

Construction of the Equipment Integrity Management System of Company A

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Abstract

The process system of petroleum and petrochemical enterprises is huge, the inducing factors of equipment accidents are complex, the probability of accidents is high, and the consequences are serious. Most accidents are closely related to the failure or unsafe operation of equipment and facilities. Equipment integrity management, starting with equipment preventive maintenance and risk control, is an important way to ensure the smooth progress of safety production in petroleum and petrochemical enterprises. Equipment integrity management is a dynamic equipment monitoring, which involves two levels of technology and management. This article carries on the equipment integrity management system construction pilot situation research object, firstly to the present stage equipment integrity management research and the situation to make the summary; Then, from the construction and implementation of equipment integrity management system in A; Finally, according to the complete situation of the pilot, the optimized future prospect is put forward.

Keywords

Petroleum and Petrochemical Enterprises; Equipment Integrity Management; Equipment Integrity Management System.

1. Summary of Research on Equipment Integrity Management

Equipment integrity originates from the safety management regulations of the Occupational Safety and Health Administration (OSHA). The construction of equipment integrity system has become an effective promotion for accident prevention and productivity. The construction of equipment integrity system can effectively improve equipment failure rate, maintenance cost and equipment safety and reliability. At present, the research on equipment integrity is abundant, mainly focusing on four aspects: equipment life cycle management, management integrity, technical integrity and economic integrity.

A lot of research has been carried out in the whole life cycle management of equipment at home and abroad. Yonggang Peng and others expounded the management content and significance of each stage from the early, middle and late management of equipment to improve the production and operation efficiency of enterprises[1]; Ma Zhao and others realized the efficient and safe operation of assets by studying ISO55000 to improve the whole life cycle management of equipment[2]; Zhen LI introduced the concept of equipment management, focusing on dividing the management content and use management of each stage of equipment life cycle[3]; Shuguang Wang expounded that each stage of equipment life cycle management from equipment procurement to equipment decommissioning and disposal corresponds to a special management plan to realize the improvement of equipment utilization rate and production and operation costs[4]; Xiaofeng Li focuses on the whole life cycle management of chemical equipment under the guidance of the whole life cycle management theory, and realizes the lean

management of the whole process and the whole life cycle to improve the safety and reliability of the whole system[5].

In view of the management integrity, it is expounded from many aspects at home and abroad Holland, Christopher P and others realized the integrity management of offshore oil and gas field equipment based on Maximo management system by studying BP and coordinating the maintenance, operation and repair of professional exploration and production equipment[6]; Campos, Campos, M.A. López and others built an operation and maintenance management framework (MMF) to realize equipment integrity management by studying PAS55[7]. Rezael Cyrus and others improved KPI goals by studying the existing HSE management system of KOC, compiling integrity management (IM) system and compass, and selecting several key performance indicators for each equipment according to its business nature[8]; On the basis of summarizing and studying the international oil and gas integrity management practice, Lingfeng Kong focused on the establishment of equipment integrity management system to realize the integrity management of the whole life cycle by documenting the management system[9]; Dongming Ma and others combined with the seven key elements of integrity management, focused on selecting KPI assessment elements to realize KPI assessment of offshore equipment integrity management and further improve management efficiency[10].

In view of technical integrity, Bragatto, Paolo A. discussed the mechanical integrity (MI) management of equipment, and realized the safety and controllability of equipment by using RBI to control major accident hazards[11]; Potty, Narayanan Sambu and others have made a risk-based inspection plan by studying the SIM of Malaysian offshore structures, combining API and ISO requirements, platform number, facility type, age and risk level to form structural integrity management (SIM)[12]; Crowther, Paul and others discussed the application of risk-based inspection (RBI) and evaluation in mechanical integrity to further improve equipment utilization[13]. Through the interpretation of relevant laws and regulations and the international HSSE management system, technical integrity tools were applied to the safety instrumentation system of static equipment of oil and gas pipelines, which standardized the equipment management mechanism and effectively improved the equipment operation level Habbal of Tang Yang, Mohamed E. Lye Jian and others established a set of systematic integrity technology management system by studying the characteristics of offshore equipment operation and maintenance and combining with the existing equipment management system, and realized the application of RCM (risk-based maintenance) and SIM (structural integrity)[14][15].

In the aspect of economic integrity, it mainly explores the measurement of the whole life cycle cost Li Tianming put forward the transformation of equipment life cycle cost calculation from cost calculation to cost control[16]; Gim, HwanSeok and others introduced the condition-based maintenance (CBM) system through the research of offshore platform life management to integrate diagnosis, evaluate prognosis and maintain platform condition and platform fatigue life to ensure the safe and efficient operation of the platform[17]; Esteve, J et al. Introduced the new Bureau Veritas solution to maximize the economic benefits of equipment by creating life cycle management equipment integrity monitoring and information system interoperability through 3D model[18]; ELHabbal, Mohamed discusses how to extend the service life of equipment and achieve efficient operation of equipment by adopting equipment integrity management (AIM) under low oil price and global economic stagnation[19].

To sum up, at present, the research of equipment integrity management at home and abroad mainly starts from the whole life cycle management of equipment, and focuses on the research and discussion of management integrity, technical integrity and economic integrity in order to establish a systematic management framework, improve equipment technology and then increase economic benefits for enterprises.

2. Overview of A Equipment Integrity Management System

2.1. Concept

Equipment integrity management system refers to the policies, strategies, objectives, plans and activities of enterprise equipment integrity management, as well as the necessary procedures and organizational structure for the planning, implementation and improvement of the above contents.

A equipment integrity management system inherits the good practice of cementing equipment management through the integration of management and technology, introduces and innovates equipment management concepts and technical tools and makes them organically integrated. Establish an equipment integrity management system with risk management and control as the main line and an equipment integrity information platform with the concept of "cockpit", integrate equipment professional management with technical tools, realize equipment management institutionalization, system flow, process form, form informationization, and achieve five integrations of organizational structure, management process integration, documents, preventive work and technical tools.

2.2. Construction Basis of Equipment Integrity Management System

A the basis of equipment integrity management construction is mainly from three aspects: theoretical basis, compilation basis, implementation basis, theoretical basis as the basis, compilation basis as the guide and implementation basis as the core to establish and improve the cementing equipment integrity management system.

2.3. Position and Function

The equipment integrity management system of A is an important part of the enterprise integrated management system, which is integrated with other management systems (safety and environmental protection, etc.). Its goal is to establish "equipment integrity management system", which is the combination of three levels of management technology and economy. "Safety" takes "risk management" as the main means and core throughout the whole life cycle management of equipment and focuses on controlling (design, supervision, inspection and maintenance, etc.), reliability (ITPM defect management), economy (KPI cost management), etc. The equipment integrity management system pays attention to the combination with actual combat, which is systematic, extensible and replicable after the equipment management is worked. It can play the role and effect of inheriting the characteristics of cementing enterprise equipment management and optimizing and improving the existing equipment management. At the same time, it is beneficial to cultivate and establish the idea of risk management and systematic management, adopt standardized equipment management and improve equipment technology, and embody the standardization of management and the advancement of technology.

2.4. Necessity of Construction

(1) The need to improve the management of equipment and facilities. Through the establishment of equipment integrity management system, the periodic inspection, maintenance and repair of equipment can be realized, and the potential failure problems of equipment can be found and prevented in time to improve the reliability and availability of equipment.

(2) The demand of economic management of equipment and facilities. The construction of equipment integrity management system can prolong the service life of equipment, the damage and maintenance frequency of equipment and the maintenance cost of equipment through reasonable equipment maintenance plan and maintenance process.

(3) The need to strengthen the whole life cycle management of equipment and facilities In view of the present situation of the whole life cycle management, it is necessary to strengthen the whole management of equipment and facilities in four stages: planning, investment, design, construction, operation, maintenance and waste disposal. In the management integrity construction, technical integrity construction and economic integrity construction, the different characteristics of equipment and facilities in each stage of the life cycle are comprehensively considered, and then the equipment and facilities management work is carried out systematically and effectively.

3. Equipment Integrity Management System Implementation and Achievement Display of company A

3.1. Implementation of Equipment Integrity Management System of company A

First of all, communicate with the professors of professional universities to sort out and summarize the equipment integrity theory, and summarize the equipment integrity management theory suitable for A itself Secondly, conduct research and interview for equipment integrity management in the same industry; Then complete the preparation of the first draft of equipment integrity system documents such as manual procedure documents; Finally, the grass-roots units carry out the construction of equipment integrity management demonstration team in A, formulate the equipment integrity demonstration squadron scheme and digital cementing squadron scheme, and organize the "three standards and one standard" team to observe and exchange. The grass-roots units complete the self-acceptance of equipment integrity demonstration team and the pre-acceptance of equipment integrity demonstration team at the level.

3.2. Equipment Integrity Management System Achievement Display of Company A

3.2.1. General Description

During the construction of the equipment integrity management system, the running model of the system is established The focus of equipment management reflects the characteristics of bottom-up, giving full play to professional management advantages in business control stage, following PDCA cycle in business execution stage, finding equipment risks and abnormal equipment status in advance through hazard identification and risk assessment, and actively preventing equipment failures or accidents On the basis of running architecture, the equipment integrity management system adopts the equipment management process model with process/task as the main line, and establishes the relationship between equipment and organization personnel through process/task Equipment integrity management system documents are divided into three levels of pyramid type. The first level is programmatic document, which clarifies the system framework, commitment, policy and target, organization and division of responsibilities. The corresponding document is equipment integrity management manual The second-level document is the guiding document of the code of conduct, which clarifies that the corresponding documents such as "who does what and to what extent" are the equipment integrity management program documents. The third level documents are equipment integrity management system and technical documents, which clarify the contents of grass-roots operations such as "when to do what to do", etc. The corresponding documents are equipment integrity management operation procedures, equipment integrity risk classification management documents, equipment integrity technical manuals and checklists, etc.

3.2.2. Equipment Integrity Management Manual of Company A

Equipment Integrity Management Manual defines the framework of equipment integrity management system, equipment policy, strategic objectives, organization and division of responsibilities. It is a programmatic document of equipment management. The equipment integrity management manual consists of 9 first-level elements and 43 second-level elements. The main contents include principles, scope, management objectives, working principles, management institutions and responsibilities. The management elements and requirements of equipment life cycle integrity management. In terms of scope, the manual stipulates the principles and general requirements of equipment integrity management within the scope, the general requirements of planning, supporting implementation and operation inspection and performance evaluation improvement, stipulates 14 individual equipment management terms, and determines four principles of closed-loop management, integrity management, risk management and life cycle value management. At the same time, the four management objectives of safety, integrity, economy and efficiency and eight integrity management indicators are defined to make the whole life cycle management of equipment digital, intelligent and visualized. Clarify the responsibilities of each department, put forward requirements for on-site management and improvement activities of education and training, and comprehensively divide the equipment life cycle management into 23 management links. Establish and improve the performance monitoring system, carry out internal inspection and tracking activities, internal review and third-party evaluation. Carry out integrity management audit to clarify management responsibilities, management content requirements and key management elements. Take corrective and preventive measures to determine the improvement of innovation and incentive system.

3.2.3. Device Integrity Management Program File of Company A

According to the total 18 program files, each link of equipment management is refined and compiled to form a total of 23 program files. Classify the program files according to the whole life cycle management of equipment, including equipment pre-management, use management, comprehensive management and risk management. Each procedure document clearly defines the corresponding purpose, scope of application, responsibilities and management process. Establish a mind map for each program, clearly organize and represent each program document, clarify the purpose of the program document, the scope of application, the division of responsibilities, the division of responsibilities, the key requirements and other matters needing attention. Each program establishes a management flow chart to show the necessary management to complete each equipment management task through the management module description.

3.2.4. Operating Procedures for Equipment Integrity Management of Company A

Operating procedures for equipment integrity management standardize post safety operation behavior. Operating procedures cover five types of equipment, such as cementing special vehicles, production auxiliary equipment, canteen, living equipment, maintenance equipment, laboratory instruments and so on. The operating procedures include the scope of application, inspection, operation, operation, maintenance, disassembly and other equipment and facilities before installation and start-up, and the safe operation requirements. Equipment Integrity Operation Procedure document provides detailed operation steps and guidance, ensures the consistency and standardization of operation, enables personnel to operate in accordance with the unified operation when performing tasks, which is conducive to improving work efficiency and ensuring the safety of personnel and equipment, and also provides corresponding reference materials for staff training and education.

3.2.5. Equipment Integrity Risk Hierarchical Management Document of Company A

Risk classification management documents shall be managed according to the principle of "identification, adequate measures, effective rating, quantification, classification and control" for equipment safety risks. Firstly, the risks that may exist in production activities such as operation, maintenance, inspection and repair of equipment and facilities are identified. Secondly, the risk assessment matrix method and operation condition hazard method are used to quantify the equipment safety risk level and divide it into four levels: "significant risk, greater risk, general risk and low risk". After that, according to the identification and evaluation results of equipment safety risks, the equipment safety risk management and control list is compiled, and the equipment safety risks are managed by list system. Finally, formulate corresponding control measures, such as low risk, general risk, post checklist and roving checklist; Formulate risk prevention and control plans for key risks determined by major risks and organize relevant reviews; Formulate emergency disposal procedures for special equipment; Equipment change four new management implementation related procedures.

3.2.6. Technical Manual for Equipment Integrity of Company A

The Technical Manual for Equipment Integrity establishes the configuration list of all equipment and facilities in use, clarifies the performance, structure and parameter configuration requirements of various equipment and facilities according to the management requirements of complete sets of equipment and single equipment, technical installation, layout inspection, maintenance contents, periodic inspection requirements, etc., and establishes technical specifications such as automatic construction of drilling rig pump management instead of oil by electricity and gas.

4. Future Prospect of Equipment Integrity Management System of Company A

4.1. Training and Education

Internalize and externalize the concept of equipment integrity management by providing employees with relevant training on equipment integrity management. It can not only improve employees' awareness of equipment safety, but also improve equipment production efficiency and prolong equipment service life, and the risk of equipment failure and accident.

4.2. Optimization Plan

4.2.1. Improvement of Related Documents

Opportunities for improvement can be identified by periodically reviewing documentation related to equipment integrity as the reality changes and updated to reflect the latest practices and technologies. Help ensure that the equipment integrity management system is always in an evolving state to adapt to new challenges and technologies.

4.2.2. Strengthen the Evaluation Index of Equipment Integrity Management

By defining the "quantitative + qualitative" equipment integrity evaluation index, establishing the evaluation documents of equipment management at different levels, strengthening the guiding role of the index, providing the evaluation support of equipment integrity management degree for equipment managers and providing the basis for improvement.

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