STRUCTURE AND ANALYSIS OF THE POWER SUBSECTOR WITHIN THE NATIONAL ENERGY SECTOR ON ENSURING AND STABILITY OF ENERGY SECURITY

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ABSTRACT: The need to analyze the power subsector, which generates critical infrastructure, comes in the context in which the possible occurrence of cases of non-energy supply (black-out), generates major issues of national interest, with European and NATO implications. The authors consider that addressing the power subsector is a strictly national security issue because the lack of electricity can cause enormous damage to national power system and the national economy, which are almost total dependent on the power subsector.

Key (expressions) words: power subsector, National Energy Sector, energy security

1. INTRODUCTION

The National Energy Sector is composed of the following subsectors: (figure 1.) [3] [4]

- Nuclear Subsector – uranium;
- Mining Subsector – coal;
- Power Subsector – electricity.

- Oil Subsector:
  • Oil branch;
  • Natural gas branch.
2. POWER SUBSECTOR – ELECTRICITY

2.1. Generalities and importance of the National Power Subsector

Electricity is the most important source of energy in the world without which a country’s economy can not function. All operational systems in a country’s economy (food, transport, health, financial, water supply, commercial, administrative, information-communication) are dependent on electricity, as shown in figure 2. [1]
In Romania, the entire energy chain, from the production, transmission, distribution and supply of electricity to consumers, is characterized by the National Power System – NPS

The following infrastructures shall be included in the National Power System:
- **Power generators**: hydrogenerators, thermogenerators, nuclear generators, wind generators, photovoltaic installations, etc., which produce electricity and are located in power stations (plants);
- **Power transformers** / autotransformers: which convert voltage and are located in electrical substations;
- **Power overhead lines**: which transport and distributes electricity;

**Purpose and requirements**

The purpose of the existence of the National Power System is to ensure all safety, technical and economic conditions for the supply of electricity to consumers.

In order to meet this goal, the National Power System shall meet the following requirements:
- safety (security) in the supply of consumers (the level of safety is preset at the request of the consumer according to its technical characteristics);
- electricity quality (the assessment of electricity quality is made by the values of the quality indices, which must be within the limits set by the regulations and / and requested by the consumers);
- economy (to operate under economic conditions);
- external requirements (environment and other external factors).

**Operating**

Romania operates in ENTSO-E, which is the European network of transmission system operators in the European Union and represents 39 electricity transmission system operators from 35 countries in Europe, thus extending beyond the EU borders.

ENTSO-E Member States: Austria, Albania, Bosnia and Herzegovina, Belgium, Bulgaria, Switzerland, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain,
Finland, France, Greece, Croatia, Hungary, Ireland, Iceland, Italy, Lithuania, Luxembourg, Latvia, Montenegro, Northern Ireland, North Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Sweden, Slovenia, Slovakia, Ukraine (observer Member), according to figure 3

Fig. 3. Map of ENTSO-E

Criteria for participation in the interconnected operation recommended by ENTSO-E:
- coverage of consumption;
- primary power adjustment;
- secondary frequency – power regulation;
- voltage regulation;
- safety of operation to criterion (N-1) elements;
- anti-damage measures.

Interconnections
The National Power System interconnection is one of the main ways to increase its reliability and security without affecting energy independence. These interconnections provide emergency aid without the need to install and maintain a significant important power in the warm reserve. International interconnections of the National Power System, according to table 1:

Table 1. National Power System – international interconnections

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>CONNECTION TYPE (Overhead power line)</th>
<th>LEVEL OF VOLTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UKRAINE</td>
<td>Rosiori – Mukacevo</td>
<td>400 kV - Connections to the UE</td>
</tr>
<tr>
<td></td>
<td>Isaceea – Ukraina Sud</td>
<td>400 kV (750 kV gauge) - line decommissioned</td>
</tr>
<tr>
<td>HUNGARY</td>
<td>Nádab - Bekescsaba</td>
<td>400 kV - Connections to the UE</td>
</tr>
<tr>
<td></td>
<td>Arad - Sandorfalva</td>
<td></td>
</tr>
</tbody>
</table>
2.2. National Power Subsector – power operations

The main actors in the energy chain are the following: [5] [6]

**Electricity production:**
- Nuclearelectrica;
- Hidroelectrica;
- Oltenia Energy Complex;
- Hunedoara Energy Complex;
- Romgaz;
- OMV Petrom.

**Electricity transmission:**
- Transelectrica S.A.

**Electricity distribution:**
- ENEL Distribution;
- Oltenia Energy Distribution;
- Delgaz Grid;
- Electrica Distribution.

The operating principle of the Power Subsector is shown in Figure 5.
2.3. The full power cycle in Romania

Romania having a mix of energy resources (oil, natural gas, coal, uranium, etc.), it has the major advantage of having a full power cycle: (table 2. / figure 6.) [7]

<table>
<thead>
<tr>
<th>No. Crt.</th>
<th>STEPS</th>
<th>TYPE OF RESOURCE</th>
<th>OPERATOR</th>
<th>THE SUPERPERATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Resource Management</td>
<td>Oil</td>
<td>NATIONAL AGENCY FOR MINERAL RESOURCES</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Natural gas</td>
<td>ROMGAZ S.A. / OMV PETROM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uranium</td>
<td>OLTENIA ENERGY COMPLEX</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coal</td>
<td>HUNEOARA ENERGY COMPLEX</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Production</td>
<td>Natural gas</td>
<td>NUCLARELECTRICA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coal: lignite</td>
<td>HIDROELECTRICA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coal: huila</td>
<td>TRANELECTRICA</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Transport</td>
<td>electricity</td>
<td>ENEL DISTRIBUTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OLTENIA ENERGY DISTRIBUTION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DELGAZ GRID</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ELECTRICA DISTRIBUTION</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Distribution</td>
<td>electricity</td>
<td>ENEL SUPPLY</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OLTENIA ENERGY DISTRIBUTION</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Supply</td>
<td>electricity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In order for the power cycle to be full, through the 5 stages, it is mandatory that all the actors involved are present, namely: (figure 6.)

1) National Agency for Mineral Resources – which owns the energy resources (oil, natural gas, coal, uranium);
2) Hunedoara Energy Complex – which produces electricity based on huila;
3) Oltenia Energy Complex – which produces electricity based on lignite;
4) Nuclearelectrica – which produces electricity based on uranium;
5) Hidroelectrica – which produces water-based electricity;
6) Romgaz / OMV Petrom – which produces electricity based on natural gas;
7) Enel Distribution / Oltenia Energy Distribution / Delgaz Grid / Electrica Distribution – which distributes and supplies electricity to consumers

2.4. Power pressure instrument

Definition: Any action or inaction of A RESOURCE-HOLDING power chain actor (oil/natural gas/coal/uranium/water) – ELECTRICITY PRODUCER (natural gas/uranium/coal/water based) – ELECTRICITY TRANSPORTATOR – ELECTRICITY DISTRIBUTOR – ELECTRICITY SUPPLIER, directly or indirectly linked to energy resources or electricity, which aims to influence the behavior of other actors, control or eliminate them, in order to achieve their own interests.
The scheme of principle for the use of electricity as a pressure instrument is shown in figure 7.

The pressure instrument can be used, throughout the respective chain, by any of the “links” involved in this process.

3. CONCLUSIONS

Because electricity is a safety and security element for those who own it, it can lead to conflicts or energy wars. It is characterized by the use of energy instruments to compel the opponent to change his policy or behavior or to undermine the state’s ability to maintain normal relations with other states in times of peace or war.

Without electricity, the national economy can suffer, causing huge damage to national industry and energy security, and for this reason energy security becomes an important component of the national security and foreign policy strategy.

Electricity can be used as a political pressure instrument or energy weapon for the purposes of profitability and blackmail.

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