

Real-time Data Acquisition with PXI System for KYLIN-II-S Facility

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ABSTRACT: Heat exchanger is one of the key components for China LEAd-based research Reactor (CLEAR-I), designed as the reference reactor of China Accelerator Driven System (ADS) project. In order to investigate the Heat eXchanger Tube Rupture (HXTR) accident, KYLIN-II-S facility is currently under construction to perform Lead-Bismuth Eutectic (LBE) and water interaction experiments. Transient measuring instruments were applied to validate the dynamic pressure wave, transient temperature, and steam bubble transportation during interaction. Since the transient response time is a few milliseconds, a dedicated real-time data acquisition system, i.e., a dual-core PXI express system running with LabVIEW, was designed and implemented. The deployed embedded code was executed on a real-time operator system to provide a highly deterministic, reliable execution platform. More than 300 analog, and 100 digital signals were saved in the data base accessed by LabSQL. Meanwhile, PXI express synchronous triggering for dynamic parameters and fault diagnosis interlock control system were realized.

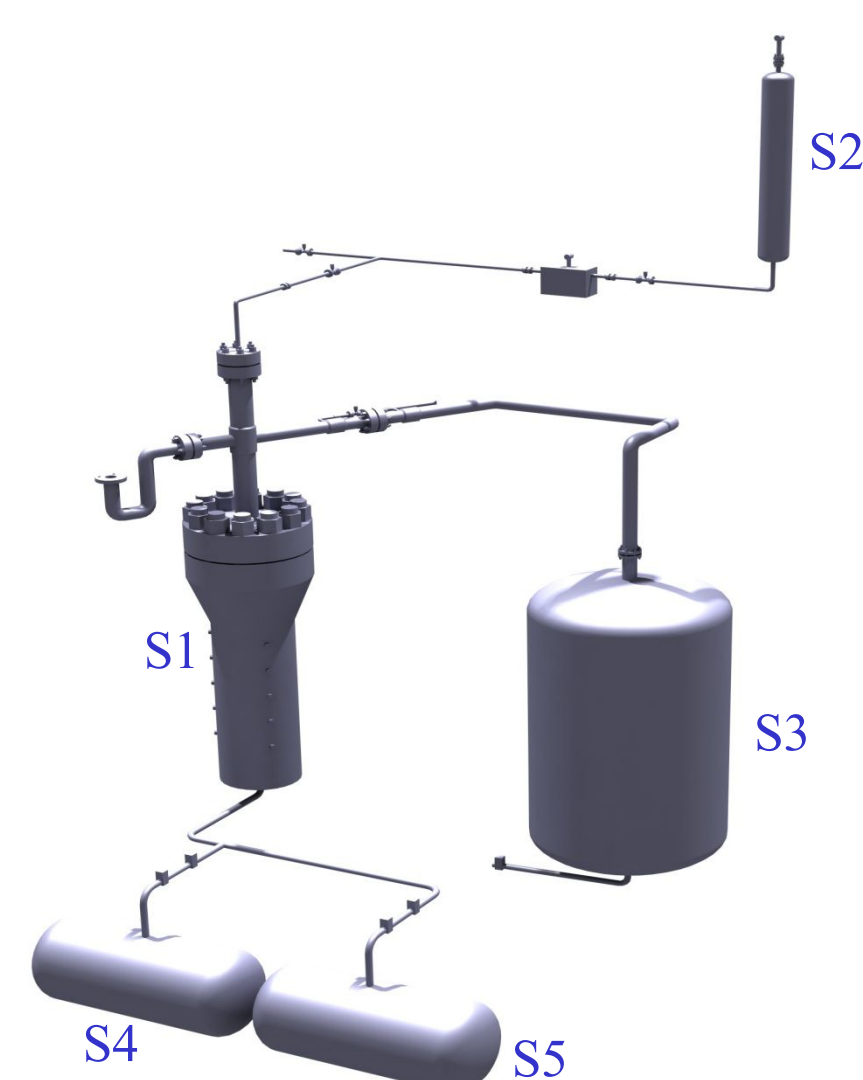
1. Introduction

- The KYLIN-II-S facility was designed in order to investigate the phenomenology of the interaction between Lead-Bismuth Eutectic alloy and water under a wide range of operating conditions (i.e. pressure <6MPa, temperature <400 °C) supporting nuclear fission (i.e. ADS). It could also implement extensive experiments between Lithium-Lead alloy and helium supporting fusion technologies development.
- A Supervisory Control and Data Acquisition system (SCADA) based on PXI express data acquisition card was developed to measure the high frequency signal of the sensors synchronously, meanwhile, to acquire slow signal of the sensors and control execution components.

2. General Description

2.1 KYLIN-II-S Facility

The facility consists of a reaction vessel (S1) where the interaction between LBE and water takes place, an expansion safety vessel (S3) linked to the reaction vessel, a water tank (S2), LBE storage tank (S4), and PbLi storage tank (S5).



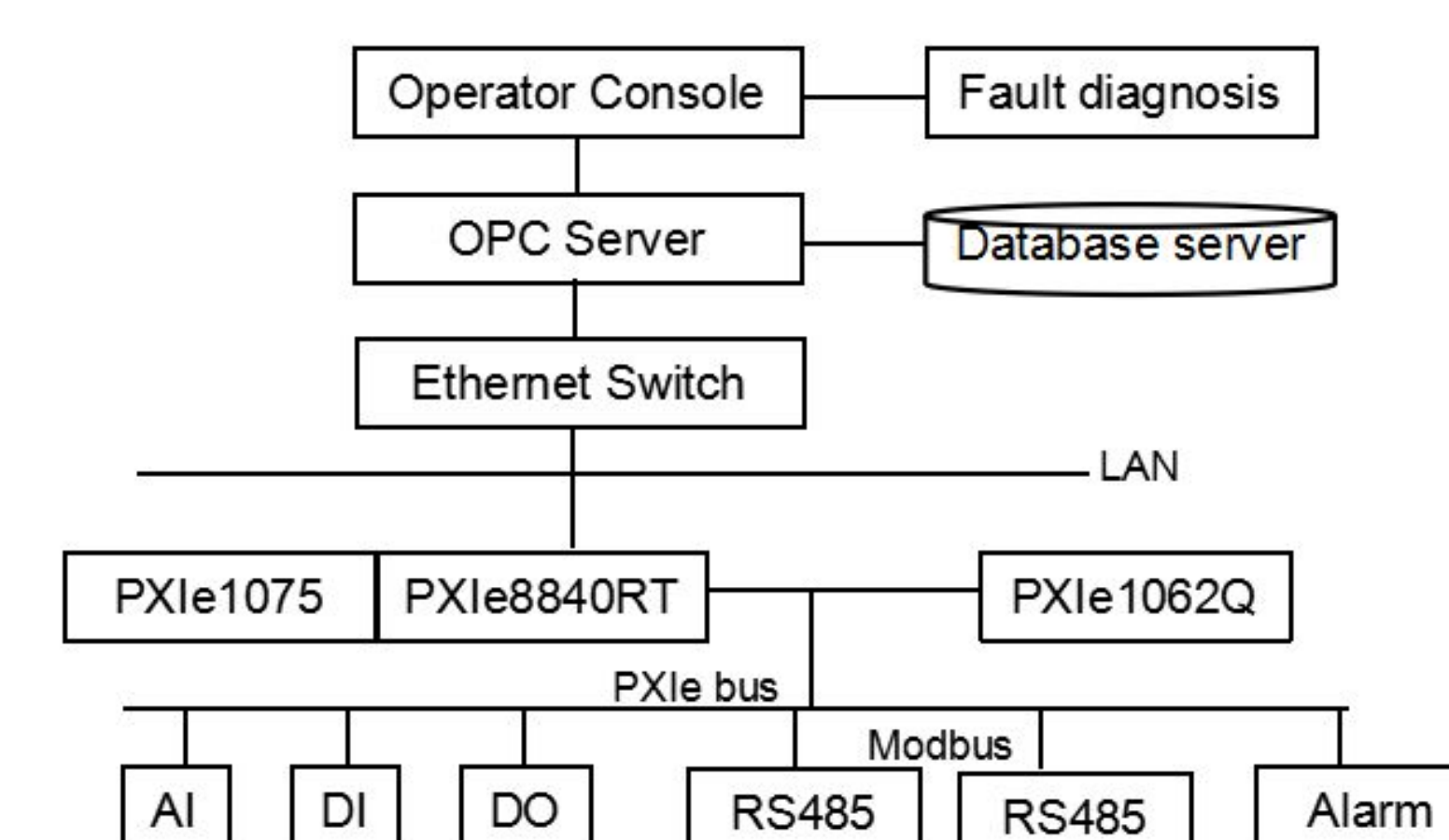
2.2 Instrument & Control

Instrument	Quantity	Parameter
Thermocouple	141	analog input
Fast acquisition thermocouple	123	90S/s
High temperature strain gauge	7	full bridge
Dynamic pressure sensor	8	sample rate: 1.25MS/s/channel simultaneously, timing resolution: 10ns, timing accuracy: 50 ppm of sample rate
Normal pressure sensor	5	0-10MPa
Level gauge	7	analog input, on/off
Coriolis flow meter	1	RS485-Modbus
Bubble rate meter	5	on/off
Valve	20	on/off

3. Data Acquisition and Control System

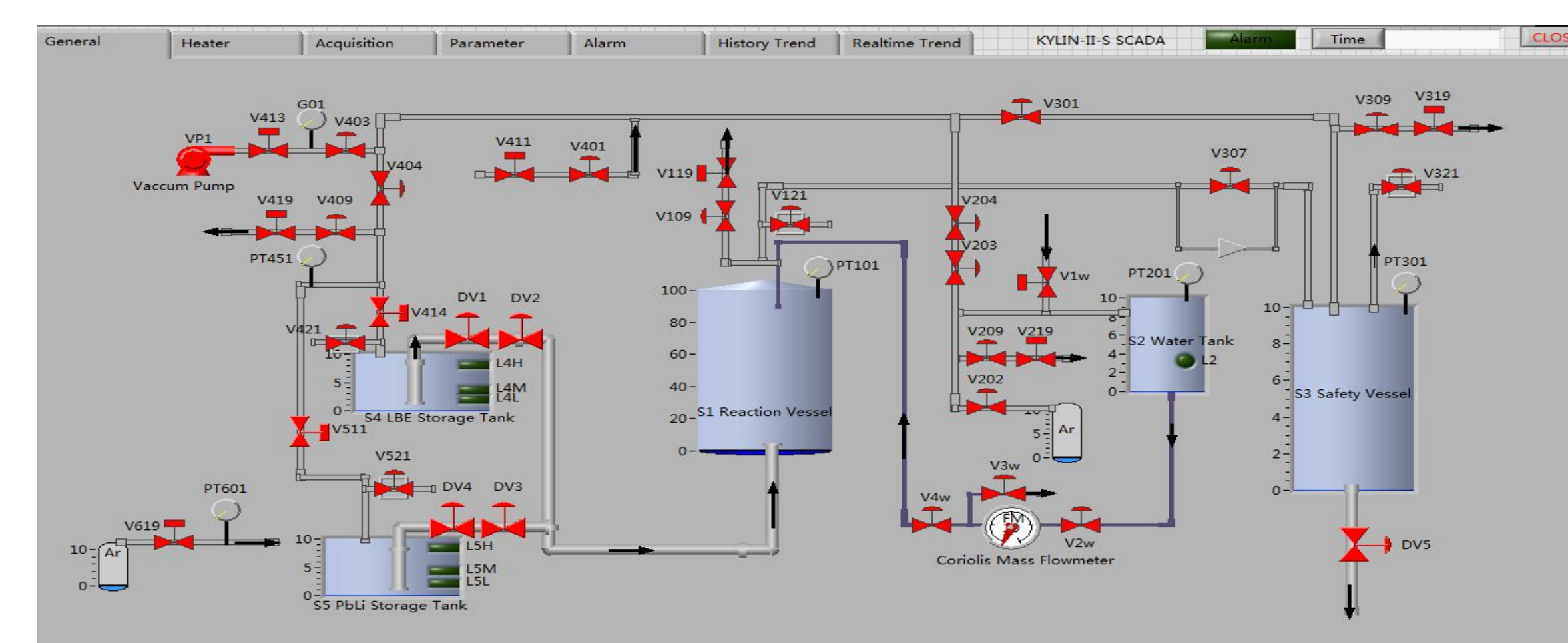
3.1 System architecture

The SCADA system was composed of PXI chassis, including real time controller, input & output modules, and RS485 communication module.



3.2 Real time acquisition & control

Once the procedure was downloaded to the embedded controller, all I/O signals could be acquired and controlled in human machine interface (HMI).



3.3 Central interlock and safety system

The central interlock and safety system (CISS) ensures the facility machine protection and personnel safety, with specific interlock logic, acting upon off-normal events or conditions.

Classification	Definition	Parameter
I	disaster accident	environmental anomaly (eg. fire), remote shutdown in hand
II	severe accident	detect leakage, severe exceed threshold, emergency shutdown automatically
III	ordinary accident	upper and lower limit alarm

4. Summary

- KYLIN-II-S facility was designed to investigate heat exchanger tube rupture accident to support nuclear fission and fusion safety issues.
- KYLIN-II-S facility is currently under construction and will undergo performance tests.
- The central interlock and safety system of SCADA was applied to ensure the KYLIN-II-S facility protection and personnel safety, which could not only acquire slow signal, but also deal with fast response sensor simultaneously in real time.

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