Design of real-time alarm system for CAFe

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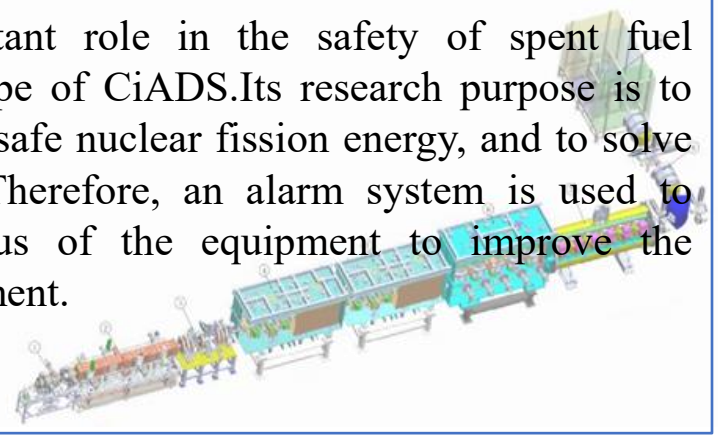
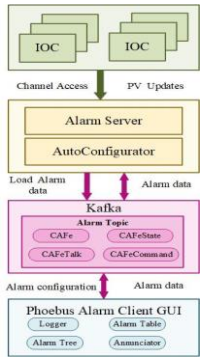
Introduction

CiADS plays an important role in the safety of spent fuel handling.CAFe as a prototype of CiADS.Its research purpose is to develop clean, efficient and safe nuclear fission energy, and to solve the future energy supply. Therefore, an alarm system is used to monitor the operating status of the equipment to improve the maintainability of the equipment.

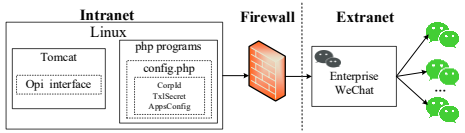


Methods



- Realize on-site alarm
- Kafka improves throughput

Fig 1. The framework of the alarm system.



- Ensure data security
- Realize remote real-time interface

Fig 2. Deployment of remote interface

Results

The interfaces of fault equipment and alarm data are displayed in the central control room and mobile terminal respectively.

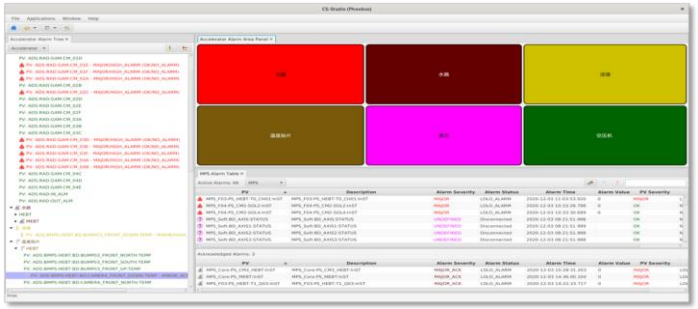


Fig 3. The alarm interface of the central control room

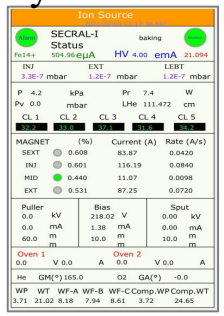


Fig 4. Mobile terminal interface

Conclusions

- The alarm function of central control room and mobile terminal is realized
- The throughput of alarm information is improved
- Reduced troubleshooting time
- The maintainability of cafe is improved

Introduction

China Initiative Accelerator Driven System (CiADS) plays an important role in the safety of spent fuel handling. This is a global challenge that has not yet been resolved by our country and the international nuclear energy community. Chinese ADS Front-end Demo Linac (CAFe) as a CiADS prototype. Figure 1 is the layout of the CAFe superconducting linear accelerator, which consists of nine parts. CAFe as a prototype of CiADS.Its research purpose is to develop clean, efficient and safe nuclear fission energy, and to solve the future energy supply. Therefore, the stable operation of the CAFe equipment is particularly important for the debugging and stable operation of the beam experiment. The alarm system can effectively improve the maintainability of CAFe.

①ECRIS: Electron Cyclotron Resonance　LEBT: Low Energy Beam Line
②RFQ: Radio Frequency Quadrupole
③MEBT: Medium Energy Beam Line
④CM1
⑤CM2
⑥CM3
⑦CM4
⑧HEBT: High Energy Beam Line
⑨Beam Dump

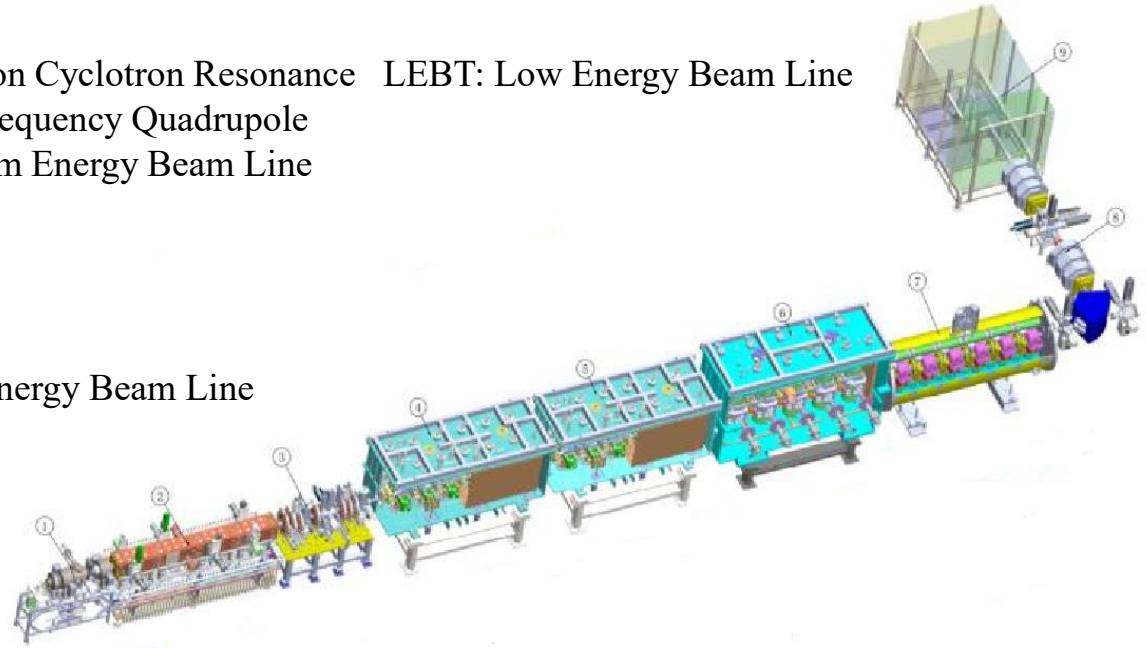


Fig 1. Layout of CAFe superconducting linear accelerator

Methods

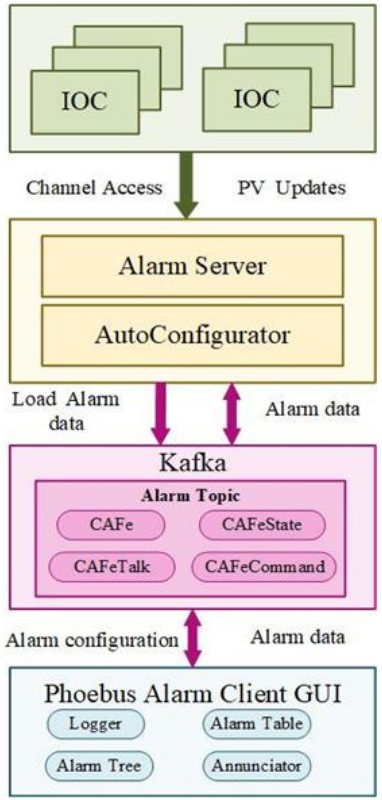


Fig 2. The framework of the alarm system.

IOC

It is used to obtain the data of the monitoring equipment and define the alarm threshold of the equipment.

Alarm service

It is the core of the alarm system. It can record alarm status, update alarm status and send alarm information.

Kafka

Realize two functions: ①Store the information of four alarm topics. ② Send alarm information.

Phoebus

Display alarm interface: Alarm Tree , Alarm Area Panel, Alarm Log Table, Annunciator and Alarm Table.

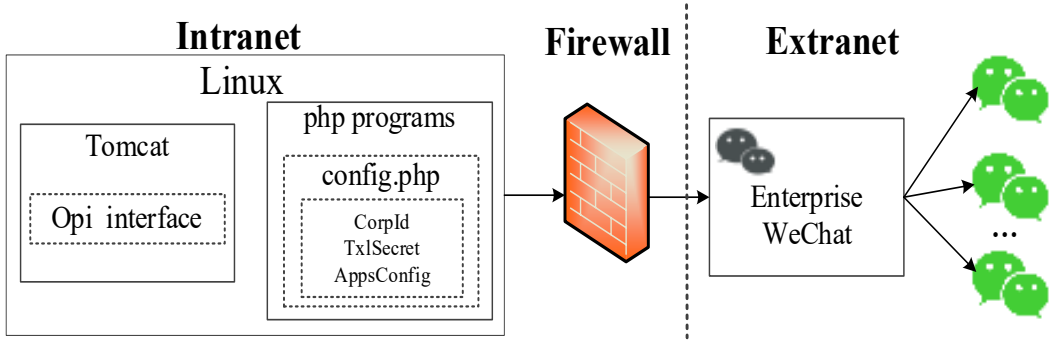
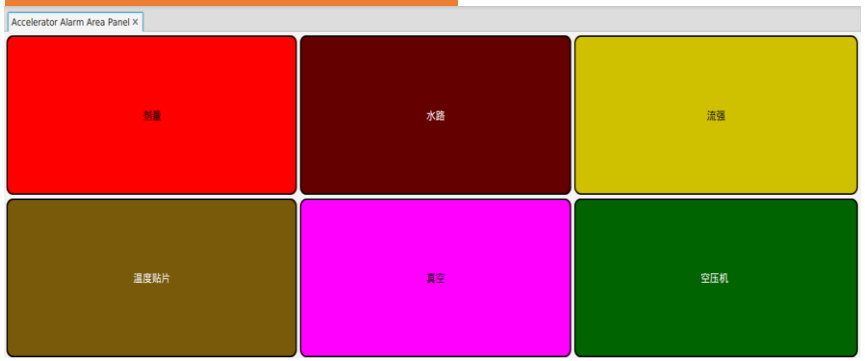


Fig 3. Deployment of remote interface

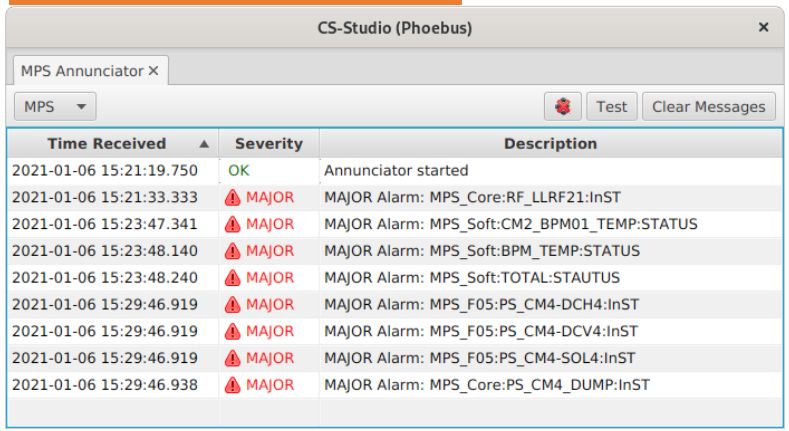
- In order to ensure data security, the server and enterprise WeChat account are deployed to the intranet and the extranet respectively.
- Intranet: The opi interface drawn by CS-Studio is deployed in the tomcat server on the intranet.
- Extranet: Deploy enterprise WeChat ac-count, and log in to the enterprise WeChat account through the administrator's authorization for staff in the office.
- The staff can view the real-time remote interface anytime and anywhere to understand the experimental situation.

Results

Alarm Area Panel

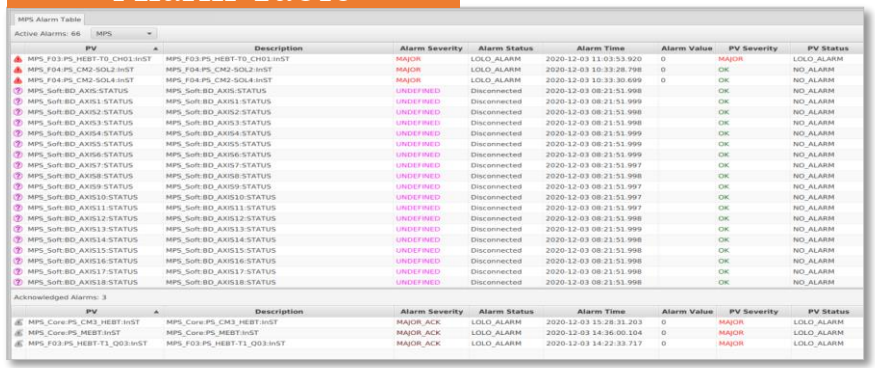


Annunciator

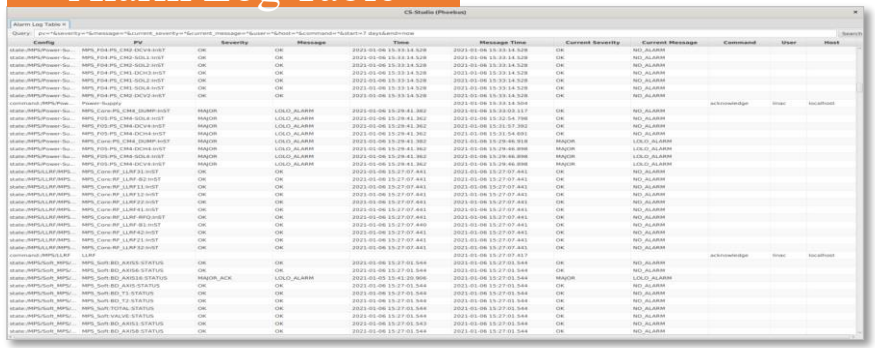


Time Received	Severity	Description
2021-01-06 15:21:19.750	OK	Annunciator started
2021-01-06 15:21:33.333	MAJOR	MAJOR Alarm: MPS_Core:RF_LLRF21:InST
2021-01-06 15:23:47.341	MAJOR	MAJOR Alarm: MPS_Soft:CM2_BPM01_TEMP:STATUS
2021-01-06 15:23:48.140	MAJOR	MAJOR Alarm: MPS_Soft:BPM_TEMP:STATUS
2021-01-06 15:23:48.240	MAJOR	MAJOR Alarm: MPS_Soft:TOTAL:STAUTUS
2021-01-06 15:29:46.919	MAJOR	MAJOR Alarm: MPS_F05:PS_CM4-DCH4:InST
2021-01-06 15:29:46.919	MAJOR	MAJOR Alarm: MPS_F05:PS_CM4-DCV4:InST
2021-01-06 15:29:46.919	MAJOR	MAJOR Alarm: MPS_F05:PS_CM4-SOL4:InST
2021-01-06 15:29:46.938	MAJOR	MAJOR Alarm: MPS_Core:PS_CM4_DUMP:InST

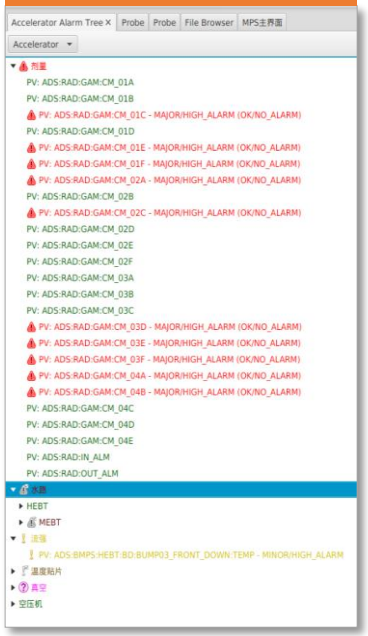
Alarm Table



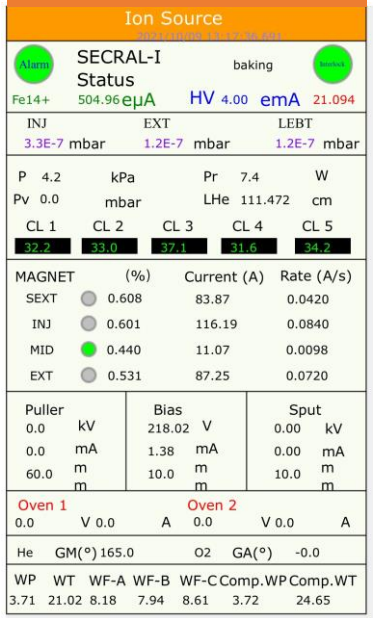
Alarm Log Table



Alarm Tree

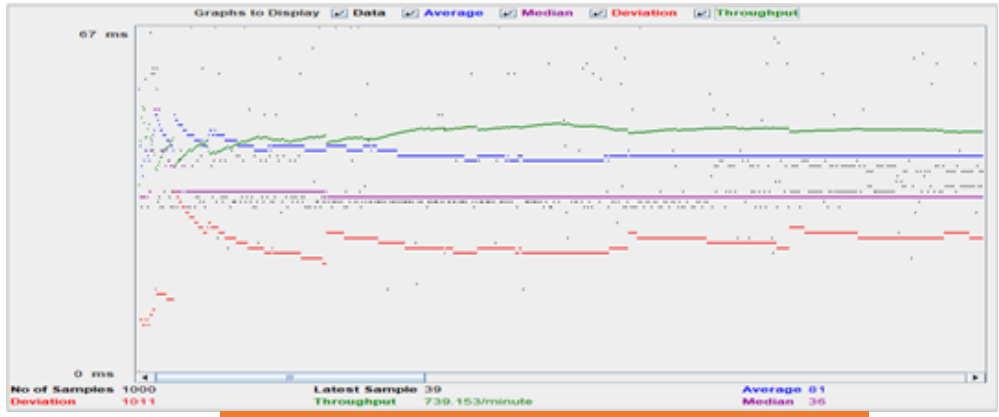


Interface Tree



Conclusions

The throughput of Kafka



The throughput of ActiveMQ

The above figure shows that using Kafka can effectively improve data throughput and ensure real-time alarms.

CAFe alarm system was built based on Kafka streaming media platform. Phoebus provides some alarm interfaces for monitoring PV.

- ✓ Remote real-time interface to achieve cross-regional alarm function.
- ✓ Phoebus‘s interface is simple to operate and easy to maintain.
- ✓ The alarm system saves troubleshooting time and improves the maintainability of CAFe.
- ✓ The entire control system has been deployed and put into operation in the central control room and is working well.