



# Fuel Control

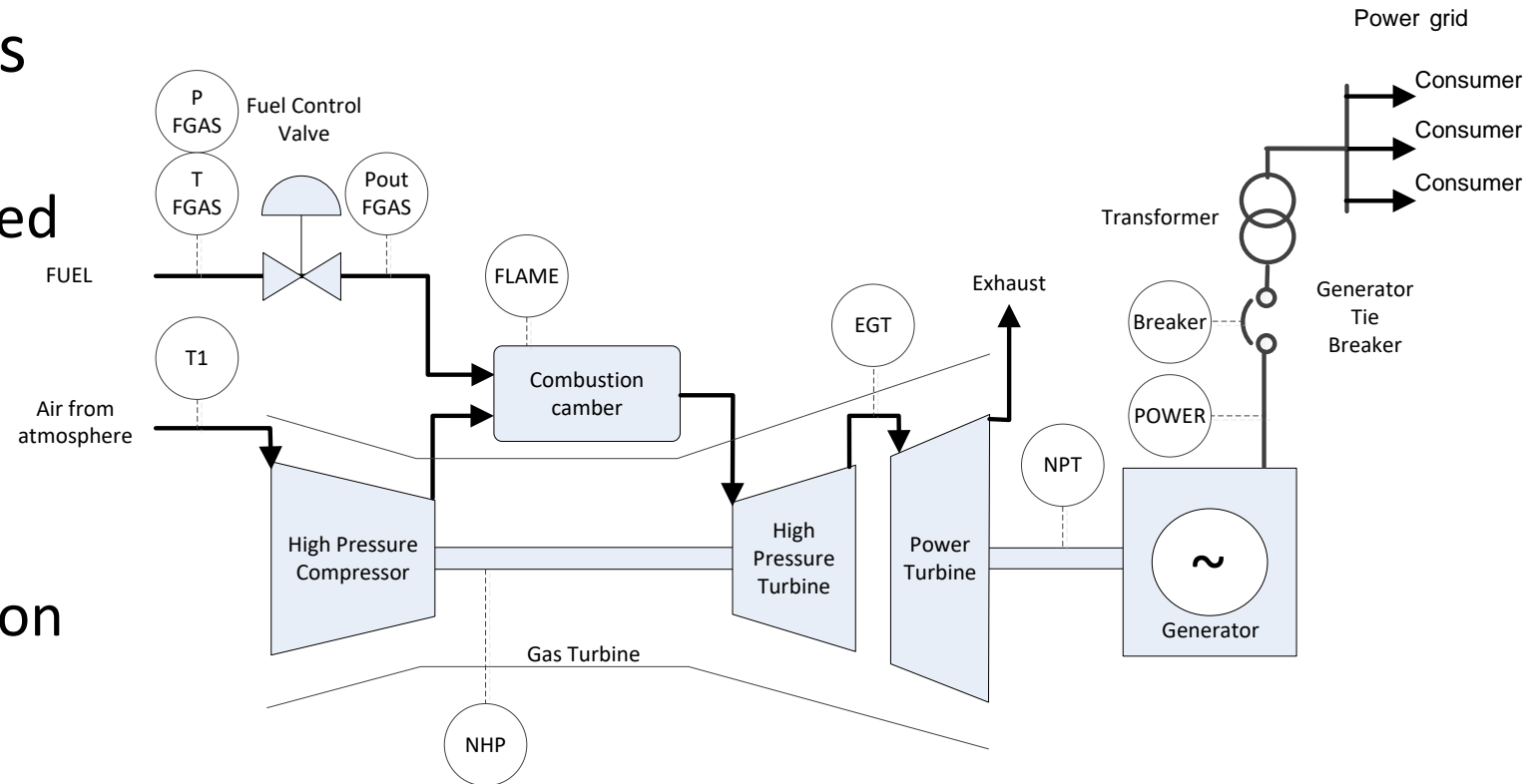
## Fuel Control for Gas Turbine Unit

# Fuel Control of Power Units

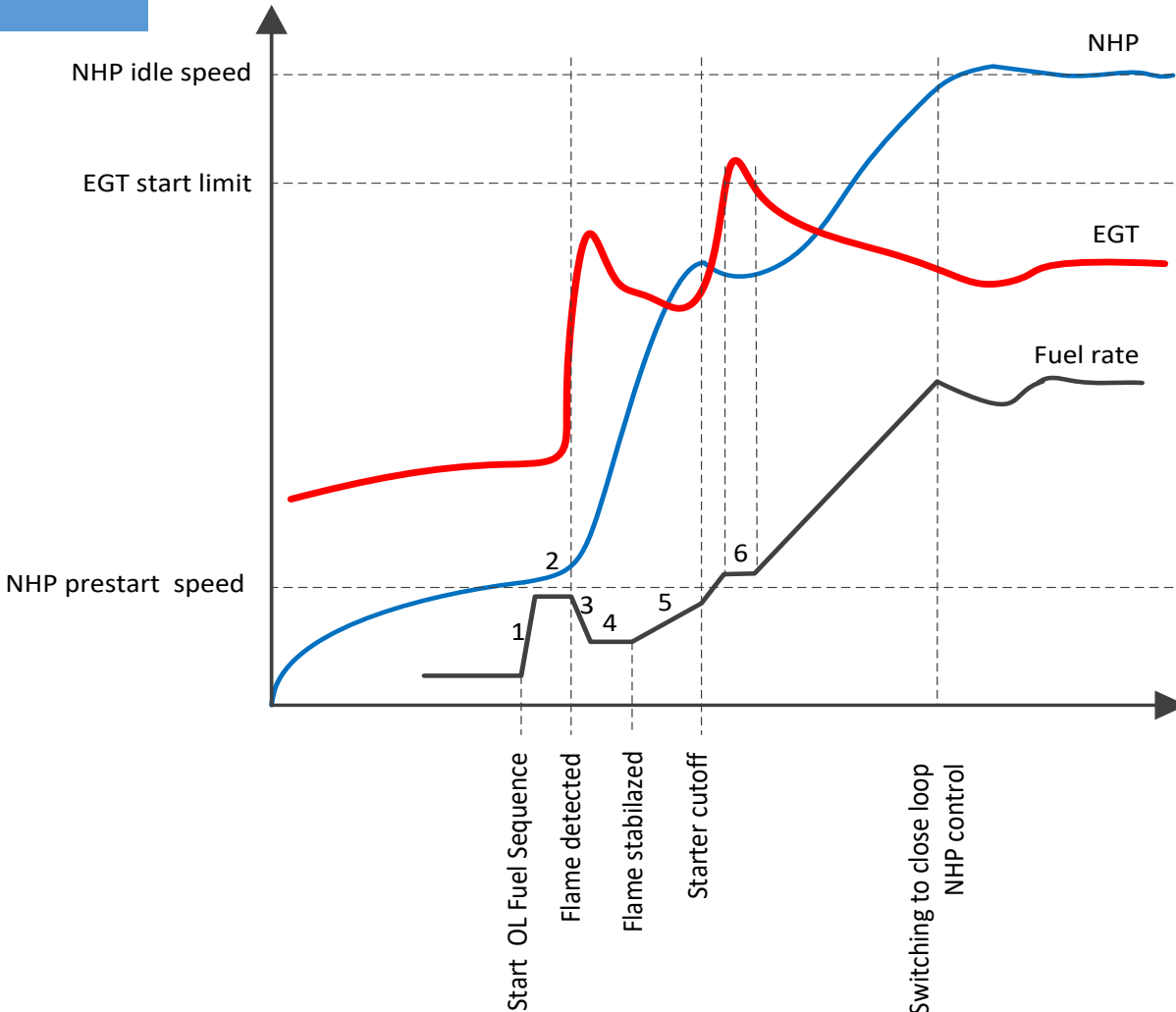
- Control generator speed or power output when generator breaker is closed
- Based on 3 preselected control strategies:
  - Isochronous
  - Droop
  - Power Control
- Control gas turbine high-pressure (gas generator) speed or power turbine speed when the generator breaker is open
- Control fuel during turbine start sequence to idle speed
- Automatic loading the turbine to a predefined goal high-pressure turbine speed or power turbine speed

# Gas Turbine Control Main Parameters

- Limit the main parameters of gas turbine:
  - High-pressure turbine speed
  - Power turbine speed
  - Exhaust gas temperature
  - Discharge pressure of gas generator compressor
  - Fuel rate during acceleration and deceleration



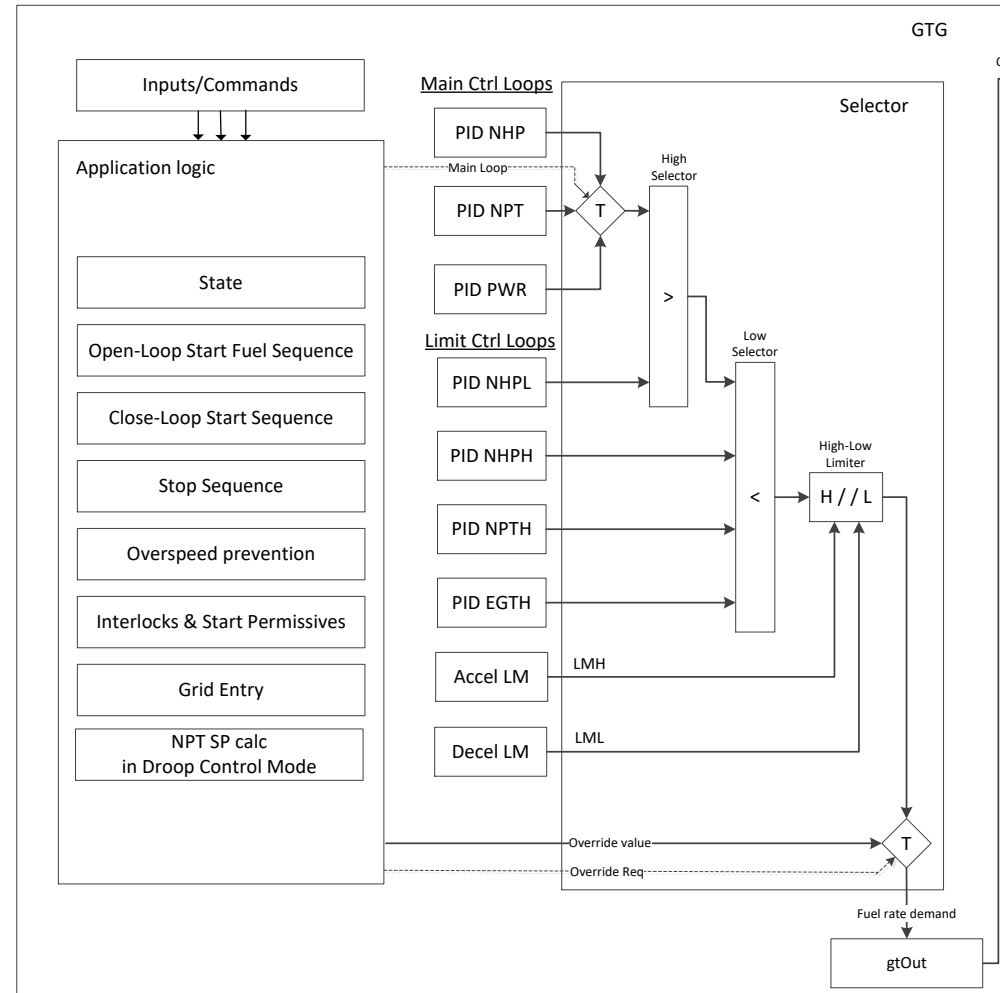
# Gas Turbine Start Fuel Schedule



1. When gas generator achieves prestart speed the fuel rate is ramped up to a predefined value
2. Fuel rate is held where ignition can be achieved
3. Flame is detected
4. Flame is stabilized for several seconds
5. Fuel rate usually ramps up until idle speed is achieved while supporting sustainable combustion and preventing flameout
6. Ramp speed while maintaining EGT start limit

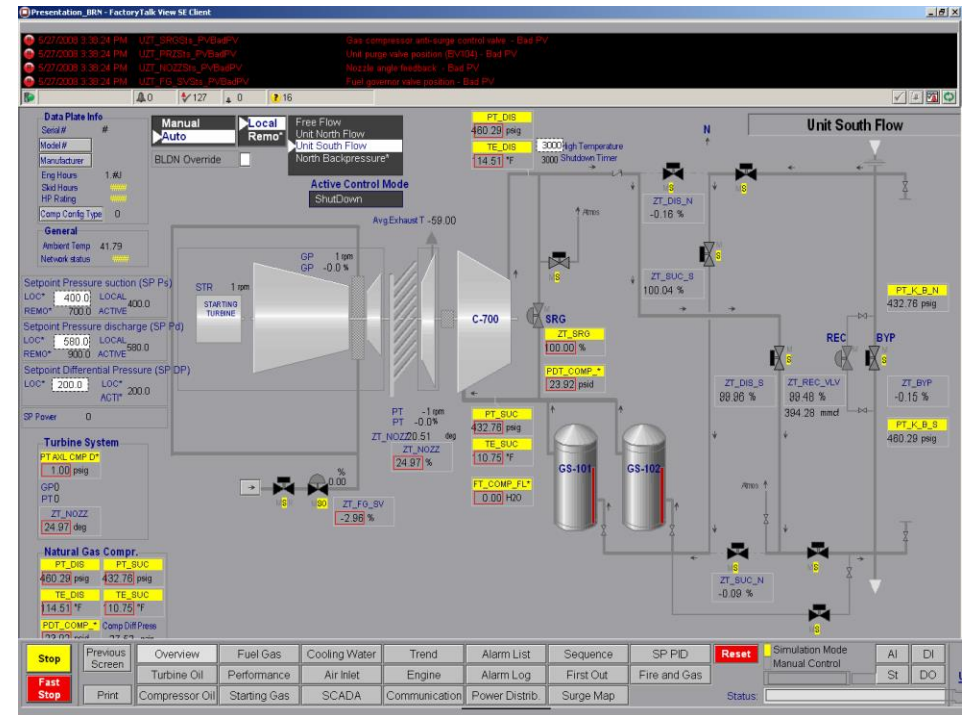
# Gas Turbine General Control Diagram

- 3 main PID control loops
- 4 limiting PID control loops
- Use simulation for extensive testing
- Easy to troubleshoot and minimal maintenance
- Synchronization with power grid
- Has 6 different states of operation/sequencing



# Customer Case 1

- Total control system retrofit for gas turbine-driven (GE Frame 3) compressor
- Provided Fuel Control, Surge Prevention, and Unit Capacity Control
- After deployment, the surge safety margin was 10% of surge flow, which increased the compressor operating envelope by 6%



# Benefits

- Easier start up of equipment
- Develop customized solutions based on user requirements
- Wider operating range for more stable control
- Can be combined with other turbomachinery control solutions for even higher benefits.