MAINTENANCE STRATEGY DEPLOYMENT OF HVAC SEMI HERMETIC COMPRESSOR USING ANALYTICAL HIERARCHY PROCESS AHP METHOD

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DECLARATION

I declare that this Choose an item. entitled Maintenance Strategy Deployment of HVAC Semi Hermetic Compressor Using Analytical Hierarchy Process (AHP) Method is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : MUHAMAD KHUZAIRI BIN MAZLAN

Date : 19/1/2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Maintenance Technology) with Honours.

Signature :

Supervisor Name : TS. DR. AHMAD FUAD BIN AB GHANI

Date : 19/1/2023

DEDICATION

I am dedicating this thesis to my parents Zawiyah Binti Suleiman and Mazlan Bin Mohamad who give their full support through my ups and downs and also to my siblings Muhammad Shafiq Ashraf Bin Mazlan, NurFarah Hanis Binti Mazlan, Humaira Asyikin Binti Mazlan that always there helps builds my motivation up and cheer me up when i felt lost. Also, a big thanks to my project supervisor Ts. Dr. Ahmad Fuad Bin Ab. Ghani and Ir Mohd Azhar Bin Shah Rizam for the guidance throughout completing this thesis and to all other UteM lecturers. Without their dedication in teaching. I wouldn't reach until this far. Lastly, to my all good friends, classmates and teammates through bittersweet four years' journey. Thank you, I appreciate all the support and good vibe through the process.

ABSTRACT

Analytical Hierarchy process is one of the most complete decisions-based methods since it allows you to hierarchically construct the problem and examine a mix of quantitative andqualitative factors. The Analytical Hierarchy Method is described in detail in this paper (AHP). The paper also investigates the issue of maintenance of HVAC system by using a quantitative method known as the Analytic Hierarchy Process (AHP) for offshore platform, focusing on electrical component, mechanical component, and alternatives types of maintenance such as Preventive Maintenance (PM), Predictive Maintenance (PDM) and Corrective Maintenance (CM). The authors look at a case study of compressor maintenance selection using the AHP process, as well as an overview of compressor testing to see how the answers correlate and compare to other multi-criteria decision analysis tools (MCDM).

Keyword: Semi hermetic compressor, AHP method

ABSTRAK

Proses Hierarki Analitik ialah salah satu kaedah berasaskan keputusan yang paling lengkap kerana ia membolehkan anda membina masalah secara hierarki dan memeriksa gabungan faktor kuantitatif dan kualitatif. Kaedah Hierarki Analitik diterangkan secara terperinci dalam kertas ini (AHP). Kertas kerja ini juga menyiasat isu penyelenggaraan sistem HVAC dengan menggunakan kaedah kuantitatif yang dikenali sebagai Proses Hierarki Analitik (AHP) untuk platform luar pesisir, memfokuskan kepada komponen elektrik, komponen mekanikal, dan jenis penyelenggaraan alternatif seperti Penyelenggaraan Pencegahan (PM), Penyelenggaraan Ramalan (PDM) dan Penyelenggaraan Pembetulan (CM). Penulis melihat kajian kes pemilihan penyelenggaraan pemampat menggunakan proses AHP, serta gambaran keseluruhan ujian pemampat untuk melihat cara jawapan berkait dan dibandingkan dengan alat analisis keputusan berbilang kriteria (MCDM) yang lain.

Kata kunci: Pemampat separa hermetic, Metode AHP

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
HVAC	-	Heat Ventilation Air Conditioning
AHP	-	Analytical Hierarchy Process
IAQ	-	Indoor Air Quality
	-	
	-	
	-	
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CHAPTER 1

INTRODUCTION

1.1 Background

The oil and gas sector may be divided into two categories: upstream and downstream. Upstream systems include exploration and production (E&P) systems. The goal of (E&P) is to locate reservoirs and drill oil and gas wells. While downstream refining and processing of crude oil into finished product before to delivery to the consumer (M. Jones, 2018). Both upstream and downstream operators in Malaysian oil blocks are run by Shell, Petronas, ExxonMobil, and others, to mention a few, and are located in offshore blocks far from shore. Production facilities known as "Platforms" are constructed with complicated types of equipment to extract oil from reservoirs, while residential accommodations are mostly accessible on the mother platform to accommodate personnel. Aside from that, the satellite platform is unmanned, and the worker travels to work from the mother platform by boat every day. HVAC is an abbreviation for heating, ventilation, and air conditioning, and it refers to the equipment, distribution network, and terminals that are used collectively or individually to supply fresh filtered air, heating, cooling, and humidity management in a structure (Roger W.Haines, 2010). HVAC is definitely used in the oil and gas industry, notably on production platforms, satellite platforms, and a variety of crude oil boats delivering crude oil to onshore processing units. Each customer has a unique HVAC system. ExxonMobil, for example, has around 380 systems in total for its platform. As a result, maintenance of each unit and system is required till the end of the lifecycle. This is critical since the cost of the new HVAC system 10 is considerably high as compared to onshore HVAC systems owing to safety requirements compliance (ATEX, IECX). HVAC structure developed for an offshore platform particularly to meet the needs of offshore environments, which are governed by tight laws and standards (DNV). According to (Walter Grondzik, 2007), the primary purpose of an HVAC system is to preserve human comfort and health or to provide a set of environmental conditions for a product process in a conditioned area. The importance of an HVAC system on an offshore platform is to maintain safety by providing pressurisation in the room enclosure while cooling for worker comfort and preventing electrical equipment from malfunctioning due to excessive heat produced.

The problems of managing offshore platform assets have intensified in recent years as a result of the high cost of operation caused by the volatility of the oil price. When facilities get older, maintenance costs rise and more complicated solutions are required; also, replacement of existing parts may become obsolete owing to new technologies created. The incorrect selection of maintenance type for specific equipment contributed to the unexpected failure of HVAC equipment, as the maintenance option entered into the CMMS system was not accurate enough to prevent failure from occurring. A few research on HVAC maintenance utilising AHP have been undertaken. (M. Bevilacquaa, 2000) introduced and applied the AHP approach for maintenance strategy selection in an Italian oil refinery processing plant, incorporating an essential selection of the maintenance policy, applicability, economic aspects and safety, expenses, and so on. While (Stefano Ierace, 2009) accessed the most popular maintenance strategies in the selection of maintenance systems using the AHP decision-making evaluation methodology and evaluated them based on two companies, and demonstrated the relationships between the infrastructural and structural decision categories. This encourages me to employ the AHP approach for oil and gas platform HVAC maintenance. The impact on cost reduction for the HVAC system in the oil and gas platform is critical while preserving 11 system efficiency and lifetime. Especially amid the low-oil-price situation, which necessitates an appropriate maintenance expenditure.

Because of developing technology, the necessity of asset maintenance is getting more complex. The department of maintenance also encountered difficulty in maintaining equipment efficiency owing to a lack of people and experience, and equipment frequently failed prematurely. Failure to regulate the possibility of dependability might result in greater catastrophe to the oil platform, as there are more aged platforms in Malaysia's oilfield. These are the difficulties that, if successfully met, will contribute to the long-term viability of Malaysia's oil and gas sector. The current study of this work is to create the maintenance hierarchy and further examine the AHP approach for better maintenance selection, which could be used to assess the most appropriate maintenance type for specific difficulties such as the high rate of HVAC compressor damages.

Maintenance has existed since the building of physical constructions such as ships and machinery. In general, maintenance is described as the combination of all technical and administrative procedures, including monitoring and action, undertaken to keep or restore the machine to a state in which it can perform a needed function. Effective maintenance eventually tries to discover appropriate actions that can keep machine performance at an acceptable level and extend the equipment's life cycle (Thor, Ding, & Kamaruddin, 2013). There is a critical need for industries to select an appropriate maintenance plan to avoid the negative impacts of disruptions. Because of the data collection phase, numerous, conflicting criteria, and decisionmakers from various fields, as well as a variety of components and functions that must be addressed in a systematic manner, choosing an optimal maintenance strategy for a system is a complex and multidimensional decision-making problem (Shafiee, 2015). Maintenance should be well planned in terms of investment, planning, and control. Maintenance strategies should be chosen in accordance with the organization's global and operational objectives when planning maintenance. However, the maintenance environment is very dynamic, with frequent technology changes, and so maintenance plans must adapt to new possibilities and practices. Maintenance selection selections that have a high influence on technology should be handled in a technologically rational manner (Zaim, Turkyılmaz, Acar, Al-Turki, & Demirel, 2012). The industrial industry, selecting a maintenance plan is critical. This is due to the fact that maintenance costs in industry may be fairly high. According to research, the three best maintenance strategies for HVAC systems are corrective maintenance, predictive maintenance, and preventive maintenance (Madu & Madu, 2002).

Phase 1 of the analysis is to calculate the pairwise comparison between each level to find out the relative intensity of the main criteria and sub-criteria.

Phase 2 focuses on deriving the relative weight as this step is important for determining each criterion and sub-criteria of the hierarchical tree.

In phase 3 to validate the model consistency ratio will be analyzed and a conclusion will be made once the consistency ratio has been finalized.

1.2 Problem Statement

Maintenance programmed of the HVAC system at the oil and gas platform was done according to normal practice (Preventive maintenance, Corrective maintenance, and RiskBased inspection). These are standard options for the maintenance department to operate a maintenance program. With the numerous studies on AHP analysis able to select precise maintenance strategies. The study of AHP application for comparative evaluation of different CMMS has shown promising result in integrating with maintenance software as well this method can be easily applied in different industrial contexts to provide the right choice of maintenance type for specific needs and to avoid an implementation without providing the expected benefits (D. Meira, 2021). However, oil and gas maintenance managers are questioning the effectiveness of the development of maintenance strategy based on analytical approachable to increase the effectiveness of maintenance program, especially on oil and gas industry. A recent study of AHP application on the suitability of maintenance contractor in turnaround maintenance (TAM) at to prevent loss and better safety orientation to prequalify a contractor due to incident of reoccurring plant loss (Laith A. Hadidi, 2015). This study aims to introduce a model of maintenance strategy using ‘’Analytic Hierarchical Process (AHP) method to justify the success of the application of HVAC equipment maintenance at the offshore platform. This model will able to help the clients & service contractors to identify the maintenance criticality for HVAC equipment's for the oil and gas sector thus reducing trial and error technique.

1.3 Research Objective

The main aim of this research is defined as follow:

a) To study and introduce the best HVAC component maintenance selection using AHP method for HVAC systems in Semi Hermetic Compressor.

b) To apply the AHP method for critical decision-making in the actual HVAC maintenance case study.

c) To evaluate and validate the case study and recommend the best maintenance approach for minimizing cost & downtime of the system breakdown.

1.4 Scope of Research

The scope of this research are as follows:

- A case study on a Semi Hermetic Compressor in oil and gas
- Mainly focused on the brainstorming to AHP method to be applied to the case study maintenance report by Hvac Experts Sdn.Bhd.

- The decision-making success criteria is by using AHP method compared Preventive maintenance, Corrective maintenance, Predictive maintenance and which are the most effective method for selected HVAC equipment maintenance type and reliability.