EMTP-RV usage for generation plants

June 20th 2011, EMTP-RV User Group

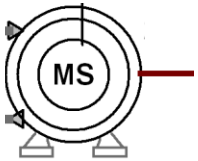
Xavier LEGRAND, THEMIS
Xavier.legrand@edf.fr

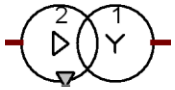
EDF
CHANGER L'ÉNERGIE ENSEMBLE

1 – A complex system

A large set of equipments

- **Synchronous machine / transformers;**
- Cables/lines/switches;
- Regulators and protections;
- Excitation system;
- Pumps and other asynchronous machines;
- Grid;
- …

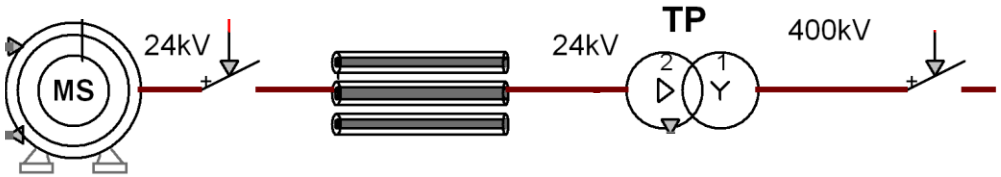




1 – A complex system

A large set of equipments

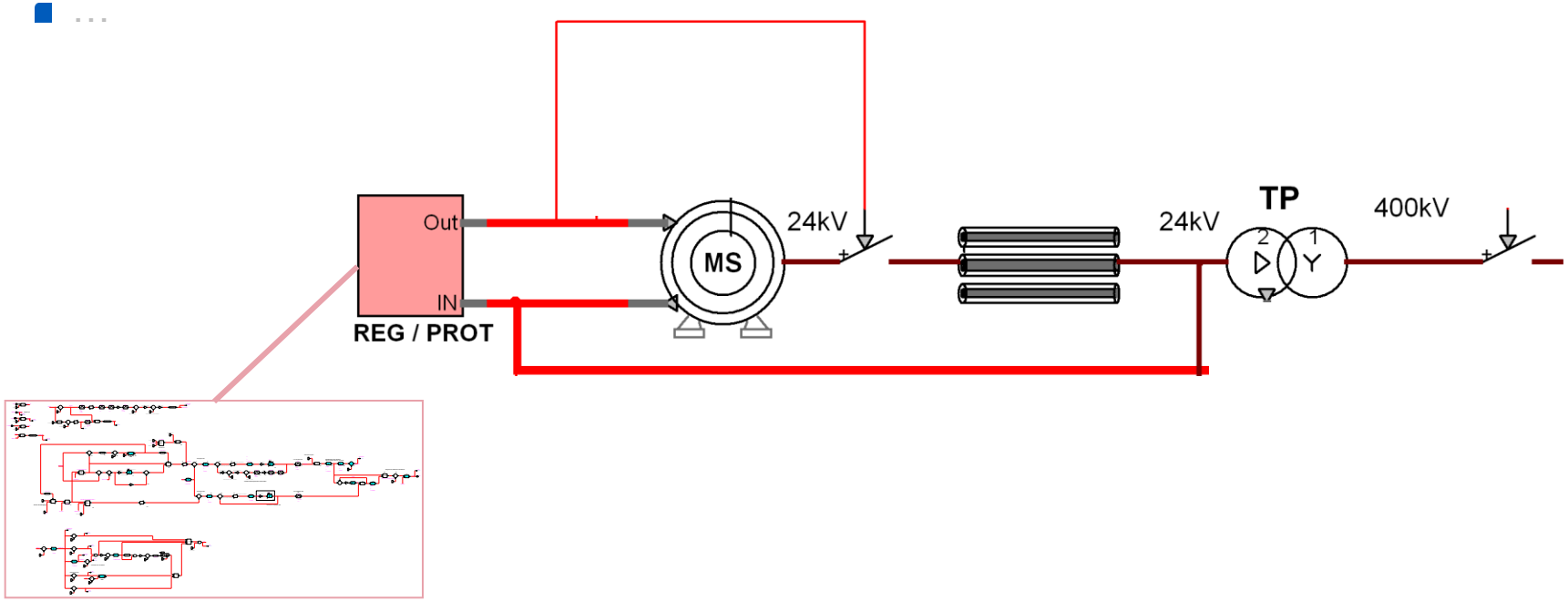
- Synchronous machine / transformers;
- **Cables/lines/switches;**
- Regulators and protections;
- Excitation system;
- Pumps and other asynchronous machines;
- Grid;
- …



1 – A complex system

A large set of equipments

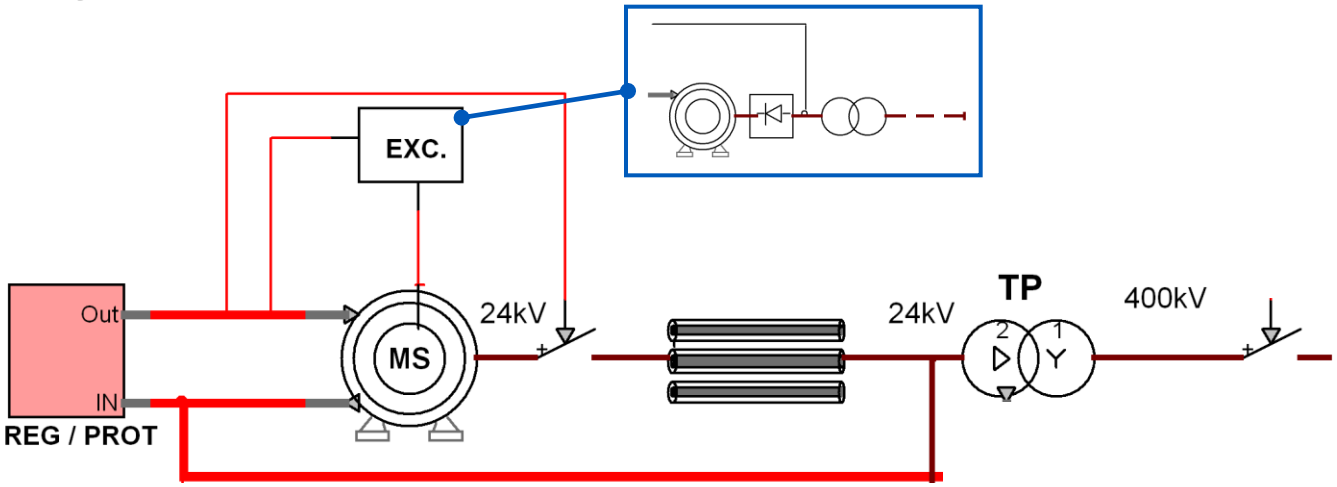
- Synchronous machine / transformers;
- Cables/lines/switches;
- **Regulators and protections;**
- Excitation system;
- Pumps and other asynchronous machines;
- Grid;
- …



1 – A complex system

A large set of equipments

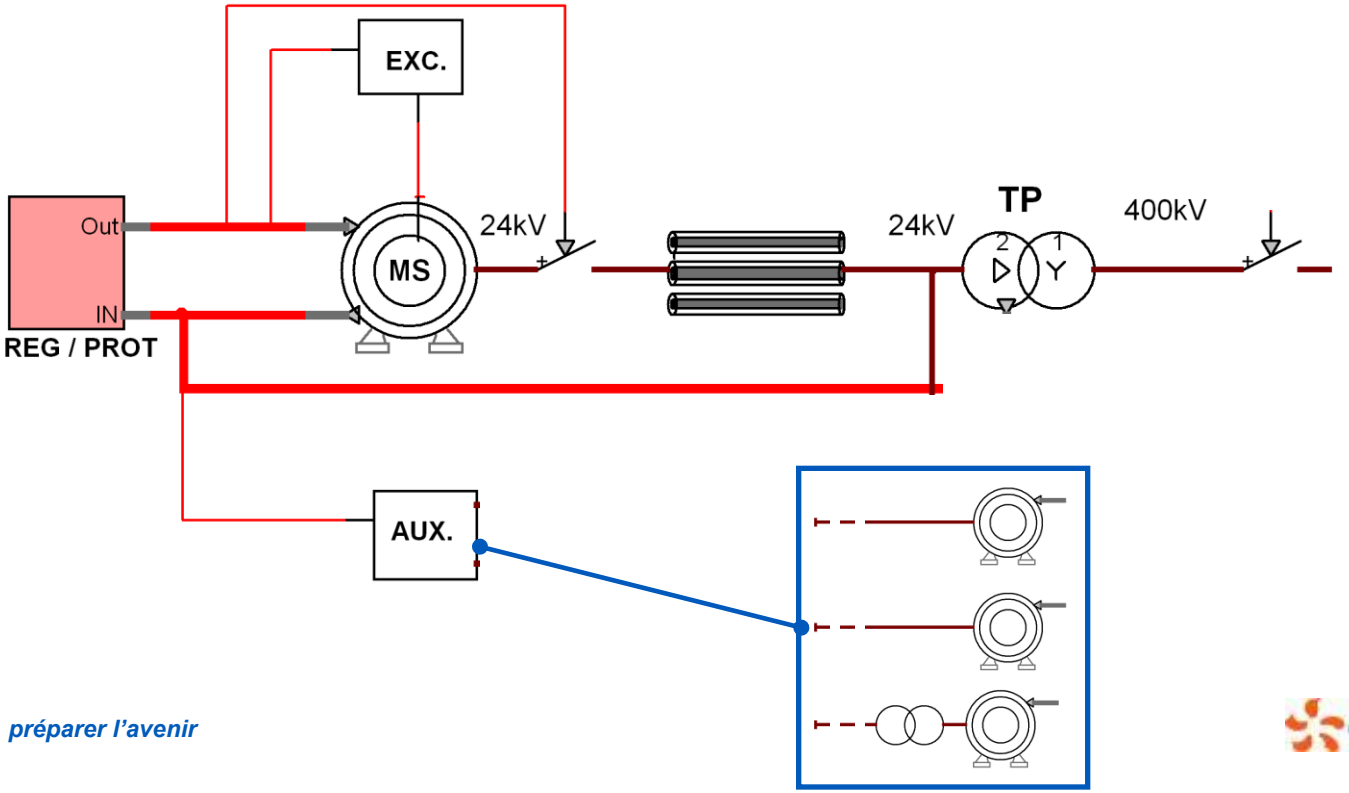
- Synchronous machine / transformers;
- Cables/lines/switches;
- Regulators and protections;
- **Excitation system;**
- Pumps and other asynchronous machines;
- Grid;
- …



1 – A complex system

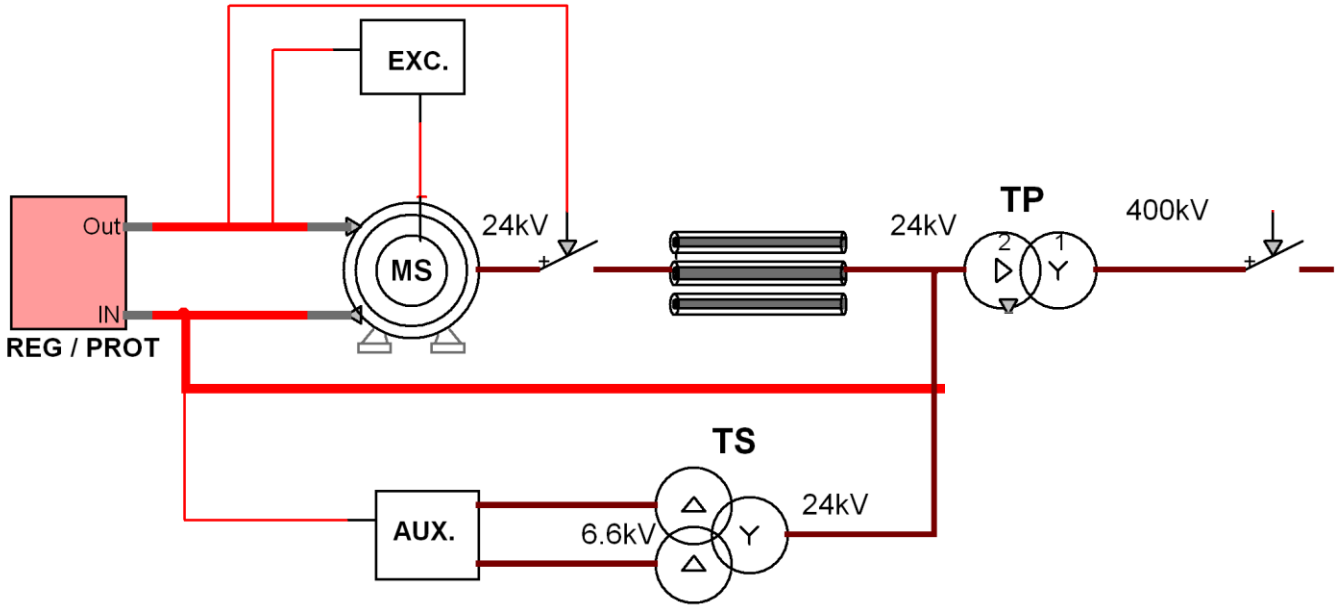
A large set of equipments

- Synchronous machine / transformers;
- Cables/lines/switches;
- Regulators and protections;
- Excitation system;
- **Pumps and auxiliary systems;**
- Grid;
- …



1 – A complex system
Different equipments

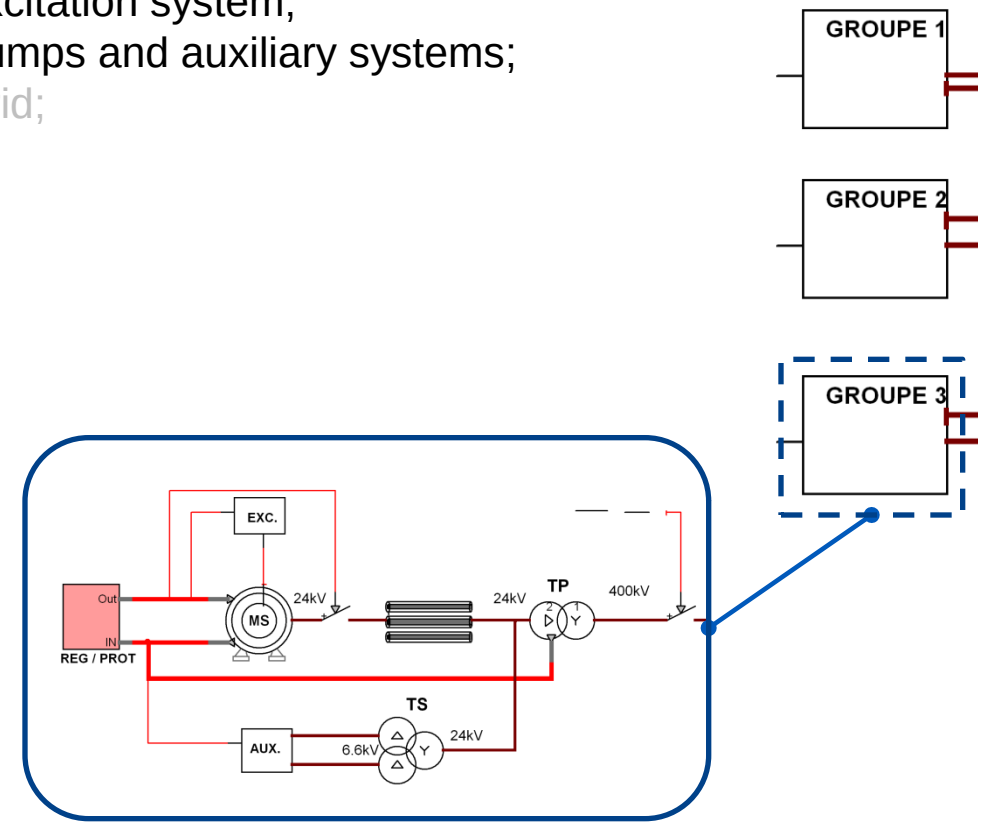
- Synchronous machine / transformers;
- Cables/lines/switches;
- Regulators and protections;
- Excitation system;
- Pumps and auxiliary systems;
- Grid;
- …



1 – A complex system

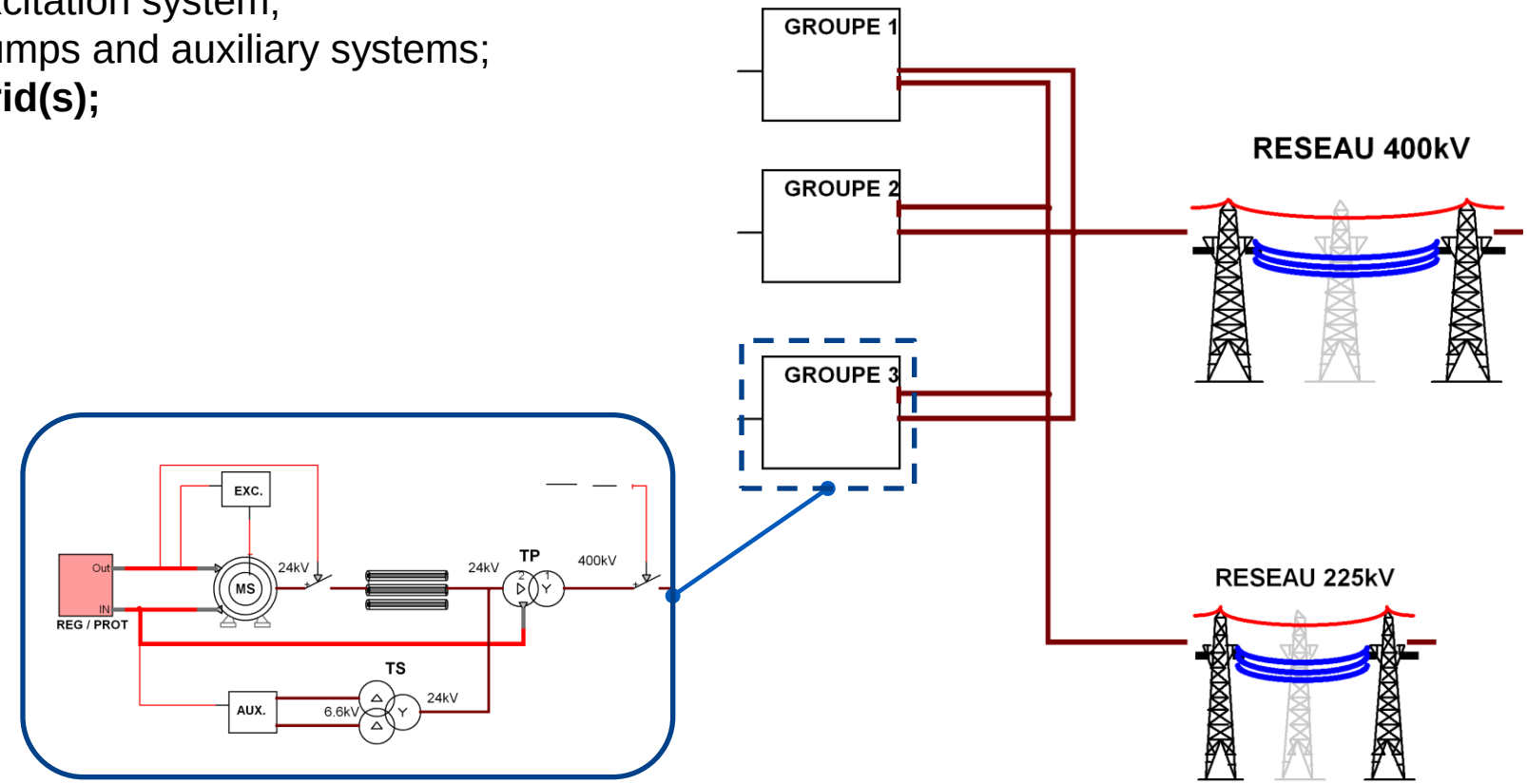
A large set of equipments

- Synchronous machine / transformers;
- Cables/lines/switches;
- Regulators and protections;
- Excitation system;
- Pumps and auxiliary systems;
- Grid;
- …



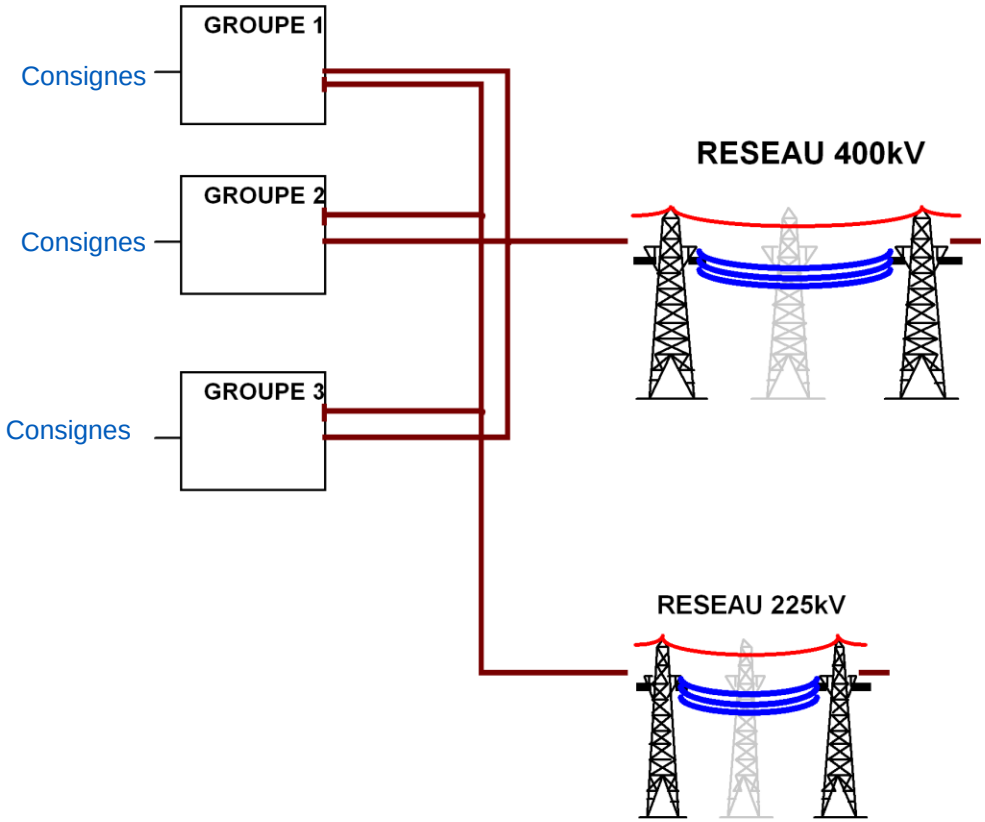
1 – A complex system
Different equipments

- Synchronous machine / transformers;
- Cables/lines/switches;
- Regulators and protections;
- Excitation system;
- Pumps and auxiliary systems;
- **Grid(s);**
- …



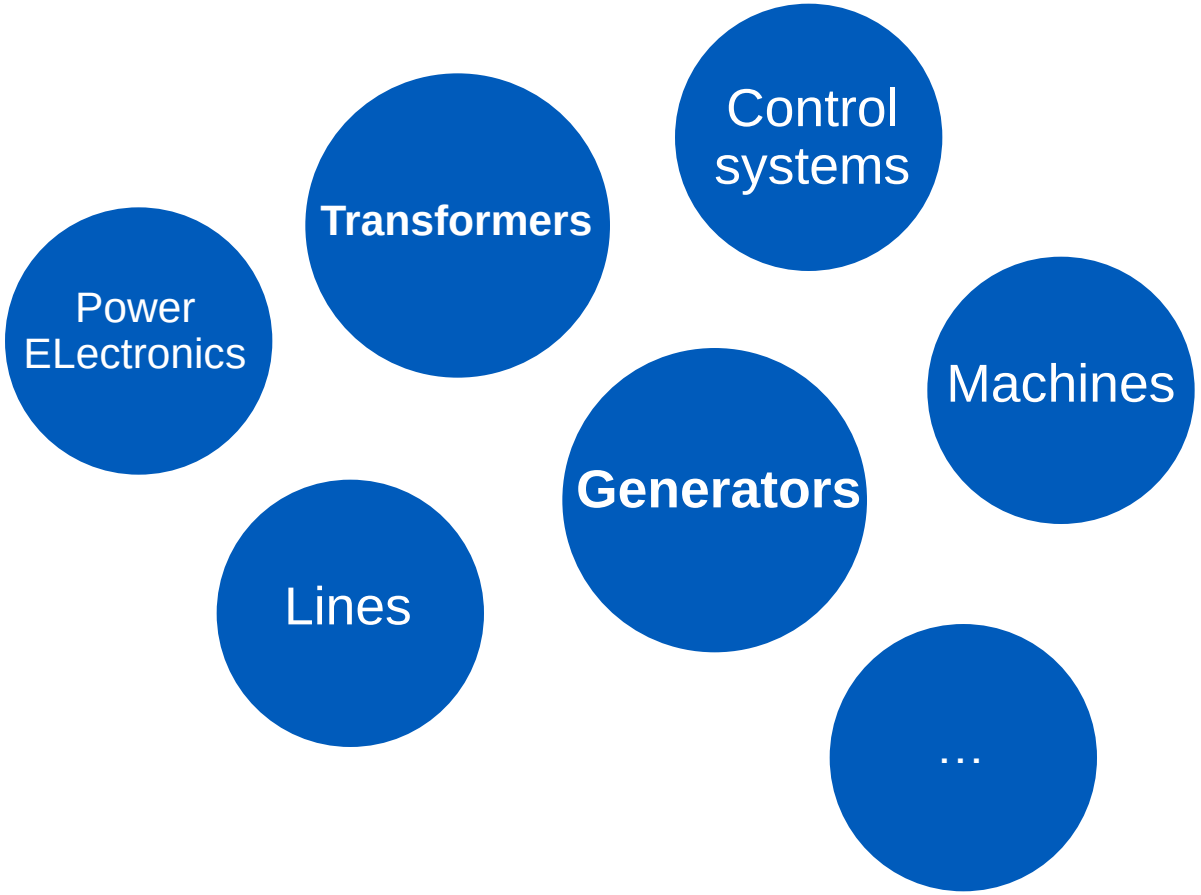
1 – A complex system
Different equipments

- Synchronous machine / transformers;
- Cables/lines/switches;
- Regulators and protections;
- Excitation system;
- Pumps and auxiliary systems;
- **Grid(s);**
- …



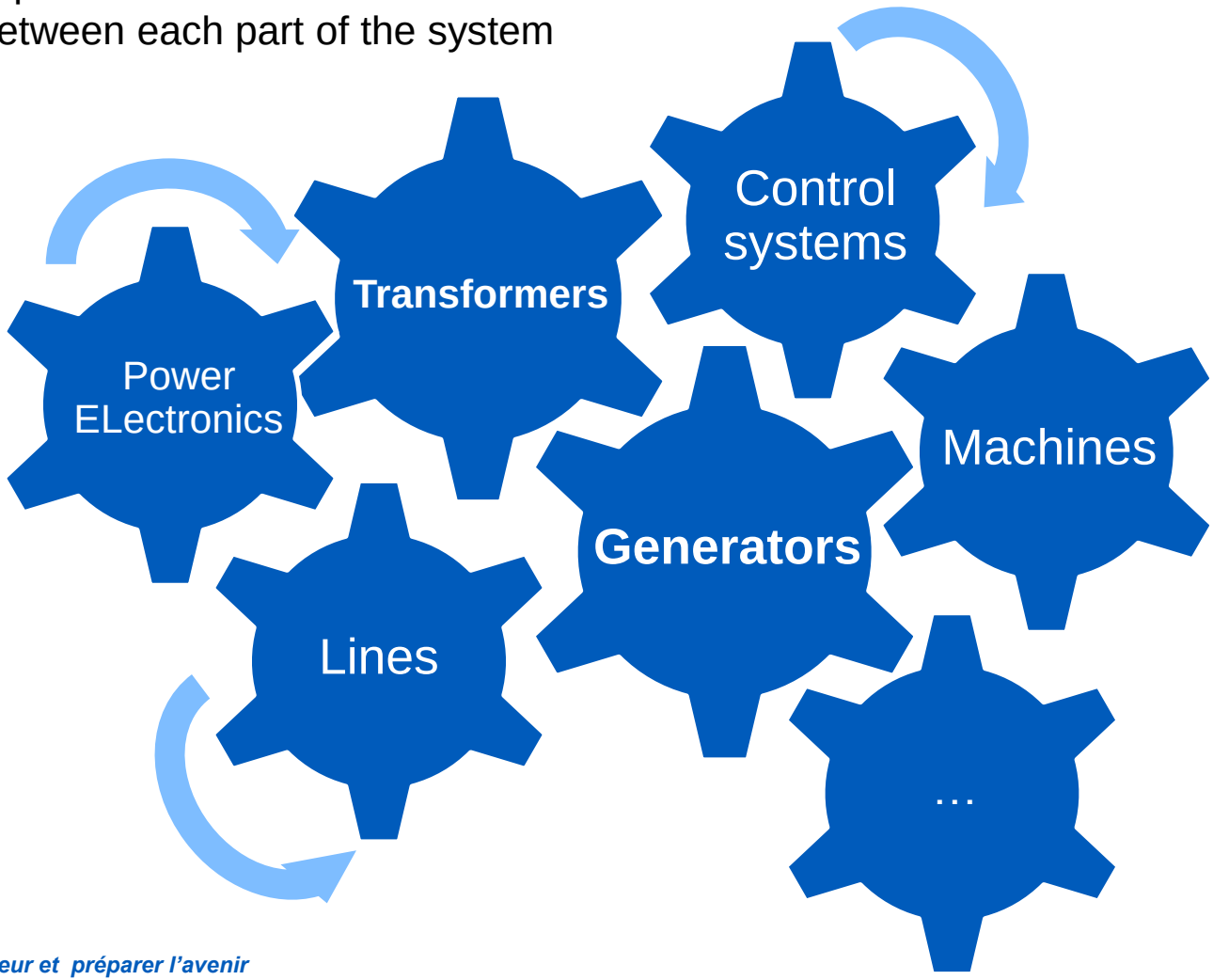
1 – A complex system
Independent behavior

- Different equipments
- Interaction between each part of the system



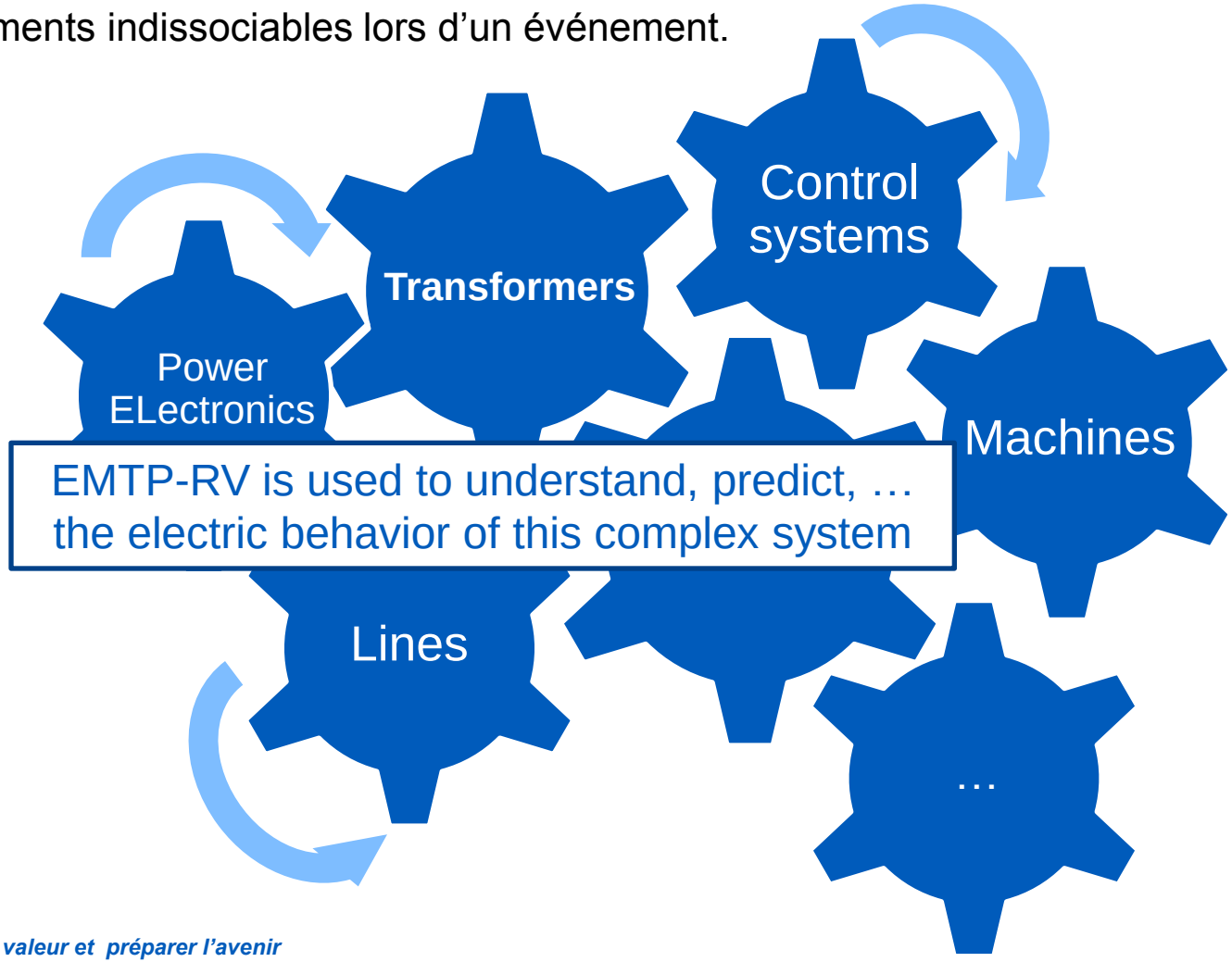
1 – A complex system
Independent behavior

- Different equipments
- Interaction between each part of the system



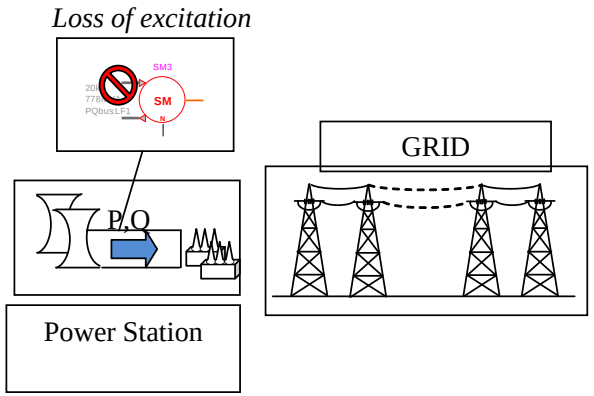
1 – A complex system
Independent behavior

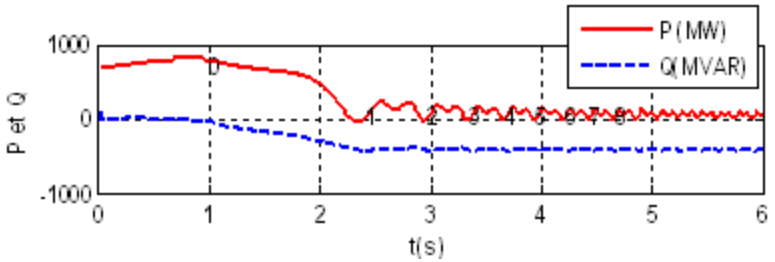
- Matériels de nature diverse.
- Comportements indissociables lors d'un événement.

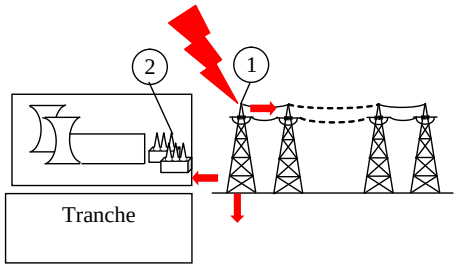


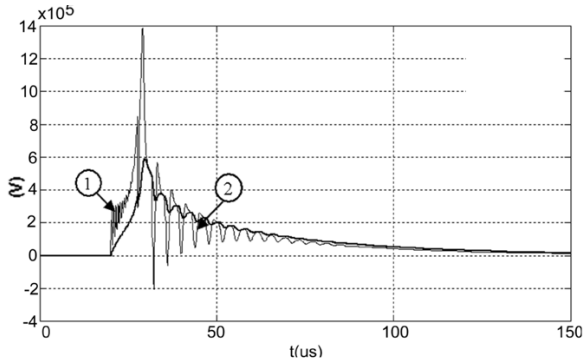
2 – EMTP-RV usage for generation power plants

Steady state to high frequency studies





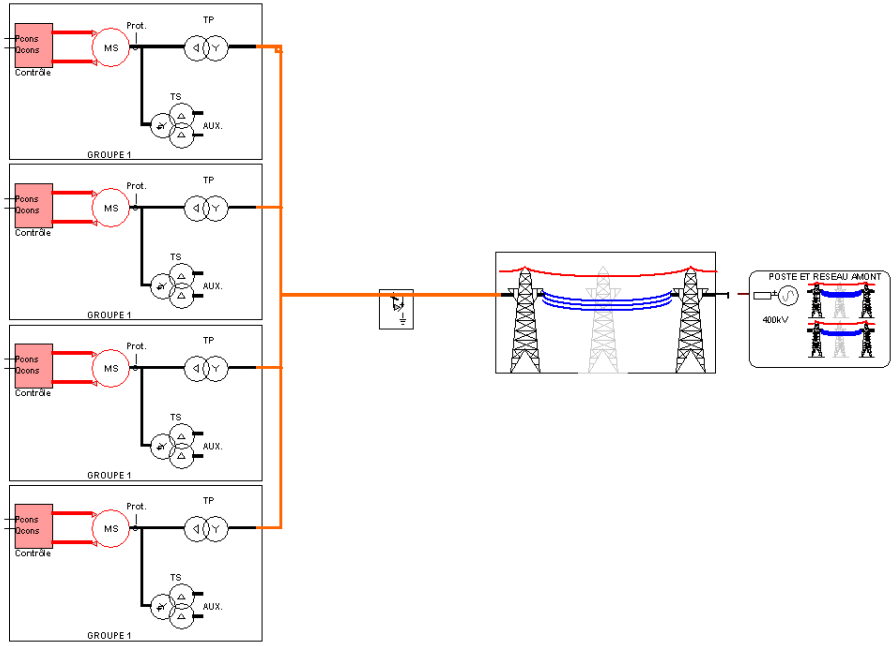


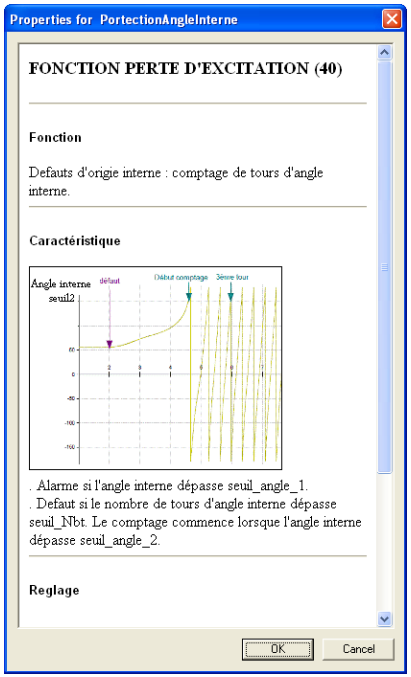


2 – EMTP-RV usage for generation power plants

Case example : Loss-of-Excitation relays

- A thermal plant:
  - 4 generators
- Best settings for a loss-of-excitation relay?



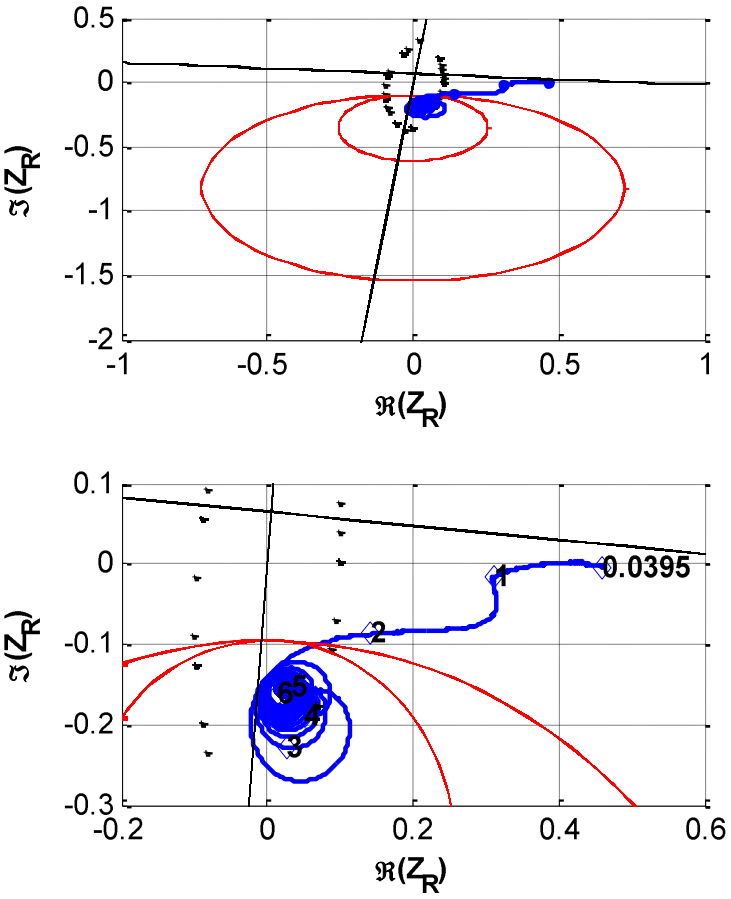


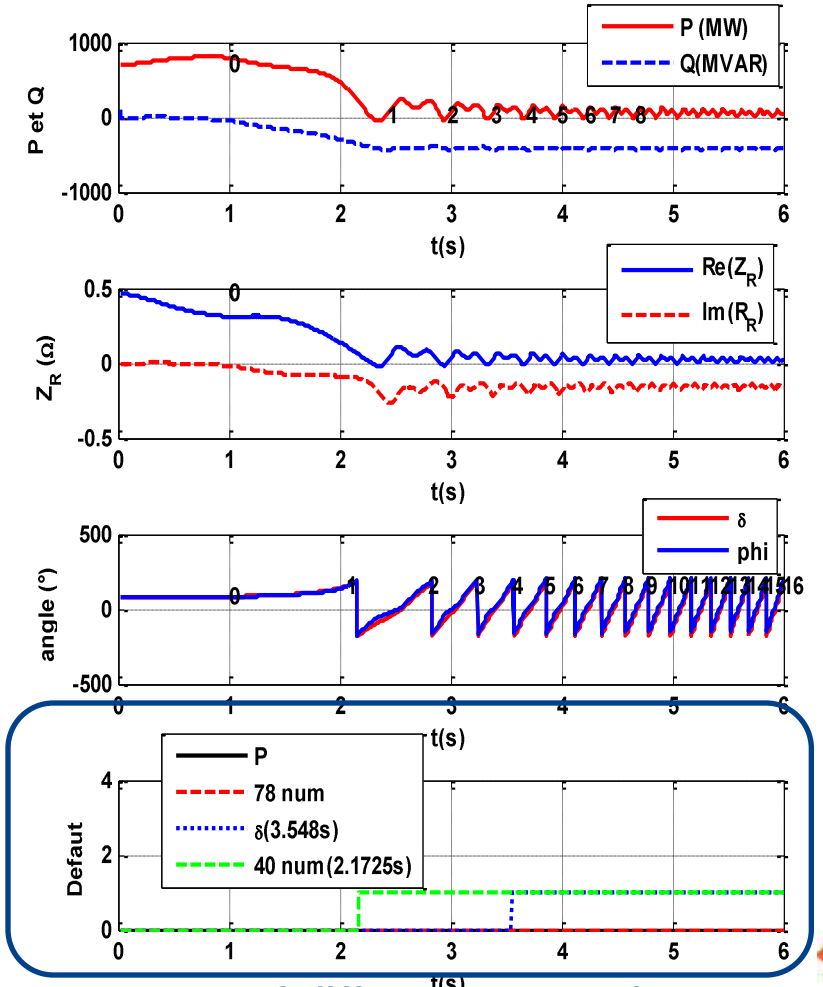
2 – EMTP-RV usage for generation power plants

Case example : Loss-of-Excitation relays

❑ **Total loss-of-excitattion at t=1s**

Measured impedance





Output of different protections

Work in progress / futur work

- **Work in progress / futur work:**
  - Iusing new synchonous machine models;
  - Probabilistic studies;
  - Taking advantage of finite elements methods (coupling?);
  - Comparison with phasors domain approach;
  - Simulate more events : inter coil faults in transformers, islanding …
  - More accurate modeling of :
    - Auxiliary systems;
    - Grids;
    - **Excitation system**…