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ANALYSIS OF FIRE WATER RESERVOIR AT ONSHORE RECEIVING FACILITY (ORF) PT XYZ

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ABSTRACT

The increasing number of fire incidents at oil and gas facilities in recent years, along with the results of fire risk assessments at the Onshore Receiving Facility (ORF) at PT XYZ, which is still ranked as medium, necessitates efforts to reduce the risk level to low. One such effort involves evaluating and developing the fire water reservoir at the ORF facility to ensure its adequacy according to standards. This research aims to enhance operational safety and environmental protection, considering the high fire risk at gas transmission facilities. The research methods include identifying fire-fighting facilities, calculating water requirements, and evaluating the capacity of existing reservoirs. Based on the analysis, a new reservoir was designed with estimated costs, locations, and alternatives to meet the fire-fighting water needs at the ORF. The fire-fighting facility at the ORF of PT XYZ, located in a densely populated area, has a water capacity of 16 m^3, but the ideal requirement is 43 m^3. It is recommended to build a 30 m^3 ground tank or explore other alternatives, such as panel tanks, sea water, or PLN hydrant networks, to improve readiness for major fires and protect public safety around the ORF. The level of fire risk at the ORF of PT XYZ is categorized as medium (yellow). Therefore, the solution could involve building a new reservoir or a panel tank that is more resistant to the risk of cracks or leaks due to land subsidence or shifting.

KEYWORDS fire protection, fire risk analysis, onshore receiving facility (ORF), operational safety, water reservoir

INTRODUCTION

Occupational safety in the oil and gas sector is very important due to the high risk of fire (Abdelrahim et al., 2023; Ajmal et al., 2022; Edmund et al., 2023; Nkrumah et al., 2021; Pishgar et al., 2021). Major incidents at Indonesia's oil and gas facilities, such as fires at the Balongan Refinery (March 2021), the Cilacap Refinery (June 2021), and the Plumpang gas pipeline (March 2023), demonstrate the need for reliable firefighting systems and adequate supporting infrastructure for a quick and efficient response.

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Gas distribution facilities, such as PT XYZ's *Onshore Receiving Facility* (ORF), face the risk of fire, which can disrupt operations and cause large losses if not managed properly. Based on the results of the fire risk analysis conducted using the *NFPA 59A* risk matrix, the fire risk level in the ORF is categorized as medium. These risks can be minimized to a low-risk category with appropriate mitigation measures, including the development of better firefighting systems. The fire risk management strategy involves the development and optimization of water reservoirs as the main source for fire extinguishing (Neidermeier et al., 2023; "Occupational Health and Safety Management in the Extractive Industry: An Exploratory Study of the Ghanaian Oil and Gas Industry," 2022; Palaiologou et al., 2018; Rodríguez et al., 2023; Talukdar et al., 2024).

Previous research conducted by Rozuhan (2021) examined the reliability of fire protection systems at offshore oil facilities, showing that the proper design and management of fire suppression systems can significantly reduce the risk and impact of fire incidents. Other studies highlight the importance of adequate water availability in gas distribution facilities to ensure the effectiveness of fire suppression systems in emergency situations. These studies reinforce the argument that the existence of adequate water reservoirs is an essential part of fire risk management in the oil and gas industry.

The presence of adequate water reservoirs in the ORF is essential to ensure a rapid emergency response in the event of a fire. With direct access to extinguishing water, fire teams can act immediately without waiting for external supplies, thus reducing damage and minimizing operational disruption after a fire.

The development of reliable fire extinguishing systems is not only related to operational safety but is also important in efforts to protect the environment. Fires at gas distribution facilities have the potential to cause significant air pollution and pose a risk of contamination to the surrounding soil and water (Chen et al., 2023; Denisov et al., 2023; Md. Selim Reza, 2018; Walter et al., 2022). Quickly putting out fires protects the company's assets and operations while helping maintain the quality of the environment around the facility.

The development of a firefighting water reservoir at the ORF is a strategic step to maintain safety, operational sustainability, and reduce the environmental impact of fires. This study analyzes the needs and effectiveness of these reservoirs as part of comprehensive risk mitigation and is expected to contribute to improving safety in the gas distribution industry and environmental protection.

The conclusion of this study emphasizes the importance of fire safety systems in the oil and gas sector, especially in relation to the high risks faced by gas distribution facilities such as *Onshore Receiving Facilities* (ORF). Through fire risk analysis using the *NFPA 59A* risk matrix, this study shows that the fire risk level in the ORF is currently in the medium category and can be downgraded to a low

category with appropriate mitigation measures, including the development of better fire extinguishing systems. The study also highlights the important role of water reservoirs as a primary source of fire suppression, allowing for rapid responses without waiting for external supplies. Previous research, such as that conducted by Rozuhan (2021) on the reliability of fire protection systems in offshore facilities, as well as other studies that emphasize the importance of water availability in gas distribution facilities, reinforce the finding that adequate water reservoirs are a key component in mitigating fire risk in the oil and gas industry. The novelty of this research lies in its focus on optimizing water reservoirs at ORF facilities, which has not been widely discussed in previous research.

The purpose of this study is to evaluate the effectiveness of water reservoirs in reducing the risk of fire in gas distribution facilities, which can improve safety, operational sustainability, and environmental protection. The implications of these findings are crucial for the development of better fire protection strategies in the oil and gas industry, as well as for maintaining environmental quality and minimizing potential risks.

RESEARCH METHOD

The method of implementation of this study includes structured stages designed to identify, evaluate, and develop solutions to the problem of fire extinguishing water capacity at the *ORF* PT XYZ facility. Data collection was carried out from February to April 2024, utilizing primary data through in-depth interviews with the company and related stakeholders, as well as secondary data from internal company documents, including technical studies and previous research results.

The first stage is the identification of firefighting facilities, which is carried out through direct observation and review of documents related to the capacity of available facilities, such as fire extinguishers, *APABs* (Automatic Fire Alarm and Fire Suppression System), fire trucks, portable water tanks, and ground tanks. The evaluation of the extinguishing water needs was then carried out by calculating water requirements based on the area and *API 2030* and *NFPA* standards, identifying that the ideal water requirement of 43 m^3 far exceeded the available capacity of 16 m^3.

Furthermore, an additional reservoir was designed to meet the water capacity shortage of 27 m^3. The proposed design includes a ground tank with a capacity of 30 m^3 and other alternatives, such as panel tanks, seawater utilization, or connection to PLN's hydrant network. The cost of building the ground tank is estimated at Rp. 90 million.

RESULT AND DISCUSSION

Identify Fire Fighting Facilities at ORF

ORF facilities are located in a densely populated area surrounded by industrial, commercial, and public infrastructure facilities such as apartments, malls, and offices. This proximity increases the risk of fires that can endanger the facilities, public safety, and disrupt the surrounding area.

The ORF facility has been equipped with a number of firefighting equipment to mitigate fire risks. The availability of 20 units of Light Fire Extinguishers (APAR), 4 units of Heavy Fire Extinguishers (APAB), and 1 unit of Fire Truck with a water tank capacity of 6,000 liters (6 m^3) is an important step in ensuring that this facility can respond quickly to fire emergencies. The existence of a Portable Water Storage Tank with a capacity of 4 m^3 and a Water Ground Tank with a capacity of 6 m^3 adds a layer of defense in providing sufficient water supply to overcome fire incidents.

This facility is adequate in the context of minimum standards, but the capacity of such water tanks and fire extinguishing equipment needs to be further evaluated in relation to the scale of fire potential at ORF facilities adjacent to high-risk areas. Based on the standards set by the National Fire Protection Association (NFPA), the determination of the capacity of a fire extinguishing system must consider the exposed area, the amount of flammable material, and the potential for the fire to spread to other facilities around the fire site.

Fire extinguishing equipment can handle minor incidents, but in the absence of an adequate water backup system, large-scale or complex fires involving high-risk industrial facilities can lead to protection system failures. Facilities such as gas compressor stations and power plants, which have high-pressure fuels and electrical equipment, can exacerbate the escalation of fires if not brought under control immediately.

Adequate water supply is a key element in dealing with fires in gas facilities, especially in areas with a high risk of fire. Limited water tank capacity is often an obstacle to efficient firefighting efforts, especially in facilities that have a direct connection to the public infrastructure network.

The water capacity available in the ORF has been evaluated and attributed to the potential for large-scale fires that can occur in dense industrial and residential environments. While the availability of fire trucks and portable water storage is sufficient for initial emergency situations, the availability of additional water reservoirs or cooperation with external water provider facilities needs to be considered to anticipate the possibility of a greater fire.

The development of the fire extinguishing system, including increasing water capacity and integration with additional water storage facilities, is a step that needs

to be taken by ORF PT XYZ to further ensure the safety of the facility and the surrounding environment.

Evaluation of the Adequacy of Fire Hydrants at ORF

From the data presented, the evaluation of the adequacy of firefighting water at *ORF* PT XYZ shows that there is an imbalance between water needs and the currently available water capacity. In fire scenarios involving gas leaks in the gas filter and pressure letdown lines, the calculation of water requirements is based on *API 2030* standards and minimum outage times according to *NFPA 20* and *NFPA 14*, with a total water requirement of 43 m^3 for one hour of outage. The current water capacity at *ORF* PT XYZ is only 16 m^3, consisting of Portable Water Storage (4 m^3), Water Ground Tank (6 m^3), and Fire Truck Tank (6 m^3). The total amount of water availability is 27 m^3, which indicates the need to increase the water storage capacity at the site.

Water Demand Analysis Based on Industry Standards

According to the standard used in the calculation, namely API 2030, water needs are determined based on the area of exposure and the water application rate per square meter (10.4 liters/minute/m^2). The total area calculated in this scenario is 69 m^2, which includes the leakage area in the gas filter and the pressure letdown line. Given the importance of ensuring adequate water spraying to cool equipment and protect firefighting personnel, this standard provides a clear picture that 43 m^3 of water is the minimum requirement that must be available in one hour of extinguishing operation.

Khidirov's research states that the existence of adequate water storage capacity is critical in large-scale fire scenarios, especially in high-risk industrial facilities such as ORF. Failure to provide an adequate amount of water can slow down the fire response and exacerbate the escalation of fires, potentially causing more severe damage and threatening public safety and the surrounding environment.

Proposed Solutions to Address Water Scarcity

To cover the shortfall of 27 m^3 of water capacity, several options can be considered:

a. Construction of Additional Ground Tank (30 m^3)

One of the proposed solutions is the construction of a fire hydrant reservoir with a capacity of 30 m^3. This design involves creating a tank with dimensions of 4 m x 3 m x 2.5 m, which is equipped with a void to prevent overflow if the water is full. The proposed location is a vacant lot in front of the PT XYZ Control Building, which is close to the *ORF* and fire truck parking area. This location is strategic

because it is at a high altitude, so it is safe from the risk of flooding due to seawater (*rob*). With an estimated construction cost of Rp 90 million (Rp 3 million/m³), this is an effective and efficient solution in terms of cost and accessibility.

b. Panel Tank or Modular Tank

Another option is the use of Panel Tanks/Modular Tanks, which have the advantage of faster installation times and do not require excavation. The estimated cost is around IDR 135 million for a capacity of 30 m³ (based on prices on online platforms such as Tokopedia). This solution can be considered if implementation time is a top priority. However, the downside of this solution is the high cost that may not be worth the time gains.

c. Use of Seawater

Another alternative is to take advantage of the seawater available around *ORF* PT XYZ. Seawater can be used as a firefighting medium, but it requires the installation of additional pumps and pipes to deliver that water to the extinguishing site. The main challenge of this option is the risk of equipment corrosion due to the abrasive nature of seawater, as well as the need for more intensive maintenance. According to *Assidik*, the use of seawater for firefighting requires special care to avoid long-term damage to equipment.

d. Hydrant Pipeline Connection to Nearest Company

The last alternative is to collaborate with a neighboring company, *PLN*, to connect *PLN*'s hydrant pipeline network in the area. This option involves coordinating with *PLN* to ensure that their water capacity is sufficient to cover the additional needs at *ORF*. While this solution is promising, the cost of hydrant pipeline installation and routine operations needs to be considered in depth, especially in terms of long-term costs.

Based on the evaluation of the fire hydrant's water needs at *ORF*, it is clear that the current water capacity is insufficient to meet the minimum requirements as per *API* and *NFPA* standards. With a water deficit of 27 m³, it is very important for the management of *ORF* to immediately increase the water storage capacity through one of the proposed solutions. The construction of a new ground tank with a capacity of 30 m³ in a strategic location seems to be the best option in terms of cost, accessibility, and ease of maintenance. Other alternatives such as panel tanks, seawater use, or connection to *PLN*'s hydrant network may be considered, depending on priorities and available resources.

CONCLUSION

The conclusion of this study shows that the risk of fire at PT XYZ's *Onshore Receiving Facility* (*ORF*) is in the medium category, with the current water reservoir capacity being less than the ideal requirement of 27 m^3. Therefore, it is recommended to build a new reservoir with a capacity of 30 m^3 in front of the Control Building, with an estimated cost of around Rp 90 million, or make modifications to the existing ground tank. Another alternative that can be considered is to build a panel tank (modular tank) that is more resistant to the risk of damage due to landslides. This research can serve as the basis for improving fire extinguishing systems in gas distribution facilities, as well as helping to improve preparedness in dealing with fire risks. For further research, it is recommended to explore the effectiveness and cost comparisons between the construction of new reservoirs and modifications of existing systems, as well as to examine the environmental impact of each of the proposed alternatives.

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