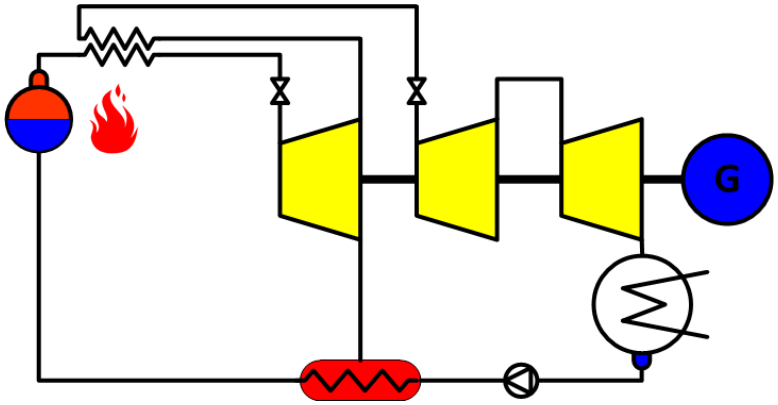
**Turbine Controls Seminar**

# STEAM TURBINE CONTROLS

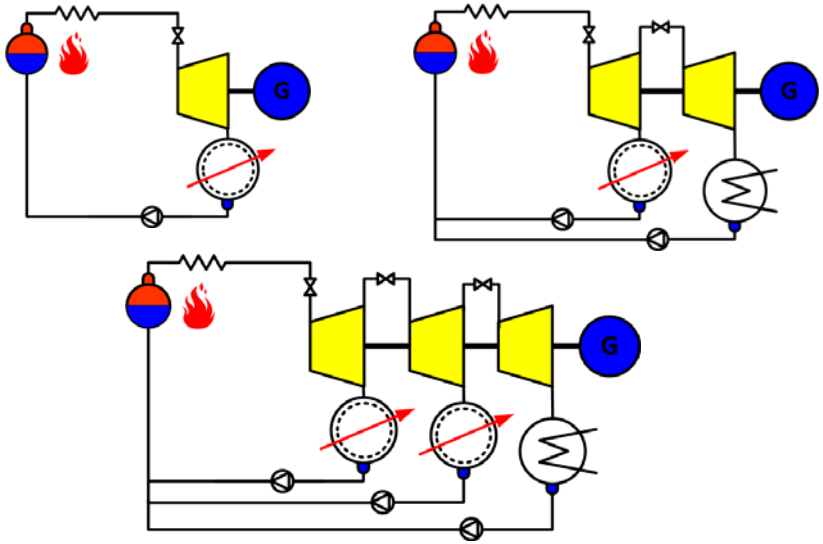
Pero Skoric - 2018

# Steam Turbines Categorizing

## There are two main groups of units as far Controls are concerned




**Power Units**
**up to ≈1000MW**

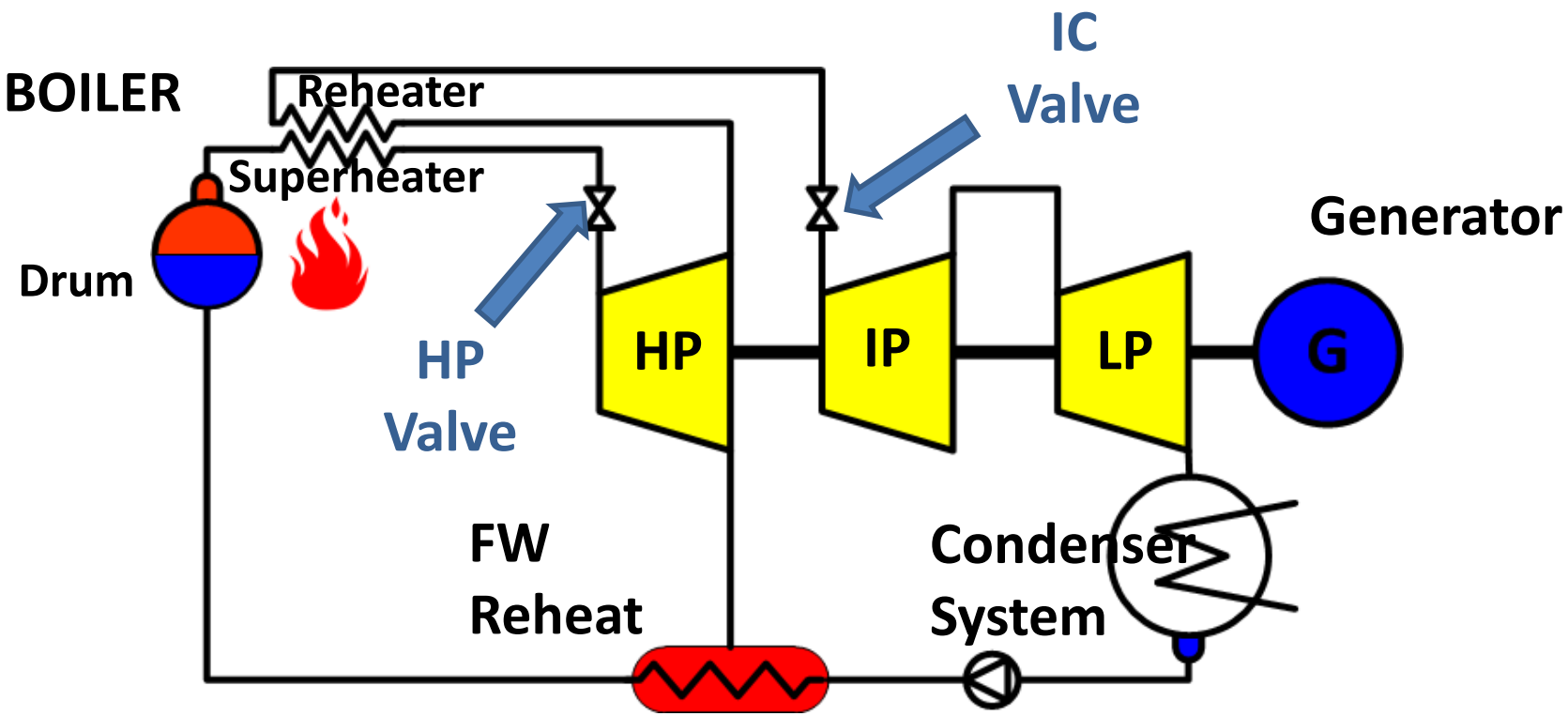



**CoGen Units**
**up to ≈200MW**

# Common For All

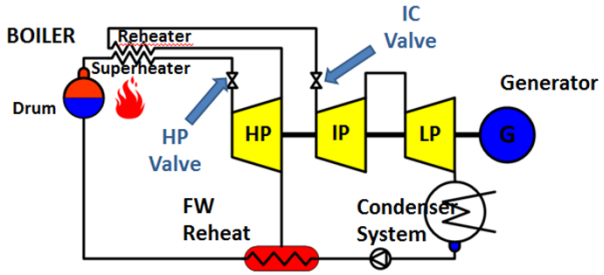
- **SAFETY….. SAFETY….  SAFETY**
  We need to make sure controls are going to close the valves when needed.  If not closed unit can go to pieces endangering people and property.
- **PROMT REACTION IS ULTIMATE**
  The load is the only thing braking unit down. Ones the load is gone the controls need to close the valves at a fast rate (0.1s). Unlike with gas turbines the full load rejection is  a challenge. PLU protection is must have for reheat units.
- **DYNAMIC IS NOT COMPLICATED**
  Dynamic is straight forward, valves closed-unit down, valves open-unit up.  Boilers drum level control dynamic is much more complex.

# Power Units (1)




- Redundancy control ( 2 of 3 or similar) is must have.
- Different manufacturer - different control strategy, GE, Alstom, Toshiba, Siemens, LMZ, etc…

# Power Units (2)

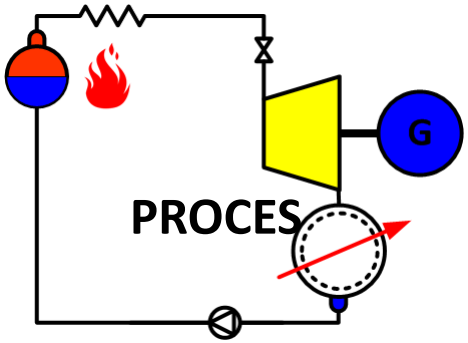



- Unit operating as a block (boiler + turbine) together. Sliding pressure start-up. Unit reaching rated pressure and temperature at a high load.
- Boiler lead is normal operating mode at rated load.
- For run up to rated speed, synchronizing and initial loading HP & IC valves both modulated. Loading up IC valve fully opens.
- PLU compares IC valve position against generator loading. If unbalance between those then PLU gives closing impulse to both HP and IC valve.
- ……

# CoGen Units (1)

**Process is used as the cool sink instead of condenser**

## Backpressure Type

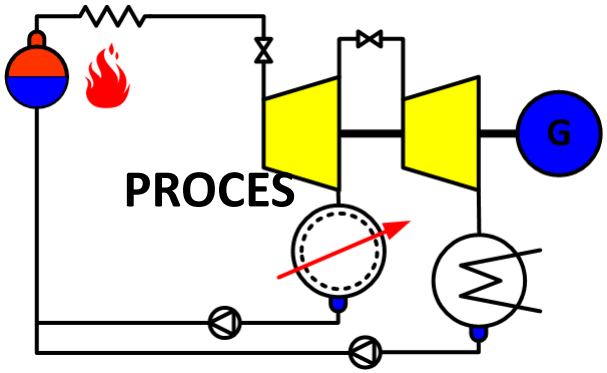



Not Flexible

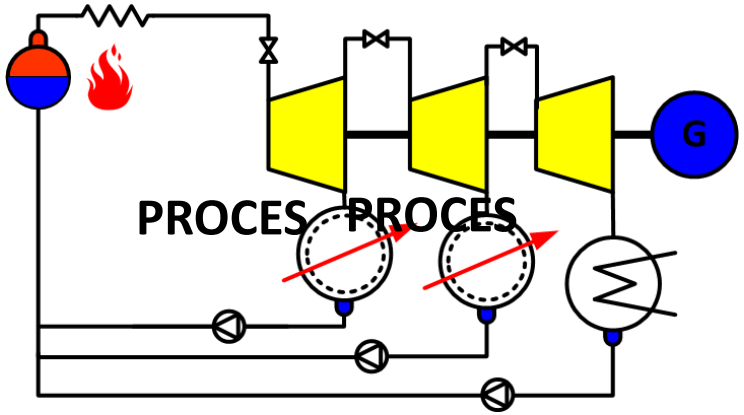
Output ≈ process needs for heat

## Extraction Type

Backpressure unit + “tail”

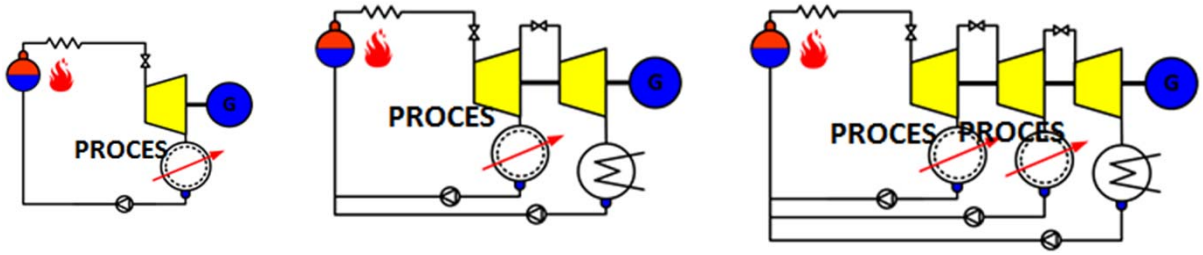



I extraction Unit




II extraction Unit

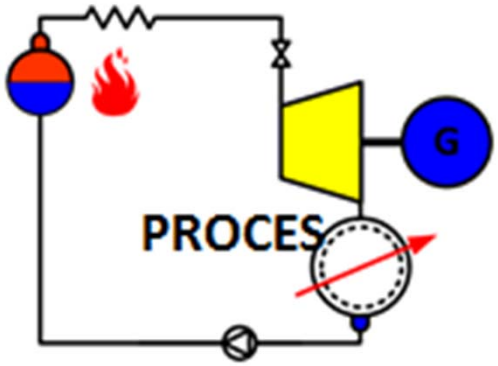
# CoGen Units (2)

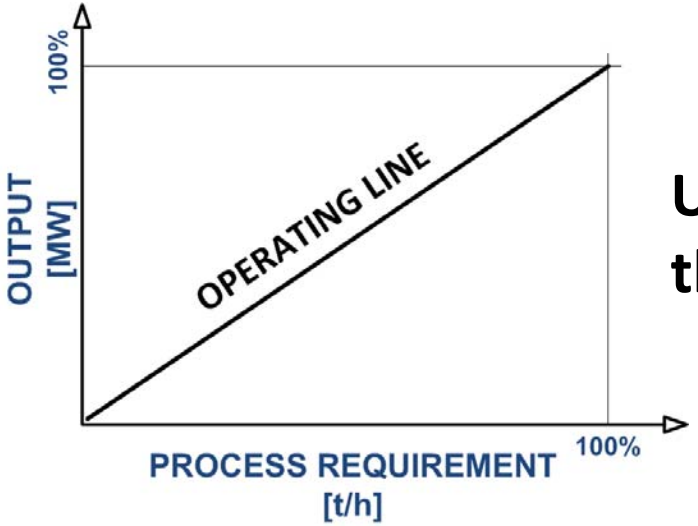



- **Unit controls combine process requirements for heat with requirements for electrical output.**
- **There is also a switchable hierarchy as sometimes it is not possible to satisfy the both requirements.**
- **Pressure control is there because steam pressure indicates the process heat balance. If the pressure is dropping the process needs more steam and opposite.**
- **Speed control have priority over all other controls. Must be able to the close valves regardless of all the other requirements**

# CoGen Units Operating Characteristic

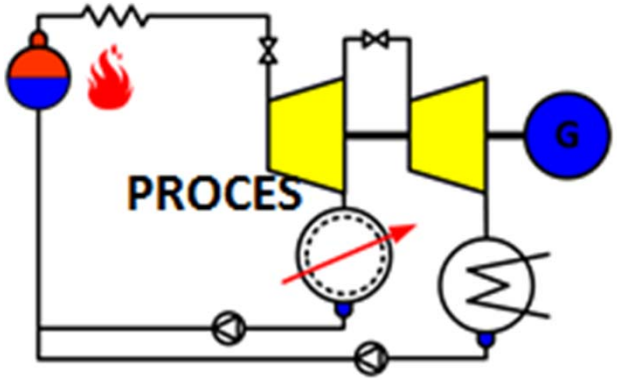
## Backpressure Type

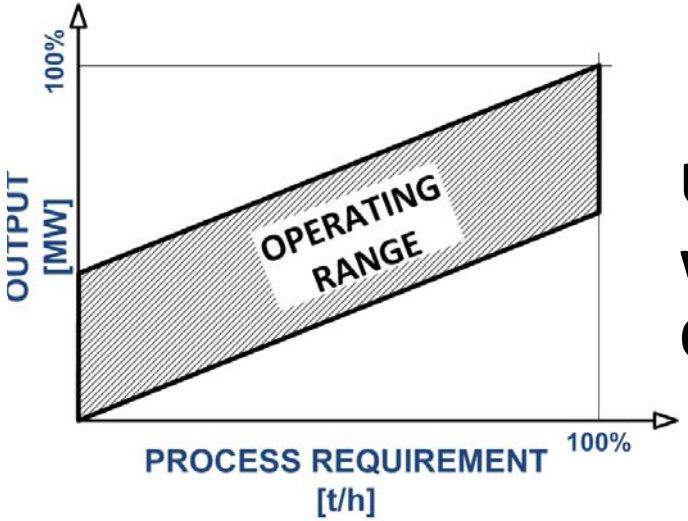



**Unit operates along the Operating Line**

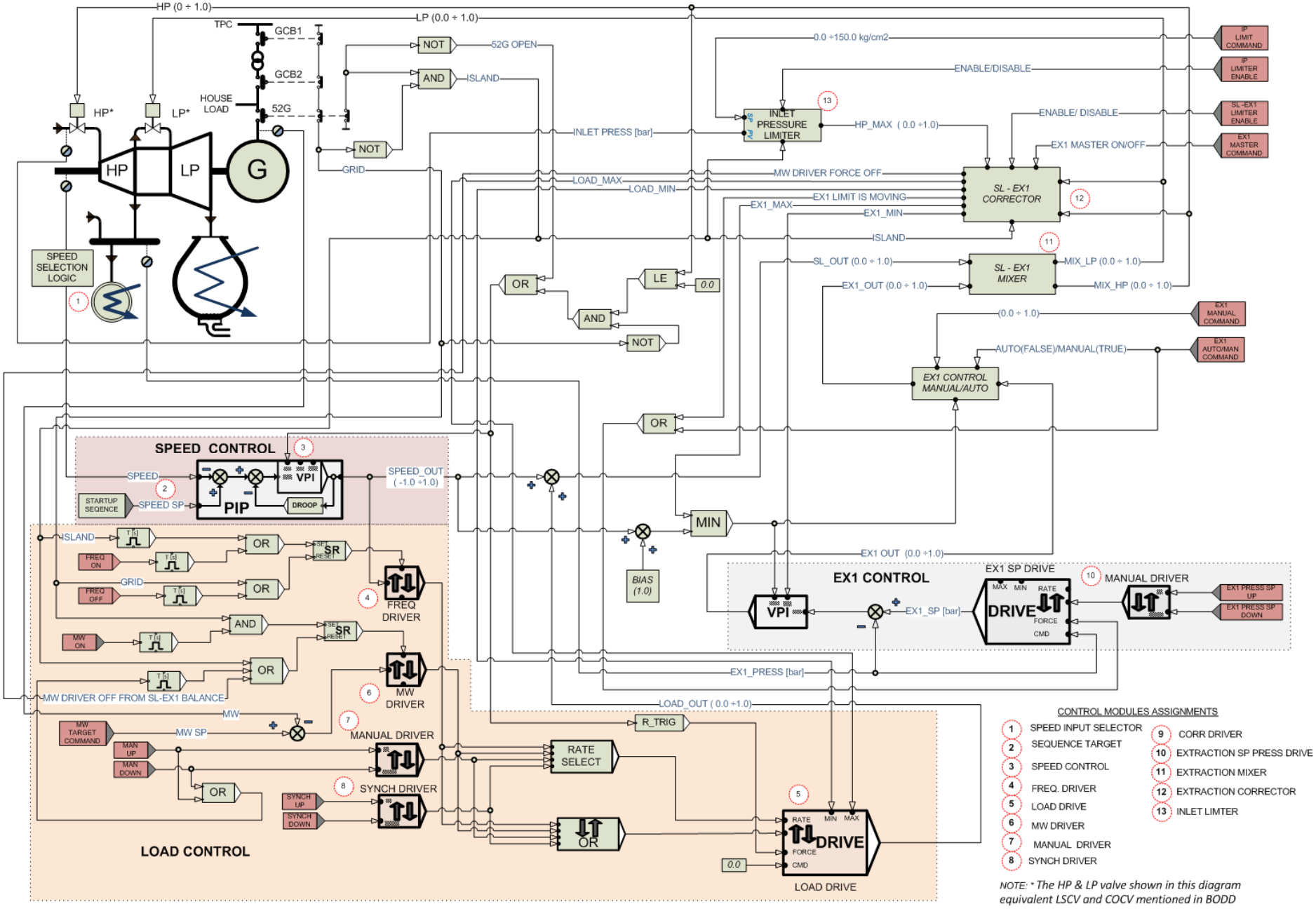
## Extraction Type



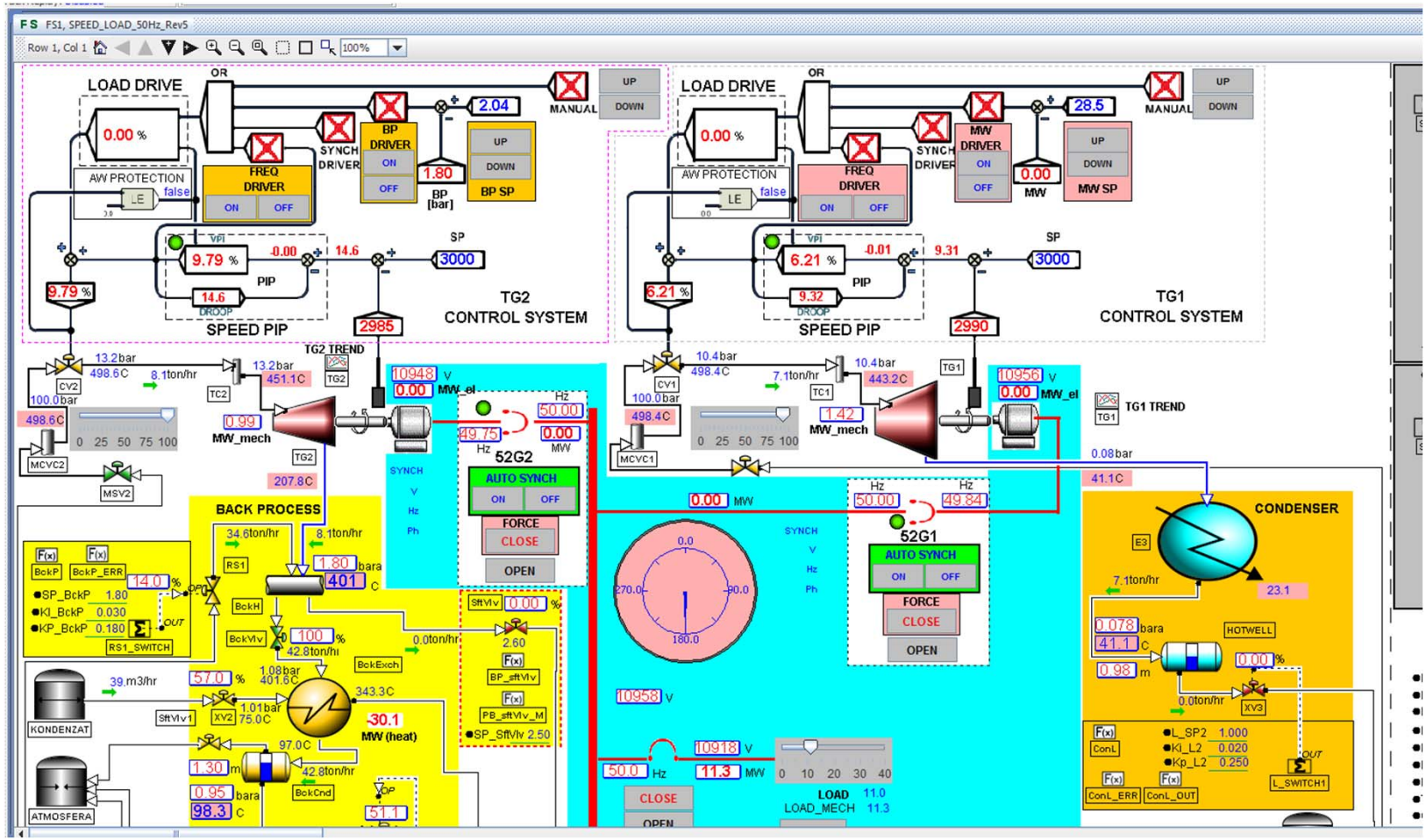




**Unit operates within the Operating Range**

# EX1 Unit Control System Diagram Example

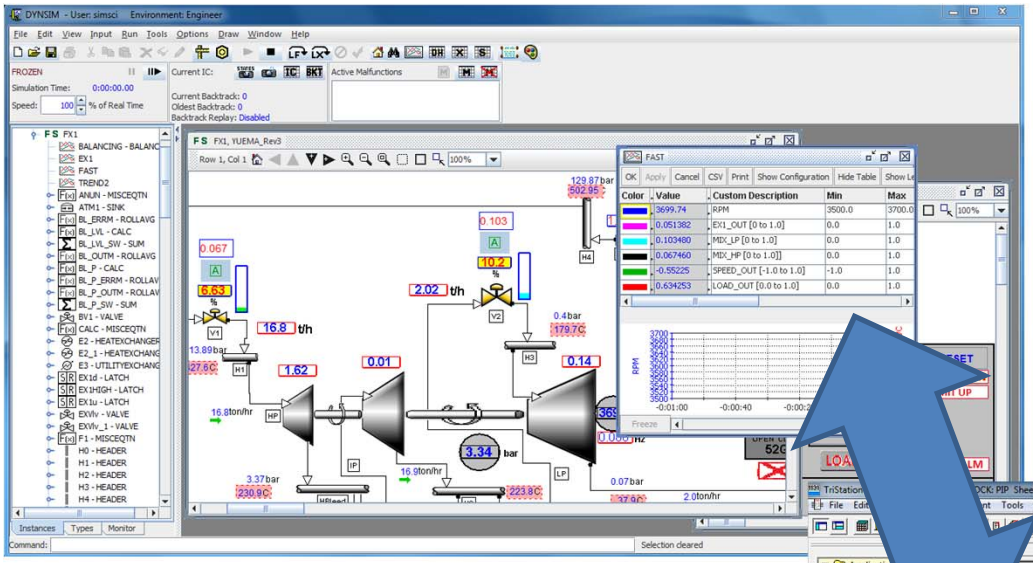


# SL Controls Simulator



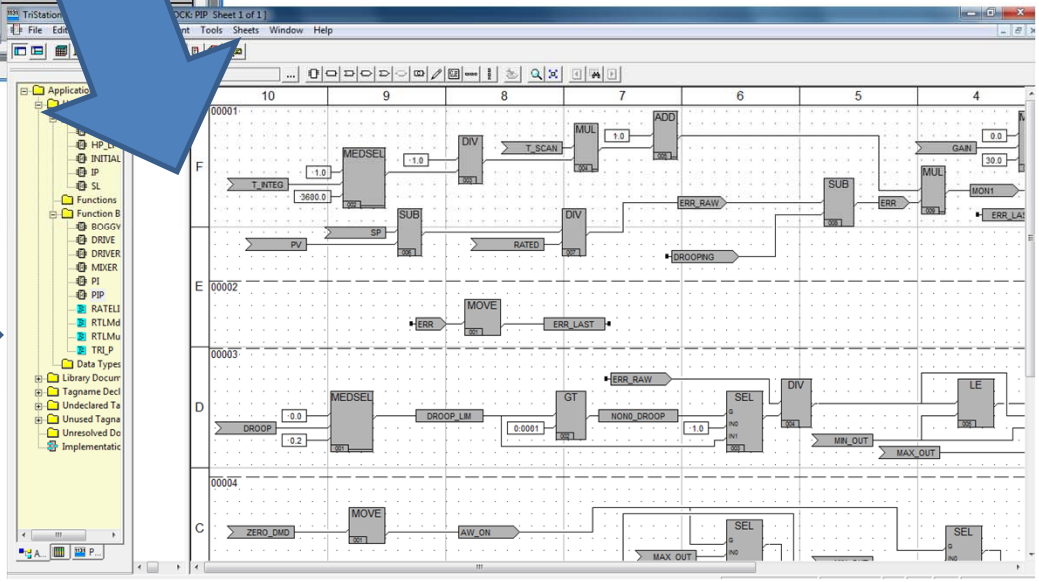

**Full model with Control Software for a plant with two turbo-generators. Backpressure + Condensing unit**

# EX1 Controls Simulator



Plant Dynamic Model mode

PLC Control Software



Software development, FT acceptance, Operators training

# OPERATING CONTROLS SIMULATORS
# +
# DISCUSSION