TECHNIREL

ICE

PROTECTION

MONITORING

&

CONTROLS

STATIC EXCITATION SYSTEMS EX 600 & 700

EX 600

EX700

Scope:

The static excitation systems **EX 600 & 700** are dedicated to the refurbishment of synchronous machines: alternators & motors.

The static excitation systems **EX 600 & 700** are tailored to meet specific characteristics of machines of various origins.

For more than 50 years, the **TECHNIREL** Department of **ICE** designs, manufactures & commissions these systems that improve performances & reliability of electrical machines.

INDUSTRIELLE DE CONTRÔLE
ET D'EQUIPEMENTS
11 , rue Marcel Sembat
94146 ALFORVILLE Cedex France
Phone : + 33 1 41 79 76 00
Fax : + 33 1 41 79 76 01
Site : www.icelec.com
E-mail : contact@icelec.com

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EX 600-700

1. Excitation types :

The static excitation systems **EX 600-700** participate to the revamping of old synchronous machines .2 main types may be considered:

- o Semi-static: The rotating exciters are left in place.
- o Full static: When the rotating exciters are removed for maintenance reasons.

2. Excitation ranges :

The static excitation systems **EX 600-700** current ranges start from few Amps up to several hundred of Amps.

3. Goals :

The full static excitation systems **EX 600-700** improve the response time of the generators to load variations & reduce the maintenance periods to a minimum.

4. Applications :

The static excitation systems **EX 600-700** are used in a wide field of applications:

- ❑ Civil or military power plants.
- ❑ Power production plants.
- ❑ Emergency power plants.

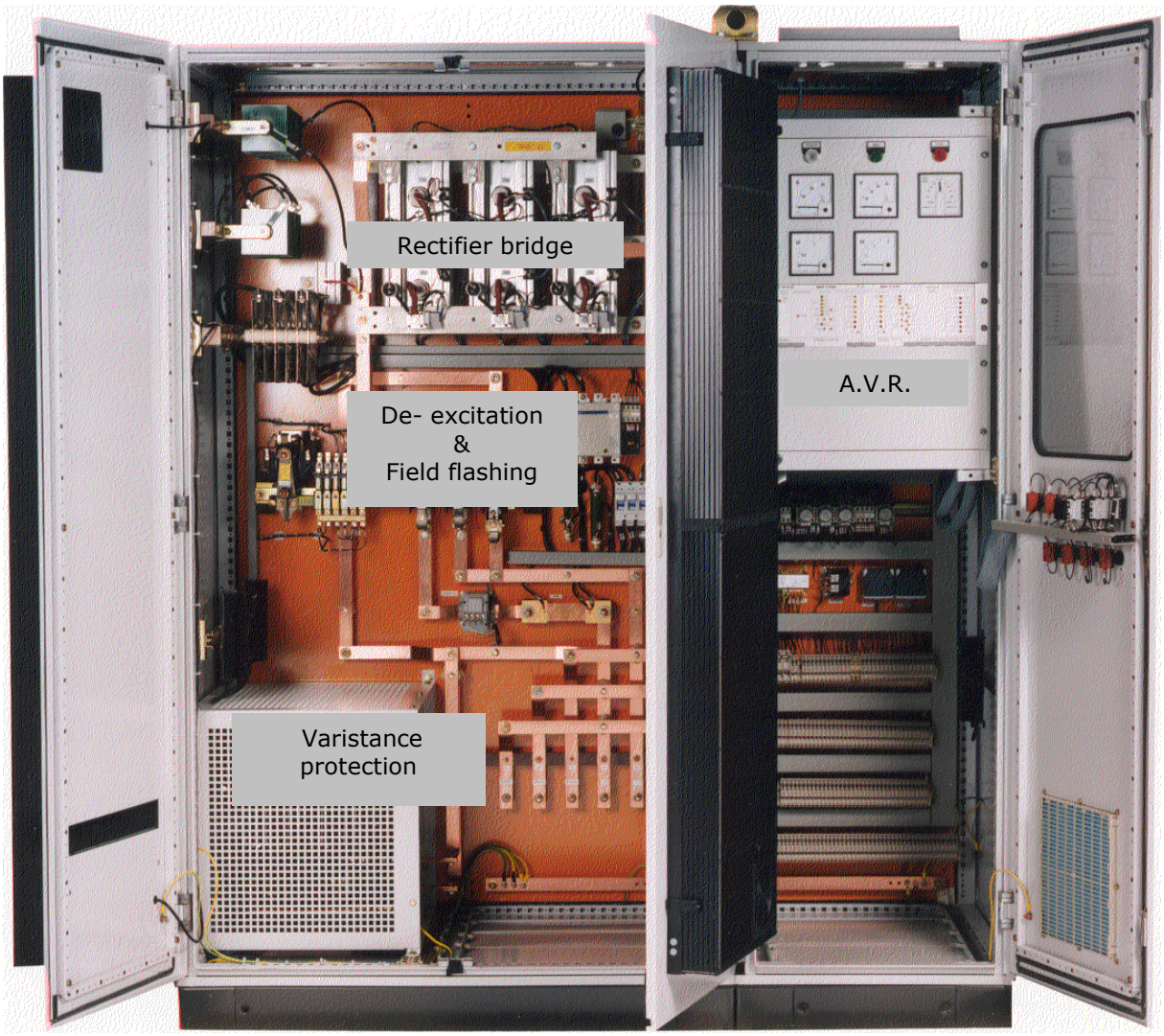
All types of synchronous machines may be fitted with static excitation systems:

- ❑ Alternators of medium or large sizes.
- ❑ Synchronous motors.

5. System description :

A static excitation system **EX 600-700** is made of up to 6 main subsystems arranged according to the specific needs of the application:

- ❑ The field – flashing circuit.
- ❑ The power transformer.
- ❑ The thyristors rectifier.
- ❑ The electronic AVR: **RG 600 – RG 700.**
- ❑ The de- excitation circuit.
- ❑ The excitation cabinet that houses most of the subsystems listed above .



EX600 / 700 CABINET

6. The field flashing subsystem :

- Operation :

  Needed for self excited generators applications, the field flashing operation is initiated & controlled by the AVR **RG 600 or 700.**

  The AVR **RG 600 or 700** starts flashing sequence from the reception of a starting up order of the excitation system and from the detection of the generator running at its nominal speed value.

  When stator voltage reaches 70 % of its nominal value, the AVR **RG 600 or 700** switched the system to self excitation.

  If stator voltage fails to reach this value in a required time the AVR stops field flashing. Fault indication is displayed. The excitation system is stopped.

- Description :

  The field flashing source is generally separate from static excitation systems **EX 600- 700**.

  In most of the cases it uses a DC source (battery) or less frequently an AC source (Inverter) available on site.

  A DC field flashing circuit includes:
  - *The DC source (not supplied).*
  - A contactor.
  - A current limitation calibrated resistance.
  - A diode to protect the source against current return.

  An AC field flashing circuit includes:
  - *The AC source (not supplied).*
  - *A step down transformer*
  - A contactor.
  - A full diodes rectifier.

7. The power transformer :

- Description :

The power transformer single or 3 phases with MV or LV primary voltage complies to the following standard specification:

- Type : Dry
- Cooling: natural in air.
- Insulation: varnish impregnated.
- 3 phases coupling : DYN11
- Protection class : IP 00 for installation in the excitation cabinet (LV), or in a separate cabinet (LV)
- Primary voltage: according to generator voltage.
- Secondary voltage: computed & calibrated to satisfy the excitation voltage value.
- Power rating: according to excitation power required.
- Compliance to standard:
  - CEI 726
  - NFC 52-100
  - CENELEC HD 464

- Function:

The power transformer, connected to the power source's terminals, steps the voltage stator down to the value required by the excitation of the machine field.

8. The thyristors rectifier :

- Description :

  The controlled rectifier single or 3 phases uses:
  - 2 / 3 thyristors + 2 / 3 diodes (semi controlled type)
  - 4 / 6 thyristors (fully controlled type).

  It is cooled by an independent air ventilation / extraction system located just above in the roof of the cabinet.
  It is protected by a set of fast fuses and fugitherms, and against AC & DC over voltages by 2 surge arresters.

- Function :

  Controlled by the **RG 600** or **RG 700** AVR that triggers the thyristors gates, the rectifier delivers to the excitation field the current required to compensate the effects of load variations in order to maintain stator voltage at its nominal value.

9. The diodes rectifier :** (Compounded / boosted excitation)

- Description :

  Single or 3 phases it may have 4 / 6 diodes connected to 2 / 3 current transformers mounted on the stator of the generator.

- Fonction :

  The compound/ booster circuit maintains a minimum excitation current even in case of voltage stator collapsing. serial or parallel operation with the thyristors rectifier are possible.

- Advantages:
  - It minimizes the effects of stator short circuits.
  - It helps the regulation recovery in case of important and sudden load application.

10. The automatic voltage regulator (AVR) :

It can be choosen in

- **RG 600** series: modular analogical AVR's.
- **RG 700** series: comprehensive digital AVR's.

❑ Brief description : (See AVR leaflet for more details)

The **RG 600 & 700** AVR are made of a set of electronic boards installed in a 19 '' rack.

LED's indicators for **RG 600** AVR or PC terminal for **RG 700** AVR inform the operator on AVR status.
Code wheels for **RG 600** AVR or PC terminal for **RG 700** AVR are used for parameters settings and PID gains adjustment by the operator.

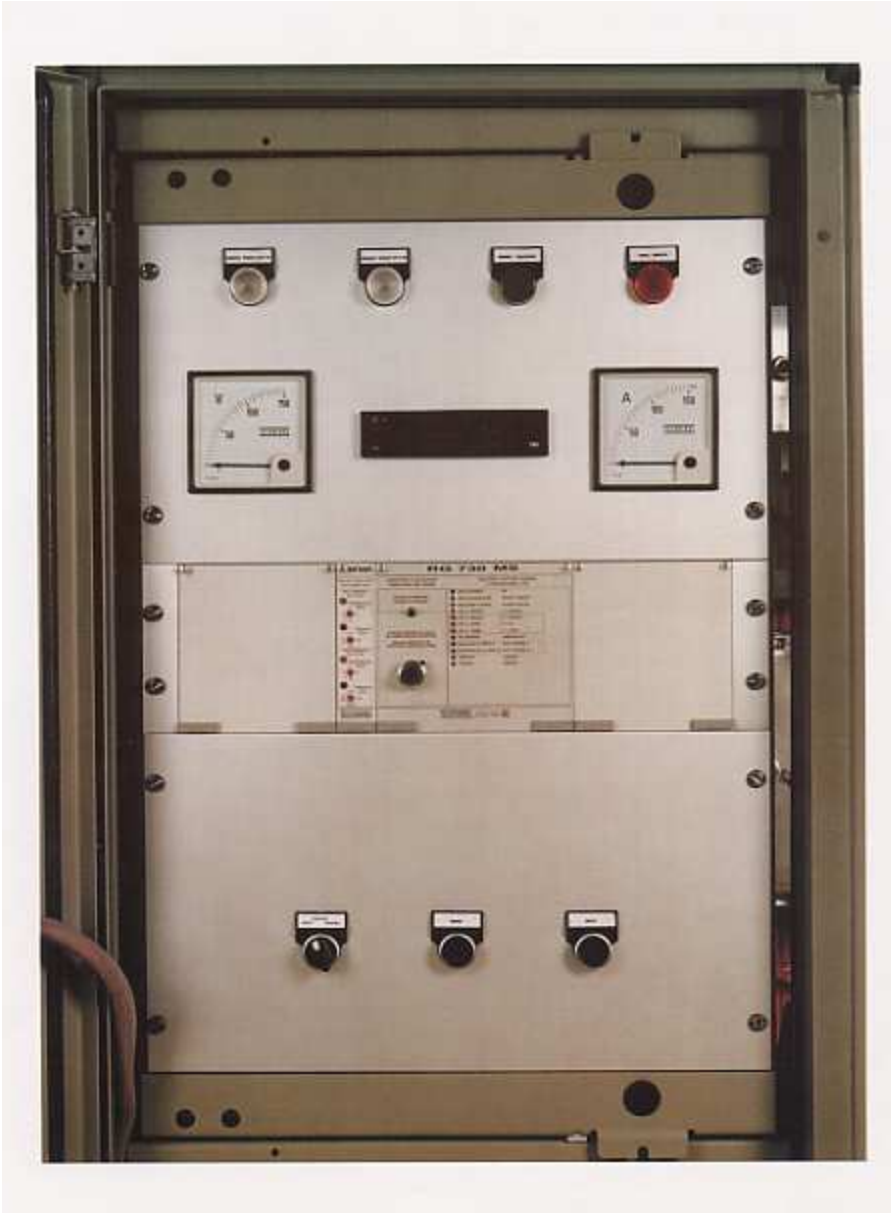
❑ Functions:

To insures stable operation of the generator inside pre-determined limits the AVR offers:

- Voltage regulation, voltage matching, and power factor or reactive power regulation.
- Rotor current & stator current limitation, reactive power absorption limitation.
- Firing function is included in **RG 600 & 700** AVR.

❑ Configurations :

- Single or dual channels configuration may offered.



Instruments & AVR panel

11. De- excitation system:

- Description:
  It includes a field contactor, a linear resistor, a non linear resistor and a free wheel diode mounted in parallel with the field for semi-controlled 3 phases rectifier.

- Function & operation:

  - Normal de-excitation: The above components are designed to dissipate the energy released by the rotor when the breaker opens the excitation field.

  - Emergency de- excitation: The non linear resistor installed in parallel with the rotor winding is designed to protect the rotor against the effects of over voltages occurring in case of a 3 phases short circuit at the stator output.

  - The efficiency of this device is improved by the use of fully controlled thyristors rectifier operated in inverter way.

12. The cabinet :

❑ Description :

- The cabinet is free standing type
- Made of steel sheets and frames.
- Size and arrangement comply to the requirement of the application.
- Colour paint: Light grey RAL7032
- Tightness IP 40
- Usually the cabinet is divided in 2 sections each protected by a key lockable door& illuminated by a neon tube.
- The left door is blind , the right door has a plexiglass window to give view on the instruments panel
- Cooling: Forced air circulation by fans installed in the roof Air entries located at the lower part, exits at top the part of the front doors. Apertures protected by removable filters.
- Cables entry by the bottom.

❑ The power section generally houses installed on the cabinet Back- panel a fixed frame:

- The thyristors rectifier.
- The hall effect sensor (optionally)
- The measurement shunt
- The de- excitation circuit.
- The field – flashing circuit. (optionally)
- The LV power transformer. (optionally)
- The busbar
- The power terminals for connection to the machine.

❑ The Regulation and control section generally houses

Installed on the cabinet back panel a fixed frame:

- A set of control relays.
- The cables ducts.
- A DC power supply.
- A plug in electrical socket.
- The control terminals.
-

Installed on a rotating frame:

- The AVR 19 ’’rack.
- The instruments panel equipped with :
  - A set of push buttons and switch selectors
  - A set of lamps indicators.

- An excitation voltmeter.
- An excitation ammeter

EX 600-700