected NPS), the discharge of the S6 section redundancy is done in good conditions in terms of network element loading and the level of voltages in the area, including for the N-1 and N-2 configurations.

10.1.2. Stage 2017

Section S1

As a result of the estimated evolution of the PTG configuration in the south-western area of NPS and new power sources in this area (SPP Sărdăneşti, SPP Tr. Măgurele), in the 2018 stage, the proposals concern changing the S1 layout as compared to the ones considered for the 2012 stage for its inclusion and the inclusion of the new sources. This is why the proposal is that section S1, in the 2017 stage, should be delimited by the following lines:

- OHL 400kV Slatina – Bucureşti Sud;
- OHL 400kV Urecheşti – Domneşti;
- OHL 400kV Sărdăneşti – Bradu;
- OHL 400kV Ţânţăreni – Sibiu;
- OHL 400kV Porţile de Fier – Djerdap;
- OHL 400kV d.c. Ţânţăreni – Kozlodui;
- OHL 220kV Urecheşti – Tg.Jiu;
- OHL 220kV d.c. Porţile de Fier – Reşiţa;
- OHL 400kV Porţile de Fier – Reşiţa;
- OHL 220kV Tr.Măgurele – Ghizdaru;
- 200MVA autotransformers of 220/110kV in the Tr. Măgurele substation.

  The area is redundant, a 2135 MW redundancy being present in RMB, and the reference design regime is 3280MW.

The reference design regime has been acquired from RMB according to PE 026/92 by loading the S1 hydroelectric substations and SPP Turceni at the actually available power.

The N-element configuration

The condition is acceptable, with the specific parameters within acceptable limits.

The most loaded lines are OHL 400kV Porţile de Fier – Reşiţa, that transmits a 550MW power, and a 800A current = 40% Ilim (Ilim = 1994 A), 47% Ilim (Ilim = 1700 A) and OHL 400kV Reşiţa – Timişoara, that transmits a 685MW power, and a 990A current = 50% Ilim (Ilim = 1700 A), 58% Ilim (Ilim = 1700 A).

On OHL 400kV Porţile de Fier – Djerdap 303MW and a 469A current are transmitted to the Serbian network.

N-1 element configurations

The N-1 element configuration, with unavailable OHL 400kV Porţile de Fier – Reşiţa

The condition is acceptable, and the most loaded lines are:

- OHL400kV Porţile de Fier-Djerdap: P=475MW,I=740A=43% Ilim(Ilim = 1700 A)
- OHL 400kV Ţânţăreni – Sibiu: P=367MW, I=530A=31% Ilim (Ilim = 1700 A)

The N-1 element configuration, with unavailable OHL 400kV Reşiţa – Timişoara

The condition is acceptable, and the most loaded lines are:

- OHL 400kV Porţile de Fier – Djerdap: P=649MW, I=1014A=60% Ilim (Ilim = 1700 A)
- OHL 220kV Urecheşti – Tg.Jiu: P=230MW, I=628A=72% Ilim (Ilim = 1700 A)

Section S2

For the 2017 stage, given that the wind electric units (CEE) produce 50% of their installed power, the S2 section-related area has a 385MW redundancy; given that CEE produces 70% of the installed power, the area redundancy is 1000MW.

These redundancies, that represent the balance on the lines delimiting section S2, circulate along 6 400kV lines, 3 220kV lines and 4 110kV circuits.

All S2 boundary lines are poorly loaded, and the transit of such redundancy does not result in stability issues.

One can note that this section is irrelevant for the NPS operation for this stage too, hence, similarly to the 2012 stage, there is no need to further monitor or analyze it.

Section S3

The considerations on S3 section stay valid for the 2017 stage as well, as shown in point 14.1., i.e. owing to new active power production sources in the south-eastern NPS, as this section is a combination of the deficient section S5 (Moldova) and the new redundant section S6, it is no longer relevant for the NPS operation, hence its monitoring should be discontinued.

Section S4, in consideration of OHL 400kV Gădălin – Bistrița - Suceava

At this stage, the lines delimiting section S4, provided in point 14.1., are added OHL 400kV Bistrița – Suceava and OHL 400kV d.c. Tarnița – Mintia.

The area is deficient, the RMB shows a 765MW deficit, and the reference design regime has an approx. 905MW deficit.

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limits.

The most loaded lines are:

- OHL 400kV Sibiu – Iernut: P=460MW, I=664A=39% Ilim (Ilim = 1700 A)
- OHL 400kV Suceava – Bistrița: P=170MW, I=268A=16% Ilim (Ilim = 1700 A)

N-1 element configurations

The N-1 element configuration, with unavailable OHL 400kV Sibiu – Iernut

The condition is acceptable, with the specific parameters within acceptable limit. The most loaded lines are:

- OHL 400kV Suceava – Bistrița: P=243MW, I=368A=22% Ilim (Ilim = 1700 A)
- OHL 220kV Stejaru – Gheorghieni: P=188MW, I=495A=62% Ilim (Ilim = 805 A)

The N-1 element configuration, with unavailable OHL 400kV Suceava – Bistrița

The condition is acceptable, with the specific parameters within acceptable limit. The most loaded lines are:

- OHL Sibiu – Iernut: P=520MW, I=747A=44% Ilim (Ilim = 1700 A)
- OHL 400kV Stejaru – Gheorgheni:P=186MW, I=489A=61% Ilim (Ilim = 805 A)

The N-1 element configuration, with unavailable OHL 220kV Stejaru – Gheorgheni

In the given reference design regime, where section S4 has an approx. 905MW deficit, the disconnection of OHL 220kV Stejaru – Gheorgheni leads to an overcharge of AT 400/220kV Iernut la 110%Sn .

Mention must be made that in RMB, where S4 has an approx. 765MW deficit only, such disconnection does not result in the surcharge of AT 400/220kV din Iernut.

On the other hand, the surcharge of this AT on disconnection of OHL 220kV Stejaru – Gheorgheni is conditioned by the operation condition of the groups in SPP Iernut, and its overcharge (at this contingency) is registered only when a certain value is produced in SPP Iernut, generally under 300MW.

It is noted that criterion N-1 is not satisfied in this section, at the 2017 stage, given the considered assumptions.

Section S4, without considering OHL 400kV Gădălin – Bistrița – Suceava

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limit. The most loaded lines are:

- OHL 400kV Sibiu - Iernut: P=513MW, I=740A=43% Ilim (Ilim = 1700 A)
- OHL 220kV Stejaru – Gheorgheni: P=188MW, I=495A=62% Ilim (Ilim = 805 A)

The N-1 element configuration, with unavailable OHL 400kV Sibiu – Iernut

The condition is acceptable, with the specific parameters within acceptable limit. The most loaded lines are:

- OHL 220kV Stejaru – Gheorgheni: P=242MW, I=640A=80% Ilim (Ilim = 805 A)
- OHL 400kV d.c. Mintia – Tarnița, on each circuit P=171MW, I=272A=16% Ilim (Ilim = 1700 A)

The N-1 element configuration, with unavailable OHL 220kV Stejaru – Gheorgheni

Furhtermore, in this assumption, the disconnection of the 220kV Stejaru – Gheorgheni line led to the overcharge of AT 400/220kV of Iernut to 117%Sn, as the factor in this overcharge is that in SPP Iernut, in the considered reference design regime, less than 300MW is produced.

It is noted that criterion N-1 is not satisfied in section S4, at the 2017 stage, on disconnection of OHL 220kV Stejaru – Gheorgheni, given the considered assumptions.

Section S5 (Moldova), in consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

In the reference design regime, Section S5 has an approx. 672MW deficit.

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limit. The most loaded lines are:

- OHL 400kV Smârdan – Gutinaş: P=779MW, I=1127A=66%Ilim (Ilim = 1700 A)
- OHL 220kV Barboşi – Focşani: P=163MW, I=429A=29%Ilim (Ilim = 1462 A), 53% Ilim (Ilim = 805 A)

The N-1 element configuration, with unavailable OHL 400kV Smârdan – Gutinaş

The condition is acceptable, though the most difficult among the N-1 configurations for S5, with the specific parameters within acceptable limits. The most loaded lines are:

- OHL 220kV Barboşi – Focşani: P=282MW, I=740A=92%Ilim (Ilim = 805 A)

Note the extremely important role of OHL 400kV Smârdan-Gutinaş the disconnection of which leads to the overcharge of the Barboşi – Focşani line almost to the highest threshold.

Section S5, without consideration of the Gădălin – Bistrița - Suceava electric highway

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limit. The most loaded lines are:

- OHL 400kV Smârdan – Gutinaş: P=740MW, I=1074A=63%Ilim (Ilim = 1700 A)
- OHL 220kV Stejaru – Gheorgheni: P=164MW, I=430A=53%Ilim (Ilim = 805 A)
- OHL 220kV Barboşi – Focşani: P=156MW, I=409A=51%Ilim (Ilim = 805 A)

The N-1 element configuration, with unavailable OHL 400kV Smârdan – Gutinaş

Assuming there is no 400kV Gădălin – Bistrița – Suceava electric highway, commissioning of the most important line for the power supply of Moldova (OHL Smârdan – Gutinaş) leads to an acceptable condition. The most loaded lines are:

- OHL 220kV Barboşi – Focşani: P =277MW, I=727A=90%Ilim (Ilim = 805 A)

Section S6

In the reference design regime, Section S6 has an approx. 4435MW deficit.

N-element configuration

The condition is acceptable, with the specific parameters within acceptable limits. The most loaded lines are:

- OHL Bucureşti-Pelicanu I = 892 A = 52% Ilim (Ilim = 1700 A)
- OHL Bucureşti-Gura Ialomiței I = 1219 A = 71% Ilim (Ilim = 1700 A)
- OHL Pelicanu-CNE I = 1187 A = 70% Ilim (Ilim = 1700 A)
- OHL Smârdan-Gutinaş I = 1273 A = 75% Ilim (Ilim = 1700 A)
- OHL Isaccea-Dobrudja I = 1207 A = 71% Ilim (Ilim = 1700 A)

The N-1 element configuration, with unavailable OHL Smârdan-Gutinaş

The condition is acceptable, with the specific parameters within acceptable limits, if in OHL 220kV Focşani - Barboşi (Ilim = 1200 A) conductors are replaced, and unacceptable if the current conductors are preserved (Ilim = 805 A); in this condition, the most loaded lines are:

- OHL Bucureşti-Pelicanu I = 1035 A = 61% Ilim (Ilim = 1700 A)
- OHL Bucureşti-Gura Ialomiței I = 1449 A = 85% Ilim (Ilim = 1700 A)
- OHL Pelicanu-CNE I = 1337 A = 78% Ilim (Ilim = 1700 A)
- OHL Focşani-Barboşi I = 821 A = 68% Ilim (Ilim = 1200 A), 102%Ilim (Ilim = 805 A)
- OHL Isaccea-Dobrudja I = 1378 A = 81% Ilim (Ilim = 1700 A)

The N-1 element configuration, with disconnected OHL Medgidia - Dobrudja

Thus, the most loaded lines are:

- OHL Bucureşti-Pelicanu I = 1133 A = 67% Ilim (Ilim = 1700 A)
- OHL Bucureşti-Gura Ialomiței I = 1524 A = 90% Ilim (Ilim = 1700 A)
- OHL Pelicanu-CNE I = 1449 A = 85% Ilim (Ilim = 1700 A)
- OHL Smârdan-Gutinaş I = 1519 A = 89% Ilim (Ilim = 1700 A)

Configuration with N-2 operating elements, with unavailable OHL NPP - Pelicanu and NPP -Stâlpu

Certain specific parameters exceed the acceptable limits in this condition.

Thus, the current transmitted on OHL Bucureşti – Gura Ialomiței is 2244 A = 132% Ilim, and on OHL Smârdan-Gutinaş I=1773 A=104% (Ilim = 1700 A).

In order to make sure of the compliance with criterion N-2, it is necessary to make at least one new OHL 400kV for power delivery from S6 to the remaining NPS.

The above indicates that, in the 2017 stage, given the assumptions (2 units in NPP Cernavoda, one approx. 3000 MW substation in the wind power units in Dobrogea, producing 70% of the installed power, as well as interconnected NPS), the delivery of the power produced in the Section S6 area is done in good conditions in the operating N and N-1 element configuration.

In the operating N-2 network element configuration (with 2 unavailable connection lines of NPP Cernavodă), the steady-state condition is a difficult one where certain specific parameters exceed maximum acceptable limits.

Considerations on OHL 400kV Stâlpu – Dârste in terms of steady-state conditions

Simultaneously with the PIF of units 3 and 4 in NPP Cernavodă, execution of OHL d.c. 400kV NPP – Stâlpu, with incoming-outgoing circuit in the 400kV Gura Ialomiței substation, is considered.

In this respect, the issue of the usefulness of its extension with OHL 400kV Stâlpu – Dârste (or Braşov) was raised.

This chapter describes the results of the analyses conducted for highlighting the extent this line is necessary.

In the operating N network element configuration, in the Section S6 reference design regime considered in this material (with an approx. 4435MW redundancy), approx. 330 MW are evacuated via this line from S6.

For lack of this line, the various N-1 configurations are actually N-2 configurations.

The calculus of these configurations' condition shows they are acceptable, with specific parameters within acceptable limits.

Indeed, the disconnection of the most important line for the S6 (OHL 400kV Medgidia – Dobrudja) power delivery, for lack of OHL 400kV Stâlpu – Dârste, leads to an acceptable steady-state condition, with specific parameters within acceptable limits.

Thus, the minimum value of the 400kV bar voltage in the eastern area of NPS is registered in the 400kV Gutinaş and Bacău substations (390kV), and the most loaded line is OHL 400kV Gura Ialomiței – Bucureşti Sud, that, in this configuration, transmits a 1074MW power, and a 1553A current =91% Ilim (Ilim = 1700 A).

Mention must be made also that, owing to the new 400kV Brazi – Pipera line, even with an approx. 1000 MW production in Petrobrazi and the existing 4 units in NPP Cernavodă, on the disconnection of any OHL 400kV in the area, there are no overcharges in the area in the absence of OHL 400kV Stâlpu – Dârste.

It is noted that, given these and the previous assumptions, the conclusion is that this line is not absolutely necessary.

A new OHL 400kV would be more useful for the delivery of power from S6 to Bucharest even to a higher extent as the importance of OHL Medgidia-Dobrudja depends on the decisions of the Bulgarian party as concerns the functions it would fulfill in the neighbouring power system. Given the new S6 sources (e.g. SPP Brăila 880MW, import 400MW in Isaccea), an additional line may be necessary to northern NPS.

10.2. PTG Elements Loading Degree

In the steady-state conditions, the power flows on the PTG elements are much under the thermal thresholds. In Annex E, tables D1÷D20 and diagrams 1÷20, the loads of the PTG elements are outlined in the annual maximum and minimum conditions (2012, 2017).

The following are noted:

– In all steady-state conditions OHL 400 kV and OHL 220 kV are loaded as follows:

Table 10.2.1

(% Sadm)

Condition	Loading of OHL 400 kV		Loading of OHL 220 kV	
	maximum	average	maximum	average
WEP 2012	37	16	48	23
WEP 2017	48	21	66	24

This situation is explanatory of the high reactive power quantity produced in the consumption peak steady-state regimes.

– The loading of AT and T (percentage in Sn) is described in Table 10.2.2:

Table 10.2.2

(%Sn)

Regime	Loading of AT 400/220 kV		Loading of AT 220/110 kV		Loading of T 400/110 kV	
	maximum	average	maximum	average	maximum	average
WEP 2012	53	39	72	28	71	25
WEP 2017	69	41	50	27	80	38

A more in-depth analysis of the PTG line and transformer loading is described in Annex E , tables 21 and 22.

The conclusion of this analysis is that the PTG use level is low as compared to the transmission capacity on thermal limit of the constituents.

Attention should be paid to the fact that, while operating, the loading of network elements varies because of the permanent change in consumption and production level and structure and the decommissionings for planned and accidental repairs. This can lead to very distinct loads on the network elements.

Also, the PTG operation specificity is that the PTG element loading limits are also determined via a NPS operation steady-state stability analysis.

10.3. Voltage Level, Voltage Adjustment and Reactive Power Compensation

Annex E – tables and diagrams D27÷D30 and schemes 1÷ 4 describe the level of voltages in PTG in operating N element conditions. They are within the standardized limits as per the PT Technical Code and included in Table 10.3.1.

Table 10.3.1 (kV)

Rated voltage	Variation margin
750	735-765
400	380-420
220	198-242

The checking done within the regimes as well at WMP and GNVs with N-1 operating elements outlined PTG voltage levels with acceptable limits.

As noted from the PTG load analysis (tables D1÷D20 and diagrams 1 ÷ 20 in Annex E), the reactive power produced by transmission lines (standing for approx. 50% of the reactive sources in annual maximum peak consumption conditions and over 85% of the reactive sources in annual minimum off-load operational regimes) requires the operation of coils to absorb reactive power (Annex E table 1).

An analysis of the PTG voltage adjustment, assuming N and N-1 elements (coils) are in operation, leads to the following conclusions:

– In the 400 kV network of Bucharest, the reactive power of the new cable network, projected in the 2017 stage, requires the installation of two 100 MVAr new coils in the area. The optimum location (on the 400 kV Grozavesti or Domneşti bars) must be the object of an in-depth economic efficiency analysis.

– The generator set adjustment capacity (primary control range) is the main means to adjust voltage (implicitly, the reactive power circulation) in PTG.

10.4. PTG Power Losses in Specific plateaus of the load curve

According to the analysis conducted for the typical steady-state regimes, the active power losses by network elements are provided in Table 10.4.1.

Table 10.4.1 MW

	WEP 2012 min	WEP 2012 average	WEP 2012 max	SMP 2012	GNV 2012	WEP 2017 min	WEP 2017 average	WEP 2017 max	SMP 2017	GNV 2017
Domestic consumption	9783	10283	10805	8777	4141	10913	12111	12850	10363	5518
Export	729	699	694	550	415	1323	1535	1735	1100	857
Import	184	154	149	300	165	123	35	135	100	57
Balance	545	545	545	250	250	1200	1500	1600	1000	800
NPS losses	270	280	305	248	117	330	364	378	322	127
PTG losses	180	198	204	168	88.4	213	206	215	209	92
Losses OHL 400kV	93	102.3	105	87	45.6	108	105	109	106	49
Losses OHL 220 kV	60	65.7	68	56	26.5	73	72	74	71	28
Losses AT 400/220 kV	9	10.4	11	9	6.5	11	10	11	11	7
Losses T 400/110 kV	7	8.2	9	7	3.8	8	7	9	9	3
Losses AT 220/110 kV	11	11.8	12	10	6.1	13	12	12	13	5

The evolution of losses in correlation with the total consumption evolution and the progressive reduction in the ΔP_{PTG} / $P_{intr.\ PTG}$ ratio because of the increasing PTG use rate in the study period are noted.

10.5. Level of Short-circuit Loads

In the design and operation stage, it is also necessary to conduct other determinations for the short circuit currents for other operation conditions/network configurations that will lead to lower values for a determination of the protection adjustments and system automations.

Mention must be made of the fact that all short-circuit calculations were done in consideration of the NPS interconnected with the neighbouring electric power systems.

The power sources were considered under Annex D-4 on group assumptions or stages 2012 and 2017.

Calculation results

In compliance with PE 026 (a document under debate on the ANRE website), the levels of short-circuit currents in the 400 kV, 220 kV and 110 kV networks, considered on reference design of power installations, are the following:

- at a 400 kV voltage: 31,5 – 50 kA (20 – 35 GVA);
- at a 220 kV voltage: up to 40 kA (15 GVA);
- at a 110 kV voltage: up to 40 kA (7.5 GVA).

Annex E tables 31, 32 and 33, 34 provides the values of loads at three-phase, one-phase and two-phase short circuit with the ground for all PTG, and RED nodes.

Stage 2012

At a 220kV voltage, out of 78 nodes:

– 54 (69.6%) have a short-circuit power less than 6000MVA

– 18(22.8%) have a short-circuit power between 6000 and 10000MVA
– 5 (6.3%) have a short-circuit power between 10000 and 12000MVA
– 1 (1.3%) has a short-circuit power higher than 12000MVA (Porțile de Fier)

At a 400kV voltage, out of 39 nodes:
– 23 (59%) have a short-circuit power less than 10000MVA
– (38.5%) have a short-circuit power between 10000 and 17000MVA
– 1 (2.5%) has a short-circuit power higher than 20000MVA (Țânțăreni)

Stage 2017

At a 220kV voltage, out of 81 nodes:
– 64 (69.6%) have a short-circuit power less than 6000MVA
– 64(79%) have a short-circuit power between 6000 and 10000MVA
– 16(19.7%) have a short-circuit power between 10000 and 12000MVA
– 1 (1.3%) has a short-circuit power higher than 12000MVA (Porțile de Fier)

At a 400kV voltage, out of 48 nodes:
– 17 (35.4%) have a short-circuit power less than 10000MVA
– 29 (60.4%) have a short-circuit power between 10000 and 17000MVA
– 2 (4.6%) have a short-circuit power higher than 20000MVA (Țânțăreni, NPP Cernavodă)

Calculus of maximum short-circuit currents in the 110kV nodes **belonging to PTG**

According to current standards, the calculus of maximum short circuit current was done in consideration of the entire 110kV looped network and the radial derivations in this network. As the calculations done with an open bus bar coupling device a 110kV resulted in exceeding the one-phase short-circuit current (>31.5kA) in the layouts of: Bucureşti Sud, Domneşti, Craiova Nord, Fundeni, Gutinaş, Işalnița, the results of the 110kV network correspond to the open bus bar coupling device scheme in these substations (normal scheme) for conformity with the acceptable limits for the existing networks.

In the 2012 stage, the values of three-phase short-circuit currents remain under the threshold value and are distributed as follows:

Table 10.5.1

Ik3 (kA)	Number of nodes	%
≤16	26	28
16 ÷ 21	27	29
21 ÷ 25	21	23
25 ÷ 31.5	18	20

In stage 2017 the values of three-phase short-circuit currents remain under the threshold value and are distributed as follows:

Table 10.5.2

Ik3 (kA)	Number of nodes	%
≤16	27	29
16 ÷ 21	27	29
21 ÷ 25	21	22
25 ÷ 31.5	19	20

10.6. Inspection of PTG under steady-state Stability Conditions

A summary of the analysis results is presented in Table 10.6.1. and Table 10.6.2. for the summer 2012 and 2017 period.

Table 10.6.1.

No.	Section	Redundancy [MW]		Deficit [MW]		Element that generated the threshold value
		$P_{rez\ st.\ st}$	P_{adm}	$P_{rez\ st.\ st.}$	P_{adm}	
1	S 1	3682	3682	-	-	Start of OHL 400kV Urechesti-Domnesti.
2	S 4 FSBG	-	-	1372	1095	Start of OHL 220 kV Gheorgheni-Stejaru
3	S 4 CSBG	-	-	1522	1120	Start of OHL 220 kV Gheorgheni-Stejaru
4	S 5 FSBG	-	-	911	722	Start of OHL 400 kV Smardan-Gutinas
5	S 5 CSBG	-	-	1105	966	Start of OHL 400 kV Smardan – Gutinas
6	S6	2683	2646	-	-	Start of OHL 400 kV Smardan – Gutinas

*- in the basic regime, on start of OHL 220kV Gheorgheni-Stejaru, AT Iernut 400/220kV is surcharged.

Table 10.6.2.

No.	Section	Redundancy [MW]		Deficit [MW]		Element that generated the threshold value
		$P_{rez\ st.\ st}$	P_{adm}	$P_{rez\ st.\ st.}$	P_{adm}	
1	S 1	4485	3890	-	-	Start of OHL 400kV P.d.F I-Resita.
2	S 4 FSBG	-	-	1407*	1115*	Start of OHL 220 kV Cluj Fl.-A.Iulia
3	S 4 CSBG	-	-	1650*	1155*	Start of OHL 220 kV Cluj Fl.-A.Iulia
4	S 5 FSBG	-	-	1139	753	Start of OHL 400 kV Smardan-Gutinas
5	S 5 CSBG	-	-	1352	1077	Start of OHL 400 kV Smardan – Gutinas
6	S6	4473	4473	-	-	Start of OHL 400 kV Medgidia-Dobrudja

**- in the basic regime, on start of OHL 220kV Gheorgheni-Stejaru, AT Iernut 400/220kV is surcharged

10.6.1. Results of Steady-state Stability Analyses – stage 2012

Owing to the power status in NPS, i.e. new power sources in the south-eastern NPS, primarily wind power units, and not only them, Section S3 (Moldova + Dobrogea) is no longer relevant and should no longer be monitored.

Indeed, in the 2012 stage, as a result of new power sources in the south-eastern NPS, the area delimited by lines:

- OHL 400kV Smârdan – Gutinaş
- OHL 220kV Barboşi – Focşani
- OHL 400kV Isaccea – Dobrudja
- OHL 400kV G.Ialomiței – Bucureşti Sud
- OHL 400kV Pelicanu – Bucureşti Sud
- OHL 110kV Slobozia – Dragoş Vodă

added, in the 2017 stage, OHL 400kV NPP – Stâlpu (section proposed to be named “section S6”) becomes excessively redundant, having in the said stage an approx. 2080MW redundancy (also considering the new 800MW generator in CHPP Galați Free Zone).

As a result, section 3, traditionally in deficit, which includes Section S5 (Moldova) with an approx. 450MW deficit, becomes redundant (however, its redundancy is less than that of Section S6), hence, monitoring this area is no longer necessary.

This is the reason why we suggest disregarding this section and analyzing/monitoring section 6 above instead.

In regard to section S2, point 14.1.1. shows the reasons why this section is no longer relevant for the NPS operation, hence its monitoring should be discontinued as well.

Section S1

The reference design regime of Section S1 of approx. 2900MW was defined by loading the S1 hydroelectric substations and SPP Turceni in RMB at the actually available power.

To aggravate the state, successive steps were taken to increase the power produced by the Section S1 generators, over their maximum acceptable power (in order to reach a theoretical critical state), simultaneously with the unloading of certain generators outside the section, i.e. increase in the power evacuated from the section.

The unavailability of the lines delimiting Section S1 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Slatina – Bucureşti Sud;
- OHL 400kV Urecheşti – Domneşti;
- OHL 400kV Ţânţăreni – Bradu;
- OHL 400kV Ţânţăreni – Sibiu;
- OHL 400kV Porţile de Fier – Djerdap;
- A circuit of OHL 400kV d.c. Ţânţăreni – Kozlodui;
- OHL 220kV Urecheşti – Tg. Jiu;
- A circuit of OHL 220kV d.c. Porţile de Fier – Reşiţa;
- OHL 220kV Craiova – Turnu Măgurele;
- OHL 400kV Porţile de Fier – Reşiţa.

The synthetic outcomes of the analyses conducted are shown in table 35.1 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), the surplus of the Section S1 reference design regime may be evacuated under satisfactory steady-state stability conditions;

- the most difficult contingency is that of unavailable OHL 400kV Urecheşti – Domneşti, where the steady-state reserve is approx. 780MW;

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the low voltage level in the 400kV Bradu substation.

Section S4

In the reference design regime, the deficit of Section S4 at this stage is approx. 940MW. To reach this state in RMB a group in SPP Iernut was shut down.

The reference design regime of the transmission capacity of the deficient Section S4 supply network (Transilvania Nord), in the N and N-1 operating element configuration, was successively aggravated by an increase in the power generated in the substations in the Oltenia, Muntenia, Central and Western Transilvania, and Moldova areas and appropriately by unloading the generators in the area (CHPP Oradea, HPP Mărişelu, SPP Iernut) and by increasing the consumed power in Section S4.

The analysis relied on 2 assumptions: with and without consideration of the 400kV Gădălin – Bistriţa – Suceava electric highway.

The unavailability of the lines delimiting Section S4 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Sibiu – Iernut;
- OHL 220kV Gheorgheni – Stejaru;
- OHL 220kV Cluj Floreşti – Alba Iulia;
- OHL 400kV Roşiori – Mukacevo;
- OHL 400kV Nădab – Oradea;
- OHL 400kV Bistriţa – Suceava, depending on the analyzed hypothesis.

Analysis with no consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 36.1 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S4 may receive power under satisfactory steady-state stability conditions;

- the lowest stability limits (appropriate to the critical and rated reserve regimes) are the ones corresponding to the state with OHL 400kV Sibiu – Iernut, which is indicative of the importance of this line for the supply of Section S4.

- because of the PTG structure of S4, in stage 2012, the minimum value of the maximum acceptable power transferred to S4 is recorded, however, on unavailability of OHL 220kV Gheorgheni – Stejaru (where the steady-state reserve is approx. 160MW, the limitation being required by the overcharge of AT 400/220kV in Iernut).

- the parameters that lead to a reduction in the maximum acceptable power as to the one with rated reserve were generally represented by: the rated power of AT 400MVA 400/220kV in the Iernut substation, the low voltage level in the 400kV and 220kV substations in the analyzed area (Iernut, Gădălin, Cluj, Roşiori, Gheorgheni, Fântânele).

Analysis with consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 36.2 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S4 may receive power under satisfactory steady-state stability conditions;

- the lowest stability limits (appropriate to the critical and rated reserve regimes) are the ones corresponding to the state with OHL 400kV Sibiu – Iernut, which is indicative of the importance of this line for the supply of Section S4.

- because of the PTG structure of S4, in stage 2012, the minimum value of the maximum acceptable power transferred to S4 is recorded, however, on unavailability of OHL 220kV Gheorgheni – Stejaru (where the steady-state reserve is approx. 185MW, the limitation being required by the overcharge of AT 400/220kV in Iernut).

- the parameters that lead to a reduction in the maximum acceptable power as to the one with rated reserve were generally represented by: the rated power of AT 400MVA 400/220kV in the Iernut substation, the low voltage level in the 400kV and 220kV substations in the analyzed area (Iernut, Gădălin, Cluj, Roşiori, Gheorgheni, Fântânele) and the 110 kV in the Bistrita area.

The maximum acceptable power in an N-element state is noted to increase by approx. 225MW as to the situation where the 400kV electric highway that connects the Transilvania Nord and Moldova areas is not considered.

Section S5

In the reference design regime, the deficit of Section S4 at this stage is approx. 476W. To reach this state in RMB a group in CHPP Suceava was shut down.

The reference design regime of the transmission capacity of the deficient Section S5 supply network (Moldova), in the N and N-1 operating element configuration, was successively aggravated by an increase in the power generated in the substations in the rest of the country and appropriately by unloading the generators in the area and by increasing the consumed power in Section S5.

The analysis relied on 2 assumptions: with and without consideration of the 400kV Gădălin – Bistrița – Suceava electric highway.

The unavailability of the lines delimiting Section S5 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Gutinaş – Braşov;
- OHL 400kV Gutinaş – Smârdan;
- OHL 220kV Focşani – Barboşi;
- OHL 220kV Stejaru – Gheorgheni;
- OHL 400kV Bistrița – Suceava, depending on the analyzed hypothesis.

Analysis with no consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 37.1 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S5 may supply power under satisfactory steady-state stability conditions;

- the lowest value of the acceptable power flow towards Section S5 is recorded in the event of unavailable OHL 400kV Smârdan – Gutinaş, where the steady-state reserve is approx. 246MW. The conclusions of steady-state conditions are confirmed as regards the special significance of the 400kV Smârdan – Gutinaş line for the supply of Section S5.

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the low voltage level in the 400kV Gutinaş, Suceava, Bacău, Roman substations.

Analysis with consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 37.2 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S5 may supply power under satisfactory steady-state stability conditions;

- the lowest stability limits (appropriate to the critical and rated reserve regimes) are the ones corresponding to the state with OHL 400kV Smârdan - Gutinaş, which is indicative of the importance of this line for the supply of Section S5.

- the lowest values of the acceptable power flow towards Section S5 is recorded in the event of unavailable OHL 400kV Smârdan – Gutinaş and OHL 400kV Suceava – Bistrița, where the steady-state reserve is approx. 490MW, and approx. 475MW respectively.

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the low voltage level in the 400kV Gutinaş, Suceava, Bacău, Roman substations.

The maximum acceptable power in an N-element state is noted to increase by approx. 180MW as to the situation where the 400kV electric highway that connects the Transilvania Nord and Moldova areas is not considered.

Section S6

In the initial state, the surplus of Section S6 is approx. 2080MW.

In the reference design regime of the transmission capacity of the power delivery network in this redundant section, the Section redundancy increased from approx. 2080MW to approx. 2360MW, mainly owing to the increase in the wind power production in the area from 50% Pi to 70% Pi .

To aggravate the state, successive steps were taken to increase the power produced by the Section S6 generators, over their maximum acceptable power (in order to reach a theoretical critical state), simultaneously with the unloading of certain generators outside the section, i.e. increase in the power evacuated from the section.

As NPP Cernavodă is inside Section S6, steady-state stability limits were determined for the N-2 operating element configuration as well, with 2 NPP connection lines unavailable respectively.

The unavailability of the lines delimiting Section S6 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Smârdan – Gutinaş
- OHL 220kV Barboşi – Focşani
- OHL 400kV G.Ialomiței – Bucureşti Sud
- OHL 400kV Pelicanu – Bucureşti Sud
- OHL 400kV Isaccea – Dobrudja

The synthetic outcomes of the analyses conducted are shown in table 38.1 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N, N-1 and N-2 operating elements), the surplus in the Section S6 reference design regime may be evacuated under satisfactory steady-state stability conditions;

- the most difficult simple contingencies are the ones with unavailable OHL 400kV Smârdan – Gutinaş or OHL Isaccea – Dobrudja, where the steady-state reserve is approx. 280MW.

The latter is virtually the separate operation of NPS in terms of Section S6.

- the parameter leading to a reduction in the maximum acceptable power as to the ones with a rated reserve was, generally, the low voltage level in certain 400kV substations (Pelicanu, Bacău, etc.).

10.6.2. Results of steady-state stability analyses – stage 2017

Section S1

The analysis of Section S1 voltage stability considered the elements delimiting this section changed according to the facts provided in sub-chapter 10.1.2. The following were considered:

- a new substation in Turnu Măgurele concurrently with the construction of a new 400kV Turnu Măgurele substation;
- a new substation in Sărdăneşti connected in a new 400kV Sărdăneşti substation and with an incoming-outgoing connection in OHL 400kV Bradu – Țânțăreni.

In the reference design regime, the surplus of Section S1 is approx. 3280MW. This was reached by the loading of the S1 hydroelectric substations and SPP Turceni in RMB at the actually available power.

To aggravate the state, successive steps were taken to increase the power produced by the Section S1 generators, over their maximum acceptable power (in order to reach a theoretical critical state), simultaneously with the unloading of certain generators outside the section, i.e. increase in the power evacuated from the section.

The unavailability of the lines delimiting Section S1 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Slatina – Bucureşti Sud;
- OHL 400kV Urecheşti – Domneşti;
- OHL 400kV Sărdăneşti – Bradu;
- OHL 400kV Țânțăreni – Sibiu;
- OHL 400kV Porțile de Fier – Djerdap;
- A circuit of OHL 400kV d.c. Țânțăreni – Kozlodui;
- OHL 220kV Urecheşti – Tg. Jiu;
- A circuit of OHL 220kV d.c. Porțile de Fier – Reşița;
- OHL 400kV Porțile de Fier – Reşița;
- OHL 220kV Turnu Măgurele - Ghizdaru;.
- One AT of the 2 220/110kV 200MVA autotransformers Turnu Măgurele.

The synthetic outcomes of the analyses conducted are shown in table 35.2 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), the surplus in Section S1 reference design regime may be evacuated under satisfactory steady-state stability conditions;

- the most difficult contingency is that of unavailable OHL 400kV Porțile de Fier - Reşița, where the steady-state reserve is approx. 610MW;

- the parameters leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the low voltage level in the 400kV Săcălaz, Reşița, Timişoara substations and the overcharges on lines 220kV Urecheşti – Tg. Jiu and Tg. Jiu – Paroşeni.

Section S4

As compared to stage 2012, this stage considered a new pump storage hydroelectric substation Tarnița concurrently with the construction of the new 400kV substation, OHL 400kV Tarnița – Gădălin and OHL 400kV Tarnița – Mintia d.c. Given the location of the new substation in the Transilvania Nord area, OHL 400kV d.c. Tarnița – Mintia was considered a new delimitation element of S4.

In the reference design regime, the deficit of Section S4 at this stage is approx. 905MW, reached by shutdown of a group in SPP Iernut.

The reference design regime of the transmission capacity of the deficient Section S4 supply network (Transilvania Nord), in the N and N-1 operating element configuration, was successively aggravated by an increase in the power generated in the substations in the Oltenia, Muntenia, Central and Western Transilvania and Moldova areas and appropriately by unloading the generators in the area (CHPP Oradea, HPP Mărişelu, SPP Iernut, SPHPP Tarnita) and by increasing the consumed power in Section S4.

The analysis relied on 2 hypotheses: with and without consideration of the 400kV Gădălin – Bistrița – Suceava electric highway.

The unavailability of the lines delimiting Section S4 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Sibiu – Iernut;
- OHL 220kV Gheorgheni – Stejaru;
- OHL 220kV Cluj Floreşti – Alba Iulia;
- OHL 400kV Roşiori – Mukacevo;
- OHL 400kV Nădab – Oradea;
- A circuit of OHL 400kV d.c. Tarnița – Mintia;
- OHL 400kV Bistrița – Suceava, depending on the analyzed assumption.

Analysis with no consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 36.3 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S4 may receive power under satisfactory steady-state stability conditions, except for the contingency of the 220kV Stejaru - Gheorgheni lines;

- the lowest stability limits (appropriate to the critical and rated reserve regimes) are the ones corresponding to the state with OHL 400kV Sibiu – Iernut, which is indicative of the importance of this line for the supply of Section S4;

- because of the PTG structure of S4, in stage 2018, the minimum value of the maximum acceptable power transferred to S4 is recorded, however, on the unavailability of OHL 220kV Cluj Floreşti – Alba Iulia (where the steady-state reserve is approx. 210MW, the limitation being required by the overcharge of AT 400/220kV in Iernut).

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the rated power of the 400MVA 400/220kV AT in the Iernut substation;

- as, on disconnection of OHL 220kV Gheorghieni – Stejaru, the 400MVA 400/220kV AT in the Iernut substation is still overloaded from the initial reference design regime, no steady-state stability limits were calculated any longer. The reasons why this contingency does not satisfy the N-1 criterion are presented in 14.1.2.

- as compared to stage 2012, no increase in the S4 transmission capacity is recorded. This may be explained by the source assumption in the Transelectrica premises for this stage that results in a higher power flow from the eastern part of the country and less from Mukacevo and Nădab, which implicitly increases the power flow via the 400/220kV de 400MVA AT in the Iernut substation.

Analysis with consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 36.4 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S4 may receive power under satisfactory steady-state stability conditions, except for the contingency of the 220kV Stejaru – Gheorgheni line (see explanations in 14.1.2.);

- the lowest stability limits (appropriate to the critical and rated reserve regimes) are the ones corresponding to the state with OHL 400kV Sibiu – Iernut, which is indicative of the importance of this line for the supply of Section S4.

- because of the PTG structure of S4, in stage 2017, the minimum value of the maximum acceptable power transferred to S4 is recorded, however, on the unavailability of OHL 220kV Cluj Floreşti – Alba Iulia (where the steady-state reserve is approx. 680MW, the limitation being required by the overcharge of AT 400/220kV in Iernut).

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the rated power of the 400MVA 400/220kV AT in the Iernut substation;

- as, on disconnection of OHL 220kV Gheorghieni – Stejaru, the 400MVA 400/220kV AT in the Iernut substation is still overloaded from the initial reference design regime, no steady-state stability limits were calculated any longer. The reasons why this contingency does not satisfy the N-1 criterion are presented in 14.1.2.

- as compared to stage 2012, no increase in the S4 transmission capacity is recorded. This may be explained by the source assumption in the Transelectrica premises for this stage that results in a higher power flow from the eastern part of the country and less from Mukacevo and Nădab, which implicitly increases the power flow via the 400/220kV de 400MVA AT in the Iernut substation.

The maximum acceptable power in an N-element state is noted to increase by less than 100MW as to the situation where the 400kV electric highway that connects the Transilvania Nord and Moldova areas is not considered.

Section S5

In the reference design regime, the deficit of Section S5 at this stage is approx. 672MW via the shutdown of a group in CHPP Suceava.

The reference design regime of the transmission capacity of the deficient Section S5 supply network (Moldova), in the N and N-1 operating element configuration, was successively aggravated by an increase in the power generated in the substations in the rest of the country and appropriately by unloading the generators in the area and by increasing the consumed power in Section S5.

The analysis relied on 2 assumptions: with and without consideration of the 400kV Gădălin – Bistrița – Suceava electric highway.

The unavailability of the lines delimiting Section S5 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Gutinaş – Braşov;
- OHL 400kV Gutinaş – Smârdan;
- OHL 220kV Focşani – Barboşi;
- OHL 220kV Stejaru – Gheorgheni;

- OHL 400kV Bistrița – Suceava, depending on the analyzed assumption.

Analysis with no consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 37.3 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S5 may supply power under satisfactory steady-state stability conditions;

- the lowest values of the acceptable power flow towards Section S5 are recorded in the event of unavailable OHL 400kV Smârdan – Gutinaş, where the power reserve is approx. 81MW, and approx. 226MW respectively.

- the parameter that leads to a reduction in the maximum acceptable power as to the one with rated reserve were generally represented by the low voltage level in the 400kV Gutinaş, Suceava, Bacău, Roman substations.

- it is noted that, for lack of the 400kV Suceava – Bistrița – Gădălin electric highway, the steady-state stability conditions of the Section S5 supply are satisfactory. Because of the reasons in pct. 14.1.2, this electric highway may be considered necessary.

Analysis with consideration of the 400kV Gădălin – Bistrița – Suceava electric highway

The synthetic outcomes of the analyses conducted are shown in table 37.4 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), Section S5 may supply power under satisfactory steady-state stability conditions;

- the lowest stability limits (appropriate to the critical and rated reserve states) are the ones corresponding to the state with disconnected OHL 400kV Gutinaş - Smârdan, which is indicative of the importance of this line for the supply of Section S5;

- the lowest values of the acceptable power flow towards Section S5 are recorded in the event of unavailable OHL 400kV Suceava – Bistrița and OHL 400kV Smârdan - Gutinaş.

- because of the PTG structure of S5, in stage 2017, the minimum value of the maximum acceptable power transferred to S5 is recorded, however, on the unavailability of OHL 400kV Suceava – Bistrița (where the steady-state reserve is approx. 389MW, the limitation being required by the voltage level in the area);

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the low voltage level in the 400kV Gutinaş, Suceava, Bacău, Roman, Munteni substations.

The maximum acceptable power in an N-element state is noted to increase by approx. 290MW as to the situation where the 400kV electric highway that connects the Transilvania Nord and Moldova areas is not considered.

Section S6

In the initial state (RMB), the surplus of Section S6 is approx. 3060MW.

In the reference design regime of the transmission capacity of the power delivery network in this redundant section, the Section redundancy increases from approx. 3060MW to approx. 4435MW, mainly owing to the increase in the wind power production in the area from 50% Pi to 70% Pi .

To aggravate the state, successive steps were taken to increase the power produced by the Section S6 generators, over their maximum acceptable power (in order to reach a theoretical critical state), simultaneously with the unloading of certain generators outside the section, i.e. increase in the power evacuated from the section.

As NPP Cernavodă is inside Section S6, steady-state stability limits were determined for the N-2 operating element configuration as well, with 2 NPP connection lines unavailable respectively.

The unavailability of the lines delimiting Section S6 was successively considered simple contingencies for the N-1 configurations:

- OHL 400kV Smârdan – Gutinaş
- OHL 220kV Barboşi – Focşani
- OHL 400kV G.Ialomiței – Bucureşti Sud
- OHL 400kV Pelicanu – Bucureşti Sud
- OHL 400kV Medgidia – Dobrudja

The synthetic outcomes of the analyses conducted are shown in table 38.2 of Annex E.

Outcome examination resulted in the conclusion that:

- in all considered configurations (with N and N-1 operating elements), the surplus of the Section S6 reference design regime may be evacuated under satisfactory steady-state stability conditions;

- the most difficult contingencies are those of unavailable OHL 400kV Medgidia – Dobrudja or OHL 400kV Bucureşti Sud – G.Ialomiței.

The first contingency is virtually the separate operation of NPS in terms of Section S6.

- the parameter leading to a reduction in the maximum acceptable power as to the one with a rated reserve was, generally, the low voltage level in certain 400kV substations (Pelicanu, Bacău, etc.).

No steady-state stability limit was calculated for the N-2 configuration for this stage as the specific parameters have been exceeded ever since the very initial steady-state reference design regime.

Mention must be made that the failure to comply with criterion N-2 in stage 2017 is caused by the new units 3 and 4 in NPP Cernavoda and the increase in the installed power in the south-eastern NPS wind power units.

For compliance with criterion N-2 it is necessary to make at least one new OHL 400kV for power delivery from S6 to the remaining NPS.

It is noted that in this stage the steady-state stability conditions for power delivery from Section S6 are more difficult than in stage 2012, which may be explained by the estimated increase in the power produced in this section in stage 2017.

These conditions are believed to be the acceptable limit and the appearance of one or several power sources in the area, in addition to the ones considered in this material, is thought to require the creation of new power delivery means in this area.

The influence of OHL 400kV Stâlpu – Dârste on the steady-state stability conditions for power delivery from Section S6

The analysis of the steady-state stability conditions for power delivery from Section S6 conducted with and without consideration of OHL 400kV Stâlpu – Dârste resulted in the conclusion that it had a minor influence on the increase in the S6-related transmission capacity (approx. 30MW).

This analysis is a confirmation of the results in sub-chapter 10.1.2. showing that the existence of this line has a minor contribution to the improvement of the NPS operation conditions.

10.7. Transient Stability and Protection Steps in PTG Nodes

Results of the transient stability analysis in stages 2012 and 2017

As all analyzed stages resulted in approximately the same (qualitative) conclusions, a common comment was issued for all stages.

It is stated that, as the analyses in the previous chapters result in the conclusion that any further monitoring of Section S2 is no longer relevant and that it should be discontinued, this chapter no longer explicitly states the transient stability conditions of this section.

However, mention must be made that the transitory conditions caused by flaws on this section boundary lines, raising stability issues, were calculated and presented in other sections (S1, S4).

The same is true for Section S3, the monitoring of which was proposed to be discontinued. However, the transient stability conditions in the S4, S5 and S6 analysis were scrutinized for this section's boundary lines.

Here are the results of the transient stability calculations for the NPS specific sections. Annex E, table 39, provides a series of significant results for exemplification purposes.

Section S1

The transitory states were calculated in this study as caused by flaws on the lines delimiting this section:

- OHL 400kV s.c. Slatina – Bucureşti Sud
- OHL 400kV s.c. Urecheşti – Domneşti
- OHL 400kV Ţânţăreni – Bradu, (in stage 2018 OHL 400kV Sărdăneşti – Bradu)
- OHL 400kV s.c. Ţânţăreni – Sibiu
- OHL 220kV s.c. Urecheşti – Tg. Jiu
- OHL 220kV d.c. Porţile de Fier – Reşiţa
- OHL 220kV s.c. Craiova – Turnu Măgurele
- OHL 400kV s.c. Porţile de Fier – Reşiţa
- OHL 400kV d.c. Slatina - Tr.Măgurele (in stage 2017)

as well as on other lines in the PTG, that the occurrence of multiple-phase flaws could OHL to unstable conditions:

- OHL 400kV s.c. Braşov – Sibiu
- OHL 220kV s.c Paroşeni – Tg.Jiu
- OHL 220kV s.c Paroşeni – Baru Mare

The following important line unavailability cases were considered for checking the transient stability in the N-1 configurations:

OHL 400kV s.c. Porţile de Fier – Reşiţa
OHL 400kV s.c. Slatina – Bucureşti Sud
OHL 400kV s.c. Urecheşti – Domneşti
OHL 400kV Ţânţăreni – Bradu, respectively in stage 2017 OHL 400kV Sărdăneşti – Bradu
OHL 400kV s.c. Ţânţăreni – Sibiu

The following are noted:

- In the analyzed situations, given the retrofitting of certain substations in the area, the transient stability of the generators in S1 is, generally, assured, with no need for special modernization measures;
- In the event of a triple-phase short-circuit in Braşov 400kV on OHL Sibiu (in the N-configuration), removed by a remote stepped protection, the generators in HPP Lotru de-synchronize. In the event it is removed quasi-simultaneously via teletransmission

remote protection, the condition had a stable result. Thus, the usefulness of the teletransmission protection installation for this line was highlighted.

- Also, providing teletransmission installations on OHL 400kV Porțile de Fier – Reşița also proved necessary (for ensuring stability of generators connected to 400kV in this substation);
- For triple-phase flaws in the area of certain Section S1 substations, even if removed by correctly activating the relevant protections, the encapsulated generators in HPP Porțile de Fier II de-synchronize.

Section S4

The transitory conditions driven by three-phase short-circuits on the NPS interior lines delimiting the section were calculated in this study for the N-operating element configuration:

- OHL 400kV Sibiu – Iernut
- OHL 400kV Oradea – Nădab
- OHL 220kV Stejaru – Gheorgheni
- OHL 220kV Alba Iulia – Cluj Floreşti

to which OHL 400kV d.c. Tarnița – Mintia and OHL s.c. 400kV Bistrița – Suceava are added in stage 2017.

Also, calculations were made for the transitory conditions on other lines of importance for the area operation: OHL 220kV s.c. Al.Iulia – Mintia and OHL 220kV d.c. Iernut – Ungheni.

The unavailability of important lines was considered in order to check the transient stability in the N-1 configurations:

- OHL 400kV Sibiu – Iernut
- OHL 220kV Alba Iulia – Cluj Floreşti
- OHL 400kV Oradea – Nădab, and in stage 2017
- OHL 400kV Suceava - Bistrița as well.

As shown in Annex E table 39, these transitory conditions generally become stable in the end even when occurring triple-phased short-circuits are gradually removed by the related remote protections.

In the event of a short-circuit near Iernut 400kV on OHL Sibiu, gradually removed by remote protection, the generators in HPP Lotru de-synchronize.

This recalculated condition became stable if the flaw is quasi-simultaneously removed from both ends of OHL 400kV Sibiu – Iernut, by activating a teletransmission remote protection.

The usefulness of tele-protection devices on this line to ensure the stability of the generators in HPP Lotru is hereby noted.

Also, the occurrence of a triple-phase short-circuit near Ungheni 220kV on a circuit of OHL 220kV d.c. Iernut – Ungheni, gradually removed by remote protection, leads to the de-synchronization of the generators in SPP Iernut connected to 220kV.

This recalculated condition became stable if the flaw is quasi-simultaneously removed from both ends of the line via the teletransmission installations.

Another line in the area in connection with which the occurrence of triple-phase short-circuits raises stability issues is OHL 220kV Al.Iulia – Mintia.

Indeed, in the event of a triple-phase short-circuit in Al. Iulia 220kV on OHL Mintia or on Mintia 220kV on OHL Al. Iulia, which is gradually removed by remote protection, the generators in HPP Şugag and HPP Gâlceag de-synchronize. Hence, it is necessary that teletransmission protection devices should be provided on this line as well.

It is however stated that, even in consideration of this assumption, on occurrence of triple-phase short-circuits near Al. Iulia 220kV on OHL Mintia, the generators in HPP Gâlceag and Şugag de-synchronize nonetheless.

This is explained by the special significance OHL Al. Iulia – Mintia has for the stability of generators in these substations

If the 220kV Al.Iulia substation is re-engineered, these transitory conditions become stable.

Assuming the quasi-simultaneous flaw is removed on both ends for teletransmission remote protection, triple-phase short-circuits near the 220kV Mintia bars on OHL 220kV Al.Iulia lead to stable conditions.

Section S5

The transitory states were calculated in this study as caused by triple-phase short-circuits on the lines delimiting this section:

- OHL 400kV Braşov – Gutinaş
- OHL 400kV Gutinaş – Smârdan
- OHL 220kV Focşani – Barboşi
- OHL 220kV Stejaru – Gheorgheni

which in stage 2017 OHL 400kV Suceava – Bistrița is added to.

The unavailability of important lines was considered in order to check the transient stability in the N-1 configurations:

- OHL 400kV Braşov – Gutinaş
- OHL 400kV Gutinaş – Smârdan
- OHL 220kV Focşani – Barboşi
- OHL 220kV Stejaru – Gheorgheni

and in stage 2017:

- OHL 400kV Suceava – Bistrița.

Table 39 (Annex E) presents a summary of calculation results. In all analyzed conditions, the transient stability of the NPS groups is noted to be ensured, with no special modernization measures in the 400 and 220kV network.

Section S6

The transitory states caused by three-phase short-circuits on the NPS interior lines delimiting the section were calculated in this study for the N-operating element configuration:

- OHL 400kV Smârdan – Gutinaş
- OHL 400kV G.Ialomiței – Bucureşti Sud
- OHL 400kV Pelicanu – Bucureşti Sud
- OHL 220kV Barboşi – Focşani

which in stage 2017 OHL 400kV Stâlpu – NPP was added to.

For the N-1 operating element configurations, the 2 more important lines (OHL 400kV Smârdan – Gutinaş and OHL G. Ialomiței – Bucureşti Sud) for the area operation were successively considered unavailable, for stage 2012; for stage 2017 the N-1 configuration was additionally considered, with unavailable OHL 400kV Stâlpu – CNE.

For these 3 configurations, calculations were made to completely cover the transitory conditions caused by triple-phase short-circuits; if some of them became unstable, they were recalculated in consideration of one-phase flaws, followed by a successful RARM.

All calculated transitory conditions, given the flaws on the lines delimiting Section S6 and the above assumption, became stable (both in the N and N-1 configuration), and there was no need to provide for teletransmission devices on these lines.

Table 39 (Annex E) presents a summary of calculation results.

In August 2008 ISPE elaborated stage II of the "Solution study for the connection to NPS for the delivery of the power produced by a plan of approx. 800MW in the Galați Free Zone in order to acquire the NPS connection approval".

The conclusions of this work show that the following lines (inside the S6 area) must be equipped with the necessary teletransmission installations required for the quasi-simultaneous removal of flaws on both ends to ensure the transient stability conditions of the 800MW generator in CHPP Galați the Free Zone:

- OHL 400kV d.c. SPP Galați Free Zone – Smârdan
- OHL 400kV d.c. Smârdan – Isaccea
- OHL 400kV s.c. Smârdan – Lacu Sărat

10.8. Continuity of Electric Power Transmission Services

The service quality (voltage present, consumer supply) is a requirement that must be fulfilled in compliance with the PTG provisions.

In line with the international and Romanian standards (primarily, the Technical Code of the Transmission Network), its presentation is as follows:

- On a system level, as a rule, based on operating data, characterizing a safety task;
- On a node level, via safety indices, predefined by calculus and, obviously, with a possibility to check during operation.

The node safety indices allow the determination of frequencies concerning the failed functions of the substation, the average length of such incidents, as well as the evaluation of maximum operation discontinuance evaluation.

The calculus of safety indices will highlight the node connection manner to PTG (by a determination of the associated safety level), as well as the node own connection and the equipment reliability parameters (by a determination of the inner safety level).

The safety indices (concerning the function achievement) will be determined in consideration of the node roles in NPS:

- source
- consumer
- power transit.

The calculus and analysis of the node safety indices for the PTG 400 kV and 220 kV kinks, as well as the associated safety indices provided by PTG on the interface with another partners (suppliers, eligible consumers, international relations) for stages 2012 and 2017.

Mention must be made that the index determination was done in consideration of the following:

- for new re-engineered substations, cutting-edge parameters;
- for the existing substations, the data in PE 013/1994 (as effective);
- for year 2017 an analysis was conducted concerning the influence of new parameter adoption according to NTE 005 013/2005;
- as concerns the network, the current parameters were maintained;
- the analysis was conducted in consideration of the network configuration evolution in compliance with the retrofitting project schedule and new lines.

The results in this paper highlight the following:

- a possibility to determine the related safety in the C.N. Transelectrica S.A. approval stage for the PTG connection.
- Outline long-term and manoeuvring interruptions that, for some eligible consumers, may lead to damages and, in this case, limitation means should be defined (by measures at the consumer or in PTG) that should be stipulated in the connection approvals.
- A possibility to introduce objective and technically defined continuity clauses with the partners in Romania or abroad.

- Outline the means to increase safety level of introduction of back-up means, retrofitting of substations (change of the connection scheme, equipment replacement).
- The importance of the retrofitting of the transmission network.

Calculations were made for safety node indices for all 400 kV and 220 kV nodes of the transmission network and 110 kV nodes (related to the 400 kV, 220 kV substations belonging to C.N. Transelectrica S.A) – stage 2012 (Annex E table 41) and 2017 (Annex E 43). The values of the 110kV indices should be deemed safety values associated to the bar of one single transformation unit. They stand for associated safety indices for one single radial source to be connected to or a transformation unit. In the other cases (with two transformation units or more), the reservation manner is dependant on the 110kV connection and the reserve use manner in the normal (intrinsic safety) operating scheme.

Annex E tables 40 and 42 show a comparison of the results obtained in the retrofitting substation projects and those in the new substations and lines for stages 2012 and 2017 (by comparison with the node safety indices before retrofitting - stage 2008).

The result analysis results in the following remarks:

- the retrofittings of substations as provided in the three analyzed stages led to an improvement in the safety node indices for all substations subject to retrofitting. If the substation subject to retrofitting is a source node for other stations, an improvement in the index values for these substations is noted as well.

- For the 400 kV and 220 kV substations subject to retrofitting, with double and transfer bars, transferred to double bar, the improvement is obvious in the interruption number and average failure times, the maximum interruption time staying the same, with plus or minus deviations.

Generally speaking, for substations not subject to retrofitting, a change in the indices may be noted, as a result of associated safety change. Thus, the retrofitting effect of the neighbouring substations is, in all cases, some reduction in the number of interruptions; however, as the line parameters, in particular their repair times, stayed the ones in NTE 005 PE 013/2005, the maximum interruption times remain high.

Stage 2012

The considerable improvement of the safety level in the 220kV Cetate node by a double bar switching substation with a single PTG 220kV connection is noted.

In stage 2012, the connection of the 400kV Tariverde substation between the 400kV Tulcea V. – Constanța N. substations does not lead to a reduction in the average interruption number, but only to a minor increase in the average failure time for the 2 substations.

The OHL 400kV Isaccea – Dobrudja connection in the 400kV Medgidia S substation (stage 2012) leads to an improvement of the indices of this substation. In stage 2008, the 400kV Medgidia S. Substation has one single connection line at the 400kV NPP Cernavodă substation.

The retrofitting of the 220kV Pestiş substation by changing the double bar scheme, with a transfer bar, to sectioned simple bar leads to less cutting-edge indices (the average failure time, and minimum time respectively), but the interruption number is reduced.

The safety level in the 220 kV T.Severin Est node considerably improves by execution of a double bar switching substation, with the initial scheme of OHL block + AT; whereas the indices are provided with no consideration of the mutual reservation of the 2 routes.

Stage 2017

The execution of OHL 400kV Reşița – Timişoara – Săcălaz – Arad, including the retrofitting of these substations leads to higher safety indices, though in the new scheme the connection of each substation with the neighbouring node is done via one single line (in the initial situation there were OHL 220kV d.c. as a connection among the Reşița – Timişoara – Arad substations).

The 2 new 400kV Tariverde and VÂNT substations have higher safety indices, each being considered with 4 PTG connection lines each. The VÂNT substation was considered as incoming-outgoing on OHL 400kV Isaccea – Medgidia S. (Varna) and a connection d.c. with the Tariverde substation.

The transfer to 400kV of OHL Brazi – Teleajen – Stâlpu and the 2 new OHL 400kV Stâlpu – NPP and Stâlpu – Dârste lead to an increase in the safety level of the 2 substations: Teleajen and Stâlpu, that initially had a radial connection with the 220 kV Brazi V substation.

For the new 400/110kV Sărdăneşti substation, with an incoming-outgoing connection on OHL 400KV Țânțăreni – Bradu, with a double bar scheme, higher safety indices are obtained. The current 220 kV Sărdăneşti substation has low indices, with a simple bar scheme, sectioned with 2 separators and transfer bar.

The analysis of the presented results may lead to the general observation that, in most nodes, the average failure time is under 0.5 hours/year, the maximum interruption number is 1 per year, the manoeuvring interruption number is max. 2 per year, the maximum time of an interruption is less than 3 hours.

The exceptions are the radial supply substations the safety indices of which are conditional on the line parameters (e.g. the 400 kV Cluj Est, Drăgăneşti Olt substations, the 220kV Şugag, Gâlceag, Sălaj, Vetiş substations etc), sectioned or non-sectioned simple bar substations and some substations not subject to retrofitting (Alba Iulia, Fileşti, Iaz, Gradişte).

In the case of polygon schemes, owing to the significant number of devices (voltage transformer isolators) in the polygon nodes, the node indices are less good. For substations with 1.5 circuit switches, the indices in Annex E correspond to the voltage presence on the 2 bus-bars. The outgoing indices determined by the connection node safety are comparable to the ones obtained for the polygon substations.

It is a known fact that schemes with ½ circuit and polygon switches respectively have cell reservation ensured; hence the failure of one of the 2 cells supplying a departure does not affect the supply continuity. The situation is similar in the case of a double bar and transfer bar scheme; however, it is not assured in a double bar scheme.

Schemes with ½ circuit and polygon switches are at a disadvantage as, on failure of one node element, the relevant departure is interrupted during the repairs while in double bar schemes, the interruption is merely a manoeuvring one.

10.9. Conclusions

Assuming the foreseen PTG development works are started, the normal operation condition will be characterized as follows:

- The OHL loading level and the PTG transformers are, on an average, below 40% of the thermal limit, at consumption peak, for the entire analyzed period. Under these circumstances, one may estimate that there are conditions favourable for avoidance of system blockages and the proper operation of preventive maintenance programmes requiring decommissionings;
- The PTG voltage values are within the acceptable limits for the entire analyzed period;
- The N-1 criterion is complied with, except for – in stage 2017, on starting of OHL 220kV Stejaru-Gheorgheni, AT 400/220kV in Iernut is overcharged, supposing the power generated in SPP Iernut is less than 300MW;
- Owing to the power situation in NPS, i.e. new power sources in south-eastern NPS, mainly, wind power units, and not only them, Section S3 (Moldova + Dobrogea) is no longer relevant and further monitoring should be discontinued. Instead, Section S6 will be monitored as it becomes highly redundant and defined in the following lines:

- OHL 400kV Smârdan – Gutinaş
- OHL 220kV Barboşi – Focşani
- OHL 400kV Isaccea – Dobrudja
- OHL 400kV G.Ialomiței – Bucureşti Sud
- OHL 400kV Pelicanu – Bucureşti Sud
- OHL 110kV Slobozia – Dragoş Vodă

which 2017 OHL 400kV NPP – Stâlpu is added to in stage 2017;

- Section 2 is no longer relevant for the operation of NPS. Its further monitoring is proposed to be discontinued;
- The PTG short-circuit load levels are within the limits accepted by the equipment in substation all over the analyzed period;
- The steady-state stability limits on the characteristic sections are within the NPS safe and stable operation requirements, in the context of the UCTE interconnected operation;
- The analyses on the control of the NPS transient stability conditions, in stages 2012 and 2017, it was shown that, in order to provide for the transient stability conditions of the 800 MW generator in CHPP Galați Free Zone, it is required to equip the following lines (inside Section S6), with teletransmission installations necessary for the quasi-simultaneous removal of flaws on the lines on both ends of it:
  - OHL 400kV d.c. SPP Galați Free Zone – Smârdan
  - OHL 400kV d.c. Smârdan – Isaccea
  - OHL 400kV s.c. Smârdan – Lacu Sărat;
- Following the calculus of the safety node indices, it is noted that the retrofitting of the substations as provided in the three analyzed stages lead to an improvement in the safety node indices for all substations subject to retrofitting. If the substation subject to retrofitting is a source node for other substations, an improvement in the index values for these substations is noted as well. For the double-bar and transfer 400 kV and 220 kV substations subject to retrofitting, with double and transfer bars, transferred to double bar, the improvement is obvious in the interruption number and average failure times, the maximum interruption time staying the same, with plus or minus deviations.

11. Compensation Mechanism for Effects of Using Electric Power Transmission Grids for Cross-Border Exchanges

Transelectrica, in its capacity of transmission and system operator, partakes in the power regional market implementation project in South-Eastern Europe and is represented in the European Network of Transmission System Operators – SETSO TF, which is a structure of the Athens Forum, an authority specially created for the coordination of this project tasks.

The European Commission supervises and guides this project, with the purpose of integrating the regional market in the EU internal market (ECSEE process - Energy Community in South-East Europe). To this end, on October 3rd, 2002 and December 6th, 2003 the Memoranda of Understanding were signed on the creation of the South-Eastern European power market by the Energy Ministers in the South-Eastern European countries, alongside with the ones in the supporting and observatory countries. On October 25th, 2005, the Energy Community Treaty was signed that become effective on July 1st, 2006.

One of the core objectives of the Forum for regional market operation is the July 2004 implementation of the joint mechanism for compensation of effects of using electric power transmission networks for cross-border exchanges, called ITC (**I**nter **T**ransmission System Operator **C**ompensation). The mechanism implementation process is under the direct coordination of the European Network of Transmission System Operators for Electricity (ETSO) and the European Commission, benefiting from the support of the Council of European Energy Regulators (CEER), energy ministries and regulatory authorities in participating countries.

The actual ITC implementation mechanism in SEE in July 2004 continued until May 2007, based on the same core principles as the ETSO ITC compensation mechanism implemented in the EU countries.

Pursuant to the *EU Regulation 1228/2003 on conditions for access to the network for cross-border exchanges in electricity*, ERGEG (European Regulators Group Electricity and Gas) drafted the document ***Guidelines on Inter TSO Compensation,*** May 2006, recommending a new methodology called IMICA (Improved Modelling for Infrastructure Cost Allocation) for compensation purposes between TSO as concerns the effects of using electric power transmission networks for cross-border exchanges.

Following the IMICA methodology analysis, the Steering Committee recommended, for a start, an intermediary ITC mechanism for June – December 2007 wherein the TSO in the SETSO countries should participate.

The ITC 2007 intermediary mechanism is an update of the mechanism implemented until May 2007 and upholds the principles of compensation between TSO depending on the transit via national networks determined based on energy flows on network elements in snapshots.

The IMICA methodology principles are applied in the ***ITC intermediary mechanism*** only by network infrastructure cost compensation. To compensate technological consumption costs in the transmission electric network, the WWT (With and Without Transit) methodology is used.

The TSO contributions to the compensation fund are formed of two pars, similarly to the 2006 mechanism: one part considers the *contribution from perimeter neighbouring countries* for exports and imports scheduled by traders in perimeter neighbouring countries to/from the ITC mechanism participating countries and another part called *"electric energy net flow for export/import"*.

Transelectrica records revenues and expenditures generated from the electric power transit requested by market participants who wish to import or export to/from Romania. For electric power transits done by electric power exporters in countries other than the ones participating in the ITC mechanism, a 1Euro/MWh network access fee was applied until May 2007 and a 1.41 Euro/MWh fee was applied in June-December 2007.

To ensure ITC mechanism continuity in 2008-2009, 34 countries in Europe signed a new ITC Contract that maintains the core principles of the ITC 2007 intermediate mechanism. This Pan-European agreement makes it possible to eliminate transit taxes for electric power cross-border exchanges and is a step ahead for the European integration of electricity markets.

At present, ETSO, together with the hired external consultants, are preoccupied with the elaboration of a sustainable methodology for the compensation between TSO that should apply after 2010 in agreement with the progress on the internal energy market (IEM). This methodology will be the basis for *Guidelines on ITC*, for its approval by the European Commission.

12. PTG Assets Maintenance Strategy for a 5-year forecast period and for 10-year forecast as a guide

12.1. PTG Facilities

12.1.1. General Maintenance Issues – as Part of Asset Management

Maintenance is included in the CNTEE Transelectrica S.A. asset management concept and is, according to global practice, one of its constituents.

In line with the requirements of the National Authority for Energy Regulation (ANRE), maintenance is carried out based on the Maintenance Plan (MP) that achieves the following: maintenance regulation, introduction of a modern concept of maintenance optimization and implementation.

MP incorporates and maintains – standing for a framework for the elaboration, revision, update of maintenance documents as necessary – the entire documentation on maintenance.

The MP implementation and the maintenance management are done by the CNTEE Transelectrica-SA staff based on the *operational procedures, prescriptions, technological sheets, internal technical standards and specific working instructions*.

Maintenance complies with the requirements of the specific documentation:

- Performance standard for electric energy transmission and system services – approved by an order of the National Authority for Energy Regulation (ANRE) 17/2007;
- Maintenance management and organization regulations - approved by an order of the National Authority for Energy Regulation (ANRE) 35/2002;
- Prevention maintenance regulations in PTG – NTI–TEL–R–001–2007-00 installations and equipment;
- Trials and measurements in the electric equipment within PTG-NTI–TEL–R–002–2007-00;
- PTG Perspective Plan and Business Plan;
- Other specific regulations.

Over the last years, in the Power Transmission Grid (PTG), the installation actual technical state has maintained at a level appropriate for safe operation, as a result of the implementation of a rigorous *maintenance* programme and a sustained *investment* programme *(retrofitting and modernization)* of the PTG installations.

Preventive maintenance programmes are also defined in consideration of the *investment programmes (retrofitting and modernization)*, being inter-connected, both on electric substation level, and electric line level (taking into account the transformation substation rehabilitation/modernization programmes elaborated on scientific bases via hierarchization criteria leading to decisions of maintenance or investments).

Major maintenance works were also included in the maintenance PTG programmes, based on "Master Plan" projects fully concerning the substation or OHL, given the works virtually done in all functional systems; at the same time, the investments component provides for modernization or retrofitting and substation preparation for telecontrol. Owing to the extremely fast technological progress and given the fact that most equipment is over 30 years old, the modernization and retrofitting, components were included that ensure operation on a current technical level by replacement of elements subject to moral and/or physical wear and tear and addition of supplementary elements (facilities), including the introduction of new technologies.

The *rehabilitation* works *(major maintenance with a modernization or retrofitting component)* started and performed at a quick pace over the last years had a common element, i.e. adoption of technical solutions proper for the safe operation of installations.

In line with the MP provisions, in such situations, both work categories (maintenance and investments) are carried out simultaneously, under a unitary approach, but strictly separates expenses of *maintenance funds* from those of *investment funds* (for the modernization/retrofitting component) associated to each work category pursuant to the related feasibility studies.

Given the current electric power production and consumption within the National Power System (NPS), the technologies used or legislative aspects, property right etc. our goal is to promote new PTG development and maintenance solutions (type and reference design of OHL conductors, multi-circuit lines for use of existing corridors, voltage work techniques (VWT), on-line treatment of insulation in transformation units for the reduction of decommissioning times and avoidance of blockage and own technological consumption costs etc.).

Principles and objectives of the maintenance strategy within CNTEE Transelectrica-S.A.

The new maintenance approach required the establishment of principles within a complex strategy that should lead to fulfilment of strategic maintenance objectives in support of the Company objective fulfilment.

The** maintenance **objectives are**:**

- provide safe operation of the electric power system;
- provide high availability of assets via:
    - reduction in accident event number and length;
    - reduction in planned maintenance action number;
    - reduction in planned maintenance action length.
- Increase in operation flexibility by:
    - solutions for deviations from the decommissioning programme;
    - modern solutions (VWT, mobile cells etc.)
- Cost optimization for:
    - directed preventive maintenance;
    - corrective maintenance;
    - decrease in maintenance-induced failures.

The principles of the maintenance strategy applied in CNTEE Transelectrica-SA are:

- Elaboration of a single Company Maintenance Programme;
- Efficient use of maintenance funds under the law;
- Organization of the Company Maintenance Programme by programmes/projects, coordinated by maintenance programme/project managers;
- Correlation of the Company Maintenance Programme with the investment programme for all tasks and on each single project level;
- Integration of the principles in the quality, environment, security, occupational health system in project implementation;
- Provision of a safety equipment stock.

The installation and equipment preventive maintenance regulations within PTG (NTI-TEL-R-001-2007-00) were elaborated as a specific internal standard in order to assure the implementation of the MP maintenance strategy.

As the need for the existence of a single transparent data and information flow has been outlined, that should provide all available data and quality control facilities, a specific database and an IT system for the management, optimization and coordination of all maintenance actions were created, with a possibility to interface with the other IT systems. The centralizer of PTG installations that are subject to maintenance includes the functional equipment and its components (classified as per NTE 004/05/00), as well as the buildings, construction elements and installations other than functional equipment.

The inventories of the functional equipment are drafted in a multilevel manner up to electric substation and electric cell level, also using a multilevel encoding manner.

The maintenance management system is organized based on these lists and contains the tools necessary for the preparation, launch and implementation of maintenance actions, expense follow-up, back-up equipment management.

The functional equipment in PTG is associated information for identification, localization, technical and construction characteristics, as well as information on (random and determinist) events required for the creation and maintenance of a unitary technical database, intended for multiple purposes, including maintenance for work selection, programming and implementation.

In CNTEE Transelectrica-SA maintenance works are done as follows:

- corrective – after the failure detection, including all actions intended for the re-commissioning of the installation to a state wherein it is able to perform its specific function;

- preventive - prophylactic, for failure prevention and reduction in failure or degradation probability, aiming at a state of balance proper between these tasks, depending on the influence of functional equipment categories / SISC on proposed objectives in PTG:

w safe operation,

w availability,

w efficiency.

Within said programmes, the preventive maintenance works are incorporated by levels (level 1 ÷ 4) that stand for the complexity degree of the work content, necessary tool/equipment, contractor necessary skills etc.

Levels 1 and 2 stand for works in the **minor maintenance** category (as a rule, technical inspections – IT and technical overhaul - TO).

Levels 3 and 4 stand for **major maintenance** works (as a rule, current repairs – CR and capital repair - RK).

Preventive maintenance is based, as applicable, on:

è **time** (for minor maintenance – inspections, overhauls), by planning on defined intervals of time **(**pursuant to the PTG installation and equipment preventive maintenance regulations) based on their category, voltage and technical characteristics (technology), deadlines may be adjusted based on the relevant state and, as applicable, local, specific and importance conditions.

è **state**, based on the technical state of the equipment/installations defined by various procedures.

The substantiation of the maintenance programme is done in a differentiated manner for each functional equipment, upon compliance with the application with the Reliability Maintenance (RCM) **-** methodology that may also serve for guiding certain proposals on the new necessary investments.

Within the methodology, the results of the technical state of the functional equipment and their importance in terms of NPS safe operation are quantified and conjugated.

For work programming and planning, given the defined priorities, perspective and annual work programmes are drafted intended to keep within the limits of the assigned resources.

- The perspective programme describes the activities necessary for the satisfaction of average- and long-term maintenance requirements (5 - 10 years).

- The annual maintenance programme contains all maintenance works to be done within PTG over one year span .

Planned and incurred costs and volumes will be maintained.

In compliance with the stated principles and criteria, the implementation of the maintenance strategy will be conducted via the following steps:

Ø Generation and structuring of the annual maintenance programme in compliance with the Company's strategy;

Ø Completion of the Annual Decommissioning Plan correlated with the annual maintenance and investment programmes;

Ø Determination of the maintenance budget;

Ø Procurement and contracting of maintenance works in compliance with the current legislation and rigorous criteria of C.N.T.E.E. Transelectrica-SA;

Ø Implementation of the maintenance programme via the projects teams coordinated with the programme/project managers, with the follow-up of the compliance with the approved budget and using the facilities in specialized software packages;

Ø Update of the maintenance programme, given the permanent correlation with the actual implementation of the investment programme and the compliance with the Annual Decommissioning Plan.

The peculiarities of each project correspond to the structure of the maintenance assets, but are included in a unitary manner in the maintenance strategy and coordination concept on CNTEE Transelectrica- SA level.

12.1.2. Completed/under execution major maintenance projects in 2005 – 2008

The determination of the perspective maintenance programme is done based on multi-criteria-based analyses via which major maintenance actions primarily concern the installations for electric energy transmission:

- interconnection with the neighbouring electric energy systems;
- connections between system areas or important electric substations;
- delivery of power from large producers;
- supply of the important consumption areas (the increase in the transmission capacity is also considered).

The maintenance programme for OHL and electric substations is elaborated in a correlated manner, and also, as shown on the maintenance strategy, in correlation with the investment programme (also, taking into account the execution of special connection works, works of transit of difficult geographic areas, new user connection to PTG etc). As a priority, works to avoid emergency situations created by floods, landslides, vandalism etc. will be conducted.

Further is a presentation of several achievements in the major maintenance programme in 2005 – 2008.

OHL maintenance programme

Year 2005

- completed works:

RK OHL 220kV Gutinaş – Dumbrava
RK OHL 400kV Porțile de Fier – Urecheşti
CR OHL 220kV Alba Iulia – Şugag – Gâlceag
CR OHL 220kV Alba iulia – Cluj Floreşti
RK OHL 220kV Reşița Timişoara
RK OHL 220kV Brazi Vest – Fundeni

Year 2006

- completed works:

RK OHL 220kV Fântânele – Gheorghieni
RK OHL 400kV Porțile de Fier – Slatina

Year 2007

- completed works:

RK OHL 220kV Gutinaş – FAI – Munteni
RK OHL 220kV Mintia – Alba Iulia
RK OHL 220kVBrazi Vest – Târgovişte
RK OHL 220kV Ghizdaru – Turnu Măgurele
Multi-spectrum helicopter air inspections
Mounting of night beaconing on the OHL poles

Year 2008

RK OHL 220kV FAI - Suceava
RK OHL 400kV Gutinaş – Bacău Sud
RK OHL 400kV Bucureşti Sud – Slatina
RK OHL 400kV Isaccea – Smârdan c1+c2
RK OHL 400kV Țânțăreni – Sibiu
RK OHL 220kV Reşița – Iaz
Corridor maintenance
Helicopter air inspections

Mention must be made of the fact that every year a large volume of urgent OHL works was done as a result of endangered poles.

Electric substation maintenance programme

- Completed works

The 220/110kV Târgovişte substation
The 220/110kV Cluj Floreşti substation
The 220/110kV Piteşti Sud substation
The 220/110 Sălaj substation
The 220kV Stupărei substation

- Works underway

The 220/110kV Turnu Măgurele substation
The 220/110kV Pestiş substation
The 220/110kV FAI substation
The 110kV Stupărei substation
The 220kV Baia Mare 3 substation
The 220/110kV Gheorgheni substation

The need to correct the values of the initially defined maintenance programme values in certain situations is the result of more ample unforeseen maintenance works following accidental events caused by unfavourable weather conditions, stolen components leading to important material losses, and equipment degradation owing to their age.

Examples are the situations occurred during the implementation of the 2008 Maintenance Programme that required the need to supplement/re-assign initially defined funds:

- technical inspections and overhauls given the increasing rates and unit prices for the equipment in substations not subject to retrofitting;
- urgent interventions for solving accidental situations (replacing elements stolen from OHL, consolidation of OHL milestone foundations affected by floods, removal of the vegetation for OHL corridor maintenance);
- special works as a result of the equipment electric parameter deterioration;
- insulation replacement works on certain OHL in voltage work condition for reduction in decommissioning times of electric energy installations and maintenance in a normal operation as voltage work rates are higher than the ones for installation decommissioning works.

The failure to supply these services/works inevitably leads to a deterioration of the PTG equipment and installation operation parameters, thus endangering the NPS operation, with implications on the compliance of quality conditions required by the PTG Technical Code, the Transmission and System Operator License granted to C.N.T.E.E. Transelectrica S.A and the Performance Standard.

12.1.3. Major Maintenance Programme of PTG Electrical Stations

The major maintenance work programme for the 2008 ÷ 2017 period considered the priority order of substations depending on the technical state and importance criteria, and the geographic position of substations. Simultaneous work programming in substation located in the same geographic area has been avoided (as much as possible). This requirement is the result of the CNTEE “Transelectrica” S.A. obligation to maintain standard-level safety and continuous operation of NPS during the works in substations and to reduce costs for removing blockages in the network. Also, planning simultaneous works in the same area of NPS leads to a need to conduct temporary works (cables, underground crossing poles etc.) that increase work costs in an unjustifiable manner.

In all substations where works were planned, the command, control, including tele-management equipment were considered.

The major maintenance programme for the 2008 ÷ 2017 period for substations and lines is described below (see also Annexes F-1 and F-2).

Schedule of major maintenance projects for OHL 110-750 kV under the administration of CN Transelectrica SA for the 2008-2017 period

No.	Name of objective										
	TRANSMISSION - LINES	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1	OHL 220 kV FAI – Suceava										
2	OHL 220 kV Gutinas-Focsani Vest(217/272)										
3	OHL 400 kV Gutinas -Smardan										
4	OHL 400 kV Gutinas - Brasov										
5	OHL 400 kV Gutinas - Bacau Sud										
6	OHL 400 kV Bacau Sud - Roman Nord										
7	OHL 400 kV Roman Nord - Suceava										
8	OHL 220 kV Gutinas - Focsani Vest(1/217)										
9	OHL 220 kV Stejaru - Gheorghieni										
10	OHL 220 kV Gutinas - Dumbrava										
11	OHL 220 kV Dumbrava - Stejaru										
12	OHL 220 kV Gutinas - AT1										
13	OHL 220 kV Gutinas - AT2										
14	OHL 220 kV Gutinas - TA7										
15	OHL 220 kV Gutinas - TA8										
16	OHL 110 kV SiPTG - Porubnoe										
17	OHL 110 kV Husi - Cioara										
18	OHL 110 kV Tutora - Ungheni										
19	OHL 110 kV Stanca - Costesti										
20	OHL 400 kV Bucuresti Sud-Pelicanu										
21	OHL 400 kV CNE-Pelicanu										
22	OHL 400 kV CNE-Gura Ialomitei										
23	OHL 400 kV Urechesti - Domnesti										
24	OHL 400 kV Brazi Vest-Teleajen										
25	OHL 400 kV Teleajen-Stalpu										
26	OHL 220 kV Derivatia Mostistea										
27	OHL 400 kV Bucuresti Sud-Slatina										
28	OHL 220 kV Bucuresti Sud-Ghizdaru										
29	OHL 400 kV Brazi Vest - Dârste										
30	OHL 400 kV Bucureşti Sud - Domneşti										

31	OHL 400 kV Domneşti - Brazi Vest										
32	OHL 400 kV Rosiori-Gadalin										
33	OHL 400 kV Rosiori-Mukacevo										
34	OHL 220 kV Cluj Floresti-Alba Iulia										
35	OHL 220 kV Cluj Floresti-Campia Turzii										
36	OHL 220 kV Iernut-Baia Mare 3										
37	OHL 220 kV Tihau-Baia Mare 3										
38	OHL 400 kV Rosiori-Vetis										
39	OHL 220 kV Rosiori - Baia Mare 3										
40	OHL 400 kV Lacu Sarat-Smardan										
41	OHL 400 kV Isaccea-Smardan										
42	OHL 400 kV CNE-Constanta Nord										
43	OHL 400 kV Gura Ialomitei-Lacu Sarat										
44	OHL 110 kV Gura Vaii - Sip										
45	OHL 400 kV. Isaccea - Vulcanesti										
46	OHL 400 kV. Isaccea - Smardan										
47	OHL 400 kV. Tulcea Vest - Isaccea										
48	OHL 220 kV Isalnita-Gradiste										
49	OHL 220 kV Craiova Nord-Isalnita C1										
50	OHL 220 kV Craiova Nord-Isalnita C2										
51	OHL 220 kV Craiova Nord-Trn Magurele										
52	OHL 220 kV Craiova Nord-Sardanesti										
53	OHL 220 kV Craiova Nord-Slatina										
54	OHL 220 kV Sardanesti-Urechesti										
55	OHL 220 kV Urechesti-Tg Jiu Nord										
56	OHL 220 kV Tg Jiu Nord-Paroseni										
57	OHL 220 kV Portile de Fier-Cetate										
58	OHL 220 kV Portile de Fier-Calalafat										
59	OHL 220 kV PdF - Tr. Severin Est C1										
60	OHL 220 kV PdF- Tr. Severin Est C2										
61	OHL 400 kV PdF - Djerdap										
62	OHL 400 kV PdF - Urechesti										
63	OHL 400 kV PdF - Slatina										
64	OHL 220 kV Isalnita-Kozlodui										
65	OHL 400 kV Tantareni-Urechesti										
66	OHL 400 kV Tantareni-Bradu										
67	OHL 400 kV Tantareni-Turceni G1+G2										
68	OHL 400 kV Tantareni-Turceni G3+G4										
69	OHL 400 kV Tantareni-Turceni G5+G6										
70	OHL 400 kV Tantareni-Turceni G7+G8										
71	OHL 400 kV Tantareni-Kozlodui C1										
72	OHL 400 kV Tantareni-Kozlodui C2										
73	OHL 400 kV Tantareni-Slatina										
74	OHL 400 kV Tantareni-Sibiu										
75	OHL 400 kV Urechesti-Rovinari G3+G4										
76	OHL 400 kV Urechesti-Rovinari G5+G6										
77	OHL 400 kV Mintia-Sibiu										
78	OHL 400 kV Sibiu-Tantareni										
79	OHL 220 kV Resita-Iaz										
80	OHL 220 kV Pestis-Mintia										
81	OHL 220 kV Mintia-Timisoara										

82	OHL 220 kV PTGezat-Hasdat										
83	Connections OHL 220 kV. SE Mintia										
84	OHL 400 kV. Mintia - Arad										
85	OHL 220 kV Lotru - Sibiu Sud 1+2										
86	OHL 220 kV Fantanele - Ungheni										
87	OHL 220 kV Fantanele - Gheorgheni et2										
88	OHL 220 kV Iernut - Ungheni 1										
89	OHL 220 kV Iernut - Ungheni 2										
90	OHL 400 kV Sibiu - Brasov										
91	OHL 400 kV Bradu - Brasov										
92	OHL 400 kV Brasov - Darste										
93	OHL 400 kV Darste - Brazi Vest										
94	OHL 220 kV Mintia - Alba Iulia										
95	OHL 220 kV Alba Iulia - Sugag - Galceag										
96	OHL 400 kV Iernut - Sibiu Sud										
97	OHL 400 kV Slatina-Draganesti Olt										
98	OHL 400 kV Urechesti-Domnesti										
99	OHL 400 kV Bradu-Brasov										
100	OHL 400 kV Tantareni-Sibiu (sc)										
101	OHL transit corridor maintenance										

Schedule of major maintenance projects for the electric substations under the administration of CN Transelectrica SA for the 2008-2017 period

No.	**Name of objective**										
TRANSMISSION - SUBSTATIONS		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
1	Turnu Magurele										
2	Cluj Floresti										
3	Stuparei										
4	Gheorgheni										
5	FAI										
6	Pestis										
7	Baia Mare										
8	Roman Nord										
9	Bacau Sud										
10	Aref										
11	Raureni										
12	Hasdat										
13	Sacalaz										
14	Baru Mare										
15	Stalpu 110kV										
16	Targu Jiu										
17	Ungheni										
18	Draganesti Olt										
19	Teleajan										

12.2. Metering System

OMEPA, as administrator of metering/tele-metering systems is responsible for the maintenance of equipment depending on its technical characteristics as resulting from the related documentations, using modern methods indicated in technical procedures or prescriptions. The maintenance programmes consider the meters, concentrators, modem communication terminals, equipment of the data management central systems, portable control kits, meter control table, measuring and standard tools, electric power quality analysis kits, electric power quality monitoring systems, parameter setting equipment. Prevention maintenance programmes are drafted annually for the equipment mentioned for each equipment type. Thus, for various equipment types, the periodicity of installation checking, as well as the methodological checking are carried out pursuant to the specific legislation. Following scheduled or accidental checking conducted by OMEPA, inappropriate equipment is replaced with first intervention equipment, and the faulty ones are repaired by specialized units, as the case may be. For the equipment and systems that cannot be maintained by OMEPA (and that are no longer under warranty), there are contracts with specialized companies for preventive and corrective maintenance (the data management central system, standard meters).

Mention must be made that, at present, the costs associated with the preventive and corrective maintenance activity are not yet increased because of the multiple local interventions to the technologically outdated equipment (electromechanical meters) and the impossibility of their remote tracking.

Given that, for the wholesale power market, the equipment used is highly reliable electronic devices, the periodicity of field checking has been changed from 6 to 12 months; in the future, the full replacement of unreliable electromechanical meters (within the substation retrofitting projects) with static electronic reliable meters will enable the implementation of a unitary strategy of the entire metering equipment park, which will certainly lead to a reduction in operation-related costs.

13. Fixed Asset Development Strategy

13.1. PTG Development Strategy

13.1.1. Foundation of the Development Programme

The modernization/retrofitting and major maintenance programme has been elaborated based on the need to satisfy the users' requirements provided the transmission service and system quality and NPS operation safety are maintained in line with the current regulations and the standards required for the UCTE interconnection operation.

The elements that were the basis for the programme elaboration were:

- The strategic guidelines of CNTEE "Transelectrica" S.A.;
- The technical characteristics of the power transmission grid (PTG);
- NPS users' necessities;
- Providing the infrastructure necessary for the implementation of the strategy implementation and Government's power policy;
- The company's firm contracts and commitments as of the date the programme was elaborated.

The strategic guidelines of CNTEE "Transelectrica" S.A.

The strategic development guidelines considered in the programme elaboration and technical solution determination in line with the mission and goals of CNTEE "Transelectrica" S.A. are as follows:

- Maintenance, modernization and PTG development and interconnection capacities for the purpose of maintaining the NPS safety in line with License No. 161/2000, rev. 2/2005;
- Introduction of cutting-edge global technologies;
- Promotion of telemanagement of the PTG substation installations;
- Obtaining a major role on the regional and European electric power market;
- Increase in the interconnection capacity with the neighbouring systems;
- Increase in the transmitted power volume;
- Promotion of solutions that lead to a reduction in PTG losses;
- Reduction in PTG blockages.

The PTG technical characteristics

The PTG investments over the last years have enabled the implementation of a modern management dispatcher infrastructure, as well as the commissioning and proper operation of the necessary infrastructure required to electric power market.

An optical fiber national coverage network and a brand new EMS-SCADA system were installed.

The system for measuring electric energy quantities transacted on the wholesale market has been updated to the standardized performances and electric power and system technological service disbursement and transacting IT platforms were made.

The programme proposed for the following ten years stipulates investment works by stages (retrofitting, modernization) and major maintenance (rehabilitation, capital repairs) in the CNTEE "Transelectrica" S.A. substations, given the following characteristics of the PTG installations:

- *Physical and moral wear and tear*

  Though over the last years a thorough retrofitting programme was implemented, much of the equipment still has a high level of physical and moral wear and tear, having been commissioned before 1988 (over 20 years of age). Under these circumstances, a great part of the NPS installation needs modernization or capital repairs, as applicable, in the following 20 years. The programme carried out over the last years should continue based on an average rhythm of 3 – 4 substations a year.
- *Loading degree*

  Part of PTG has, at present, a capacity reserve. In line with the information the Company has, this favourable situation will not go on for long, consequently a sustained work rhythm should be preserved over the following years.
- *Applied technology*

  Old equipment is worn both physically, and morally, which has a negative influence on maintenance, reliability and behaviour in case of incidents, environment pollution, occupied space, precision of measurement parameters. Also, the inferior characteristics of the equipment installed in the past do not allow telemanagement implementation in substations.

  Old equipment will be replaced with: increased arc-breaking power and speed switch devices, enabling an increase in speed and selectivity of fault elimination; quick selective protection systems with flexible and complex logic and remote control; compact and eco-friendly primary equipment; copper and iron reduced loss transformers; conductors with increased acceptable thermal limit, enabling an increase in the transmission capacity in cases where the construction of additional lines, cutting-edge measuring cannot be done in time at the level required by the electricity market operation requirements.

Electricity quality monitoring systems will be introduced, first in substations that potentially disturbing specific operation consumers are connected to.

Necessities of the NPS users

The Law on Electric Energy No. 13/2007 stipulates:

Art. 30(1): The license holder and client with regulated access to public interest electric networks. The access to the public interest electric networks is a compulsory service under the regulated conditions that the transmission and system operator (TSO), and the distribution operator (DO) must provide.

Art. 36(1) TSO has to elaborate perspective plans on transmission in line with the current status and future evolution of the energy and source consumption, including energy import and export.

Law No. 220/27.10.2008 "Law on determining the energy production promotion system from energy renewable sources" stipulates :

Art. 20- (1) The producers of electric energy from energy renewable sources have priority access to the electric energy transmission/distribution network to the extent the Romanian Power System safety is not affected.

For an evaluation of the PTG suitability and development needs, TSO makes sure system studies are conducted to check the compliance of operation conditions with standardized parameters by performing steady-state condition, static, dynamic stability calculations and a short-circuit current evaluation. The reliability indices are also calculated on the transmission electric substation bars.

These calculations are done for various scenarios based on consumption projections on specific sectors, assumptions on the progress of the production park structure on various time horizons and power plant loading assumptions for consumption equilibrium and exchange balance with neighbouring systems.

13.1.2. Guidelines for Development, Retrofitting/Modernization and Major Maintenance Programme

13.1.2.1. Priority criteria or the retrofitting/modernization and major maintenance actions

The high volume of installations in need for retrofitting/modernization and major maintenance works, corroborated with the favourable situation (comparatively low loads) existing in PTG in the following 5 ÷ 7 years, is a justification of an increased investment and financial effort in this period.

In the following 15 years, it is necessary to complete the retrofitting/modernization and major maintenance action in all PTG installations (400 kV, 220 kV and 110 kV) in order to maintain the quality standards required by the UCTE inter-connection operation.

In order to define the priority order of the retrofitting/modernization and major maintenance actions, an analysis was conducted based on the following criteria:

- Technical state
- Importance

Within each criterion, the electric substations under analysis received a 1 ÷ 100 score.

The criterion percentage was : technical state – 50 %, importance– 40 %.

In addition to the scores granted based on these criteria, a 10-point bonus was granted (0 or 100 points standing for 10 %) to electric substations that are directly involved in the proper operation of NPP Cernavodă, ALRO Slatina, SIDEX Galați and the supply of the Bucharest Municipality; these areas, by the high value of the concentrated installed power (generation or consumption), load PTG to the highest extent.

Within criterion *Technical state*, the score points were granted given the commissioning year of the substation. If said year is different for various voltage levels, the most remote year is considered (the oldest installation).

Within criterion *Importance*, the score points were granted based on a complex multi-criterion analysis that took into account the impact of the relevant substation on the significant aspects of the NPS operation: power circulation in steady-state conditions, stability limits in the NPS specific sections, dynamic stability. The DINLAP calculation programme was used in this respect, a constituent of the programme package used within the RCM project.

Sensitivity analyses elaborated for this criterion have proved that the scores have a high stability degree regardless of the values of the percentage coefficients used.

The analysis was conducted in 2007 and will be updated in 2009-2010. The priority order of the above criteria cannot incur significant changes on an annual basis.

The results are provided in Table 13.1 It does not include substations where retrofitting/modernization or major maintenance were performed over the last 10 years and are being performed at present.

Table 13.1 – Priority order of electric substations in PTG

No.	Substations	Score
1	Smârdan 400/110 kV	63.36
2	Turnu Severin Est 220/110 kV	60.18
3	Fileşti 220kV	59.45
4	Braşov 400/110 kV	57.82
5	Arefu 220/110 kV	57.10
6	Stupărei 220/110 kV	56.90
7	Barboşi 220kV	56.68
8	Timişoara 220/110 kV	56.29
9	Craiova Nord 220/110 kV	55.41
10	Lacu Sărat 400/220/110 kV	55.40
11	Bradu 400/220/110 kV	54.90
12	Peştiş 220/110 kV	54.22
13	Hăşdat 220/110 kV	53.83
14	Grădiştea 220/110 kV	53.64
15	Reşiţa 220/110 kV	52.98
16	Mintia (400)/220/110 kV	52.55
17	Gura Ialomiței 400/110 kV	50.55
18	Piteşti Sud 220/110 kV	50.45
19	Tulcea Vest 400/110 kV	49.48
20	Cetate 220/110 kV	48.83
21	Domneşti 400/110 kV	48.05
22	Arad 220/110 kV	46.52
23	Râureni 220/110 kV	46.29
24	Alba Iulia 220/110 kV	45.95
25	Gheorghieni 220/(110) kV	45.06
26	Ungheni 220/110 kV	44.45
27	Baru Mare 220/110 kV	43.56

28	Sărdăneşti 220/110 kV	43.45
29	Iaz 220/110 kV	42.41
30	Pelicanu 400/110 kV	42.21
31	Săcălaz 220/110 kV	42.14
32	Târgu Jiu Nord 220/110 kV	37.80
33	Dârste 400/110 kV	37.10
34	Calafat 220/110 kV	36.45
35	Baia Mare 3 220/(110) kV	34.95
36	Medgidia Sud 400/110 kV	33.49
37	FAI 220/110 kV	33.06
38	Oțelărie 220kV	31.83
39	Mostiştea 220/110 kV	30.91
40	Suceava 220/110 kV	29.52
41	Isaccea 750/400 kV	29.00
42	Munteni 220/110 kV	28.76
43	Tihău 220/110 kV	28.72
44	Ghizdaru 220/110 kV	27.91
45	Câmpia Turzii 220/110 kV	27.56
46	Stâlpu 220/110 kV	27.37
47	Gădălin 400kV	25.41
48	Bacău Sud (400)/110 kV	25.32
49	Focşani Vest 400/110 kV	24.45
50	Vetiş 220/110 kV	23.84
51	Teleajen 220/110 kV	21.72
52	Drăgăneşti Olt 400/110 kV	21.22
53	Cluj Est 400/110 kV	20.95
54	Roman Nord (400)/110 kV	16.72

13.1.2.2. Priority technical solutions

The following technical solutions will be promoted as a priority:

- The new 400 kV lines will be done in line with a double circuit solution, with one or two initial circuits, thus reducing impact on the environment;
- Disposal of the transfer bar will be considered in all substations subject to retrofitting, given the fact modern reliable primary equipment is used;
- Solutions will be adopted to enable the provisions of the Company substations' own services in its own network.

Work was planned, taking into account all existing voltage levels in the relevant substation in a unitary project.

In all substations where work was planned, the control, protection and automation part and the telemanagement assurance equipment were considered.

The PTG development resulting from the need to eliminate blockages in interfaces with areas that become strongly in excess, in deficit or are subject to high power transit, requires major maintenance or modernization/retrofitting of substations included in delivery routes first.

13.1.3. Foreground Investments for PTG Adaptability to NPS Evolution

The investment programme considered the following objectives:

- Supply of consumption at standardized quality and safety parameters;
- PTG suitability in the development of the NPS production park;
- PTG development in correlation with the retrofitting/quashing plans of some producers;
- Increasing capacity of interconnection with other systems.

Supply of consumption at standardized quality and safety parameters

Development needs were analyzed as determined by: increasing consumption in Bucharest by a rate much higher than the national average, request of a technical connection approval for the increasing consumption of S.C. FERAL S.R.L. – Tulcea, information and firm requests received for increase in the consumption of large consumers and new consumers in the Braşov, Constanța area.

Given the above assumptions, the result was the increasing transmission capacity and injection capacity in certain areas where they have reached or will reach a threshold, in the following 10 years, by:

- The urgent installation of a third 400/110 kV, 250 MVA transformer in the Domneşti substation;
- Replacement of the active conductors of OHL 220 kV d.c. Bucureşti S – Fundeni, for an increase in the acceptable transmitted power;
- Installation of a third 400/110 kV, 250 MVA transformer, in the Tulcea V substation;
- Installation of a second 400/110 kV, 250 MVA transformer, in the Dârste substation;
- Execution of the 400 kV ring and 400 kV deep connection injections for the supply of the Municipality of Bucharest;
- Execution of a OHL 400 kV d.c. Medgidia S– Constanța S – Constanța N;
- Installation of a second 400/110 kV transformer in the Sibiu Sud substation for keeping one single injection in PTG in the area;
- Installation of one 220/110 kV or 400/110 kV AT in the northern area (in the Câmpia Turzii or Gădălin substations – the decision to be made after the completion of the ongoing analyses) to keep a 400/110 kV AT and a AT 220/110 kV Iernut, given the quashing of groups in the Iernut (Luduş) power plant that represents sources for the area, as announced by the producer

PTG suitability in the development of the NPS production park

- Installation of the nuclear units 3 and 4 in Cernavodă, as forecast according to the Government's power strategy in 2015 and given its status of solution under completion, requires an increase in the power delivery capacity in Cernavoda and the Dobrogea area by:
    - Execution of OHL 400 kV d.c. Cernavodă – Stâlpu – Braşov, and transit to 400 kV of the OHL 220 kV Brazi V – Teleajen – Stâlpu, correlated with a new 925 MW OMV Petrom Brazi power plant;
    - Execution of OHL 400 kV d.c. Medgidia S – Constanța S –Constanța N;

- Executing incoming-outgoing connections in the Medgidia Sud substation in the OHL 750 (400) kV Isaccea – Varna and OHL 400 kV Isaccea-Dobrudja, also correlated with wind power plants in the Dobrogea area.
- In a correlated manner, an extension of the 400 kV Medgidia Sud substation is also necessary.

- The development of NPP Cernavodă up to 4 groups requires capital repair or retrofitting of substations providing the power plant connection, as a priority, and the system area before the power installed in the power plant leads to increasing costs of such operations by increased safety operating conditions. The action was started several years ago and must be continued at a sustained pace.

- Execution of SPHPP Tarnița-Lăpuşteşti – 1000 MW, strictly necessary for reaching the system suitability in terms of production/consumption balance, given the two new nuclear units and wind power plants, requires the execution of the 400 kV Tarnița substation and the system connection lines. According to the previous studies, these lines are: OHL 400 kV d.c. Tarnița – Mintia and OHL 400 kV Tarnița – Gădălin. This solution must be confirmed by a study that should consider a potential change of NPS progress assumptions as compared to the previous study.

- Maintaining PTG suitability given the achievement of the Government target concerning the electric power production in wind power stations implies the development and/or consolidation of PTG in the Dobrogea area and the increase in the number of power delivery lines from this area to the remaining NPS.

  The new wind power stations in Dobrogea are analyzed in close correlation with the forecast creation of the two new nuclear units in Cernavodă and coal-fuelled groups in Brăila and Galați.

  OHL 400 kV Gădălin – Suceava may create an additional delivery route for the newly installed power in Dobrogea and Moldova, necessary to balance the power variation produced by the wind power stations in the E-S-E area of NPS with the N and SPHPP Tarnița Lăpuşteşti areas.

- The announced creation of traditional high-power thermal and electric substations requires the following PTG adaptation measures (studies under completion, except for OMV Petrom, that is already completed):
  - OMV Petrom - 1000 MW à 400 kV Brazi V substation development;
  - Turnu Măgurele – 1320 MW à – Connection to the final solution in the 400 kV Slatina substation, with a possibility of temporary connection of a group in the 220 kV Turnu Magurele substation, if the substation is completed before the completion of the connection lines; an AT 400/220 kV will be installed in Turnu Măgurele;
  - Sărdăneşti – 700 MW à Network connection of the new 400 kV Sărdăneşti substation via an incoming-outgoing connection in OHL 400 kV Țânțăreni – Bradu and the installation of a 400/110 kV Sărdăneşti T;

    The current power delivery network in the Oltenia area is capacitated to take over the production of the new Sărdăneşti and Turnu Măgurele power plants, assuming the reduction in the production park of the Rovinari and Turceni power plants. The assumption is credible if the difficulty of these plans are considered to adapt to the new environment restrictions.

- Galați - 800 MW, Brăila – 800 MW à Increase in the power delivery capacity in the Dobrogea+Brăila+Galați+Ialomița area, also taking into account the installation of the wind power plants in the area by execution new connection lines in this area and the Moldova and Muntenia area: OHL 400 kV Smârdan – Gutinaş double circuit, the second 400 kV Bucureşti Sud – Gura Ialomiței circuit.

PTG development in correlation with the retrofitting/quashing plans of some producers

- For the safe power delivery from HPP Porțile de Fier II, an agreement was reached with S.C. Hidroelectrica SA to go to 220 kV, via the construction of a 220 kV Ostrovul Mare substation, the construction of the 220 kV Cetate substation and the OHL 220 kV d.c. connection Ostrovul Mare in OHL 220 kV Porțile de Fier - Cetate; the project will be financed by S.C. Hidroelectrica SA;

Increasing capacity of interconnection with other systems

The three projects have been considered in connection with which memoranda of understanding have already been entered into with partners:

- Execution of the 400 kV second interconnection line with Serbia, that was included in the Plan;
- Execution of an interconnection with Turkey's Electric Power System via underwater cable;
- Increase in the electric power exchange capacity with the Republic of Moldova and Ukraine, via OHL 400 kV Suceava - Bălți.

Terms of References have been approved for them and feasibilities studies will be drafted.

The Plan also comprises the domestic PTG consolidations along the power flows transited by the interconnection substations:

- Execution of OHL 400 kV Porțile de Fier – Reşița and transit to 400 kV of the Reşița – Timişoara – Arad axis;
- OHL 400 kV Gădălin –Suceava.

13.1.4. Uncertainties concerning NPS Evolution and Settlement thereof in the PTG Development Programme

In compliance with the Electric Power Law No. 13/2007, the PTG Perspective Plan must ensure the long-term planning of the necessary investments in transmission capacities in order to cover the system's electric power demand and ensure deliveries to clients in compliance with the current status and future evolution of power consumptions and sources, including power import and export.

A core element of the territorial consumption forecast should have been the consumption forecasts by substations made by distribution operators and provided by Transelectrica S.A. in compliance with the provisions of the PTG Technical Code and the RED Technical Code. Among the eight major NPS distribution operators, it is only ENEL Distribuție Dobrogea and EON Distribuție Moldova that provided the requested forecasts.

Hence, in terms of the territorial consumption distribution forecast, the starting point was the readings in the 110, 220 and 400 kV substations in the calendar days of 2006: January 18th, 4, 10, 18 o'clock and July 19 4, 10, 22 o'clock. The domestic consumption increase global coefficient was applied. Thus, the result was a forecast of consumed power during the specific sectors of the total energy line, for the winter evening consumption peak (WEP), summer morning consumption peak (SMP) and summer night low consumption (GNV).

In Bucharest, the increase in consumption estimated by the distribution operator has a rate higher than the national average rate. However, ENEL Distribuție Muntenia Sud did not submit any request for an increase in the transmission capacity for the area supply.

Fair consideration was also given to the information collected via the connection solution studies submitted to distribution operators for endorsement by potential users requesting network connection for obtaining the technical connection approvals. The technical connection approval requests is not, however, a beneficiaries' firm commitment and their own announced programme is no risk to them. For an increase in the forecast reliability that the Perspective Plan is based on, it is necessary to implement methodologies that should render the PTG development beneficiary responsible.

An essential aspect on network reference design analysis is the dependence of the necessary transmission capacity on the geographical location of consumption and production and the maximum values of the power supply or delivery of which must be ensured. Hence, the estimations of the entire NPS and annually consumed/generated power values that are achievable within an acceptable error level do not have low relevance on the network reference design studies.

The late 2008 financial crises has introduced an additional uncertainty element that appears in the Perspective Plan completion period. This element could not be integrated in the assumptions that were its basis. It is, however, possible, that the crisis effects should alleviate during 2012- 2017, so as future evaluations may lead to conclusions close to those presented in the Plan.

Fair consideration was given to the fact that the time required for the construction of new lines can be sensibly higher than the time for construction of new production or consumption objectives, the uncertain length primary element being introduced by the need to obtain rights over the land. This makes it necessary to construct new lines before starting the user's investment, thus introducing an important risk element for Transelectrica S.A.

Taking into account the many important above-mentioned uncertainty elements, Transelectrica S.A. considered, in the elaboration of the PT development programme, the same projects and related time stages that could have been reliably considered. Thus, the following PTG major impact projects were taken into account:

- Commissioning of units 3 and 4 from NPP Cernavodă, with a completion deadline 2015;
- Commissioning of SPHPP Tarnița – Lăpuştești, with a completion deadline in 2015, taking into account how necessary this power plant for the NPS production/consumption balance given the increasing production in NPP Cernavodă;
- Commissioning of wind power plants, totalizing an installed power of
  - 1500 MW until 2012;
  - 3000 MW until 2017.
- Commissioning of traditional 800 MW power plants in the Galați – Brăila area until 2013.

As, except for SPHPP Tarnița – Lăpuştești, all above-mentioned projects lead to a very high increase in production in the Dobrogea area, the existing power delivery Section S6, as well as some internal lines of the area cannot cope with the current conditions in the foreseen power flows (a detailed analysis can be read in chapter 10).

The analyses conducted by Transelectrica S.A. and the Transelectrica S.A. consultants (mention must be made of the important contribution of ISPE S.A. and TRAPEC S.A.) resulted in the need of significant PTG consolidation in the area, with no capacity to delivery the newly installed power. Such consolidation was included in the programme, with a stage schedule that may be complied with if the financing manner is clarified in time (detailing in chapter 14.3. Otherwise, its execution will be postponed.

In terms of Bucharest supply network consolidation, Transelectrica S.A. had a dedicated study drafted that outlined a series of necessary consolidations.

To include these projects in the development programme, it is required that the distribution operator in the area should provide a firm updated forecast and complete its own ongoing studies that will take into account the conclusions of the study provided by Transelectrica S.A. Hence, the current Perspective Plan included only the urgent installation of the third 250 MVA, 400/110 kV transformer in the Domneşti substation.

13.1.5. Programme for Development, Retrofitting / Modernization and Major Maintenance of PTG Facilities

Company's firm contracts and commitments

- To continue the retrofitting/modernization ongoing projects (Table 13.2-A);

- To conduct the development, retrofitting and/or modernization project that firm commitments are in place at present, as included in Investment Work Commissioning Schedule for the following regulatory period (Table 13.2-B).

Table 13.2 – Ongoing projects and projects contracted by CNTEE "Transelectrica" S.A.

No.	Project contracting type	Modernization/retrofitting/development projects
1	**A – Ongoing projects**	1. OHL 400 kV Gutinaş – Bacău S – RomanN – Suceava + St.400 kV respectively 2. OHL 400 kV Oradea-Bekescaba+OHL 400 kV Arad-Nădab+st. 400 kV Nădab 3. Gutinaş 110 kV 4. Bucureşti Sud 110 kV 5. Brazi V 110 kV 6. Turnu Măgurele 110 kV 7. Cernavodă 400 kV 8. Târgovişte 220 kV 9. Işalnita 220 kV 10. Sibiu Sud 220 kV and 20 kV 11. Oradea Sud 110 kV 12. Fântânele 13. Vetiş 14. Piteşti Sud 15. Sălaj 16. Command and control systems in 11 substations

2	**B – Undertaken commitments (contracted or included in current Perspective Plan and in the Investment Work Commissioning Schedule for the following regulatory period)**	1. Gura Ialomiței 400/110/20 kV 2. Ostrov 220 kV, OHL 220 kV Ostrov-PTG, Cetate 220 kV 3. Lacu Sărat 400/220/110/20 kV 4. OHL 400 kV Gădălin-Suceava 5. Gădălin 400 kV 6. Suceava 110 kV/m.t. 7. OHL 400 kV Porțile de Fier-Resița-Timişoara-Săcălaz-Arad + OHL 400 kV Romania – Serbia 8. Barboşi 220/110 kV 9. Tulcea Vest 400/110 kV/ m.t. 10. Mintia 220/110 kV 11. Turnu Severin 220/110 kV/m.t. 12. Oradea S – T1 400/110 kV 13. Braşov 400/ 110 kV/m.t. 14. Domneşti 400/ 110 kV/m.t. 15. Craiova N 220/110 kV/m.t. 16. Bradu 400/ 220/ 110 kV/m.t.

New PTG projects

The analysis of the PTG development was done with consideration of all new forecast elements for the analyzed timeframe (Table 13.3).

Table 13.4 presents the new objectives included in the Transelectrica S.A. development programme.

The other projects will be conducted under the law by partial or full coverage of expenses by third party beneficiaries by the network connection fee.

The following were taken into account:

- development projects that are absolutely necessary to maintain the PTG suitability given the implementation of the Government's Power Strategy (Table 13.3 - C).
- development and modernization/retrofitting works resulting from:
  - analyses and condition calculations, as strictly necessary to maintain PT suitability given the consumption forecasts, production and power flow forecasts resulting under these conditions;
  - approach of uncertainties in chapter 13.1.4.

  (Table 13.3 - D)

Table 13.3–New PTG projects and correlated modernization projects

No.	Substantiation of the project	Main projects (a) and correlated projects (b)
1	**C – Projects for supporting the national power strategy** Units 3+4 Cernavoda	a) § OHL 400 kV d.c. Cernavodă– Stâlpu- Braşov § Transit to 400 kV a OHL 220 kV Brazi V - Teleajen – Stâlpu § OHL 400 kV d.c. Medgidia S– Constanța S - Constanța N b) § St. 220 kV Stâlpu – transit to 400 kV § St. 220 kV Teleajen - transit to 400 kV
	C.H.E.A.P. Tarnița 1000 MW	a) § St. 400 kV Tarnița § OHL 400 kV d.c. Tarnița – Mintia § OHL 400 kV Tarnița-Gădalin
	Electric wind plants and coal-fuelled plants in Galati/ Braila (correlated with NPP Cernavoda)	a) § Connection of 400 kV Tariverde substation in OHL 400 kV Constanța N – Tulcea V § Incoming-outgoing connection OHL 400 kV Isaccea – Varna / Isaccea – Dobrudja in the 400 kV Medgidia S substation; § OHL 400 kV d.c. Tariverde - Vânt; § OHL 400 kV d.c. Smârdan – Gutinaş § OHL 400 kV Gura Ialomiței – Bucuresti Sud b) § St. 400/110 kV Medgidia S – extension § St. 220 kV Fileşti retrofitting § Substation 400 kV Isaccea – retrofitting § Substation 400/110kV Smardan – extension + retrofitting

2	**D – Projects for PTG suitability assurance based on the foreseen evolution of consumption, production and transit through PTG**	
	Increase in the RED injection capacity for S.C. Feral Tulcea	a) T3 Tulcea V 400/110 kV 250 MVA (included in substation retrofitting project)
	Increase in the RED injection capacity in the Domneşti area	a) T3 Domneşti 400/110 kV 250 MVA
	Increase in the injection capacity in the Constanța area	a) § St.400 kV Constanța S § OHL 400 kV d.c. Medgidia S– Constanța S - Constanța N
	Increase in the safe supply of the Bucharest Municipality (to be considered depending on the classification of the distribution operator position)	a) § Execution of the 400 kV ring and deep connection injections for the Bucharest power supply (Grozăveşti, Otopeni) § Conductor replacement in OHL 220 kV d.c. Bucureşti S - Fundeni
	Increase in the RED injection capacity in the Braşov area	a) T2 Dârste/ Braşov 400/110 kV 250 MVA
	Increase in the RED injection capacity in the Sibiu S area	a) T2 Sibiu S 400/110 kV 250 MVA
	Connection of HPP Porțile de Fier II in PTG	a) § Ostrov 220 kV § Cetate 220 kV § OHL 220 kV Cetate – Ostrov
	Increase of the exchange capacity with the Serbian Republic	a) § OHL 400 kV Romania - Serbia § Transition to 400 kV Porțile de Fier – Reşița –Timişoara – Săcălaz - Arad b) § St. 400 kV Reşița § St. 400 kV Timişoara § St. 400 kV Săcălaz

	Increase in exchange capacity with the Republic of Moldova	a) L400 kV Suceava - Bălţi b) § OHL 400 kV Suceava – Gădălin b) Extension of the 400 kV Brazi V station
	CCG OMV Petrom 1000 MW SPP Turnu Măgurele 1320 MW	a) Extension of the 400 kV Slatina station b) AT 400/220 kV Turnu Măgurele
	SPP Sărdăneşti 700 MW	a) 400 kV Sărdăneşti connection to OHL 400 kV Ţânţăreni - Bradu b) T 400/110 kV Sărdăneşti
	SPP Galaţi 800 MW SPP Brăila 800 MW (correlated with the installation of U3+4 Cernavodă and electric wind plants)	a) § OHL 400 kV Gura Ialomiţei – Bucureşti S § OHL d.c. 400 kV Smârdan – Gutinaş b) St. 400/110 kV Smârdan – modernization/ retrofitting
	Interconnection with Turkey	a) Underwater cable 400 kV Romania - Turkey b) St. 400 kV Constanţa S

Given the smaller financial and physical effort for the construction of a double-circuit line as compared to that for the gradual installation of two parallel lines, as well as the difficulties for obtaining a corridor and the required authorizations in order to build a new line, the programme promoted double-circuit solution for the new 400 kV lines. If the forecast is indicative of an increase in the power circulation in the relevant direction for a more remote timeframe, these lines will be initially equipped with one single circuit. The reduction in the negative environment impact also justifies this solution.

The gradual organization of the works in the PTG Perspective Plan for the 2008÷2017 is shown in Table 13.4.

Table 13.4

RET Perspective Plan – Period 2008 – 2012 and until 2017 as guide

Gradual stages of investment expenses

Planul de perspectiva al RET - Perioada 2008 - 2012 şi orientativ până în 2017

Eşalonarea cheltuielilor pentru investiţii

Nr. Crt.	Denumire proiect	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Staţia Iernut 400 / 220 / 110 kV										
2	Staţia Gutinaş 400 / 220 / **110 kV**										
3	Staţia Brazi - Vest 400 / 220 / **110 kV**										
4	Staţia Sibiu - Sud 400 / 110 / **20 kV**										
5	Staţia Bucureşti - Sud 400 / 220/ **110/ 10 kV**										
6	Staţia Cernavodă 400 kV										
7	Sisteme comanda-control în 11 statii										
8	LEA 400 kV Oradea - Bekescaba (linie nouă)										
9	LEA 400 kV Arad - Nădab (linie nouă)										
10	Statia 400 kV Nădab (staţie nouă)										
11	Trecerea la 400 kV a axului Gutinaş - Suceava										
12	Staţia Işalniţa 220 / 110 kV / MT										
13	Staţia Gura Ialomiţei 400 / 110 / 20 kV										
14	Staţia Lacu Sărat 400 / 220 / 110 / 20 kV										
15	Statia Gădălin 400 kV										
16	Staţia Mintia 220 / 110 kV										
17	Staţia Ostrovu Mare 220 kV (staţie nouă)										
18	Staţia Cetate 220 kV (staţie nouă)										
19	LEA 220 kV Ostrovu Mare - RET (linie nouă)										
20	Sisteme integrate de securitate staţii şi sedii sucursale, DEN şi DET-uri										
21	Staţia Barboşi 220/110 kV										
22	Staţia Suceava 110 kV / MT										
23	Staţia Braşov 400 / 110 kV / MT										
24	Staţia Tulcea Vest 400 / (110 kV) / MT										
25	Staţia Turnu Severin Est 220 / 110 kV / MT										
26	Oradea Sud: trafo 1 - 250 MVA, 400 / 110 kV										
27	Staţia Bradu 400 / 220 / 110 kV / MT										
28	Staţia Domneşti 400 / 110 kV / MT										
29	LEA 400 kV PdF I - Reşiţa - Timişoara - Săcălaz - Arad, inclusiv interconexiunea cu Serbia (linii noi)										
30	Staţia Reşiţa 220 / 110 kV										
31	Staţia Timişoara 220 / 110 kV										
32	Staţia Arad 110 kV										
33	LEA 400 kV s.c. Gădălin - Suceava (linie nouă)										
34	LEA 400 kV s.c. Suceava - Balti (linie nouă)										
35	Staţia Craiova Nord 220 / 110 kV / MT										
36	Staţia Stejaru 220 kV										
37	Staţia Bistriţa (Viişoara) 400 kV (staţie nouă)										
38	Staţia Pelicanu 400 / 110 kV / MT										
39	Staţia Câmpia Turzii 220 / 110 kV / MT										
40	Staţiile: Bacău Sud şi Roman Nord (400) / **110 kV**										
41	Statia Filesti 220										
42	Statia Isaccea 750/**400** kV										
43	Statia Smardan 400/110 kV										
44	Staţia Alba Iulia 220 / 110 kV / MT										
45	Staţia Grădişte 220 / 110 kV / MT										
46	T5 Domneşti - 250 MVA, 400/110 kV										
47	Marirea capacitatii de transport LEA 220 kV d.c.Bucuresti S-Fundeni										
48	T2 Dârste/Braşov - 250 MVA, 400/110 kV										
49	T2 Sibiu Sud - 250 MVA, 400/110 kV										
50	Trecere la 400 kV LEA Brazi V-Teleajen-Stalpu										
51	LEA 400 kV d.c. Cernavoda-G.Ialomitei-Stalpu-Brasov (linie nouă)										
52	Racord 400 kV d.c. Medgidia S la LEA 400 kV Isaccea - Varna										
53	Racord 400 kV d.c. Medgidia S la LEA Isaccea - Dobrudja										
54	LEA 400 kV d.c. (1ce) Constanta N (-Constanta S) - Medgidia S (linie nouă)										
55	Statia Medgidia S 400/110 kV										
56	LEA 400 kV d.c.Smardan - Gutinas										
57	LEA 400 kV d.c.(1c.e.) Smardan - Munteni										
58	Alte cheltuieli de investitii										

Owing to the large work volume that needs to be done in the analyzed period in the same area (Dobrogea), until the new announced producing groups, the safe implementation of all works requires the correlated scheduling of the works.

The proposed gradual implementation avoids work simultaneity that could generate network blockages or deviations from safe operation standards.

As the technical solutions and substation project actual implementation conditions are not known yet, this gradual implementation was based on assumptions with a certain level of uncertainty. Execution of all planned works will require the special effort of the Company for project correlation purposes.

13.2 Dispatcher Management Development Strategy – EMS/SCADA

At present, a Company-based project will be implemented until 2014 that involves the retrofitting of all electric substations belonging to Transelectrica S.A. so as there should be no need for permanent operating human personnel.

Every area includes between 2 and 4 substations already subject to retrofitting, and the implementation of these micro-SCADA in every substation is made by various producers (ABB, AREVA, SIEMENS etc). On an area level, these micro-SCADA of the substations may be controlled by a telemanagement centre, a location that is near the branches' headquarters. These micro-SCADA systems in the substations already subject to retrofitting are implemented in a redundant technology, an optical fiber ring being built inside the substations, and the communication lines used by transducers being also redundant.

These systems will monitor all substation operation parameters (transformers etc.) and there are up to 1000 acquisition points. These systems will interaction with the EMS/SCADA on a server level, providing it all the information that is necessary for the operative management of the Romanian Power System.

On a national level, Transelectrica S.A., via the IT and Communications Department, is implementing a consulting contact with an internationally reputed company in order to determine a coherent development strategy.

13.3 Metering System Development Strategy

The development of the metering systems in Transelectrica considers:

- The needs and regulations of the power market in Romania,
- The Transelectrica development strategy in the area,
- The Company's business plan,
- Harmonization with the EU and UCTE rules.

In this respect, Transelectrica S.A. via the OMEPA Branch, a neutral entity as to the electric power market participants, may ensure the safe development and operation of telemanagement systems impartially, transparently, efficiently and reliability, with all electric power market participants, providing the data necessary for the implementation of the power market concept in Romania.

13.3.1. Transelectrica Telemetering System

The Transelectrica project, 100% completed in 2007, led to the achievement of a unitary wholesale market telemeter system (in particular, A category locations) that enable the synchronous measurement (hourly, at present, according to the current Regulations) of active and reactive electric power, as well as the acquisition, transmission, validation, data import from other measurement operators, processing and aggregation of all data, as well as the automated export of this information to TSO, commercial operator (OPCOM) and authorized and concerned entities.

The telemeter system also covers the needs of Transelectrica as concerns the telemeter of measuring points for its own internal services (that have become eligible) and on exchange lines between the transmission branches.

Given the Law on Energy stating that TSO (Transelectrica) is electric power wholesale market measuring operators and that it should ensure measurements on the interface between PTG and its users; also given that the provisions of the Electric Power Wholesale Commercial Code via which TSO – OM (OMEPA) should provide for the unitary aggregation for the entire power market, as well as those of the Measuring Code: the conclusion is that in the future TSO-OM will be responsible for the NPS integration (in terms of electric energy measurements) of the new electric substations to be built and for the metering systems to be implemented on the occasion of the Transelectrica electric substation retrofitting.

13.3.2. Data Teletransmission Local Metering Systems

Transelectrica is carrying out and considering projects for the retrofitting of its own electric substations, also resulting in their possible operation without local personnel. In order to fulfill this purpose, a study was conducted that established the principles and requirements of the local metering systems. They will automate the local checking processes of power measurements and, at the same time, establish as redundant information sources for the electric power wholesale market telemetering. This study was approved in CTES Transelectrica and contains principles for execution of local metering systems within the substation retrofitting projects. The local systems will be autonomous, having the necessary functions on a substation level, and will send measurement data both to the MMS of the telemeter system of Transelectrica S.A. (13.3.1), and the OMEPA territorial centres. This way remote metering may be supervised (efficient supervision, reduced interventions, minimized costs).

The metering local system principles will also apply to new electric substations integrated in PTG that are owned by Transelectrica S.A.

For the electricity wholesale participants to introduce new reimbursement/measuring points, technical conditions for the measuring system compatibility according to the above-mentioned principles or 100% compatibility of meters with MMS will be required.

During 2008-2009 the investment objective of "Regional metering systems" will be achieved within which every OMEPA centre will have a system in charge of the management of the metering data taken from local metering systems in the relevant centre's area. This system may take over any local metering system, regardless of who made it, owing to a logic standardized interface applied to all local metering systems.

Mention must be made that these systems may perform additional functions depending on the electric power parameter quality (via the use of specialized modules and software), as they cannot be made by other SCADA/EMS type systems.

13.3.3. Laboratories for Meters' Metrological Inspection

OMEPA considers the analysis concerning the activity of metrological control laboratories in the OMEPA Sibiu, Timisoara and Craiova centres for the purpose of their functional and economic optimization, possibly in view of a reduction in their number and a cutting-edge equipment of the remaining ones.

13.3.4. Power Quality Control in PTG and at the Consumers

OMEPA aims at developing this service in the following years, given both the harmonization with the EU standards, electric power supply contracts, publication of the PTG and RED Power Performance Standards, introduction of specific meters, and the intensification in consumer demanding behaviour. To this end, electric power quality measurement portable equipment (for a limited 1-2 weeks) was purchased via the Transelectrica telemeter system project and an electric power quality parameter monitoring system was established for large consumers connected directly to PTG, with data transmission to the data management centre in the OMEPA Sibiu centre (the Sibiu Sud substation).

The 2008-2009 goal is to implement the investment work of "PTG power quality monitoring integrated system" that enables "online" checking during various timeframes of NPS operation in terms of transited power quality. This system will integrate all electric power quality equipment in place at present.

13.4 Telecommunication System Development Strategy

The Transelectrica S.A. mission is to provide the infrastructure of the national electricity market for the National Power System operation under safe and stable conditions, upon compliance with quality standards, guaranteeing at the same time the regulated access to the electric power transmission grid in a transparent, non-discriminatory and impartial manner for all market participants.

In this context, one of the Transelectrica preoccupations is the permanent consolidation and extension of the IT&Tc infrastructure, which is an important support for carrying out the company's activity under maximum quality conditions by its modernization of state-of-the-art technologies by the various projects in the IT&C area.

The communication infrastructure is the decisive factor in terms of functionality and security of IT applications in the organization. The telecommunication equipment makes up a national infrastructure of integrated communications.

Given the activity carried out in CN Transelectrica S.A, C.N. TRANSELECTRICA S.A. is implementing a cutting-edge networking architecture development contract in order to increase the data processing and service diversification capacity on a national level;.

On a national level, Transelectrica, via the IT&C Department, carries out a consulting contract with an internationally reputed company in order to establish a coherent development strategy.

14. Financial Projections

The main revenue source of "Transelectrica" S.A. is the transmission services and the system services provided to the electric power market participants. The Company also provides other services that, however, do not generate equally high revenues for the moment.

14.1. Regulated Tariffs

The regulated tariffs consist of the transmission tariff, system service tariff and market administration tariff, which must be periodically justified by the Company and later approval by ANRE.

14.1.1 Transmission Tariff

Starting in 2005, the rating methodology has changed and has been based on the "threshold income" principle approved by ANRE. Using this methodology, ANRE sets a target-income, that has the same increasing rhythm as the consumption price index and that is reduced based on efficiency increase, thus forming a basis of the regulated income.

On establishing the threshold income, the following elements were considered:

- performance and quality standards required to the transmission and system operators according to the PTG Technical Code, the current legislation and contracts entered into with the main clients of the transmission service;
- evolution of the forecasts by the transmission and system operator on the transmitted power volume;
- changes of the technological losses within the high voltage network;
- regulated profitability tariff applied to the regulated basis of the high voltage network assets;
- evolution of tariffs expressed as possible via a linear evolution within a regulated period of time (3 or 5 years);
- taxes paid or payable by the transmission and system operator related to the transmission service supply;
- providing to the transmission and system operator financial stability.

The "threshold revenue" methodology based on which transmission tariffs are established is used in the beginning of each regulation period for the calculus of regulated revenues depending on the data forecast for the regulated period t and the correction factors related to years t-1 and t-2. The correction factors of the revenues regulated for the annual tariff calculation applies, at the end of each tariff period, to the aligned revenue determined in the beginning of the regulation period in order to correct the forecast errors related to the transmitted power volume, the costs of power purchase to cover technological losses, costs of blockage elimination, costs related to cross-border power exchanges and revenues from other activities in the prior period, as well as the differences between achieved and estimated values.

On this date, the following ANRE regulations were considered:

- "Methodology for the determination of tariffs for the electric power transmission service" (Order No. 60/2007- Official Journal 892/28.12.2007);

- ”Framework Contract on transmission service, system services and services provided by the commercial operator to the electric power wholesale market participants between C.N. “Transelectrica” S.A. and [client]” (Order No. 44/2006 – Official Journal 1035/28.12.2006);
- ”Approval of average tariffs for transmission services, system services and services provided by the commercial operator to the electric power wholesale market participants and regional tariffs related to the transmission service set by economic agents in the electric power sector (Order no. 64/2007 – Official Journal 891/27.12.2007 and Order No. 63/2008 – Official Journal 479/27.06.2008).

The electric power transmission tariff in compliance with the methodology approved by ANRE via Order No. 60/2007 (Annex 6 – Tariff calculation formula), is calculated by dividing the regulating revenue to the electric power volume drawn from PTG and RED.

The regulated revenue is calculated on the basis of the liniarised revenues and correction factors.

The linearised revenue is calculated based on controllable and non-controllable costs recognized by ANRE, the amortization of asset regulated basis, cost of electric power purchase to cover own technological loss, cost of network blockages, correction factor of asset regulated basis and profitability of the asset regulation basis minus revenues from other activities. The linearised revenue is the result of the linear variation application for a regulated period.

As of the second regulation period, starting with the third tariff period for the calculation of the regulated revenue, the correction factor associated to reaching/failing to reach the transmission service performance indices will also intervene.

It is worth underlining that the regulated revenue includes, according to the ANRE methodology, rendering profitable the regulated asset basis obtained by multiplying the value of regulated assets with the weighted average cost of capital (WACC). WACC includes the capital cost percentage and the average cost of debts from the Company’s total financial sources.

A brief description of the most important factors for determining the threshold revenue and the resulting tariff is provided below:

a) Regulated asset basis (RAB)

RAB includes the value of tangibles and intangibles used by the Company to provide the transmission service, thus including most assets used by the Company. The RAB defined in the beginning of the regulation period for the five years can be corrected only in the last year of the regulation period with the investments and procurement by “Transelectrica” in addition to the ones approved by ANRE in the beginning of the regulation period.

b) Weighted average cost of capital (WACC)

WACC applies to the regulated asset basis for each regulated period and is defined according to the methodology, in the beginning of each regulated period. WACC used for tariff determination for the year 2007 was 7.5%. The value of this index is influenced by the size of external or own sources used to finance the transmission activity, and the capital and financing source cost.

In 2007, the 0.34 value of the indebtedness degree was low enough in comparison to the forecast value of this index, given the vast investments that the Company made over the last years. In addition to this, the maximum value of the indebtedness degree, included as a requirement in the long-term loan contract entered into by the Company with external financial institutions (EB and ERDB) is 2.33. Hence, “Transelectrica” has the opportunity to enter into additional loan contracts without any effect on the Company’s liquidity.

The financing cost has a rather low level owing to the following factors:

- cost of capital is low owing to the Company's stability;
- cost of indebtedness is low as the Company pays its debts on time, and some of the contracted loans are guaranteed by the Romanian State.

c) Other costs recognized by ANRE in the initial target-revenues

These costs are recognized only if connected to the transmission activity and include: controllable costs (materials, electricity, water, insurance premiums, rent, workforce, studies and research, travels, telecommunications and other fees) and uncontrollable costs generated by the operation and maintenance activity (taxes, special costs, contributions to social staff funds), amortization of fixed assets included in RAB, costs for technological losses in the transmission network, costs of blockage elimination (determined based on the costs of these blockages on the balancing market) and costs of electric power cross-border exchanges on interconnection lines (compensation between TSO and the CBT mechanism).

The transmission tariff determination methodology as applied by ANRE includes other important aspects such as:

- starting the third tariff period corresponding to the second regulation period, bonuses/penalties for exceeding/incompliance with the performance and quality indices of the transmission service will be in excess of 2.5% of the value of the regulated revenue;
- starting the third regulation period, i.e. 2013-2017, transmission service clients will be assigned 50% of the amount related to the efficiency earnings over the targets defined for the second regulation period, and this will be deducted from the linearised revenue related to the first tariff period of the third regulation period;
- transmission tariffs will not increase on an annual basis by more than 7% in real terms;
- if the inflation rate goes over 5% on a quarterly basis, the Company may request tariff increases on a quarterly basis;
- the electric power volume to cover unbalances cannot exceed ± 2% of the monthly value of the electric power volume to cover OTC;
- earnings resulting from the over 10% reduction of the regulated OTC are left at Transelectrica's disposal.

Applying the "threshold revenue" methodology, Transelectrica recovers all recognized costs that are the result of the transmission service to the power market participants and records profit because of the profitability of the regulated asset basis.

The tariff for electric power transmission is divided into two components and calculated as follows:

$\mathbf{T = T_G + T_L}$, where

- tariff $\mathbf{T_G}$ – nodal transmission tariff for the introduction of electric power in PTG, differentiated by six injection area;
- tariff $\mathbf{T_L}$ – nodal transmission tariff for drawing electric power from PTG, differentiated by eight extraction area.

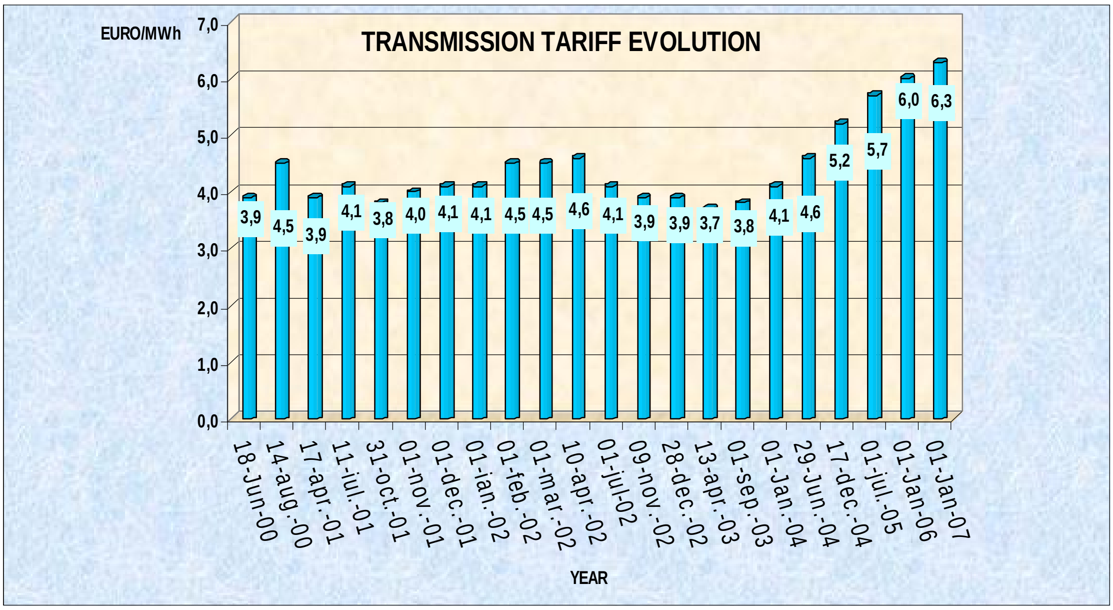
The T_G component covers approximately half of the value necessary to cover all transmission costs, and the T_L component covers the other half.

In 2003-2006 tariffs were changed on a semester basis.

In compliance with the provisions of ANRE Order No. 64/2007, the tariff for the electric power transmission service was determined for 2008 at 15.33 lei/MWh.

The Lei periodical tariff changes, approved by ANRE (usually, every six months) correlated with the relative decrease in the currency exchange detrimental to the EURO in the latest periods led to a variable evolution of tariffs denominated in EURO, as shown in figure 14.1:

Figure 14.1 – Evolution the EURO electric power transmission tariff



The electric power transmission tariff applied by the Company is lower than the one of the European electric power transmission companies. In mid-2006 its value was approximately half of the highest tariffs: in Eastern Denmark 9.25 EURO/MWh, and in Great Britain and Wales 7.5 EURO/MWh.

14.1.2. Tariffs for System Service and Tariffs for Services Rendered by the Central Market Operator to Market Participants

Based on License No.161/2000, rev. 2/2005, Transelectrica the system services consisting of the management and maintenance of the safe NPS operation, as well as electric power quality according to the current regulations.

The costs supported by the Company for providing these services are covered for the tariff regulated by the system and the tariff regulated for the services provided by the central market operation to market participants.

Pursuant to the Methodology for the system service tariff determination as approved by the ANRE Order No. 20/2007, the annually regulated revenue for functional system services and the revenue regulated for system technological service procurement are calculated based on justified cost principles for the safe NPS operation.

The system service tariffs and the functional system tariffs may be amended every 6 months if differences higher than ± 10% are recorded between justified revenues and costs for the analyzed period.

The revenue regulated for a tariff period t is adjusted based on the revenue correction factors related to the tariff periods t-2 and t-1.

The revenue regulated for functional system services is calculated with due consideration to the controllable costs adjusted with the efficiency factor equal to the factor applied to the calculus of the transmission service regulated revenue, non-controllable costs, amortization, profitability of the regulated asset basis, amortization of the fixed means included in RAB, costs of unplanned exchanges.

The profitability of the regulated asset basis is calculated based on the transmission WACC.

Tariffs for system services are defined once a year unless other factors interfere. The main constituents of the tariff determination methodology are summarized below:

- for the functional system service that covers the dispatcher activity, the administration of the balance market and the network blockage management, the regulated revenue is divided to the total power consumption in Romania plus exports;
- for the technological system service that covers the power purchased by Transelectrica for stable and safe NPS operation, the total expenses related to the prior period on purchase is also divided to the total power consumption plus exports.

The expenses included in the tariff determination for the technological system services are related to the purchased availability on primary, secondary and tertiary regulation reserves, the capacity reserve, as well as the power reserve assured by the efficient production capacities of groups that can be controlled in co-generation as necessary to the Dispatcher following contracts and transactions on the balance market.

Mention must be made that, owing to the re-assignment mechanism for technological system services, this activity generates costs equal to the obtained revenues, hence they do not generate profit.

The tariff for the services provided by the central market operator to market participants is calculated based on the costs incurred by the central market operator.

14.2. Non-regulated tariffs

Revenues from assignment of the interconnection capacity

After the interconnection of the two synchronous areas of UCTE, in October 2004, cross-border electric power exchanges between the interconnected countries constantly went up, which resulted in an increase in the revenues obtained from interconnection capacity assignment.

The Company's Investment Programme aimed at the construction of new interconnection lines and the existing lines were re-engineered, which resulted in an increase in the interconnection capacity increase.

Transelectrica is compliant with the Barcelona criterion to have cross-border transmission capacities that should be in excess of 10% of the power produced at a given time. However, the value of the interconnection capacity does not satisfy the increased demand, implicitly leading to an increase in the revenues obtained by Transelectrica from the assignment thereof.

The investment plan for the analyzed period will lead to the almost complete elimination of cross-border exchanges and simultaneously to a reduction in the revenues achieved by the assignment of the exchange capacity.

14.3. PTG Development Project Financing

The annual investment volume of CNTEE "Transelectrica" S.A. is laid down in the Business Plan, elaborated in 2008, to be approved by the Company's Board of Directors.

Cell cost indices were evaluated per voltage level and transformer/autotransformer, per voltage and installed power level in order to assess the necessary expense volume for the entire PTG. These costs also include the expenses with related constructions, secondary circuits and command-control-protection systems.

Unit costs were estimated based on the costs achieved in the investment projects in 2005, 2006 and 2007. These costs were increased by 10%, given the ascending tendency of the electric power price and the influence of this index on equipment prices. For lack of own recent experience, price-related information was used from the ISPE studies or as obtained in the network cost estimation process for the implementation of the loss compensation mechanism between TSO on a European level.

The economic indices – equipment estimated unitary costs (primary and secondary/related), that were used for evaluation purposes, are shown in Annex G-1.

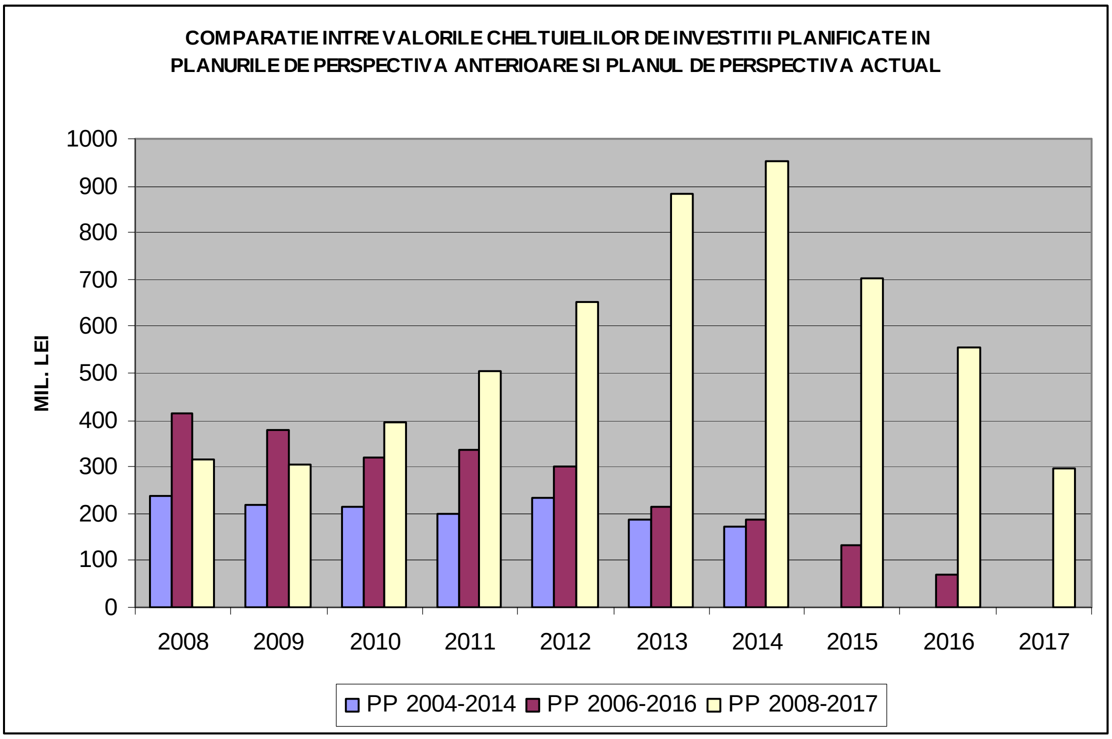
The financial effort necessary for implementing all the investment projects proposed in the Perspective Plan was presented in Annex G-2.

The simultaneous high production volumes requiring connection to the network in the following period leads to a need for a network development effort unprecedented in the last years and results in a substantial increase in estimated expenses as compared to the estimations for the same period in the prior Perspective Plans.

A comparison between these estimations is shown in figure 14.2:

Figure 14.2

COMPARISON BETWEEN THE VALUES OF PLANNED INVESTMENT EXPENSES IN PRIOR PERSPECTIVE PLANS AND THE CURRENT PERSPECTIVE PLAN



14.3.1 Transmission Tariff Forecasts

In compliance with the ANRE methodology, the forecasts on the transmission tariff evolution in the following periods are based on the “threshold income” methodology (described above) and include forecasts on the regulated asset basis, the WACC level, operating expenses, inflation rate and forecast quantities.

The assumptions and the other factors influencing the transmission tariff are listed below:

- *RAB evolution*: RAB values will go up in 2008 – 2017, primarily owing to the fact that most investments will take place and be completed during this period; for 2011 – 2017, though the investments in the transmission network continue, their value will be low and compensated by the amortization expense increase;
- *WACC level*: is expected that, at the end of the forecast period, owing to an increase in the Company activities and reduction in the long-term financing cost, it should have an approximate value of 8.4%;
- *operating expenses:* generated by the transmission activity that are approved for the introduction of the tariff calculation, are expected to go up owing to the increase in the activity level (transmitted power quantity);
- *inflation rate:* in 2006 – 2017, as estimated by the Company based on the current inflation rate and the forecasts published by the National Statistics Institute and the National Forecast Commission;

- *PTG transmitted electric power quantity* will increase owing to the following:
  - *a)* increase in the GDP (as forecast by the National Statistics Institute and the Ministry of Finance),
  - *b)* increase in power intensity (slower increase than that of GDP).
- *eclectic power quantity delivered* in transmission and distribution networks.

The 2008 tariff was 15.33 lei/MWh, approved by an ANRE Order No. 64/2007.

Starting from this value and given the inflation-related increase, the Company drafted a tariff evolution forecast that is shown below:

Table 14.1 Transmission tariff forecast for 2008 – 2017

Name	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Forecast transmission tariff (lei/MWh)	**15.33**	**15.94**	**16.50**	**17.00**	**17.44**	**17.84**	**18.25**	**18.67**	**19.10**	**19.54**

Source: "Transelectrica",

The Company's long term objective is to improve its operational performance. Hence, the Company believes that one of the results of such objective would reflect, in real terms, in the tariff.

It is important to notice that there are other aspects besides the evolution of the above-mentioned factors that may influence the forecast tariffs. Among them, the most relevant is the Government and ANRE's goal on maintaining the final consumer tariff at an acceptable social level.

The strategic goals of the following 10-year period for the entire energy sector, including the development of production in the electric wind units, the introduction in the system of two new nuclear units, the development of coal-fuelled production and the satisfaction of the consumption demand at the rated quality and safety parameters require the short-term consolidation of the transmission network that should ensure the implementation of these requirements. The performance by Transelectrica of the PTG consolidation works shown in Annex G-2: TOTAL I + TOTAL II is possible provided there is a tariff increase. If the minimum consumption scenario is achieved, forecast as probable in the context of the economic and financial crisis started in 2008, the tariff evolution that would enable such consolidation is presented in table 14.2.

Table 14.2 Tariff necessary for PTG consolidation

Tariff increase

Tariff

		2008	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Crestere tarif	**%**		5,22*	10,75	10,42	10,00	2,50*	2,50*	2,50*	2,50*	2,50*
Tarif	Lei/MWh	15,33	16,13	17,86	19,73	21,70	22,24	22,80	23,37	23,95	24,55

* only inflation increase is considered.

Pursuant to the PTG connection regulations approved by the Government's Decision No. 90/ 2008, the investments dedicated exclusively to producers and over 60% of the consumers may be cofinanced by them. Also, to accelerate the network consolidation deadlines, there is the possibility that concerned beneficiaries may participate in financing, upon the sum's subsequent reimbursement.

As concerns the connection of the renewable source power plants, Law No. 220/27.10.2008 – "Law on the establishment of the energy production promotion system from renewable energy sources" - sets forth in Art.20-(4) that incurring the costs related to technical adaptations, connection to the network and network consolidation is done via a mechanism to consider the producers' and network operators' connection benefits.

The legal aspects regarding the implementation of these provisions are still under analysis, and clarification is necessary before the start of the projects that fall within these categories.

Taking into account that some PTG connection works are exclusively dedicated to producers or consumers (e.g.: SPHPP Tarnița, FDFEE "Electrica Muntenia Sud", electric wind units connected to the Tariverde and Vânt substations), it was deemed that the financing of these projects would be incurred, under the law, by the PTG users and would not be included in the estimated financial effort of Transelectrica.

The expenses for the uncertain financing projects that are included in the above category were not included in the estimation presented in figure 14.2 and were not taken into account in assessing the necessary tariff presented in Table 14.2.

14.3.2 Prospects for System Service Tariffs and Tariffs for Services Rendered by the Central Market Operator to Market Participants

The assumptions of the Business Plan on the system service tariff evolution during future periods are based on the summarized methodology above and include estimations used in connection with the regulated asset basis, inflation index, consumed and exported power quantities, WACC level and operational expenses. Also, the system service tariffs, as forecast below, are used in the Company's financial projections.

The assumptions and the other factors that influence the system service tariff and the tariff of services provided by the central market operators in the administered markets are presented below in brief:

Table 14.3 Forecast tariffs for system services and market administration services

Name	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
Tariff forecast for system services (lei/MWh)	**17.66**	**18.37**	**19.01**	**19.58**	**20.09**	**20.55**	**21.02**	**21.51**	**22.00**	**22.51**
Tariff forecast for functional system services (lei/MWh)	**0.82**	**0.85**	**0.88**	**0.91**	**0.93**	**0.95**	**0.98**	**1.00**	**1.02**	**1.05**
Tariff forecast for market administratio	**0.23**	**0.24**	**0.25**	**0.25**	**0.26**	**0.27**	**0.27**	**0.28**	**0.29**	**0.29**

n services (lei/MWh)										

Source: "Transelectrica"

Taking into account the Company's goal to increase operational performance and the fact that the important investment projects will be completed within a medium-term deadline, the Company management also considers a deadlock of tariff increase in the real terms, and a sufficient increase to cover inflation in rated terms.

15. Analysis Directions for the Next Stage

Analyses should be elaborated on the following aspects for the following stage:

- Continue analysis for the safe operation of NPS
- Make a SPHPP in Tarnița.
  The Ministry of Economy and Finance and SC Hidroelectrica started to perform again the feasibility study for the SPHPP Tarnița-Lăpuştești project, with IRDB financing. Transelectrica experts collaborate with Hidroelectrica and the consultants to identify the best solutions for plant integration in NPS and PTG associated developments. Also, scenarios considering the SPHPP existence are analyzed in the studies on the future PTG development.
- Make an underwater cable for interconnection with south-eastern Turkey.
  A feasibility study is necessary.
- Make the interconnection OHL 400 kV Suceava (Romania) – Bălți (Republic of Moldova).
  A feasibility study is necessary.
- Make a 400/220 kV transformation substation in Arefu.
  The opportunity analysis will be elaborated with careful consideration to future plans.
- For an analysis of a PTG development needs in the outskirts and urban area of Bucharest, Transelectrica has conducted a study for best solution identification. This study is, however, supplemented by the complementary study made by ENEL Distribuție Muntenia Sud, that should outline the distribution network development needs. The two projects should be appropriately correlated.
- Voltage adjustment and reactive power circulation.
  The analysis will identify the needs and possibilities to adjust voltage and coordinate the reactive power circulation. Due consideration is given to the study of the possibilities to introduce the secondary adjustment of reactive energy and a system technological service for the future development of the balancing market.
- Make a back – to – back substation in Isaccea.
  If investors are interested, a study will be made on the technical and economic possibilities to execute the back – to – back substation and use the existing OHL 750 kV for the development of the electricity trade between Ukraine and European countries.
- Conduct the necessary system analyses on the existing necessary reserves and making the production/consumption balance given the future construction of units 3 and 4 in NPP Cernavodă.
- Conduct the necessary system analyses to provide for the delivery of the power in excess in the Dobrogea and Moldova areas. Consideration should be given to new connection requests, and the change of the assumptions resulting from the requests received that are so far certain.
- Conduct studies for the identification of requirements on the wind unit integration in NPS in order to maintain a safe electric power supply to consumers.

- Conduct the pre-feasibility study on execution of a new 400 kV line for interconnection with Serbia.
- PTG will be compliant in terms of the quick energy flow changes, as a result of the renewable energy source evolution (mostly wind energy).
- Romania's accession to the European Union will lead to a further reconsideration of the existing regulations on the safety and security of the power system operation in order to avoid extended system failures and the interruption of the consumer supply.
- Transelectrica will promote the stimulation of power efficiency increase and renewable resource projects via its network development and network development design policies by its own services.

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19. *Study on the planned development of transmission networks in the NPS eastern area given the significant power supplementation in Dobrogea, TRAPEC S.A.,2008*

20. *Study on the analysis of new injections from PTG for supplying the Bucharest Municipality under reference design and operation conditions. Planning of transmission network development in the Bucharest city area, TRAPEC, 2008*

21. *Study on the optimization of the transmission and distribution network in the Drobeta Tr. Severin, Reşiţa, Timişoara, Arad, Cetate and Calafat substation area to increase safety of NPS operation, ISPE S.A.*

22. *Substantiation study: "Construction of Romania-Serbia interconnection OHL 400 kV and transition to the 400 kV voltage of the Porţile de Fier 1 – Anina - Resiţa – Timişoara – Săcălaz – Arad axis", Fichtner Engineering*

23. *Pre-feasibility study: "Construction of Romania-Serbia interconnection OHL 400 kV and transition to the 400 kV voltage of the Porţile de Fier 1 – Anina - Resiţa – Timişoara – Săcălaz – Arad axis" , Fichtner Engineering*

24. *Feasibility studies for the following investments:*

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    2. Gutinaş 400 / 220 / 110 kV Substation
    3. Brazi - Vest 400 / 220 / 110 kV Substation
    4. Sibiu - Sud 400 / 110 / 20 kV Substation
    5. Bucureşti - Sud 400 / 220/ 110/ 10 kV Substation
    6. Cernavodă 400 kV Substation
    7. OHL 400 kV Oradea - Bekescaba
    8. OHL 400 kV Arad - Nădab
    9. 400 kV Nădab Substation
    10. Transit to 400 kV Gutinaş - Suceava axis
    11. Işalniţa 220 / 110 kV / MT Substation
    12. Gura Ialomiţei 400 / 110 / 20 kV Substation
    13. Lacu Sărat 400 / 220 / 110 / 20 kV Substation
    14. Gădălin 400 kV Substation
    15. Mintia 220 / 110 kV Substation
    16. Barboşi 220/110 kV Substation
    17. Suceava 110 kV / MT Substation
    18. Braşov 400 / 110 kV / MT Substation
    19. Tulcea Vest 400 / (110 kV) / MT Substation

    Solution studies for new user connection:

25.

	Investor name	Name of electric substation	County	Installed power (MW)
1	SC MW TEAM INVEST SRL	Fantanele Est	Constanta	90
2	SC TOMIS TEAM SRL	Fantanele Vest	Constanta	255
3	SC OVIDIU DEVELOPMENT SRL	Cogealac	Constanta	255
4	SC ROMWIND INTERNATIONAL SRL	Mihai Viteazu	Constanta	29.9
5	EUROPP ENERGOCONS	Frumusita	Galati	33
6	EXIMPROD SRL Buzau	Baleni	Galati	70
7	SC SABLOAL ENERGIE EOLIANA SRL	Pestera	Constanta	204
8	SC WIND POWER PARK SRL	Crucea	Constanta	150
9	E-ON Moldova	Victoria Sculeni	Iasi	38
10	CONTINENTAL WIND PARTNERS	Serbotesti	Vaslui	242
11	EOLICA DOBROGEA	Mihai Viteazu - SE 4	Constanta	148
12	EOLICA DOBROGEA	Eolica	Constanta	1500
13	EXTRA POWER	Cobadin	Constanta	50
14	ENERGYCUM W	Adjud	Vrancea	537.5
15	TOTAL ELECTRIC	Topolog	Tulcea	15
16	ALPHA EOLICA SRL	Crucea	Constanta	162
17	PLUSENERG	Vulturu, Crucea, Saraiu	Constanta	600
18	EXIMPROD	Cudalbi	Galati	400
19	LAND POWER SRL	Dorobantu-Topolog	Tulcea	168
20	WINSTAR TRADING INTERNATIONAL	Casimcea, Daeni, Topolog	Tulcea	50
21	ALFA WIND SRL	Casimcea, Daeni, Topolog	Tulcea	150
22	BETA WIND SRL	Casimcea, Daeni, Topolog	Tulcea	232
23	SC SABLOAL ENERGIE EOLIANA SRL	Valea Dacilor	Constanta	147
24	SC BLUE LINE IMPEX SRL	Agighiol-Valea Nucarilor	Tulcea	25
25	SC BLUE LINE IMPEX SRL	Agighiol-Valea Nucarilor	Tulcea	70
26	SC BLUE LINE IMPEX SRL	Agighiol-Valea Nucarilor	Tulcea	35
27	SC BLUE LINE IMPEX SRL	Agighiol-Valea Nucarilor	Tulcea	70
28	SC BLUE LINE IMPEX SRL	Corugea-Cismeaua Noua	Tulcea	70
29	SC RENOVATIO POWER SRL	Pestera	Constanta	90
30	BLUE PLANET INVESTMENTS SRL	Baia	Tulcea	35
31	CERNAVODA POWER SRL	Cernavoda	Constanta	138
32	MONSSON ALMA SRL	Targusor	Constanta	50
33	SC WIND POWER PARK SRL SILISTEA ENERGIES SRL	Silistea	Constanta	25
34	MARKET EXPERT (Renovatio - dupa ENEL)	Sarichioi	Tulcea	33
35	LAND POWER SRL	Cerna	Tulcea	72
36	S.C. Total Electric S.R.L.	Topolog	Tulcea	15
37	SC EVIVA Nalbant SRL	Babadag 1	Tulcea	33.6
38	SC WIND POWER PARK SRL	Dorobantu	Tulcea	45
39	EOLICA DOBROGEA SRL	Mihai Viteazu	Constanta	80

40	ECO ENERGIA	Stejaru	Tulcea	34
41	E-ON Moldova	Falciu Berezeni	Vaslui	30
42	E-ON Moldova	Rosiesti	Vaslui	46
43	E-ON Moldova	Vetrisoaia	Vaslui	36
44	SC RENOVATIO POWER SRL	Vutcani	Vaslui	24
45	SC SIBIOARA WINDFARM SRL	Albesti	Vaslui	28
46	SC WIND POWER PARK SRL	Crucea	Constanta	150
47	E-ON Moldova	Victoria Sculeni	Iasi	38
48	CONTINENTAL WIND PARTNERS	Serbotesti	Vaslui	242
49	EOLICA DOBROGEA	Mihai Viteazu - SE 4	Constanta	148
50	EOLICA DOBROGEA	Eolica	Constanta	1500
51	EXTRA POWER	Cobadin	Constanta	50
52	ENERGYCUM W	Adjud	Vrancea	537.5
53	TOTAL ELECTRIC	Topolog	Tulcea	15
54	ALPHA EOLICA SRL	Crucea	Constanta	162
55	PLUSENERG	Vulturu, Crucea, Saraiu	Constanta	600
56	EXIMPROD	Cudalbi	Galati	400
57	EOLIANA SRL	Tataranu, Suraia, Vulturu	Vrancea	240
58	PS WIND MANAGEMENT	Independenta	Galati	470
59	ENERGOECO	Nalbant	Tulcea	60
60	SC BIO ZEPHIROS SRL	Harsova	Constanta	585
61	PECINEAGA SRL	Pecineaga	Constanta	50
62	WIND EXPERT	Tudor Vladimirescu, Piscu, Slobozia Conachi, Pechea	Galati	200
63	CONTINENTAL WIND PARTNERS	Adjud Vest	Vrancea	42.5
64	EP Wind Project	Chirnogeni	Constanta	80
65	ENERGYCUM SRL Adjud/ENERGYCUM W	Adjud	Vrancea	62.5
66	SC Wind Power SRL	Limanu	Constanta	72
67	SC INFUSION SRL	Crucea	Constanta	122.5
68	VENTUREAL	Greaca-Hotarele	Giurgiu	79.5
69	SC INFUSION SRL	Sulita	Botosani	65
70	SC CELSA TEAM SRL	Mironeasa, Scheia, Tibanesti-Ipatelele, Dobrovat si Schitu Duca	Iasi	642.5
71	EOLIAN COMPANY BUCURESTI	Adamclisi, Urluia Deleni, Pietreni	Constanta	300
72	M WIND ENERGY SRL	Stelinica	Constanta	38
73	M WIND ENERGY SRL	Platonesti	Constanta	66
74	M WIND ENERGY SRL	Saraiu	Constanta	33
75	M WIND ENERGY SRL	Casimcea	Tulcea	38
76	CONTINENTAL WIND PARTNERS	Adjud Est	Vrancea	200
77	ECOENERGIA	Stejaru	Tulcea	44
78	SINUS HOLDING	Gura Ialomitei	Ialomita	240
79	SINUS HOLDING	Beresti-Meria	Galati	80

80	SINUS HOLDING	Garoafa	Vrancea	400
81	ELIZOR PREST	Mahmudia-Bestepe	Tulcea	120
82	ALIZOR ELIN	Faurei	Braila	200
83	ALIZOR ELIN	Isaccea	Tulcea	120
84	VICTOLOGIC ENERGIE	Salcia Tudor	Braila	144
85	EVIVA	Rahmanu	Tulcea	79.8
86	LAND POWER	Jurilovca	Tulcea	117
87	ENERGIE ECOLOGICA ROGIS	Insuratei-Surdila	Braila	338
88	VENTUREAL	Amara	Ialomita	600
89	VENTUREAL	Victoria Insuratei	Braila	90
90	ELEKTRA INVEST	Mircea Voda	Constanta	51
91	FAS BROS DATA SRL	Silistea	Constanta	20
92	FAS BROS DATA SRL	Tepes Voda	Constanta	20
93	CELSA TEAM	Mironeasa	Iasi	600
94	KAROMEX INVEST	Harsova	Constanta	40
95	EVN WINDPOWER DEVELOPMENT	Mircea Voda	Constanta	30
96	FAS BROS DATA	Topalu	Constanta	20
97	VENTUREAL	Tecuci	Galati	30
98	VICTOLOGIC ENERGIE	Salcia Tudor, Racovita, Sutesti, Movila Miresii, Maxineni	Braila	444
99	EVIVA ENERGY	Ostrov	Constanta	84
100	SC EOLGEN SA	Racoviteni	Buzau	60
101	SC EOLGEN SA	Horezu	Valcea	51
102	TOPLET ENERGY	Toplet	Caras Severin	31.5
103	ENERGIE INVESTMENTS GROUP	Vacareni	Tulcea	450
104	EOLIA INVEST	Murfatlar	Constanta	300
105	VANT DIVISION GREEN GROUP	Vaslui	Vaslui	1242.5
106	ENERGIA VERDE VentUno SRL	Cerna	Tulcea	18
107	WIND EXPERT	Pantelimon	Constanta	300
108	HOLROM RENEWABLE ENERGY	Stejaru	Tulcea	300
109	VENTUREAL	Grivita	Galati	50
110	Wind Expert	Harsova	Constanta	40
111	Wind Expert	Cobadin	Constanta	26
112	Raggio Verde	Tichilesti	Constanta	27.5
113	VENTUREAL	Pogoanele	Buzau	102
114	VENTUREAL	Nana	Calarasi	600
115	SC Monsson SRL	Cogealac Vest	Constanta	100
116	Energia Verde VentiTre SRL	Mastacani	Constanta	100
117	VENTUREAL	Dudesti	Braila	80
118	VENTUREAL	Valea Argovei	Calarasi	150
119	EUROLAND 2002 SRL Bistrita	Negresti	Vaslui	64
120	SC MULTIMEDIA ART&TEHNIC SRL	Pechea, Rediu, Cuca, Frumusita, Smardan	Galati	150

119	EUROLAND 2002 SRL Bistrita	Negresti	Vaslui	64
120	SC MULTIMEDIA ART&TEHNIC SRL	Pechea, Rediu, Cuca, Frumusita, Smardan	Galati	150
121	TERMOELECTRICA S.A.	SPP Brăila	Brăila	800
122	S.C. J & T Investment Advisors s.r.o.	SPP Ungheni – located on the Republic of Moldova territory	Rep. Moldova	350
123	S.N. NUCLEARELECTRICA S.A.	U3+U4 Cernavodă	Constanța	700
124	PETROM S.A.	CCC OMV Brazi	Prahova	925
125	S.C. GLOBAL POWER INVESTMENT S.R.L.	SPP Galați	Galați	800
126	S.C. ENERGY HOLDING S.R.L.	SPP Sărdăneşti	Gorj	700
127	TM POWER S.A.	SPP Turnu Măgurele	Teleorman	1320

Programme Team designated to elaborate the PTG Perspective Plan –
Period 2008-2012 and 2017 as a guide

NO.	POSITION	FULL NAME
1.	DPR- Perspective Plan Programme Manager	Petrescu Dana
2.	Programme Manager	Soare Simona
3.	DPR- Consumption Forecast Department Head	Antemir Anca
4.	DPR- Network Development Department Head	Borza Cornelia
5.	DPR- Renewable Resource Integration Project Head	Oprea Simona
6.	DPR- Production Forecast Project Head	Giosanu Georgiana
7.	DMA – Project Manager	Bărbulescu Christiana
8.	DMA – Electric Substation and Transformation Unit Maintenance Programme Manager	Marciu Roxana
9.	DMA – Electric Air Line, Technological Building and Installation Maintenance Programme Manager	Matea Constantin
10.	DTIC – Project Head	Olovinaru Dan
11.	DMA – Power Trafo Maintenance Project Manager	Boruz Liviu
12.	DMA - Technological Building and Other Installation Maintenance Programme Manager	Chirea Laurentiu
13.	DMA – Project Manager –PTG Connection Works	Dimoftache Mihaela
14.	DMA – Operation Department Head	Florea Costin
15.	DMA - Department Head SCPA	Nitu Mihaela
16.	UNO-DEN – Operational Planning Department Head	Rădoi Cristian
17.	UNO-DEN – Regular Scheme Planning Department Head	Balaurescu Rodica
18.	UNO- DEN – Central Power Dispatcher Department Head	Erbaşu Cornel
19.	UNO-DEN – Programming and Operation Analysis Department Head	Ivan Virgiliu
20.	UNO-DEN–PTG Code requirement technical control Department Head	Ilişiu Doina
21.	UNO-DEN – 400 /220 kV network control, protection and automation system management Department Head	Lazăr Felicia
22.	UNO-DEN – Senior Engineer	Soare Alexandru
23.	DSCPC – Business Plan Programme Manager	Romaşcu Gabriel
24.	DC– Transmission Contract Administration Department Head	Ştefănescu Vasile Zacheu
25.	DC– Transmission Rate Project Head	Cîrlan Florica
26.	DC– Rate Management and Monitoring Department Head	Duţoiu Mirela
27.	DMPI – Department Head	Novac Alexandru
28.	D.E. – C.T.F.	Damian Silvia
29.	CMRU – HR Department Head	Mihart Alexandru
30.	MICMSSM – Department Head	Ilie Mariana
31.	OMEPA – Technical Manager	Sarbu Theodor Mircea
32.	CSMSU – Installation Security Manager	Vâlciu Adrian
33.	ST Bacău - Technical Manager	Lişman Petru Cătălin
34.	ST Bucureşti – Technical Manager	Ioan Traian
35.	ST Constanţa - Technical Manager	Vâju Marian
36.	ST Craiova - Technical Manager	Dadulescu Paul
37.	ST Piteşti - Technical Manager	Trandafir Florea
38.	ST Timişoara - Technical Manager	Sturza Florinel
39.	ST Sibiu - Technical Manager	Meţiu Vasile
40.	ST Cluj - Technical Manager	Moldovan Mihai
41.	DET Bacău –-DET Head	Munteanu Vasile
42.	DET Bucureşti –DET Head	Setran Marius
43.	DET Craiova –DET Head	Stroică Mihai
44.	DET Timişoara –DET Head	Negru Ion
45.	DET Cluj–DET Head	Bote Teofil