Application Analysis of Oil and Gas Safety Active Protection System in the Sealing of Large External Floating Roof Tanks

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Abstract. In the use of large-scale external floating roof storage tanks, the application performance of sealing problems is very critical, which is related to the safety of storage tanks to a certain extent. In the practical application of storage tanks, it is found that the main cause of fire problems in large oil storage tanks with external floating roof is caused by sealing problems. Therefore, it is very important to deal with the sealing performance of large-scale external floating roof tanks when they are put into use. In this paper, the active safety protection system for large-scale external floating roof storage tanks is analyzed, and its application is analyzed, including its structural design, functional design and working principle design, and its specific application in XX project is put forward.

Keywords: Large external floating roof tank, sealing, oil and gas safety active protection system.

1. Introduction
Petroleum resource is an important resource used in industrial production in China at present, and plays a very important role in the safety production in China. In the process of using oil resources, it is very important to store oil resources. In the current oil storage process in China, large-scale external floating roof storage tanks are often used as storage devices. However, in the specific working process, the fire will be affected by the sealing problem of oil storage tanks. According to relevant investigations, in the use of large-scale external floating roof tanks. The loss of sealing performance of sealing ring is the main problem of oil fire, and the proportion of fire accidents induced by sealing ring is about 75%. Therefore, in the current use of large-scale external floating roof tanks, in order to ensure the safety of oil resources storage and use, the sealed tanks should be sealed to ensure more effective use. The application of active protection system for oil and gas safety is of great significance to the sealing safety management and control of large-scale external floating roof storage tanks.

2. Application importance of oil and gas safety active protection system
The active protection system for sealing oil and gas safety of large-scale external floating roof storage tanks is a practical control for the working and running safety of floating roof oil storage tanks, which is of great significance to the working and running of the system. Through the application of oil and gas safety active protection system, the problem of tank fire in the traditional tank working process can be reduced to the greatest extent. In the actual application process of the system, it can complete the...
automatic sealing performance detection, and improve the fire prevention and control ability of the storage tank, so as to ensure that the oil and gas safety system is more effective, and also can maximize the use effect of the system, and ensure the safety of the large floating roof storage tank.

3. Design of sealing oil and gas safety active protection system for large external floating roof storage tank

Sealing of large-scale external floating roof storage tanks, especially the design and application of safety active protection system, plays a very important role in the storage and use of petroleum resources. Therefore, in the current research on oil resources storage, relevant experts have designed the active protection system for sealing oil and gas safety of large-scale external floating roof storage tanks in detail, and the following analysis and research on its system design.

(1) Overall structure design of the system

In the design process of sealing oil-gas safety protection system for large-scale external floating roof storage tanks, the design and application of its overall structure is very important, which is related to the operation effect of oil-gas safety active protection system. In the specific structural design process, it includes two modules: oxygen concentration analysis and inerting protection. In the process of actual system operation, the whole design and analysis of the system can also be completed. In the actual operation process of the system, nitrogen can be used as inerting medium to complete the sealing defense in the sealing ring area of large-scale external floating roof storage tank, thus improving the overall defense of the system and implementing the overall defense of large-scale external floating roof storage tank system. In the whole system operation process, its main organizational structure also includes network hierarchy and computer monitoring system structure. On the one hand, the network structure of the large-scale external floating roof tank sealing safety protection system is connected by Ethernet. In the actual application process, the completion of data exchange within the system has an important impact on the overall operation of the system. On the other hand, in the process of system structure design, the actual design of video surveillance system is completed. During the operation of the specific system, the video monitoring system can complete the real-time monitoring of fire and combustible gas, so as to ensure that the overall operation of the system is more reasonable. It can also improve the overall protection performance of the system.

(2) System active protection function design

In the specific operation process of the oil and gas safety active protection system, the safety active protection function is designed as a whole to ensure more effective application of the system. Its main safety protection functions include the following contents: ① The safety protection work in the main body of the system is too heavy, so it is possible to analyze the state of oil, gas and oxygen in the seal ring of the storage tank by using the live detection technology, and in the actual system operation process, it mainly completes the gas content detection and the use state of the system. ② When the system is put into use, it has a certain safety protection function, which can realize the safety risk identification of the sealing ring of the storage tank. It mainly includes the identification of fire hazard and explosion hazard. Complete effective protection of the system through safety hazards. ③ In the process of system function design, the safety protection function of the whole system is designed to ensure that the system can protect the seal ring of the storage tank under severe weather such as lightning and high temperature, and ensure that the system works normally. ④ In the process of system function design, it includes data monitoring of the whole running state of the system.

(3) System active protection process design

In the design process of active protection system for sealing safety of large-scale external floating roof storage tanks, it is very critical to shoot the boundary according to the application process of the system, which is related to the actual operation effect of the system to a certain extent, and ensures the more effective application of the system. In the actual system application process, the system application process design mainly includes the following contents: starting the emergency protection device-running the sampling pump-sampling electromagnetic valve-displaying the data after delaying Tn-confirming whether the system working link is safe-starting the safety defense alarm. Through the design of the
system active defense protection process, the overall application of the system is ensured to be reasonable. In the actual system active protection design process, it also needs to analyze the system data through the analyzer and the monitoring host, so as to determine the working state of the protection system. In the actual system protection detection process, it mainly completes the oil and gas detection and oxygen detection of the sealing ring of the large-scale external floating roof storage tank. Table 1 below summarizes the main points of the system workflow.

| Workflow of system protection | Analysis of key points of work |
|------------------------------|--------------------------------|
| Key points of gas analysis   | After a series of treatments, such as cock valve, filter, flame arrester, sampling electromagnetic valve, sampling pump and voltage stabilization, it enters the infrared detector to analyze the oil and gas concentration of the sample gas, and the oxygen detector to detect and analyze the oxygen concentration of the sample gas. |
| Key points of safety judgment process | Especially, the PLC inside the safety protection system completes the command sending and command recovery control to ensure the effective operation of the system. |
| Inerting protection | Executive components such as partition solenoid valve and partition pressure reducing valve of inert gas control assembly are in automatic standby state at ordinary times, and their behavior is controlled by electronic control device. |

(4) Design of relevant system parameters

In the actual design process of this system, it is also very critical to design the operating parameters of the system. The design of the overall operating parameters of the system also has an important impact on the operating effect of the system, and is also related to the safety protection of the sealing of large-scale external floating roof tanks to a certain extent. In the process of parameter design, it is important to complete the calculation of nitrogen required for storage tanks, the design calculation of pipelines and nozzles, and the design calculation of nitrogen injection nozzles. The following is a practical analysis of each parameter design link.

① In the process of parameter design and calculation of active safety protection system, it is very important to complete the calculation of nitrogen required by storage tank, which is of great significance to the nitrogen safety protection of the system and the overall safety protection operation of the system. During the actual operation of the system, the calculation method of nitrogen quantity in the internal storage tank is: the internal diameter of the storage tank ×π× the cross-sectional area of the sealing ring area. Table 2 below shows the calculation of specific parameters of nitrogen required for storage tanks. The actual calculated value is 26.41m³, but after the actual application, the numerical gas demand will increase by about 8%, so it is suitable to control the injection quantity at about 28m³ [1].

| Table 2. Parameter design of nitrogen required for storage tank |
|---------------------------------------------------------------|
| Parameter design                                             | 0.140158m² |
| Cross-sectional area of sealing ring area                     | 60 m       |
| Internal diameter of storage tank                             | 26.41m³    |

② In the process of system parameter design, it is very important to complete the design of nitrogen injection pipeline parameters, which is also related to the overall design and operation of the system. In the actual design process, the ground pipeline length of the whole safety protection system is 110m, and the length from the tank to the cofferdam of the system reaches 80m, so the overall pipeline length is designed as 190m. In the actual pipe diameter design process, we should refer to the nitrogen density, kinematic viscosity and other related factors for design analysis. In this system design process, DN32
pipe diameter is selected as the overall pipe diameter of the system, which also plays an important role in the system operation [2].

③ In the process of system parameter design, the number of nozzles in the system is also calculated. During the overall design of the system, Pt05 special nozzle is selected. It has good working performance and anti-corrosion performance, and its working operation has an important impact on the overall operation of the system. In the specific design and calculation process, it is necessary to know the flow rate and rated flow rate of a single storage tank. In actual calculation, the flow rate/rated flow rate of a single storage tank is the application number of nozzles. Table 3 below shows the design parameters of sprinkler system in the process of system design.

| Specific parameter name        | Parameter design |
|-------------------------------|-----------------|
| Single tank flow              | 104m³/h         |
| Rated flow                    | 4.5m³/h         |
| Number design of nozzles      | 23.11≈23        |

4. Specific analysis of active protection system for oil and gas safety

In order to complete the system operation design, the design and application of the system are completed after the completion of this design. S oil company applies oil and gas safety active protection system to 50000m³ storage tank. After the specific application of the system, the safety risk of the tank is mainly identified. ① There are explosive and elastic gases near the sealing ring of the tank. ② The problem of electrostatic discharge occurs in the sealing body of the storage tank, and it is easy to cause explosion hazards in thunderstorm weather. Through specific system processing and corresponding integration, s oil company has completed the safety protection of storage tanks [3].

5. Conclusions

In this paper, the design and application of oil and gas safety active protection system in the use of large-scale external floating roof storage tanks are described with specific case application and actual design. It has a good safety protection effect, and I hope this paper can be helpful to the specific design and application of the system.

References

[1] Lang Xuqing, Jiang Chunming, Mou Xiaodong, et al. Application research of compound fire extinguishing device in sealing ring of floating roof storage tank [J]. Industrial Safety and Environmental Protection, 2019, 45(8):41-44.
[2] Wu Guoqiang, Zou Le. Research on the Existing Problems and Countermeasures of Large-scale External Floating Roof Tank Sealing Device [J]. Real Estate Guide, 2019, 000(6):243-243.
[3] Li Haocen, Ma Duanzhu, Lou Renjie, et al. Research on the mechanism of lightning strikes and safety evaluation methods for floating roof storage tanks [J]. Petroleum Depots and Gas Stations, 2020(1):14-18.