Actualităţi şi perspective în domeniul maşinilor electrice,
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The History of the Romanian Transformer Designed, Manufactured and Tested at ELECTROPUTERE Craiova and…… Preparing for the Future!

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Craiova

This paper is a true history of the birth, rise and demise of the Romanian transformer designed, manufactured and tested at "ELECTROPUTERE" Craiova written by those who lived it to the fullest. It has been planned for a long time, but this year a special occasion came up:

75 years since the founding of ELECTROPUTERE

50 years since the founding of ICMET Institute

events that together led to the fame of the Romanian transformer all over the world.

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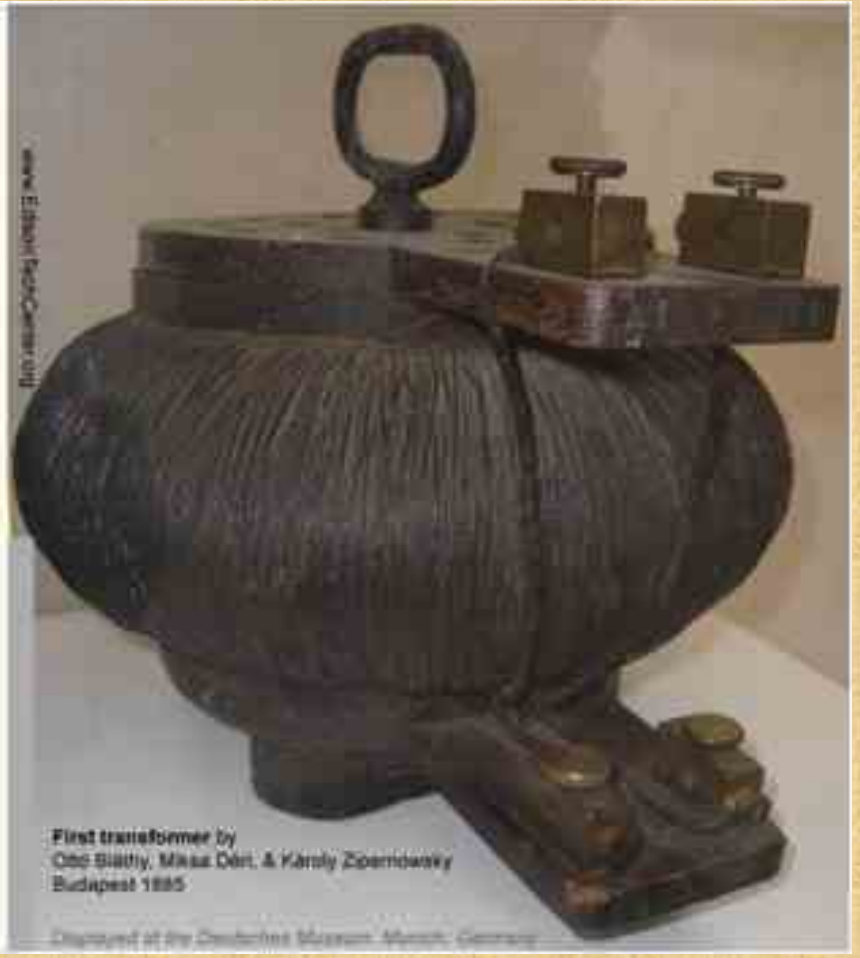
CRAIOVA & ELECTROPUTERE

Craiova - a centuries-old city located in a renowned Romanian agricultural area became an industrial city with the establishment of the ELECTROPUTERE factory in 1949 on the site of the planned Malaxa rolling stock

On the occasion of the 75th anniversary of the birth of this industrial complex we have the opportunity to pay homage to the Romanian School of Power Transformers founded here

Invention of the Transformer
The Patent Blathy, Deri, Zipernowsky - Ganz 1885



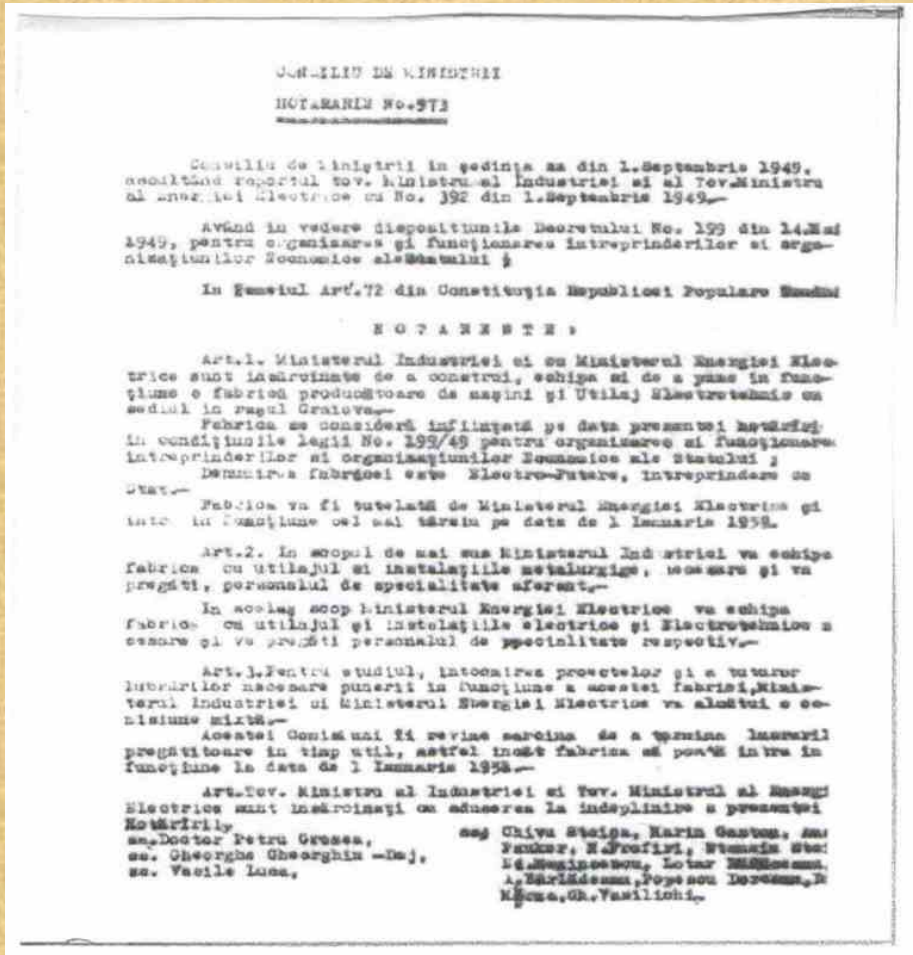
core-type *(conductors are wound on the toroidal core)*

shell-type *(the core consisting of iron wires surrounds the inner conductors)*

Brief History of the EP Location

- On the present site of **ELECTROPUTERE** (**EP**), in 1938 the **MALAXA** rolling stock repair workshops were operating.
- By an economic agreement of 04.12.1938 the Romanian government hands over the administration of these workshops to the German side.
- According to the project 108491, the German company **ARDELT WERKE** had to transform these workshops into a modern rolling stock repair plant which in 1945 had to repair 300 steam locomotives and to do intermediate maintenance works for other 300, so a very large capacity even today.
- Construction started in 1942 and by 1944 most of the construction was completed but some were damaged due to bombing. Immediately after the war in 1945, the workshops are called “Atelierele CFR Craiova”.

The Establishment Act of the State Enterprise "Electroputere" for the production of Machinery and Electrotechnical Equipment with headquarters in Craiova



CONSILIUL DE MINISTRI

HOTARARE No. 973

Consiliul de Ministri in sedinta sa din 1 Septembrie 1949, ascultand raportul tov. Ministrul Industriei si al Tov. Ministru al Energiei Electrice cu No. 392 din 1 Septembrie 1949,-

Avand in vedere dispozitiunile Decretului No. 199 din 14 Mai 1949, pentru organizarea si functionarea intreprinderilor si organizatiunilor Economice ale Statului ;

In temeiul Art. 72 din Constitutia Republicei Populare Romine

H O T A R A S T E :

Art.1. Ministerul Industriei si cu Ministerul Energiei Electrice sunt insarcinate de a construi, echipa si de a pune in functiune o fabrica producatoare de masini si Utilaj Electrotehnic cu sediul in orasul Craiova.-

Fabrica se considera infiintata pe data prezentei hotarari in conditiunile legii No. 199/49 pentru organizarea si functionarea intreprinderilor si organizatiunilor Economice ale Statului ;

Denumirea fabricei este Electro-Putere, intreprindere de Stat.-

Fabrica va fi tutelata de Ministerul Energiei Electrice si intra in functiune cel mai tarziu pe data de 1 Ianuarie 1950.

Art.2. In scopul de mai sus Ministerul Industriei va echipa fabrica cu utilajul si instalatiile metalurgice, necesare si va pregati, personalul de specialitate aferent.-

In acelas scop Ministerul Energiei Electrice va echipa fabrica cu utilajul si instalatiile electrice si Electrotehnice necesare si va pregati personalul de specialitate respectiv.-

Art.3. Pentru studiul, intocmirea proiectelor si a tuturor lucrarilor necesare punerii in functiune a acestei fabrici, Ministerul Industriei si Ministerul Energiei Electrice va alcatui o comisiune mixta.-

Acestei Comisiuni ii revine sarcina de a urmari lucrarile pregatitoare in timp util, astfel incat fabrica sa poata intra in functiune la data de 1 Ianuarie 1950.-

Art.Tov. Ministru al Industriei si Tov. Ministrul al Energiei Electrice sunt insarcinati cu aducerea la indeplinire a prezentei Hotarari.

ss. Dr. Petru Groza, ss. Gheorghe Gheorghiu-Dej, ss. Vasile Luca, ss. Chivu Stoica, Marin Gaston, [illegible]

Original Decision # 973/1949 of the Council of Ministers of the Romanian People's Republic

Signed by: Dr. Petru Groza, Gheorghe Gheorghiu-Dej, Chivu Stoica, Marin Gaston

September 15, 1949: the unit is registered with the Ministry of Finance and thus **ElectroPutere becomes operational**

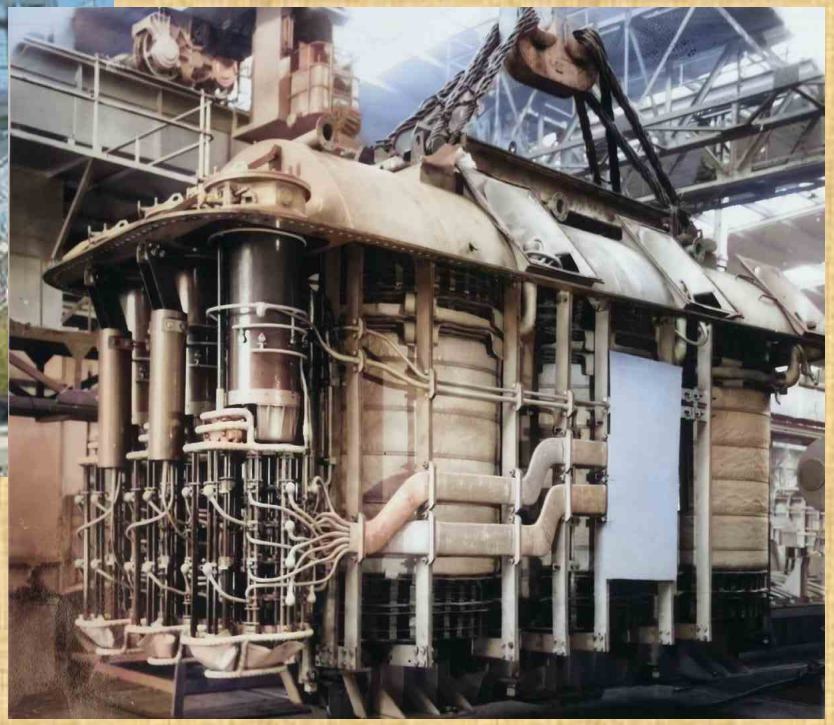
but.... without any technical staff

However, the EP was born, the IMAE (Higher Education Institute) was created and disappeared after a few years

- The Communist Party wanted the Electroputerea Craiova Enterprise, established on September 1, 1949 to become one of the main manufacturers of electrical and energy equipment in our country.
- For this purpose in the autumn of 1951 the Institute of Electrical Machines and Apparatus (**IMAE**), the first electrotechnical higher education institution in Oltenia, opened its doors.
- The Rector of this higher education institution was appointed ***Prof. Cezar Parteni Antoni*** *(1900-1956*), one of the leading Romanian specialists with outstanding achievements in Iasi and Bucharest.
- Other engineers from other parts of Romania, most of them from Bucharest came with him, willingly or unwillingly.
- Many of the IMAE graduates were immediately employed at EP and fully contributed to the development of this economic sector.
- At the end of the academic year 1956-1957, the IMAE was renamed **"Institut Tehnic"** and subordinated to the Polytechnic Institute of Bucharest, functioning under these conditions until 1958, when it was completely disbanded!!!!!!
- **The year 1966 brought the Faculty of Electrical Engineering back to Craiova within the newly founded University of Craiova**

Auto Trafo 200/200/60 MVA, 231/123/20 kV (ELIN License) Prototype built in EP - 1961

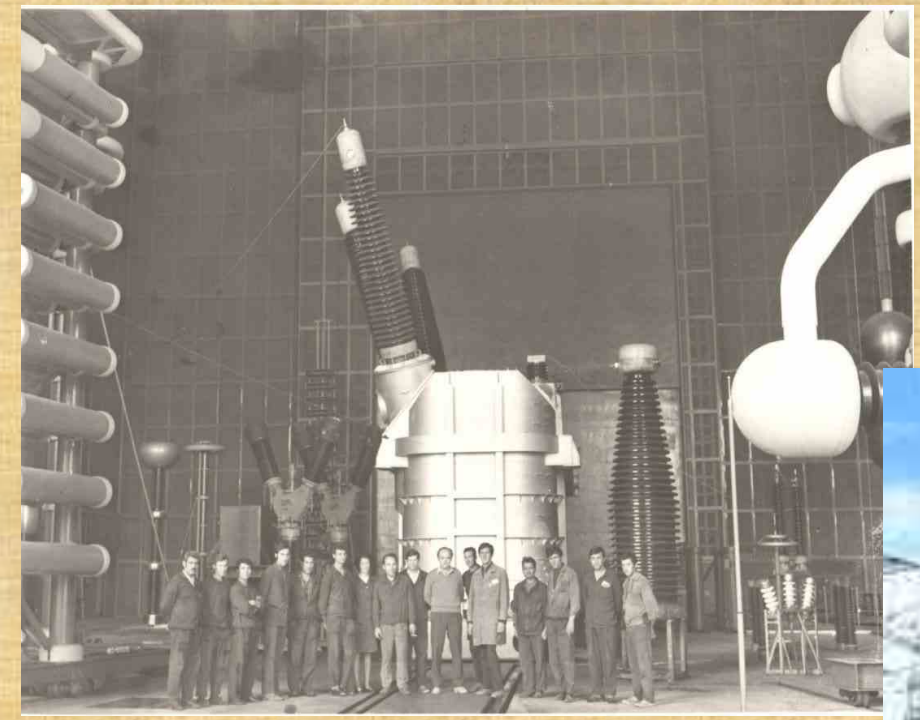
123 kV with Cornuti Insulators for protection arresters



Active Part

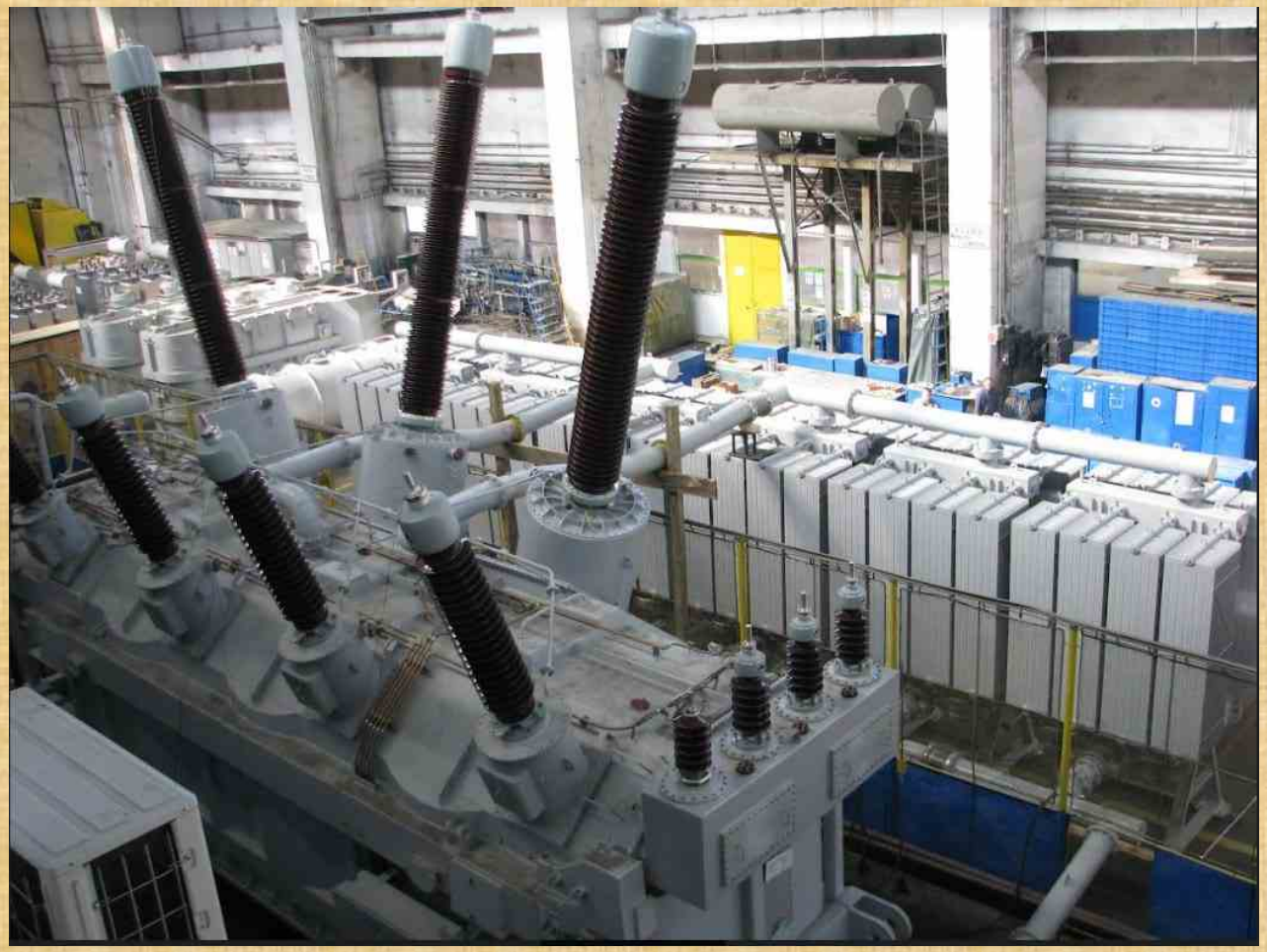
First EP 400 kV insulation class transformers

400 MVA Block Trafo, 420/24 kV for Rogojelu Thermoelectric Power Plant (under Test in HV Lab)-1973



400 MVA Auto-Trafo 420/231 kV with included regulation for Bradu Power Plant

Interconnection Auto trafo 280/280/60 MVA, 400/157,5/30 kV



Ready for the heating test in the EP test stand (to be delivered in Greece)

Step-down trafo 73 MVA 110/15/6.6 kV; 15 kV cable output for Saudi Arabia

Interconnection Auto trafo 150 MVA 220/110 kV for Philippines

Special Transformers

16 MVA 110/27.5 kV 1 Ph trafo for Romanian electrification railways

100 t furnace trafo 50 MVA ready for transportation to COS Targoviste-1978

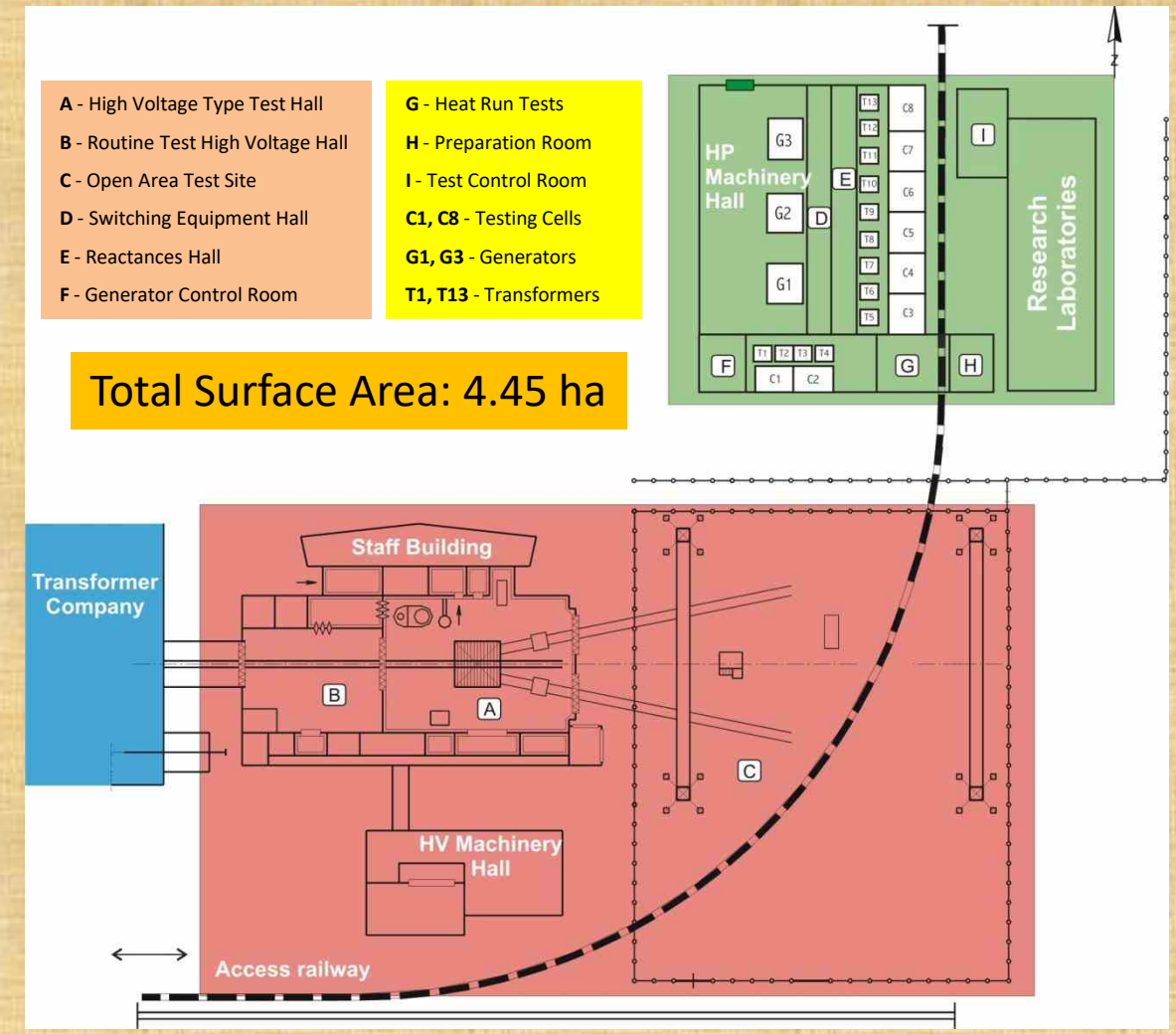
7850 kVA Transformatoric Complex Group for graphitizing (regulating transformer, two rectifier transformers and smoothing chokes in a common tank)-1982

One of the six Generator Transformers of the "Iron Gates 1" Hydroelectric Power Plant

Step-up Trafo 216 MVA 242/15.75 kV on site; HV cable outputs, LV inputs via incapsulated busbars.

ICMET HV & HP Laboratories Campus

Accredited "Third Part Laboratories"



The largest 440 MVA 420/24 kV Trafo for “Nuclear Power Plant – Cernavoda” 1985-1987, 3 pcs

Trafo fully equipped transported by internal rail from Trafo Factory to the HV Lab

Sudden Short-Circuit Tests at Power Transformers

- Tested transformers (1975-2016) about 500 pcs – (2,5MVA-167MVA)
- The biggest tested trafo: Auto trafo 167/167 MVA, 420/242 kV Single Phase, Uk=12,5%, Psc=2500MVA for “Iron Gates 1” Hydroelectric Power Plant
- Defectoscopy before and after sh-circuit: FRA – ITT – Uk - Active Part View

HV Lab Entry ←

HP Lab Entry →

Some outstanding achievements 1/2

- **Patent Application Publication: RO 42705/1964 CAMPEANU**

  Development for the first time ever of a method for the heating test of high voltage, large unequal three windings power transformers. The research has been capitalized by testing 5/3/2 MVA (for India) and 40/30/30 MVA (for Poland) transformers

Test team for the heating test of the 5/3/2 MVA trafo (India) in october 1961

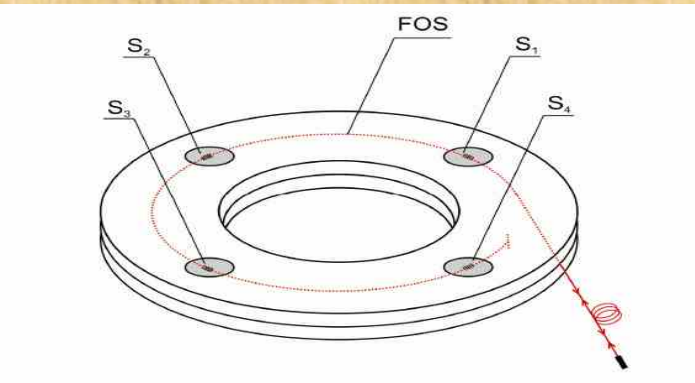
from left to right:
tech. Ilie Radoi, Eng. Ovidiu Draganescu, Eng. Aurel Campeanu, tech. Paul Strainu, eng. Virgil Tenescu, eng. Andrei Marinescu

Some outstanding achievements 2/2

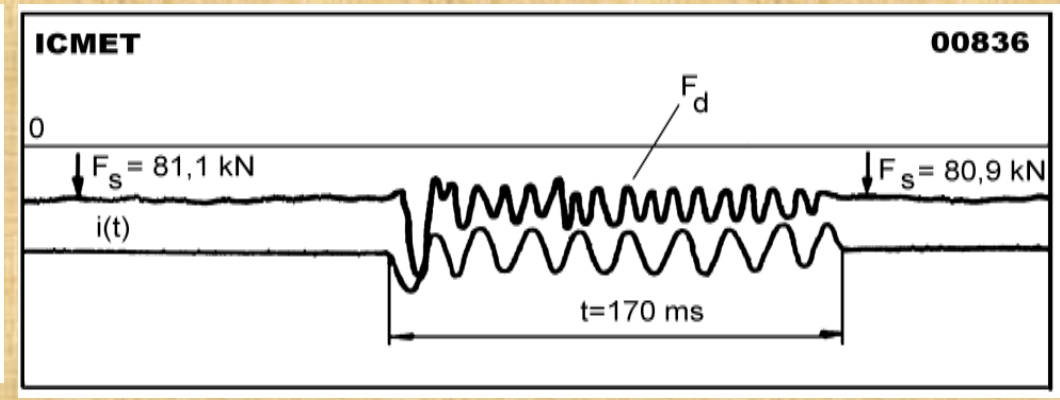
- **Patent Application Publication: RO 126339 B2/2010 MARINESCU**

The first known solution for static and dynamic axial force management in high power transformers, essential for ensuring their lifetime

First application: 80/600 MVA Sh-Circuit Trafo from HP Lab



Transverse sensitivity of fiber optic (red) sensor in the pressing ring



Oscillogram of static (F_s) and dynamic (F_d) axial force for an 80/600 MVA short-circuit trafo from HP Lab

The EP Reference List Transformers

- Clients: RO, BG, GR, TR, SRB, PL, ES, BR, CDN, IN, JO, PK, RP, UAE, CN, VN
- > 300 Mln Euro
- > 120000 pcs
- > 3000 workers (EP total >14000 workers)

EP privatization

- Unsuccessful attempts to privatize the Trafo Factory with famous companies (Fuji Electric, Siemens, etc.) for reasons such as "we are not selling our country“,
- A global privatization of the whole EP was made with a civil construction **Al Arrab Contracting** company from Saudi Arabia chosen by political interests for 2.34 million USD plus broken promises of refinancing (!!!) in **2007**.
- It destroyed the entire Electroputere known worldwide.
- **In 2019, the Trafo EP COMPANY CLOSES ITS ACTIVITIES.**
- This was not the only situation of this kind in Romania: the whole electric and electronic industry suffered the same fate

ENGINEERS EMPLOYED IN TRANSFORMER DESIGN

- ***Period 1951-1959 - The promoters***
- ***AMBROZIE CORNEL, CATANA MARIN, CIGUSIEVICI MIHAI, COJOCARU IANCU, GROSU STEFAN, MOISESCU MARIUS, NAZDRAVAN ILIE, POPESCU THEODOR, RADUCAN IONEL, RADULESCU COSTIN, SARPE MARIUS, TOMA GHEORGHE, TRESCHIN CONSTANTIN***.

The Future of Large Power Transformers

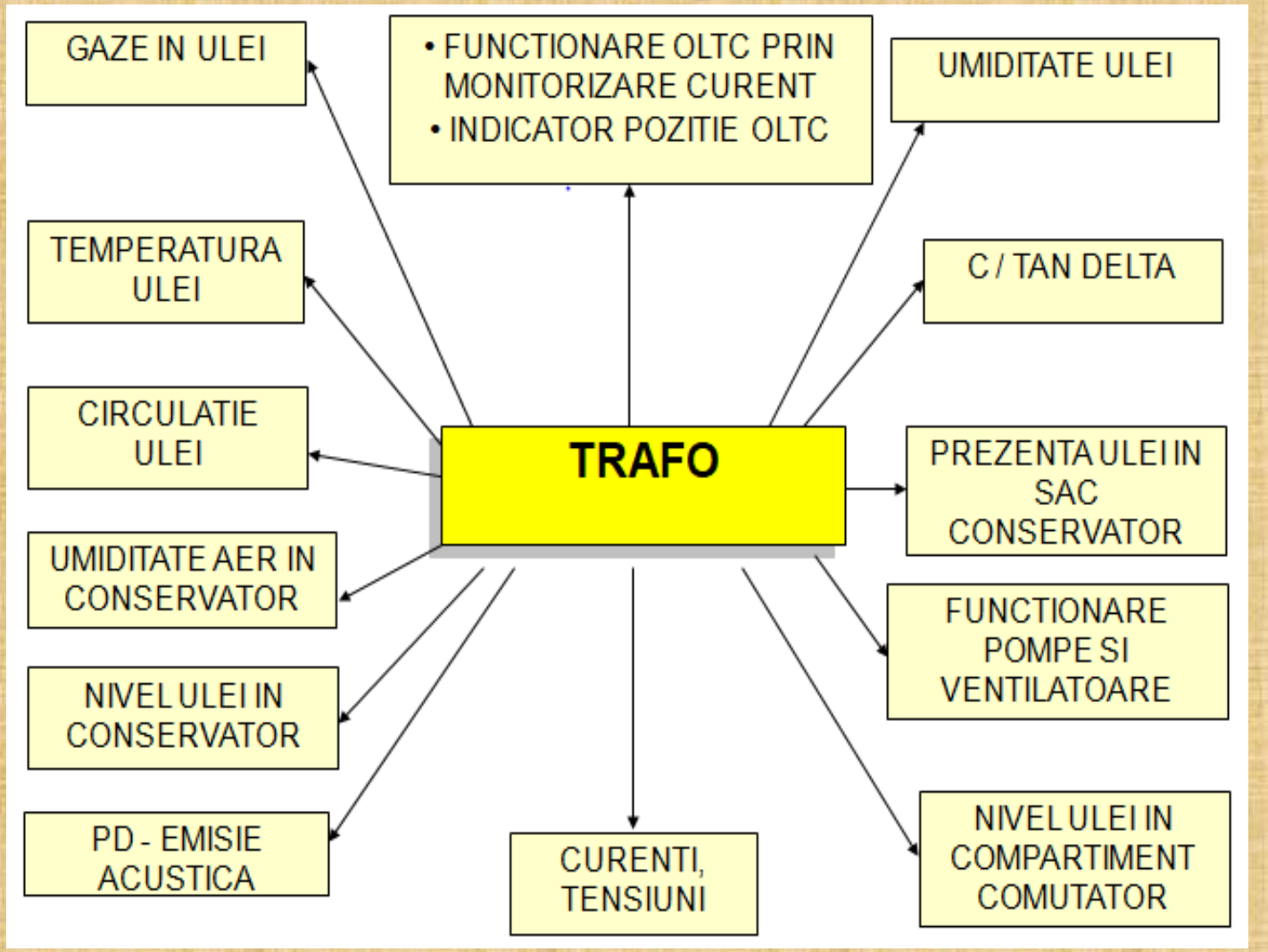
- *The Traditional Large Power Transformer, has been a cornerstone of the **Power Grid** for over a century and its **electromagnetic energy transfer principle** is irreplaceable in the future!*
- *The Modern Large Power Transformer, is being transformed into a digitalized version that can provide operators with real-time data on its operation and health for **Smart Grid;***

  This digital transformer integrates a multitude of sensors, communication interfaces and data analysis capabilities into the transformer to enable advanced monitoring, diagnostic and predictive capabilities.
- *The Emergent Power Electronic Transformer (PET or SST)*

  Near future solution preserves electromagnetic energy transfer

Monitoring Large Power Transformers

analog/digital



The Main Idea Behind the PET/SST

To replace and enhance conventional transformers through MFT or to enable new applications

The size of any transformer can be related to the area product, A_p

$$A_p = \frac{P_t}{K_f K_u B_m J f}$$

$$A_p(f)/A_p(50Hz) = 1/f$$

- Working frequency: 10 - 50 kHz
- Core material: Ferrite, Amorphous or nanomagnetics

SST becomes key components of future traction and smart grid systems

Power Electronic Transformer

- SST este un echipament emergent care va transforma rețelele electrice ale viitorului
- SST permite dezvoltarea de rețele DC, atât pe MRT cat si pe JT
- SST poate avea rolul de „Grid former” in micro rețele autonome (off-grid)
- SST poate îngloba sisteme de stocare bazate pe baterii (BESS)
- SST are deja domenii de nișă, cum ar fi stațiile de încărcare VE de mare putere, de exemplu de 2 x 350 kW sau 4 x 350 kW = 1.4 MW

At the end

WITHOUT HISTORY THERE WILL NEVER BE A FUTURE

Some thoughts on Romania today

- **It starts from the current situation in our country where everything is constantly changing, without any noticeable progress, especially in the world of research, where professional, moral and ethical rules of conduct are frequently taken into derision.**
- **The mass media irresponsibly impose a host of pseudo-models of false brilliance and rather harmful effects.**
- **The authentic role models that Romanian society and in particular the scientific community needs so much are rare.**

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