ORGANIGRAM OF UPGRADING AND OPTIMIZATION POWER STATIONS AT HIGH VOLTAGE, VERY HIGH VOLTAGE AND ULTRA HIGH VOLTAGE

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Abstract
Upgrade the power stations at high voltage, very high voltage and ultra high voltage and transmission and distribution networks of electricity, is a key point in optimization european power systems UCTE, NORDEL, TSOI and UKTSOA. By upgrading and optimization improve reliability european systems, increased quality electrical energy, increased transit of electricity, reducing power consumption and eliminate accidents of works and occupational diseases.
The author of this scientific paper, in the context of upgrading and optimization of power stations 110, 220, 400, and 1000 kV designed organigram upgrading and optimization.
This organigram can be example for future upgrading and optimization of power stations all over the world.
Cuvinte cheie: organigram, upgrading, optimization, power stations

1. Power stations – element of power systems

A. Definition and role

Power stations is the set of installations and annexes building in which the least one of the followings operations: electrical connections of two or more power sources (generators or centrals), the electrical connection of two or more ways to make a power transit, distribution electricity for consumers at the same voltage or other voltage (through power transformers or power autotransformers).

B. Constructive aspects of power stations

The upgrade of power stations depends on the type of station (outside and inside). Power stations of outside type depend on influences (single line diagram and restriction of land) and configuration (type high, average height, low height, mixt). Power stations of inside type depend on prefabricated switchgears (line, transformers, coupling, measuring, compensation, surge arrester, etc.) and isolating gas (sulphur heaxafluoride SF6, compressed air and insulating oil, etc.)

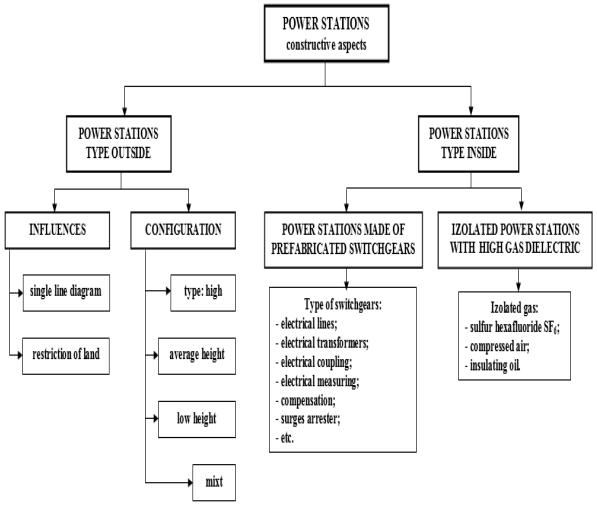
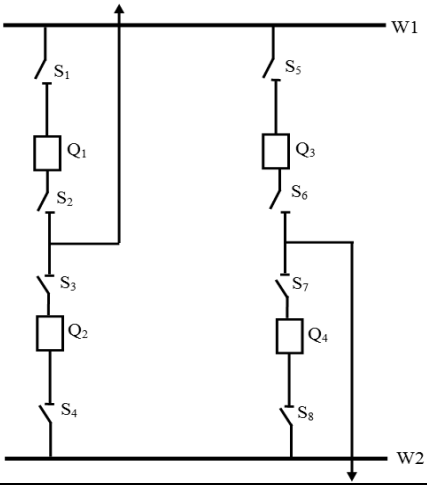


Fig. 1 *Constructive aspects of power stations*

C. Different schemes used for power stations

SCHEME WITH ONE SYSTEM OF BUSBAR WITH 2 CIRCUIT BREAKER/CIRCUIT



W1, W2 – busbars; Q_1 - Q_4,– circuit breakers; S_1 - S_4 – disconnectors.	Voltage: 1000 kV, 750 kV, 400 kV, 220 kV, 110 kV.

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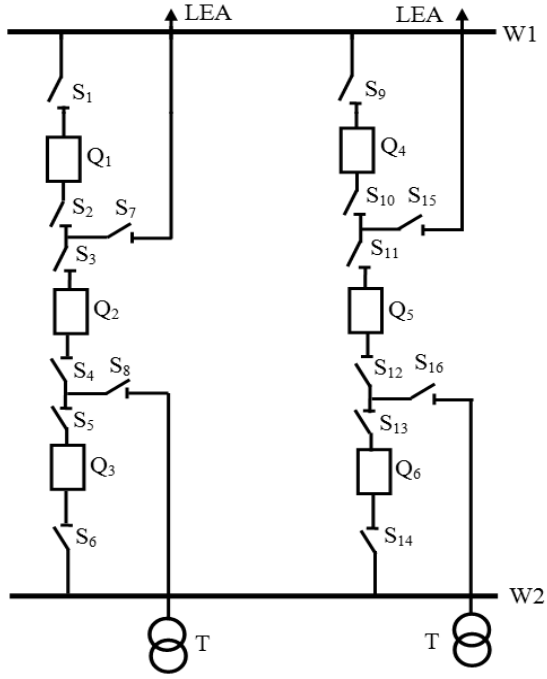
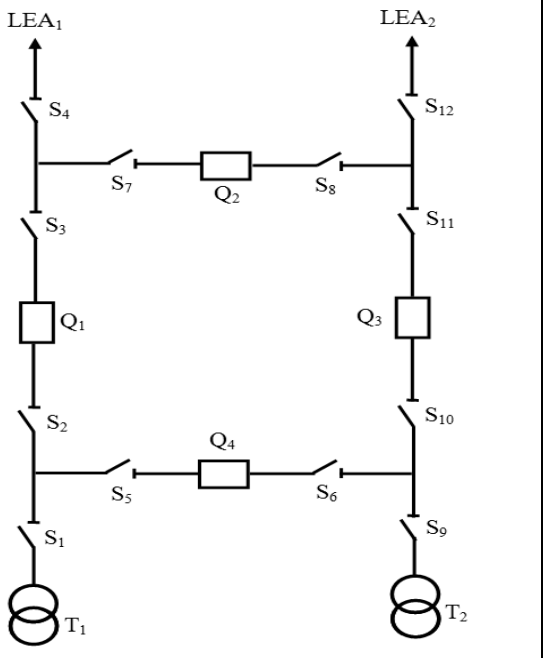
SCHEME WITH ONE SYSTEM OF BUSBAR WITH 1,5 CIRCUIT BREAKER/CIRCUIT



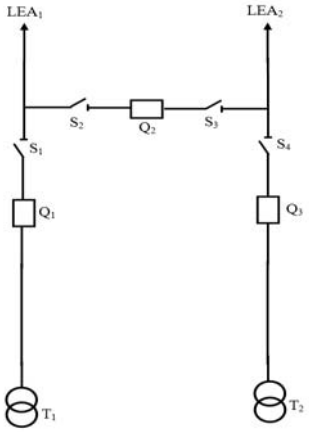
W1, W2 – busbars; $Q_1 – Q_6$,– circuit breakers; $S_1 – S_{16}$ – disconnectors; T – transformer; LEA – overheadline.	Voltage: 1000 kV, 750 kV, 400 kV, 220 kV.

SCHEME WITH POLIGONAL SYSTEM WITHOUT BUSBAR



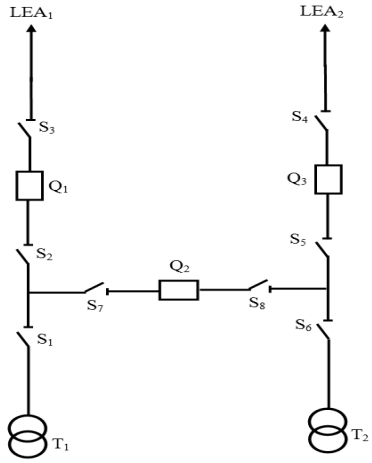
$Q_1 – Q_4$,– circuit breakers; $S_1 – S_{12}$ – disconnectors; T_1, T_2 – transformer; LEA_1, LEA_2 – overheadlines.	Voltage: 1000 kV, 750 kV, 400 kV, 220 kV.

SCHEME WITH TYPE H SUPERIOR SYSTEM WITHOUT BUSBAR



$Q_1 – Q_3$,– circuit breakers; $S_1 – S_4$ – disconnectors; T_1, T_2 – transformer; LEA_1, LEA_2 – overheadlines.	Voltage: 1000 kV, 750 kV, 400 kV, 220 kV.

SCHEME WITH TYPE H INFERIOR SYSTEM WITHOUT BUSBAR



$Q_1 – Q_3$,– circuit breakers; $S_1 – S_9$ – disconnectors; T_1, T_2 – transformer; LEA_1, LEA_2 – overheadlines.	Voltage: 1000 kV, 750 kV, 400 kV, 220 kV.

2. Criteria for choice of apparatus and electrical equipments

a) nominal electrical characteristics *:*

- rated voltage use U_e, rated insulatation voltage U_i, rated impulse voltage U_{imp};
- rated current use I_e, rated current uninterrupted I_u;
- nominal frequency.

b) behavior under shortcircuit*:*

- short-term permissible rated current I_{cw};
- nominal capacity of shortcircuit shutdown I_{cm};
- nominal capacity of shortcircuit breaking I_{cn};
- the rated shortcircuit condition.

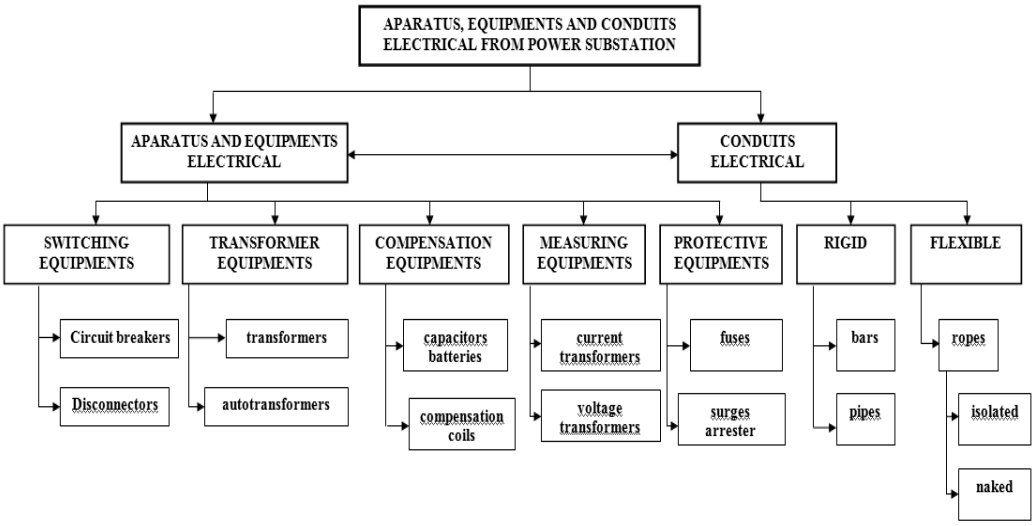
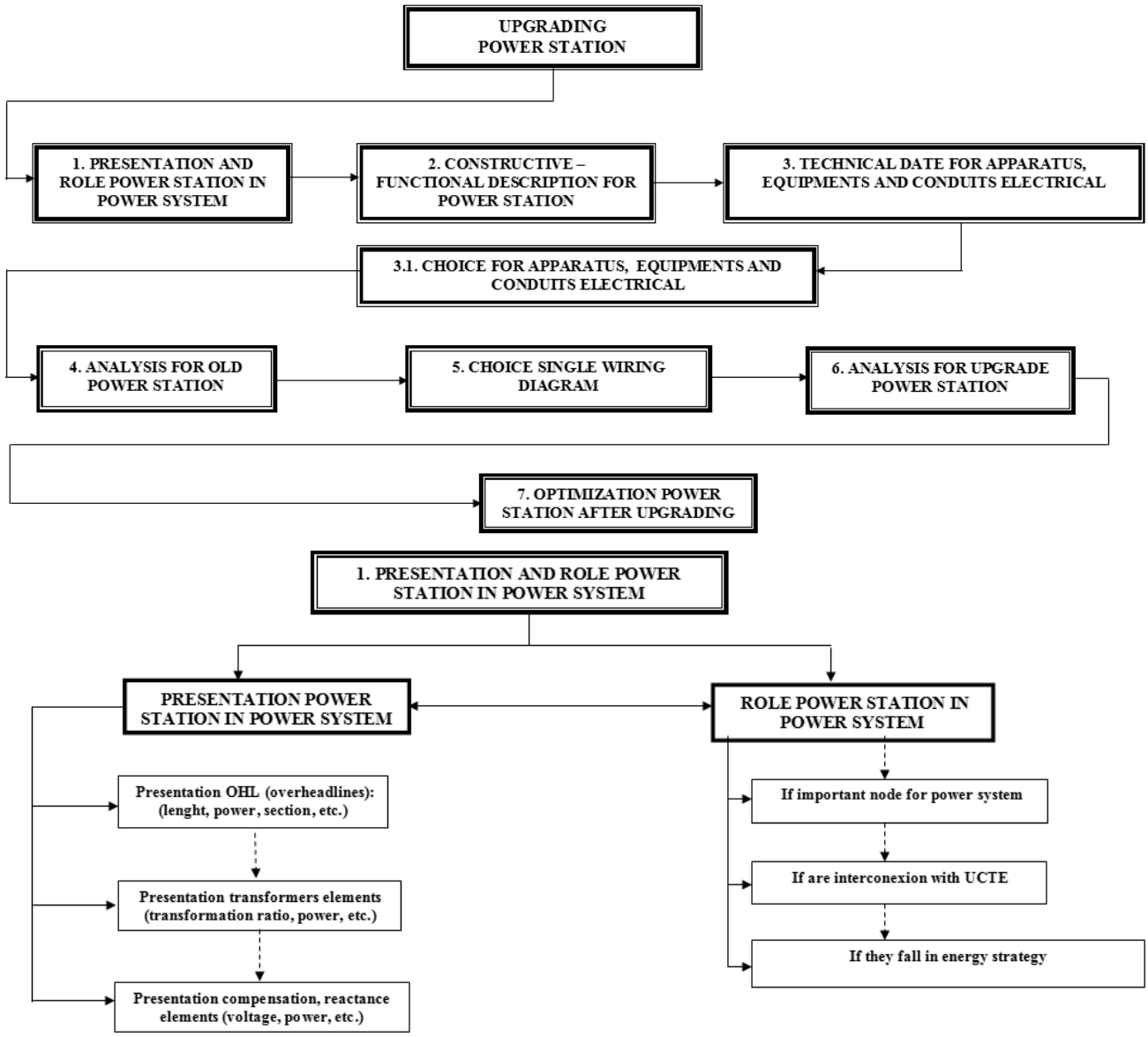
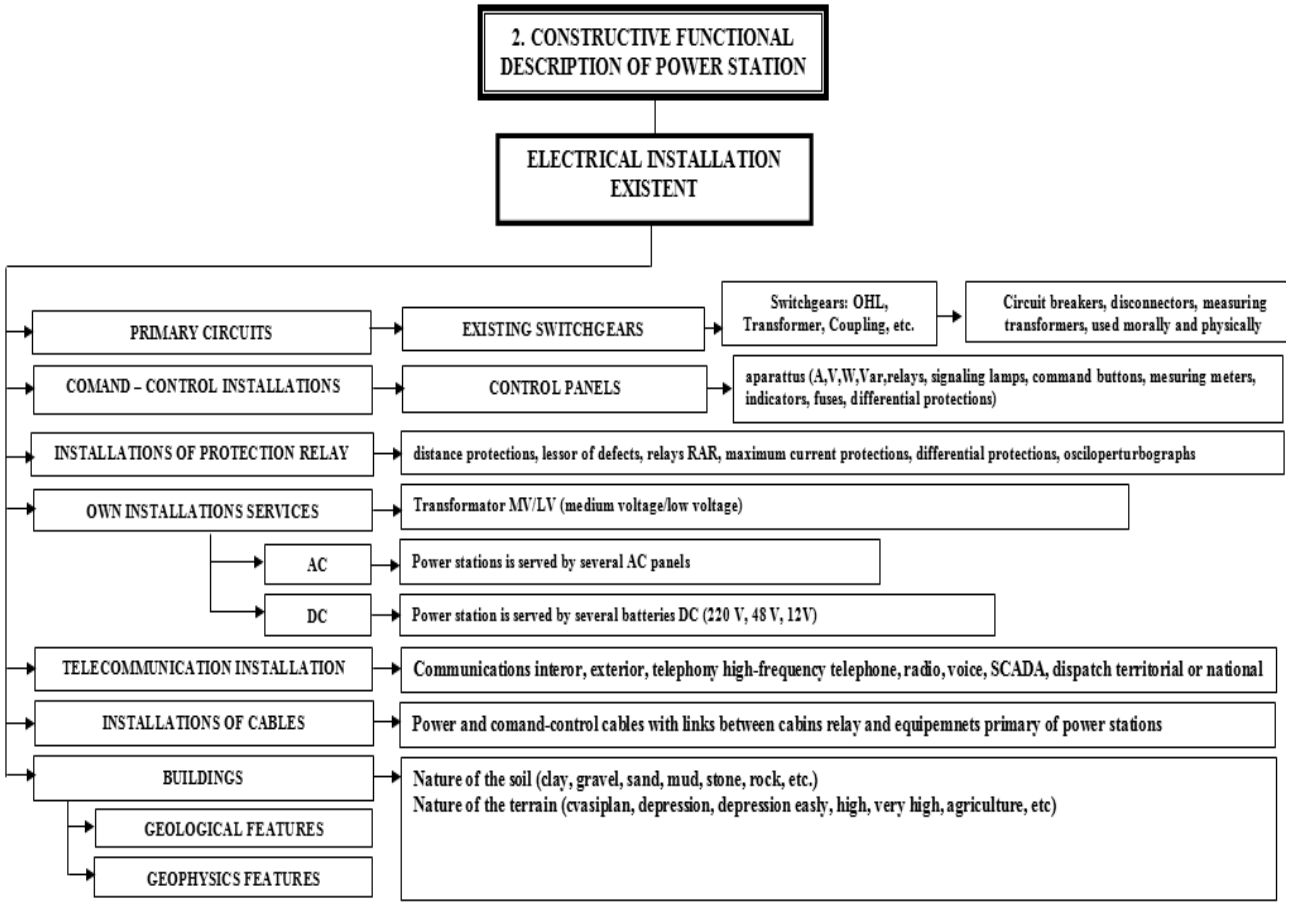
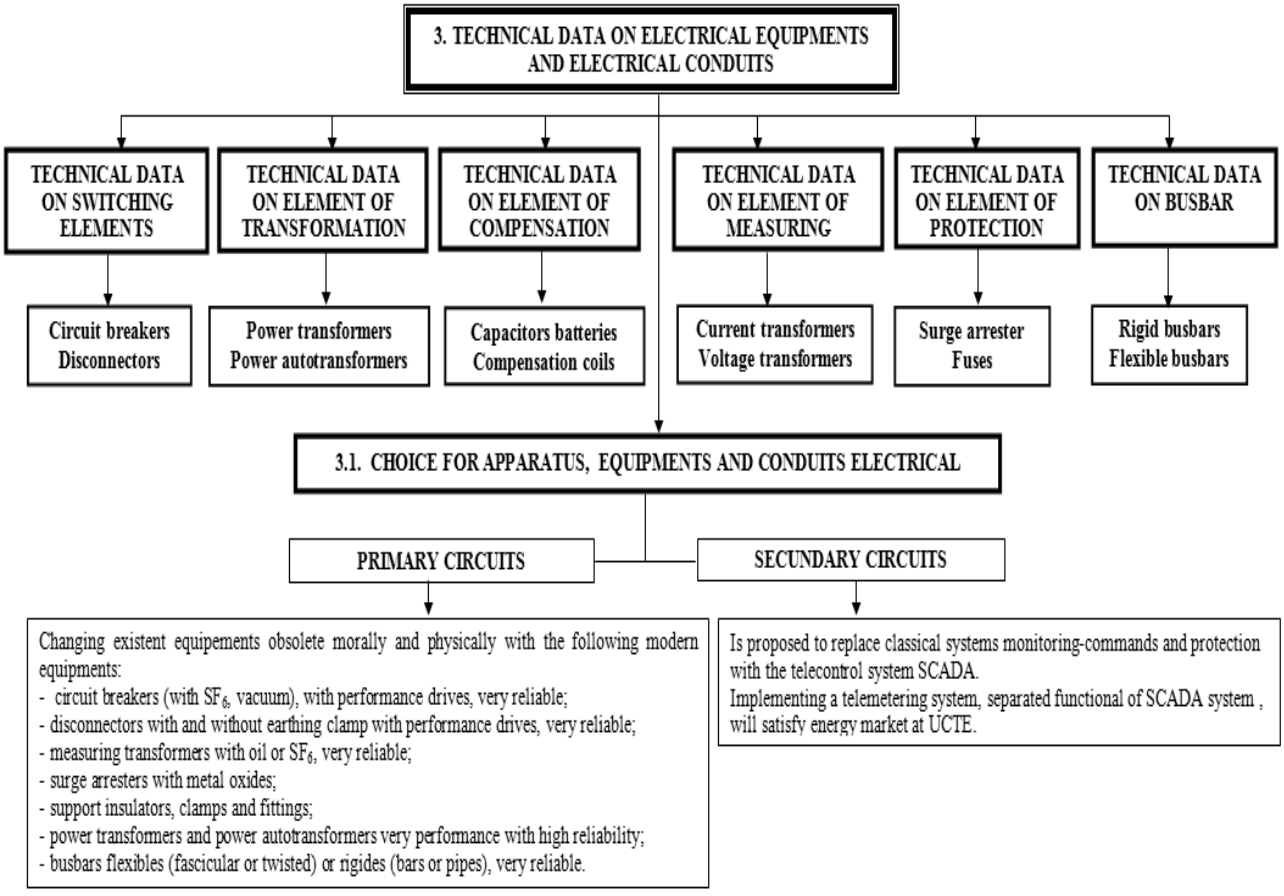


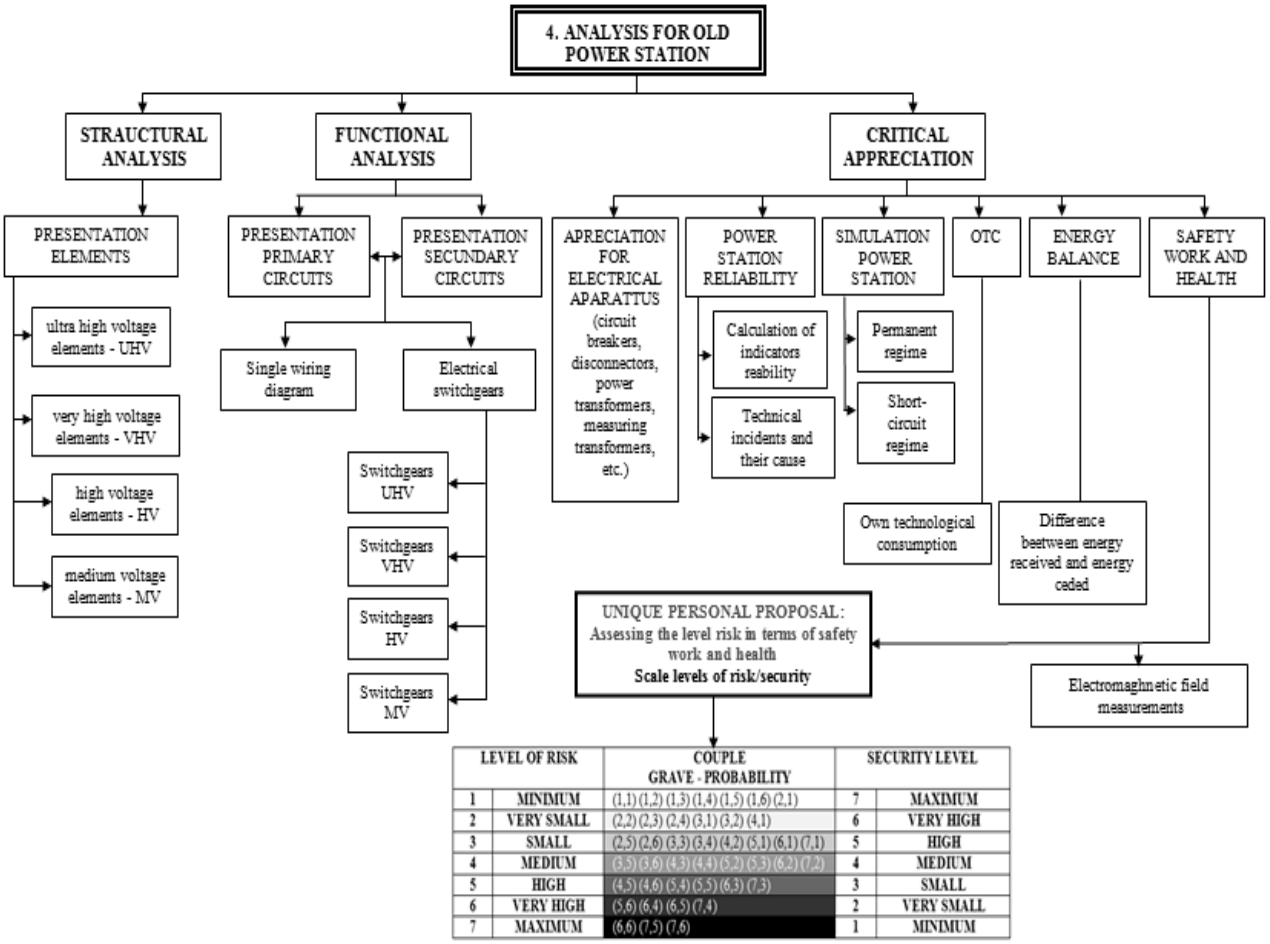
Fig. 2 *Criteria for choice of apparatus and electrical equipments*

3. Organigram of upgrading and optimization power stations

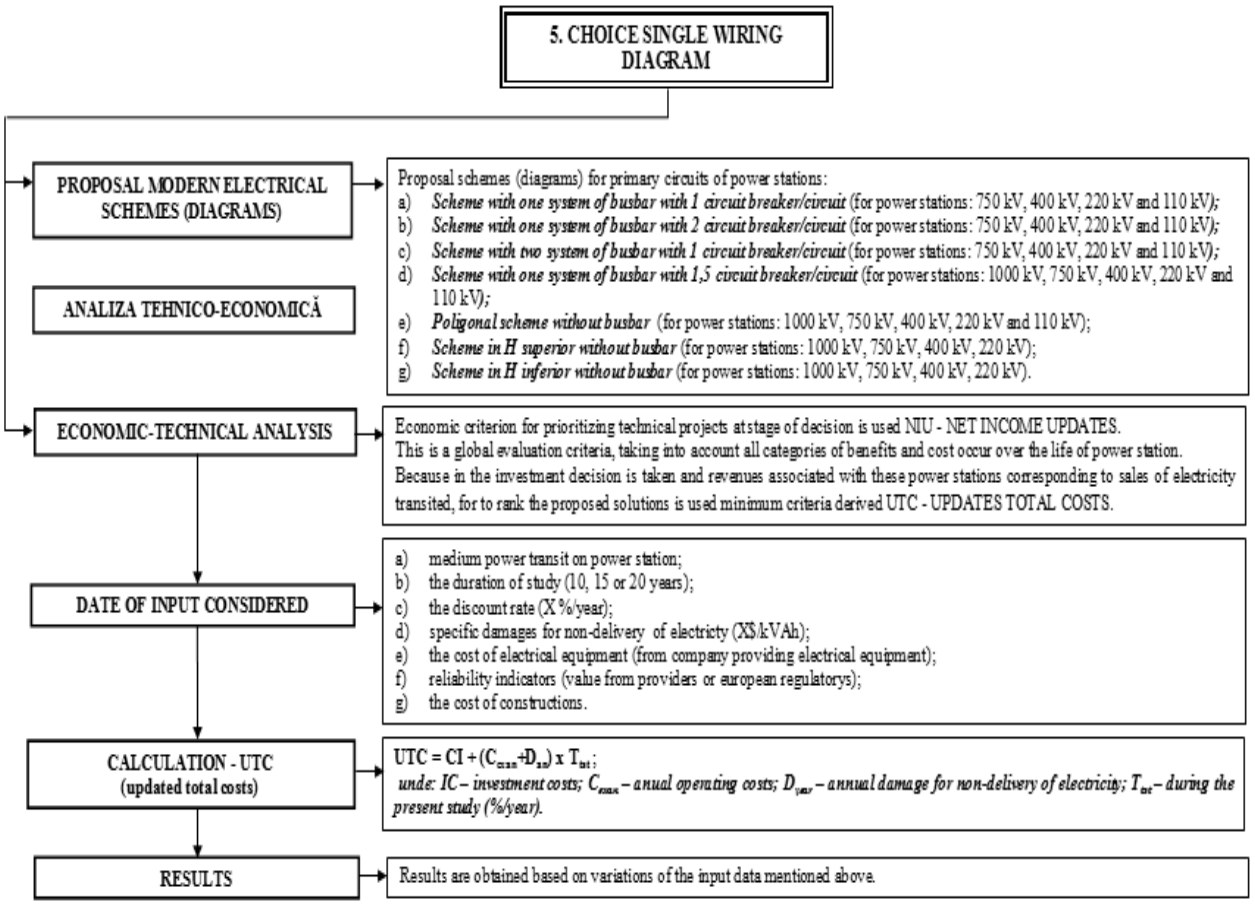



2. CONSTRUCTIVE FUNCTIONAL DESCRIPTION OF POWER STATION
ELECTRICAL INSTALLATION EXISTENT
PRIMARY CIRCUITS
EXISTING SWITCHGEARS
Switchgears: OHL, Transformer, Coupling, etc.
Circuit breakers, disconnectors, measuring transformers, used morally and physically
COMAND – CONTROL INSTALLATIONS
CONTROL PANELS
aparattus (A,V,W,Var,relays, signaling lamps, command buttons, mesuring meters, indicators, fuses, differential protections)
INSTALLATIONS OF PROTECTION RELAY
distance protections, lessor of defects, relays RAR, maximum current protections, differential protections, osciloperturbographs
OWN INSTALLATIONS SERVICES
Transformator MV/LV (medium voltage/low voltage)
AC
Power stations is served by several AC panels
DC
Power station is served by several batteries DC (220 V, 48 V, 12V)
TELECOMMUNICATION INSTALLATION
Communications interor, exterior, telephony high-frequency telephone, radio, voice, SCADA, dispatch territorial or national
INSTALLATIONS OF CABLES
Power and comand-control cables with links between cabins relay and equipemnets primary of power stations
BUILDINGS
GEOLOGICAL FEATURES
GEOPHYSICS FEATURES
Nature of the soil (clay, gravel, sand, mud, stone, rock, etc.)
Nature of the terrain (cvasiplan, depression, depression easly, high, very high, agriculture, etc)


3. TECHNICAL DATA ON ELECTRICAL EQUIPMENTS AND ELECTRICAL CONDUITS
TECHNICAL DATA ON SWITCHING ELEMENTS
TECHNICAL DATA ON ELEMENT OF TRANSFORMATION
TECHNICAL DATA ON ELEMENT OF COMPENSATION
TECHNICAL DATA ON ELEMENT OF MEASURING
TECHNICAL DATA ON ELEMENT OF PROTECTION
TECHNICAL DATA ON BUSBAR
Circuit breakers Disconnectors
Power transformers Power autotransformers
Capacitors batteries Compensation coils
Current transformers Voltage transformers
Surge arrester Fuses
Rigid busbars Flexible busbars
3.1. CHOICE FOR APPARATUS, EQUIPMENTS AND CONDUITS ELECTRICAL
PRIMARY CIRCUITS
SECUNDARY CIRCUITS
Changing existent equipements obsolete morally and physically with the following modern equipments:
- circuit breakers (with SF6, vacuum), with performance drives, very reliable;
- disconnectors with and without earthing clamp with performance drives, very reliable;
- measuring transformers with oil or SF6, very reliable;
- surge arresters with metal oxides;
- support insulators, clamps and fittings;
- power transformers and power autotransformers very performance with high reliability;
- busbars flexibles (fascicular or twisted) or rigides (bars or pipes), very reliable.
Is proposed to replace classical systems monitoring-commands and protection with the telecontrol system SCADA.
Implementing a telemetering system, separated functional of SCADA system , will satisfy energy market at UCTE.



LEVEL OF RISK		COUPLE GRAVE - PROBABILITY	SECURITY LEVEL	
1	MINIMUM	(1,1) (1,2) (1,3) (1,4) (1,5) (1,6) (2,1)	7	MAXIMUM
2	VERY SMALL	(2,2) (2,3) (2,4) (3,1) (3,2) (4,1)	6	VERY HIGH
3	SMALL	(2,5) (2,6) (3,3) (3,4) (4,2) (5,1) (6,1) (7,1)	5	HIGH
4	MEDIUM	(3,5) (3,6) (4,3) (4,4) (5,2) (5,3) (6,2) (7,2)	4	MEDIUM
5	HIGH	(4,5) (4,6) (5,4) (5,5) (6,3) (7,3)	3	SMALL
6	VERY HIGH	(5,6) (6,4) (6,5) (7,4)	2	VERY SMALL
7	MAXIMUM	(6,6) (7,5) (7,6)	1	MINIMUM



Proposal schemes (diagrams) for primary circuits of power stations:

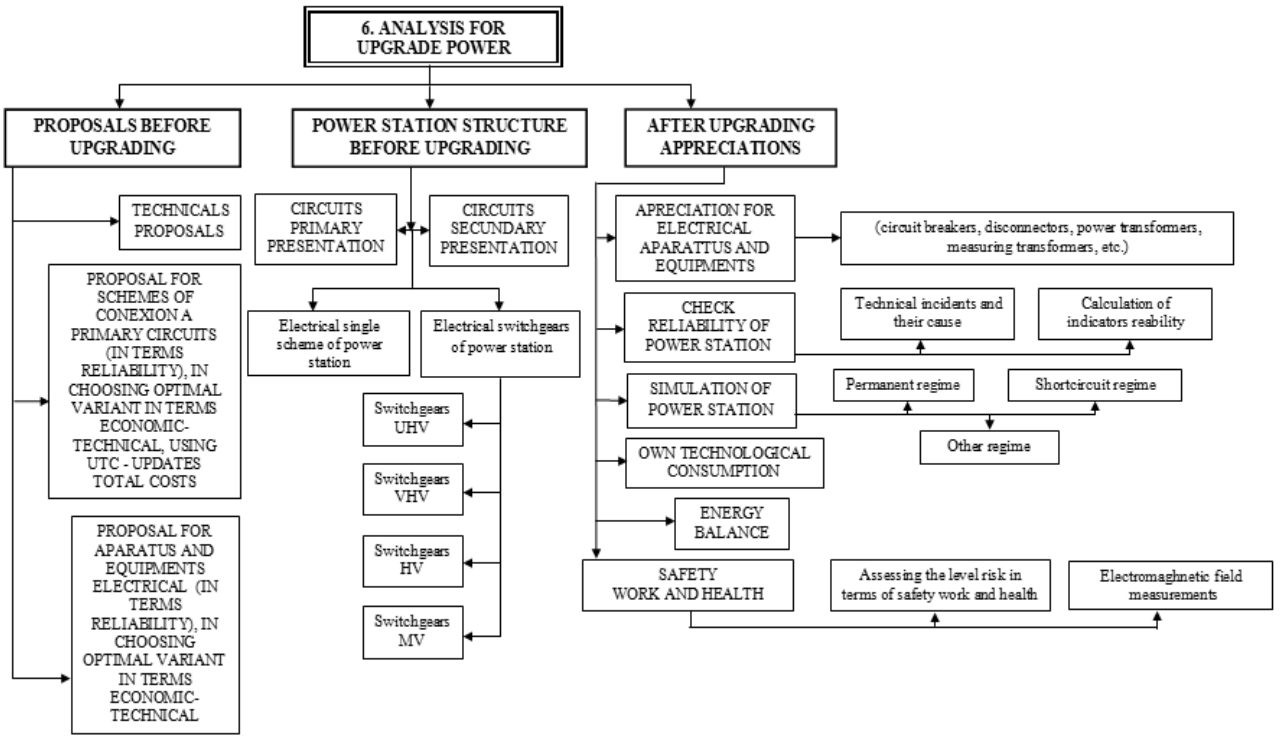
a) *Scheme with one system of busbar with 1 circuit breaker/circuit* (for power stations: 750 kV, 400 kV, 220 kV and 110 kV);
b) *Scheme with one system of busbar with 2 circuit breaker/circuit* (for power stations: 750 kV, 400 kV, 220 kV and 110 kV);
c) *Scheme with two system of busbar with 1 circuit breaker/circuit* (for power stations: 750 kV, 400 kV, 220 kV and 110 kV);
d) *Scheme with one system of busbar with 1,5 circuit breaker/circuit* (for power stations: 1000 kV, 750 kV, 400 kV, 220 kV and 110 kV);
e) *Poligonal scheme without busbar* (for power stations: 1000 kV, 750 kV, 400 kV, 220 kV and 110 kV);
f) *Scheme in H superior without busbar* (for power stations: 1000 kV, 750 kV, 400 kV, 220 kV);
g) *Scheme in H inferior without busbar* (for power stations: 1000 kV, 750 kV, 400 kV, 220 kV).

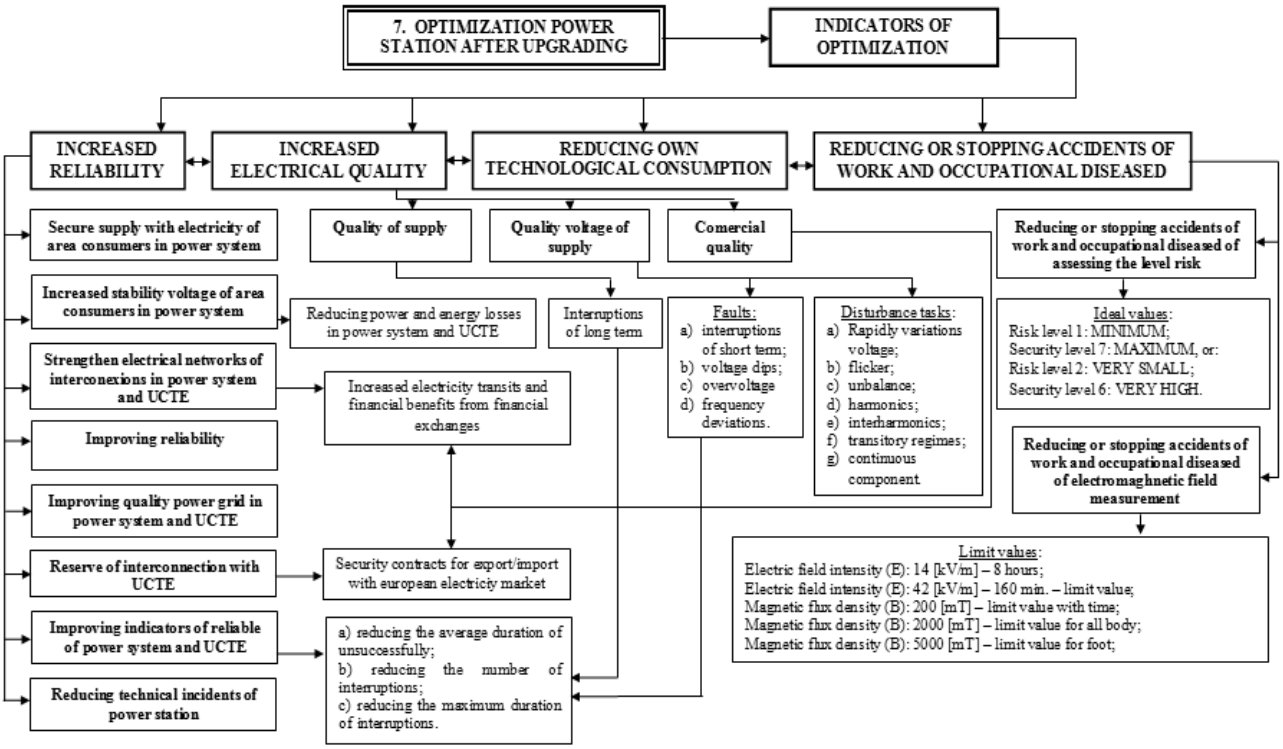
Economic criterion for prioritizing technical projects at stage of decision is used NIU - NET INCOME UPDATES.
This is a global evaluation criteria, taking into account all categories of benefits and cost occur over the life of power station.
Because in the investment decision is taken and revenues associated with these power stations corresponding to sales of electricity transited, for to rank the proposed solutions is used minimum criteria derived UTC - UPDATES TOTAL COSTS.

a) medium power transit on power station;
b) the duration of study (10, 15 or 20 years);
c) the discount rate (X %/year);
d) specific damages for non-delivery of electricty (X$/kVAh);
e) the cost of electrical equipment (from company providing electrical equipment);
f) reliability indicators (value from providers or european regulatorys);
g) the cost of constructions.

$UTC = CI + (C_{exp} + D_{an}) \times T_{at}$;
unde: IC – investment costs; C_{exp} – anual operating costs; D_{an} – annual damage for non-delivery of electricity; T_{at} – during the present study (%/year).

Results are obtained based on variations of the input data mentioned above.





4. Concluzii

In organigram upgrading and optimization power stations is presents methodology of upgrading, step by step, each step is well definited and structured.

Applicability to power station for following voltage: 1000 kV, 750 kV, 400 kV, 220 kV, 110 kV.

References

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2. **Fîță, D., Moraru, R., Breben, F., Iorga, N., Păsculescu, D., Păsculescu, V., Mihai, N.**
Electrical safety in work, Editura Universitas, Petroşani, 2011.