



المؤتمر الدولي لإدارة الأصول والمرافق والصيانة في الدول العربية  
International Asset, Facility and Maintenance Conference  
in the Arab Countries

**Digitization - Excellence - Sustainability**

# **Asset Integrity Management & Predictive Maintenance Application Guidelines Interpretation and Case Study**

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# Part1: Guidelines Interpretation

## Background Introduction

The rapid development of industrial Internet provides new opportunities for the safe production of hazardous chemicals.



Challenges and problems in the safe production of hazardous chemicals.

The potential of industrial Internet in solving these problems.



# Part1: Guidelines Interpretation

## Five major challenges for hazardous chemical production enterprises



### High-Risk

Management difficulties caused by high-risk characteristics



### Complex production process

Safety hazards in complex production processes



### Lack of risk identification

Inaccurate or untimely risk assessment and identification



### Strict regulatory oversight

Continuous updates of regulations, policies, and standards



### Extreme weather impact

Safety risks under extreme weather conditions

# Part1: Guidelines Interpretation

the Ministry of Emergency Management of the PRC

中华人民共和国应急管理部

## Asset Integrity Management & Predictive Maintenance Application Guidelines

- In March 2023, the Department of Dangerous Chemicals of the Ministry of Emergency Management of the People's Republic of China issued a notice on the issuance of **five guidelines**,
- including the Application Guide for the Construction of the "Industrial Internet plus+Safe Production of Dangerous Chemicals" Process Production Alarm Optimization Management System (Trial).
- The notice gave **specific guidance requirements** for the construction and application of the "Industrial Internet plus+Safe Production of Dangerous Chemicals" **asset integrity management and predictive maintenance system**.

### 关于印发《“工业互联网+危化安全生产” 工艺生产报警优化管理系统建设应用指南 (试行)》等5项指南的通知

各省、自治区、直辖市应急管理厅(局),新疆生产建设兵团应急管理局,有关中央企业安全管理部门:

为推动“工业互联网+危化安全生产”建设深入展开,在总结有关单位实践做法基础上,应急管理部危化监管一司组织制定了《“工业互联网+危化安全生产”工艺生产报警优化管理系统建设应用指南(试行)》等5项建设应用指南(见附件1至5)。现印发给你们,请指导有关企业开展建设。如有问题建议,请及时反馈应急管理部危化监管一司(联系人及电话:付加鹏,010-64463240)。

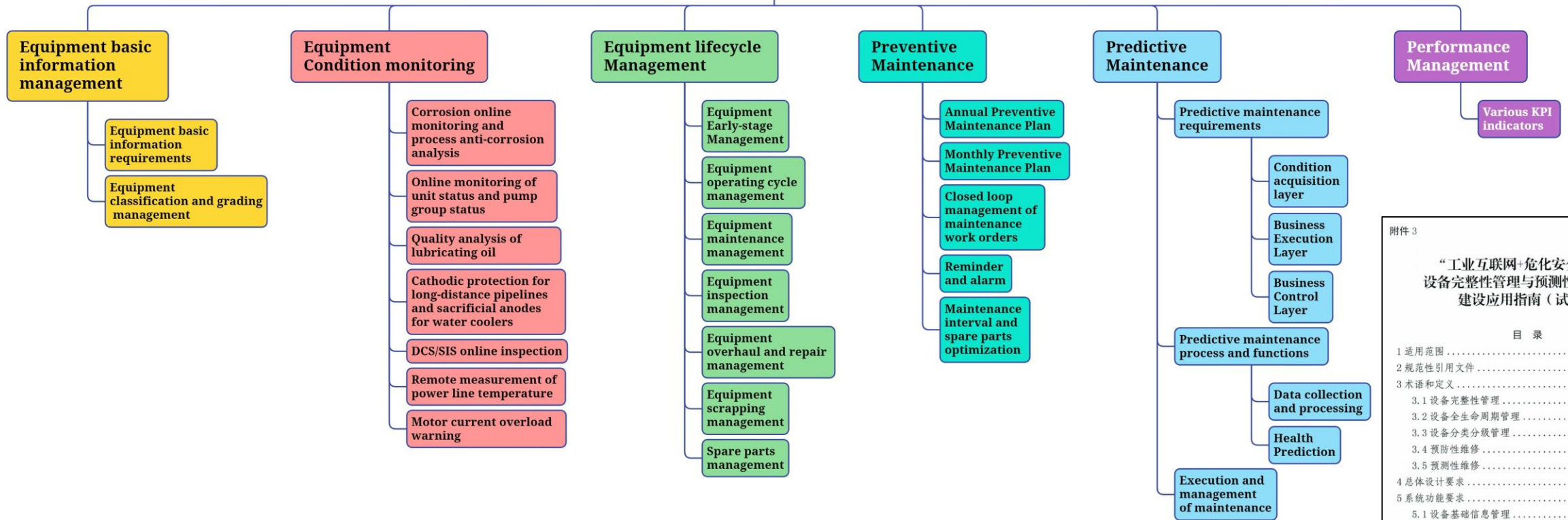
- 附件: 1. “工业互联网+危化安全生产”工艺生产报警优化管理系统建设应用指南(试行)  
2. “工业互联网+危化安全生产”自动化过程控制优化系统建设应用指南(试行)  
3. “工业互联网+危化安全生产”设备完整性管理与预测性维修系统建设应用指南(试行)  
4. “工业互联网+危化安全生产”培训管理系统建设

搜狐号@POGSTAR5

# Part1: Guidelines Interpretation

## Structure of the guide

guidance requirements for the construction and application of the "Industrial Internet +Safe Production of Dangerous Chemicals" asset integrity management and predictive maintenance system.



附件3

“工业互联网+危化安全生产”  
设备完整性管理与预测性维修系统  
建设应用指南（试行）

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# Part2: Technical Solutions

## Equipment Overview and Organizational Structure

- ❑ There are 6,083 sets of process equipment in the entire plant (564 sets of imported equipment), including 3,394 sets of dynamic equipment and 2,689 sets of static equipment;
- ❑ 22,267 sets of instruments and 3,503 sets of electrical equipment;
- ❑ There are a total of 8 functional departments and 7 production centers in the entire plant, with 966 full time employees and 95% having a bachelor's degree or above;
- ❑ 6 on-site outsourced maintenance companies, with 549 personnel and 170 personnel with senior engineer or above qualifications;
- ❑ 137 outsourced cooperation maintenance teams or companies;



ChinaCoal Shaanxi Energy and Chemical Group Co., Ltd.

# Part2: Technical Solutions

## Technical Architecture of iMIS

analysis and forecast

Analysis and prediction of maintenance management based on big data

Deterioration trend

Failure rate

Intelligent maintenance strategy

Intelligent predictive maintenance

Performance Analysis

Weekly, monthly, quarterly, and annual reports

Business applications

**Equipment Basic Management**

Equipment account

Digital handover

Special Equipment Management

Metering & Instrument Management

Equipment History

**Preventive maintenance**

Inspection management

Hidden dangers troubleshooting

Equipment Checking

lubrication management

Corrosion diagnosis and evaluation

No Leakage Management

**Maintenance Management**

Main. Plan

Main. Task

Blind plate management

Special Job-Permits

Maintenance execution

Spare parts

**Improvement activities**

6H activities

6S activities

ChinaCoal Industrial Internet platform

(Organization, Users, Permissions, Single sign on, To-do list)

system integration

Monitoring system for large units and pump groups

Online Corrosion

Online monitoring of lubricating oil

MDM

outsourced maintenance management

WMS

Attendance of outsourced personnel

Equipment

Methanol equipment

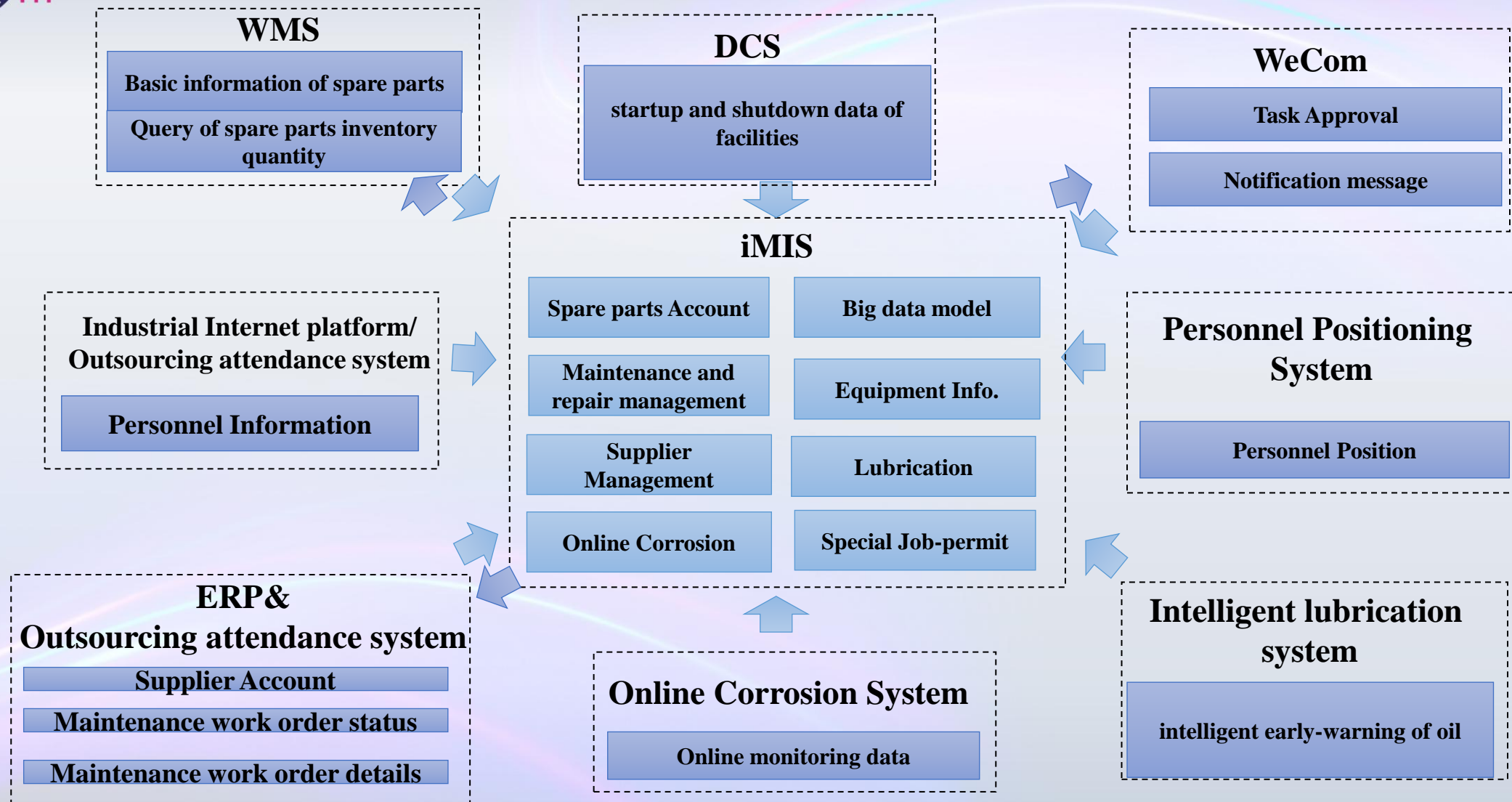
Olefins Equipment

.....

Other system devices that have been connected to OPC



# Solution for sub-System Interface



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# Major intelligent application subsystems

1-Online monitoring of large units (pump groups) effectively reduces the occurrence of equipment failures.



1- Pump groups online monitoring

2-Pipeline remote monitoring

2-Pipeline remote monitoring system, to establish a warning mechanism and reduction of accidents

记录	区域	标识	名称	MAC地址	流量 (立方米/天)	流速 (米/秒)	报警类型	报警次数
✓	气化装置	#005	1#高压空冷塔循环水(总管网-进)	GDGG	11.47	1.47	流量多数据	1.05
✓	气化装置	#006	2#高压空冷塔循环水(总管网-进)	GDGR	11.32	1.32	流量多数据	1.42
✓	气化装置	#007	1#炉斗管链入气化炉本体码头	GBR9	14	13.98	流量多数据	0.32
✓	气化装置	#008	2#炉斗管链入气化炉本体码头	GDGM	13.59	13.57	流量多数据	0.21
✓	气化装置	#009	3#炉斗管链入气化炉本体码头	GDGS	12.49	12.48	流量多数据	-0.17
✓	气化装置	#010	4#炉斗管链入气化炉本体码头	GDGX	11.87	11.86	流量多数据	0.22

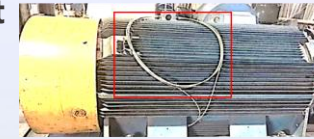
3-Online monitoring of lubricating oil to ensure safe operation of equipment units



3-Online monitoring of lubricating oil

4-Realize intelligent monitoring

4-Realize intelligent monitoring of key equipment



Fiber optic monitoring machine pump vibration (sound) and temperature



Fiber optic monitoring of pipeline vibration (sound)



pipeline corrosion(52 positions)



Thermal imaging inspection of gasification and acid-base station pump room

5-WMS and outsourced maintenance

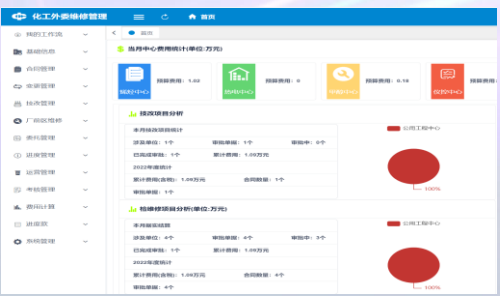
6-Personnel Positioning System

5-WMS and outsourced maintenance management system to assist in more efficient material maintenance management

6-Personnel Positioning System, to improve personnel safety control and monitor the dynamics of workers in real time

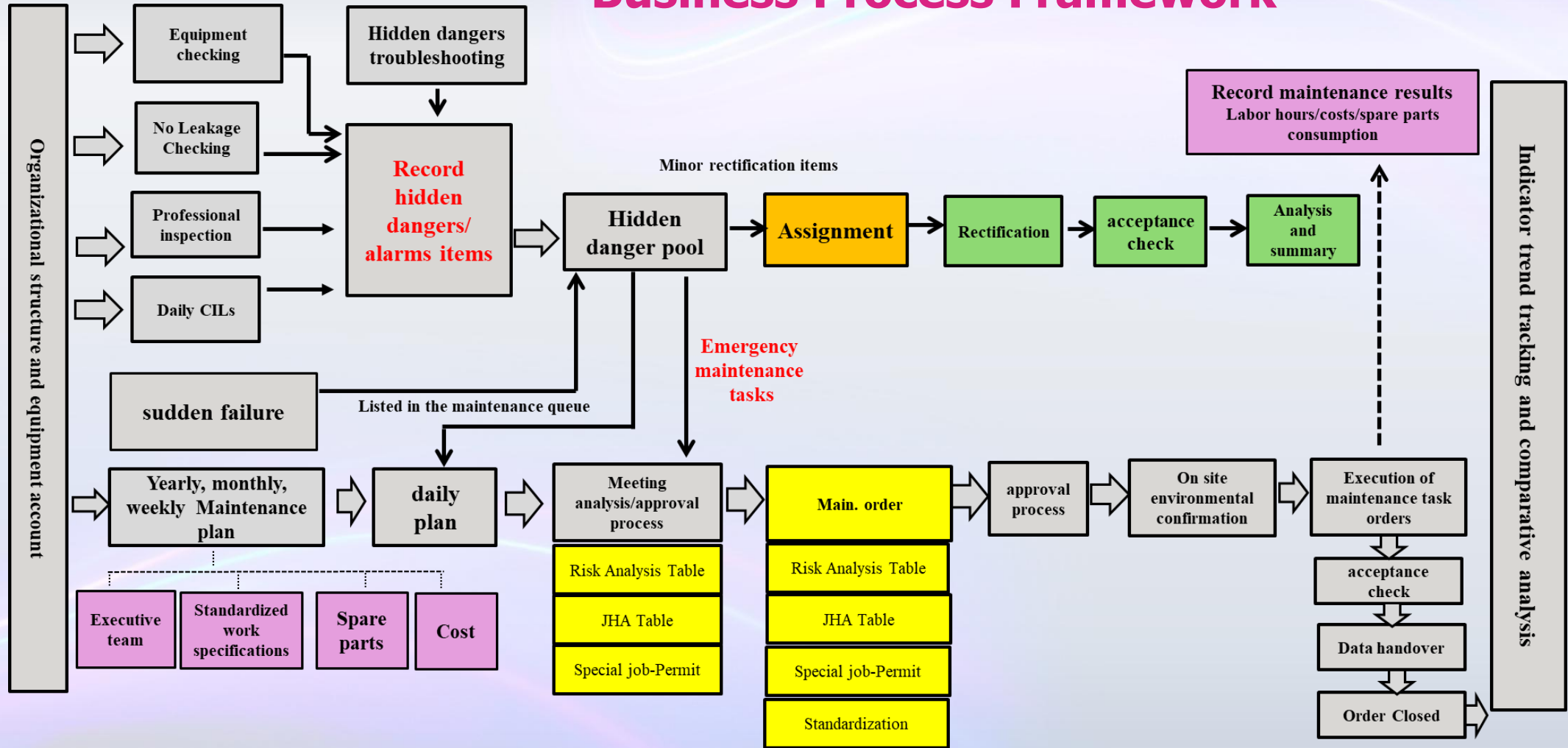


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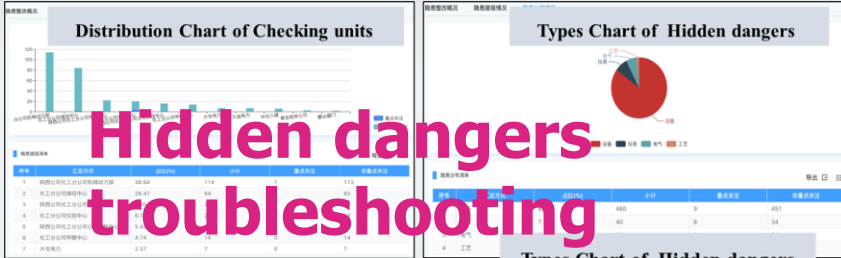


# Part3: Function Introduction

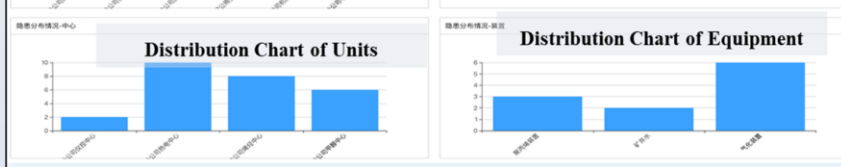
## Business Process Framework



# Part3: Function Introduction



**Hidden dangers troubleshooting**



**Automatic association between JHA and Task Cards**

**JHA Details**

**JHA Signature confirmation**

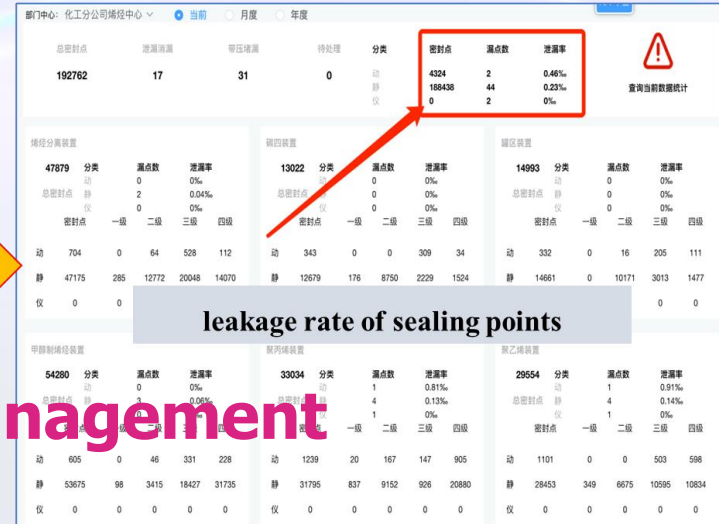
**JHA Signature confirmation on one by one**

**Account of Dynamic sealing points & Static sealing points**

**Account of Dynamic sealing points & Static sealing points**

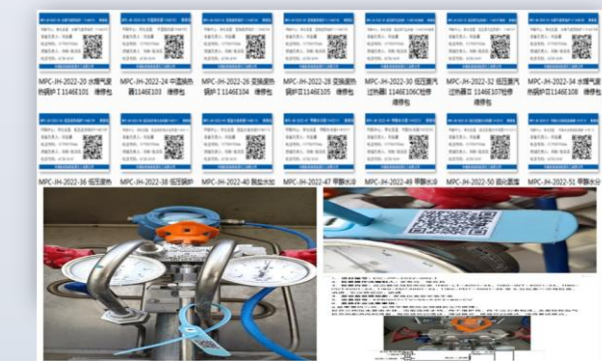
**leakage rate of sealing points**

**No Leakage Management**



**Maintenance cost statistics table**

**Maintenance project statistics table**



**Maintenance activities**

# Part3: Function Introduction

## Application and Practice of Predictive Maintenance

### Equipment

#### fault diagnosis

Through advanced fault diagnosis technologies such as vibration analysis and infrared temperature measurement, real-time monitoring and prediction of equipment status are carried out to timely detect and handle hidden faults, ensuring the normal operation of the equipment.

### Equipment

#### performance evaluation

By evaluating the performance of equipment, such as accuracy and efficiency, data support is provided for the optimized operation and maintenance of the equipment.

### Equipment

#### life prediction

By managing the life of equipment, such as predicting life of the equipment, arranging equipment maintenance, etc., to ensure the continuous maintenance of the equipment in good condition and extend its service life.

# Intelligent analysis of equipment big data-PHM

- By importing historical data, setting equipment parameters to supplement warning rules, and connecting real-time data, the iMIS establishes a health monitoring model for 5 sets large units.
- Regularly and automatically generate **PHM status assessment report**

The image illustrates the PHM (Predictive Health Monitoring) system's workflow. On the left, the software interface shows a list of monitored equipment, including:
 

- 20区反应气压缩机-20区反应气压缩机 (1160C401)
- 净化装置-净化装置冷冻站丙烷压缩机 (1142C201)
- 空分装置-氮气压缩系统A2氮气压缩机 (1110C501A2)
- 空分装置-DAdA (内部测试)

 Each equipment entry includes a gauge showing a value of 10.00 and buttons for '实时监测' (Real-time Monitoring) and '历史回放' (Historical Playback).

The center part of the image displays several data analysis charts:
 

- A bar chart showing periodic data points.
- A line chart with a sharp peak, indicating an abnormal state.
- A detailed line chart showing fluctuations over time.

On the right, a sample '设备状态评估报告' (Equipment Status Assessment Report) is shown, featuring:
 

- Report Title: 设备状态评估报告
- Report Date: 2022年11月02日 09:04:00
- Summary: 设备运行正常
- Charts: Multiple line graphs showing data trends.
- Conclusion: 设备运行正常, 无异常报警, 建议继续运行.

Vertical text labels on the right side categorize the analysis:
 

- 动态状态评估 (Dynamic State Assessment)
- 异常状态分析 (Abnormal State Analysis)
- 稳定性趋势分析 (Stability Trend Analysis)



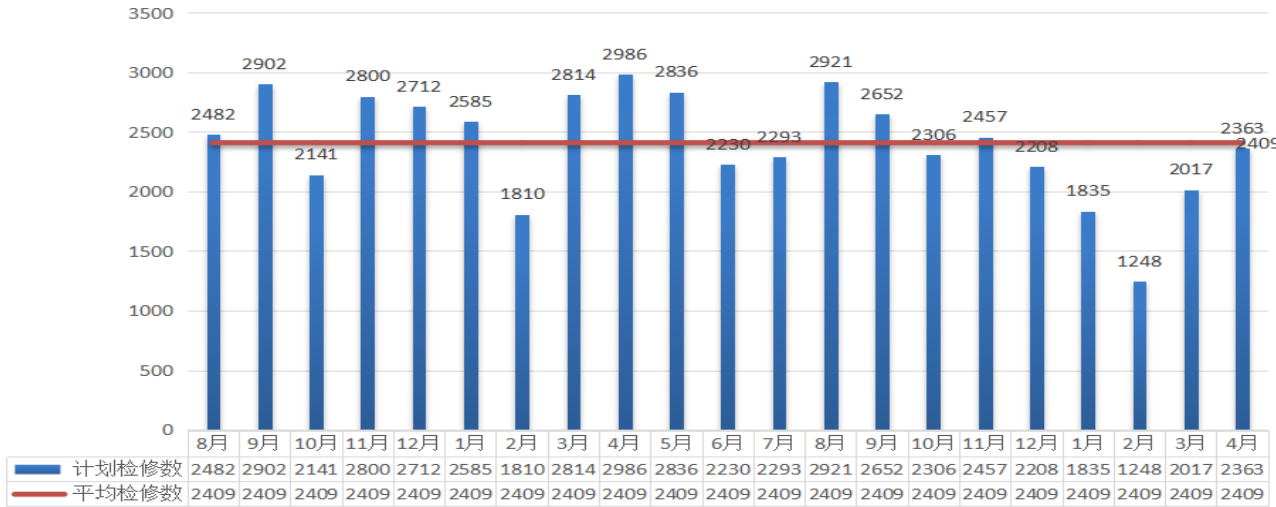
# Part4: Achievements & next Plan

## Achievements

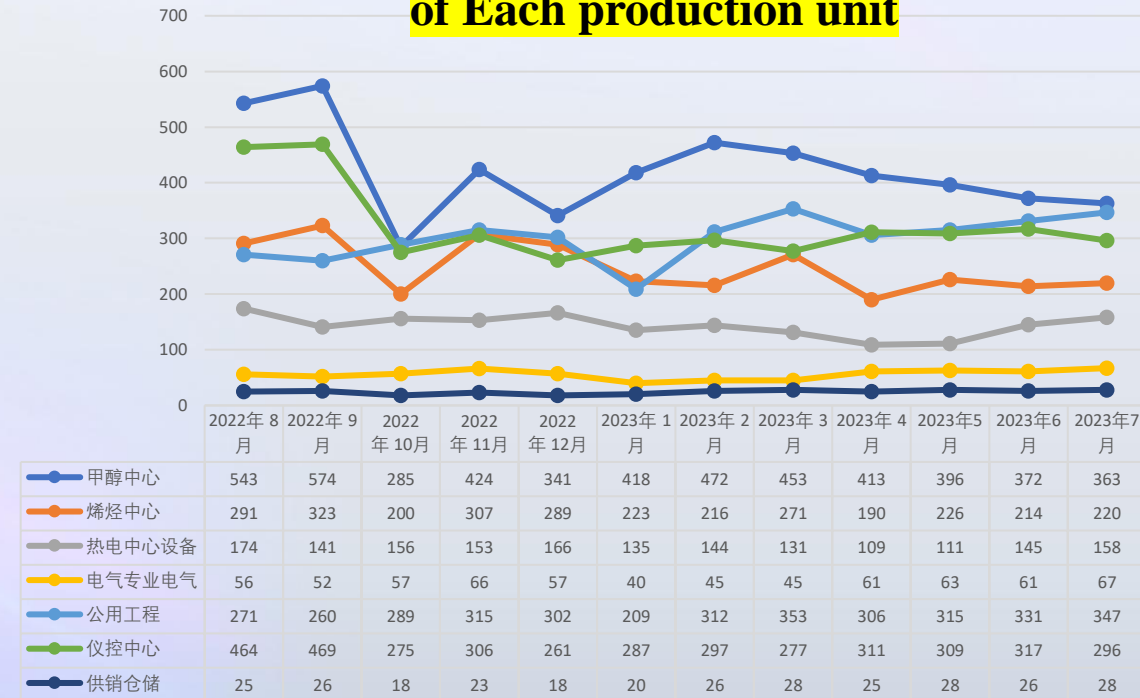
- ❑ In 2023, the completion rate of maintenance and repair plans reached over 98%;
- ❑ The number of maintenance operations in 2022 has decreased by about 20% compared to the same period in 2021;
- ❑ The number of maintenance operations in 2023 has decreased by about 10% compared to the same period in 2022, which reduces the risk of on-site maintenance operations.

The trend chart of Monthly Maintenance Task Quantity

月度计划检修数与平均检修数对比



Monthly Maintenance Task Quantity of Each production unit



# Part4: Achievements & next Plan

## "No Leakage Plant" audit

- In 2020 and 2022, passed the "No Leakage Plant" audit of the group company, awarded the "No Leakage Plant" Medal;
- The leakage rate of the dynamic sealing point reaches **0.43 ‰**;
- The leakage rate of the static sealing point reaches **0.026 ‰**;
- The instrument leakage rate reaches **0.016 ‰**.
- Implement digital management of QR codes for leakage points.

### The leakage rate of sealing points(2020-2022)



dynamic sealing point

static sealing point

instrument leakage rate



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# Part4: Achievements & next Plan

## Next plan (~2025)

### 1-Expand AI hardware applications

Introducing inspection Robots, Augmented Reality(AR) glasses, AI Cameras, Non-invasive Sensors and other technological means to enhance the ability to quickly identify equipment defects in Unmanned and less humanized factory.

### 2-Expand professional management

Based on the iMis, it will realize the full life cycle management of equipment, and will strengthen the data model support for the selection and decision-making of spare parts consumption and planning management, equipment renovation, and equipment procurement. and to extend the application of Asset Integrity Management System(AIM).

### 3-Strengthening the application of artificial intelligence

The AIGC will be implanted into the iMIS to realize the quick sharing of equipment knowledge, maintenance experience, fault maintenance cases and diagnosis results by voice input, keywords or other information, and to have more opportunities to improve skills of maintenance engineers.

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