Development of a measurement and control system for 40L/h helium liquefier based on Siemens PLC S7-300

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Introduction

A 40L/h helium liquefier is established at the TIPC, CAS. The designed liquefied rate of helium is 40L/h. A measurement and control system based on Siemens PLC S7-300 is developed. Proper sensors and transmitters are adopted. To fill the different operating modes’ requirements, a specific control logic and control strategy are developed. After several months’ commissioning, the outlet temperature of the second stage turbine has reached to 8.6K and the temperature before the throttle valve has reached to 13.1K.

Helium Liquefier PFD & Temperature Sensors

- Designed liquefied rate of helium: 40 L/h
- Compressor: KAESER CSD162, 90KW, 25g/s
- Dirty helium gas: 15.5g/t/a273bar
- Temperature sensors and transmitters used in helium liquefier
  - 24 temperature sensors
  - Three types of transmitters
  - Rhodium-iron, calibrated accuracy: ±0.1K
  - PT-100, calibrated accuracy: ±0.1K

Control Structure and HMI

- Control Structure: Siemens PLC S7-300
- HMI: Siemens Panel PC 1772

Control Logic and Strategy

- Logic and control strategy will be verified and updated.
- To control the compressor’s frequency, adjusting the bypass valve to control the turbo loops’ rotary speeds.
- The suction pressure Pin is controlled by the bypass valve CV-1.
- The discharge pressure Pout is controlled by the discharge valve CV-2.
- The control program is mainly composed of sequential control and control loops. Most of the control loops can be implemented by means of a standard PID (Proportional, Integral and Derivative) controller.

Turbo-expander Loop Control

Through controlling the inlet valve of the first stage turbo to control the turbo loops’ rotary speeds.

Commissioning Result

- Outlet temperature of the second stage turbo-expander
- After several months’ commissioning, the outlet temperature of the second stage turbine has reached to 8.6K and the temperature before the throttle valve has reached to 13.1K.

Conclusion

- A measurement and control system based on Siemens PLC S7-300 for 40L/h helium liquefier is developed.
- After several months’ commissioning, the outlet temperature of the second stage turbine has reached to 8.6K and the temperature before the throttle valve has reached to 13.1K.
- This helium liquefier will be commissioned continuously, during this process, the measurement and control system, the control logic and control strategy will be verified and updated.

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