MPPKI (June, 2024) Vol. 7 No. 6

ISSN 2597– 6052

DOI: https://doi.org/10.56338/mppki.v7i6.5234

MPPKI

Media Publikasi Promosi Kesehatan Indonesia

The Indonesian Journal of Health Promotion

Research Articles *Open Access*

Analysis of Fire Emergency Response Readiness at Oil and Gas Company

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ABSTRACT

Introduction: Fire is one of the dangers that is often found in the oil and gas industry. A fire preparedness system is needed by companies to avoid dangers and risks that have the potential to cause damage, injury or death.

Objective: This research aims to see the readiness of Fire Emergency Response system. The results of this research can be used as a basis for developing policies and programs Fire Emergency Response work.

Method: This research uses the FERRAT Form as the basis for the research. The instrument used in this research is the FERRAT Form. Field observations were carried out to see directly the field conditions and the form filling process.

Result: The results of this research show that the company's readiness in implementing the Fire Emergency Response system as a whole has reached an average of <90% with an overall value of 40.33%.

Conclusion: It is hoped that with this research, companies can carry out independent evaluations and immediately initiate improvements related to risk-based system design, adequacy levels according to potential fire risks and ensuring emergency response equipment is always in a ready-to-operate and alert condition

Keywords: Emergency Response; Fire; Oil and Gas; Fire Preparedness System

INTRODUCTION

Blackley (1) defines the oil and gas industry as an industry engaged in the removal of oil and gas reserves that are under the earth to the surface of the earth. Over time, the oil and gas industry has evolved and its use has expanded and become an important part of the world economy today (2). The oil and gas industry has an important role in national development both from the energy sector and also raw materials. This is because the oil and gas industry is one of the largest contributors to foreign exchange in Indonesia (3).

Basically, the oil and gas industry includes many work processes, such as exploration, drilling, processing, and so on. One of the biggest risk factors in the oil and gas industry is fire and explosion (4). This is influenced by the work process as well as components in the company environment, such as steam, well gas, and hydrogen sulfide (5).

Based on data released by the U.S. Fire Administration and the National Fire Protection Association's, in 2020, there were 364,100 fire cases, 2,360 fatalities, 11,010 injuries, and losses of 7.55 billion US dollars (6). Some examples of accidents in the oil and gas industry are the *naphtha tank fire at the ITC Tank Farm in Houston* and *the toluene tank fire at Sinopec Dalian Petrochemical Company* (7). A similar incident also occurred in Indonesia, according to Ayomi Amindoni, there was a fire at one of the petroleum industry refineries located in Indramayu, West Java caused by a tank leak and lack of fire safety systems..

Oil and gas companies are required to have a commitment to maintaining safety in every work process and workplace activity (9). One of the preventive measures to avoid fire and explosion is *Fire Emergency Response*. *Fire Emergency Response* is a system that ensures that a building has been designed in such a way as to ensure the safety and security of people around from danger. The implementation of this fire preparedness system is carried out to avoid hazards and risks that have the potential to cause damage, injury, or death (11). According to research conducted by Nwabueze (2016), regarding fire hazard management with the title "Liquid Hydrocarbon Storage - How Prepared is your Facility?" which focuses on facilities with liquid hydrocarbon storage tanks *(oil and fuel*), this research discusses the preparations made at each facility, which can lead to accidents. In his research he considered tank characteristics, logistics facilities, code restrictions, foam quality and lastly emergency preparedness practices by the facility. Not just limited to storage tanks, he emphasized that for any organization or operator to successfully respond to a fire emergency, adequate attention must be paid. Starting from fire pre-planning, staff training, emergency preparedness reviews and finally conducting regular planning testing of emergency response plans (12).

PT X is a State-Owned Enterprise (SOE) that has been engaged in providing sustainable energy evenly. In running its business as an integrated national energy company in Indonesia, PT X is divided into 6 (six) *Subholdings*. PT X has several branch sectors, including *upstream, oil and gas, refinery, geothermal, gas station, shipping,* and *liquified natural gas*. Despite having a fire safety system, PT X has experienced several problems in fire prevention. This fire caused a loss of approximately 1.2 trillion. The investigation that has been carried out shows several results, namely: the need to improve*fire system* management and management of changes in facility *design* and operations, the adequacy of facilities and infrastructure in accordance with fire risk, and the readiness of extinguishing equipment and firefighting agents in the field. In addition, the feasibility of fire emergency response preparedness from both regulations and company management also needs to be improved. Therefore, it is necessary to reassess the aspects of standards, designs and procedures, adequacy of resources & equipment, performance, and a more in-depth study of the fire management system at PT X.

METHOD

This study is a cross sectional study using the FERRAT (Fire and Emergency Response Readiness Assessment Tools) form instrument. There are 40 assessment items divided into 3 elements in the FERRAT form. The first element consists of five indicators on fire emergency response preparedness design based on hazard identification and fire risk assessment. The second element contains twenty-one indicators with questions about the availability of facilities and infrastructure in accordance with the expected design. The third element contains fourteen indicators with questions about the readiness of equipment and resources available in the field.

In the FERRAT form, there are four types of questions used to explore the implementation of the FERRAT criteria. These questions are Conformance Test (CT), Frequency Test (FT), Professional Judgement (PJ), and Proportional Test (PT). CT is an assessment by direct comparison of implementation against the FERRAT criteria. FT is a question about how often something must be implemented against the FERRAT criteria / against the applicable procedures / established programs / required coverage, PJ is an assessment based on the opinion of the Assessor / Appraiser regarding the quality or how well the implementation has been carried out against the FERRAT criteria, and PT is an assessment of partial implementation of all FERRAT criteria that must be implemented.

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RESULTS

Overview of Fire & Emergency Response Readiness Assessment Tools (Ferrat) Questionnaire Results

Table 1. Fire and Emergency Response Readiness Assessment Tool (FERRAT) Questionnaire Results

Komponen Utama	SV Results		
	> 90%	70% to < 90%	<70%
Element 1 - Aspects of fire emergency response preparedness design based on hazard identification and fire risk assessment	40%	20%	40%
Element 2 - Aspects of availability of facilities and infrastructure according to the expected design	43%	33%	24%
Element 3 - Readiness aspect of equipment and resources available in the field(readiness)	38%	54%	8%

Table 2. Elements and indicators of the FERRAT form

Element	Indicator
Basic Design & Philosophy	Availability of Basic Design & Philosophy related to Fire aspects
	Basic design of security system for Emergency condition
	Identification of Potential Fire Hazards
	Preparation of Pre-Fire Planning based on Fire Basic Design & Philosophy
	Evaluation of Fire Readiness
Fire & Gas Detection And Emergency Response Resources Adequacy	Emergency Response Command Organization & Facilities
	Competency of Emergency Response Team
	STK Emergency Response
	Fixed Fire & Gas Detection System
	Fire Water Supply
	Cooperation with assistance resources around the location
	Fire Pumps (Fixed and Portable)
	Fire Main Pressure Requirement
	Fire Main, Hydrant & Hose Cabinet
	Fixed Fire Water Spray / sprinkler
	Tank Fire Protection System
	Hose Reel
	Monitor
	Fixed, Semi Fixed, portable Foam System
	Fire Extinguisher
	Fire Alarm / Detection System
	Fire Emergency Vehicle (FEV)
	Foam Agent Stock
	Fire Hose
	CCTV Installation
	Facilities and means of security control
	Availability of Security Manpower
Existing Fire & Emergency Response Resources Readiness	Source Of Water
	Fire Pump
	Fire Water line, Hydrant and Hose Cabinet
	Sprinkler System
	Water Spray Fixed System
	Foam System
	Fire Monitor (Water / Foam)
	Tank Fire Protection System
	Hose reel
	Alarm and Detection System
	Portable & special Fire Extinguisher
	Foam stock
	Fire Emergency Vehicle (FEV)

Table 1. shows the results of the Fire & Emergency Response Readiness Assessment Tools (FERRAT) questionnaire. well because overall the elements that have reached an average greater than < 90% with an overall value of 40.33%. In the first element, the results of the FERRAT questionnaire show that 40% of the preparedness design at PT X has been at an acceptable level. However, 40% of these aspects are still at the not acceptable level and require further improvement. The results of the second element show that 43% of all aspects of facility availability are at an acceptable or very good condition. The results of the third element show that PT X has very good readiness of equipment and resources in the field. In this element, there are 38% of aspect points that are at an acceptable level, 54% are at an adequate level, and only 8% of these aspects require further improvement.

DISCUSSION

Fire disaster preparedness is crucial in the oil and gas industry. Fire disaster preparedness requires effectiveness in procedures, infrastructure, equipment, knowledge and behavior to achieve successful implementation (13). Study conducted by Gary Glauberman (14) on fire preparedness, states that fire training and education is one of the important things that can help workers to understand fire situations. Fire prevention and preparedness means that a fire event has occurred that poses a danger to the safety of life, property, and the environment. Early action at the time of the incident is very important, therefore good knowledge of fire prevention and control is needed (15). In addition to the initial action, a person's personal knowledge related to fire disasters found in the surrounding environment is an important element in preparedness in the face of fire disasters. (16). According to the Minister of Public Works Regulation of Indonesia No. 20 of 2009 on Technical Requirements for Buildings in the 4th annex, the management of fire prevention and pre-incident activities is often referred to as "preplanning" and/or "pre-fire planning". These two things are related, but different. From the perspective of fire prevention, it is assumed that an incident can occur and that efforts are made to prevent it from occurring. Pre-incident management assumes that an incident has already occurred and by using tactics and strategies, and coordinating resources, the impact of the incident on human life and property will be minimized (17).

The five points in the first element regarding fire preparedness include questions regarding the availability of basic & design philosophy related to fire aspects, the availability of basic design of security systems related to emergency conditions , the implementation of identification of potential fire hazards, pre-fire planning, and evaluation of the availability of fire readiness.

According to the Basic & Design Philosophy indicator related to fire aspects, the evaluation was conducted using Conformance Test (CT), and the results showed a score of 120 points and 100% compliance with the evaluation criteria. This score indicates that the Basic Design and Philosophy related to fire aspects are available at the location and meet the applicable criteria. The results of the indicator regarding the availability of the basic design of the security system in connection with emergency conditions carried out using the Proportional Test (PT) showed an assessment result of 120 and met 50% of the assessment criteria. This value indicates that the basic design of the security system for fire incidents is available on site, but is not based on the results of security hazard identification.

The last indicator regarding the evaluation of the availability of fire read iness was carried out using the Proportional Test (PT), resulting in an assessment of 96 and meeting 80% of the assessment criteria. This value shows that the evaluation of the availability of fire readiness has not been carried out periodically in accordance with applicable standards.

Aspects of Availability of Suggestions and Infrastructure as Expected Design

The design of facilities and infrastructure regarding fire is explained in the Minister of Energy and Mineral Resources Regulation number 18 of the Year concerning Safety Inspection of Installation and Equipment in Oil and Gas Business Activities. In the fifth article, it is stated that design review can be carried out on the suitability of the use of standards, risk management, environmental documents, technical specifications, application of good engineering principles, utilization of goods, services, technology, engineering capabilities, and domestic design. Not only in Indonesia, but a study conducted by Ali Sahebi (19) also shows that this implementation is done in other countries. This study explains that factors that can influence fire evacuation systems include fire characteristics, command, operations, worker characteristics, planning, and logistics (19).

To prevent fire hazards must have a system. The system in question aims to protect property and lives in the building in the form of Fire Management (MPK). MPK consists of both active and passive protection systems, fire management teams, and operational procedures (20). In fire prevention and fire fighting, it is important to note tanks can be equipped with a wide variety of accessories (mixer equipment, inerting systems, monitoring instrumentation (level, temperature, controllers, fire proven valves) and each site must maintain an up-to-date database of its tanks, their specifications, and the products they routinely contain (21).

In the second element, there are 37 indicators divided into 21 sub-elements, namely emergency management command organization & facilities, competence of the Emergency Management Team, STK Emergency Response,

fixed fire & gas detection system , availability of fire water supply, cooperation with assistance resources around the location, number and capacity of fire pumps and their availability, fire main pressure requirement, fire main, hydrant & hose cabinet, fixed fire water spray / sprinkler, tank fire protection system, hose reel , availability of monitor, fixed, semi-fixed, and portable foam system, fire extinguisher, Fire Emergency Vehicle (FEV), Foam Agent Stock, fire hose, CCTV installation, security control facilities and facilities, and availability of security manpower. In this second element, there are sub-elements that have not run optimally or have not been carried out routinely. Some of these sub-elements are the 1st, 3rd, 4th, 10th, 11th, 14th, 17th, and 19th sub-elements.

The first sub-element contains the emergency management command organization & facilities. The results in table.4. shows that this indicator was measured using PT and received a score of 40.5 and met 90% of the assessment criteria. This value shows that the Emergency Management Organization (TPKD) at the location (UO / related AP) has been formed and determined through the ratification of the highest leadership, but the Puskodal at the location is not running optimally.

The third sub-element contains the emergency response STK. This sub-element is again divided into two indicators, namely scenario setting and the availability of a community safety management system. The first indicator shows that the assessment result is 40.5 and meets 90% of the assessment criteria. This value indicates that there is an emergency response STK/ Procedure in accordance with the scenario that has been determined, but the STK has not been communicated to all parties involved (including contractors). While this second indicator is measured using PT with an assessment result of 48 and meets 80% of the assessment criteria. This value shows that there is a safety management system for the community, but the training or drilling system has not been carried out regularly.

The fourth sub-element contains a fixed fire & gas detection system. The results show that this indicator is measured using PT with an assessment result of 22.5 and meets 50% of the assessment criteria. This value indicates that the fixed fire & gas detector facilities are less than the number specified in the needs analysis. In addition, the fixed fire & gas det ectors have been installed, but there are still some that are not properly located.

The tenth sub-element contains fixed fire water spray / sprinkler. The results show that this indicator is measured using PT with an assessment result of 20.25 and meets 45% of the assessment criteria. This value indicates that the number of fixed fire water spray / sprinkler system installations is less than the needs determined based on the needs analysis.

The 11th sub-element contains the tank fire protection system. This sub-element is further divided into five indicator points. The first indicator is the availability of cooling facilities. The results show that this indicator is measured using PT with a measurement result of 40.5 and meets 90% of the assessment criteria. This value indicates that the number of cooling facilities available is not sufficient. The second indicator is the connection between cooling facilities and fire water sources. This indicator is measured using CT with an assessment result of 45 and meets 100% of the assessment criteria. This value indicates that there are cooling facilities connected to the fire water source.

The third indicator is the availability of fixed foam system facilities in each stockpile tank. This indicator is measured using PT with an assessment result of 45 and fulfills 100% of the assessment criteria.

The 14th sub-element contains fixed, semi-fixed, and portable foam systems.The results show that this indicator is measured using PT with an assessment result of 36 and meets 80% of the assessment criteria.This value indicates that the number and capacity of foam systems for certain areas have not fully met the needs analysis.

The 17th sub-element contains Foam Agent Stock.The results show that this indicator is measured using PT with an assessment result of 0 and meets 0% of the assessment criteria.This value indicates that there is no ready-to-use foam concentrate with the type and amount that is in accordance with the needs analysis.

The 19th sub-element contains CCTV installation. The results show that this indicator is measured using PT with an assessment result of 0 and meets 0% of the assessment criteria. This value indicates that there is no CCTV installation that reaches all fire-prone areas and has the potential for fire.

Readiness Aspects of Equipment and Resources Available in the Field (*Readiness*)

The maintenance process will affect theavailability of production facilities, production rates,end product quality, production costs, and safety operations. These factors will then affect the company'sprofitability (22). According to Ignatius Derajad Pranowo (22) The maintenance process assists in keeping facilities and equipment running effectively and efficiently and avoiding damage (zero breakdown). In Indonesia, this maintenance is regulated in the Minister of Energy and Mineral Resources Regulation No. 18 of 2008 in Chapter III Article 6 which mentions the obligations in inspection and safety checks. Also based on the Regulation of the Minister of Public Works No. 26/2008, fire safety management elements, especially those related to periodic inspection, care and maintenance activities, fire safety audits and fire drills must be carried out periodically as part of the maintenance activities of active protection facilities installed in buildings (23).

Based on the survey conducted, there are 2 cases of gas station fires in Indragiri Hulu Regency caused by the unavailability and lack of monitoring of active fire protection facilities. The importance of active protection facilities

in gas stations that play an important role as fire detection and extinguishing immediately before officers and fire trucks arrive at the location of the fire (24).

Companies have an obligation to maintain and improve, as well as evaluate policies, programs, procedures, and capabilities using performance objectives, especially regarding disaster preparedness. Companies must improve program effectiveness through evaluating the implementation of changes resulting from preventive and corrective actions. NFPA explained that evaluation should be done periodically and when there is a change in the situation, so that the program is always in accordance with existing conditions (25).

The third element contains 26 indicators with 14 sub-elements. The sub-elements are as follows: source of water, fire pump, fire water line, hydrant and hose cabinet, sprinkler system, water spray fixed system, Foam System, fire monitor, tank fire protection system, hose reel, alarm and detection system, portable & special fire extinguisher, foam stock, Fire Emergency Vehicle (FEV), and facilities and resources for security control. From these 14 sub-elements, three sub-elements do not meet the criteria, specifically sub-elements 11, 13, and 14.

Sub-element 11 pertains to portable & special fire extinguishers available on the field. It consists of two indicators. The first indicator is the implementation and maintenance of portable & special fire extinguishers, including halon systems. According to Table 4, this indicator is measured using PT with an evaluation score of 20% and meets 18 criteria for evaluation. The score indicates that the program and execution of maintenance, inspection, and testing of portable & special fire extinguishers, including halon systems, have not been implemented in accordance with the required regulations. The second indicator is the condition of all equipment, which is in good condition and ready to operate through inspection and testing in the previous year. According to Table 4, this indicator is also measured using PT with a score of 20% and meets 15 criteria for evaluation. The score suggests that the condition of the equipment is not suitable for operation.

Sub-element 13 pertains to the Fire Emergency Vehicle (FEV) available on the field. It consists of two indicators. The first indicator is the implementation and maintenance of the FEV, including pumps, foam pumps, hoses, engines, and other related equipment. According to Table 4, this indicator is measured using PT with a score of 20% and meets 18 criteria for evaluation. The score indicates that the program and execution of maintenance, inspection, and testing of FEVs have not been implemented according to the recommended guidelines. The second indicator is the condition of all equipment, which is in good condition and ready to operate through inspection and testing in the previous year. According to Table 4, this indicator is also measured using PT with a score of 20% and meets 15 criteria for evaluation. The score suggests that the condition of the equipment is not suitable for operation.

Sub-element 14 pertains to facilities and resources for security control available on the field. It consists of two indicators. The first indicator is the implementation of maintenance, inspection, and testing of perimeter fences, security posts, security vehicles, communication systems, access gates (metal detectors, personnel screening, mirrors, logbooks for visitors and vehicles, logbooks for materials, access gates). According to Table 4, this indicator is measured using PT with a score of 20% and meets 18 criteria for evaluation. The score indicates that the implementation of maintenance, inspection, and testing of these facilities and resources has not been carried out in accordance with the required criteria. The second indicator is the condition of all equipment, which is in good condition and ready to operate through inspection and testing in the previous year. According to Table 4, this indicator is also measured using PT with a score of 20% and meets 15 criteria for evaluation. The score suggests that the condition of the equipment is not suitable for operation.

Trikomara in its research (26) uses the inspection safety manual for fire safety in buildings (Pd-T-11-2005-C) with the aim of ensuring that all fire protection equipment is always ready for use with an evaluation of the safety system for fire safety in buildings. In the inspection manual for fire safety in buildings (Pd-T-11-2005-C), it also covers not only the building itself, but also the surrounding area. In this manual, it is fully described how to assess, categorize, and evaluate the criteria for inspection. With this manual, it is assumed that comprehensive inspection can be carried out for prevention, active or passive fire fighting, resulting in a high level of safety system for fire safety in buildings.

By looking at and using the inspection manual for fire safety in buildings, there are several recommendations that can be used to achieve the safety system for fire safety in buildings, such as regular cleaning, maintenance/maintenance on schedule, maintenance and repair on schedule, setting/repair of elements, and completing components that are lacking.

CONCLUSION

According to the data obtained through the completion of the FERRAT form, it can be generally stated that the company has an adequate fire emergency response system. This is evidenced by the data that through three elements of the FERRAT form, the evaluation results are dominated by excellence or very good criteria. However, there are still values with unacceptable criteria, such as: competence of the emergency response team, cooperation

with local support resources, availability of fixed water spray, foam agent stock, and others. In addition to values with unacceptable indicators, the company must also pay attention to indicators that are in the tolerable category. The author hopes that with the evaluation using FERRAT, the company can conduct self-assessment and immediately take corrective action related to system design with a risk basis, level of compliance according to the potential fire risk, and ensuring that emergency response equipment is always in a condition ready to operate and in good condition.

SUGGESTION

Based on the data obtained through the completion of the FERRAT form, it can be generally stated that the company has an adequate fire emergency response system. This is evident from the data that through three elements of the FERRAT form, the evaluation results are dominated by excellence or very good criteria. However, there are still values with unacceptable criteria, such as: competence of the emergency response team, cooperation with local support resources, availability of fixed water spray, foam agent stock, and others. In addition to values with unacceptable indicators, the company must also pay attention to indicators that are in the tolerable category. The author hopes that with the evaluation using FERRAT, the company can conduct self-assessment and immediately take corrective action related to system design with a risk basis, level of compliance according to the potential fire risk, and ensuring that emergency response equipment is always in a condition ready to operate and in good condition.

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