FITNESS FOR SERVICE ASSESSMENT FOR TUBULAR OBJECT IN OIL AND GAS APPLICATION

By

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Project Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Mechanical Engineering (Hons.) in the Faculty of Information Sciences and Engineering

June 2022

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ABSTRACT

Abstract of the project presented to the Senate of Management & Science University in partial fulfilment of the requirements for the degree of Bachelor of Science in Mechanical Engineering (Hons.).

FITNESS-FOR-SERVICE ASSESSMENT FOR TUBULAR OBJECT IN OIL AND GAS APPLICATION

By

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June 2022

Faculty : Information Science and Engineering

This article presents a case study of the engineering integrity evaluation of mechanically damaged gas boot equipment belonging to Pertamina Hulu Rokan, an Indonesian oil and gas corporation. An in-line inspection run of the gas boot instrument was performed after discovering a simple dent. This was done following the code and standard established by the American Petroleum Institute (API) 579. As a result of the Level 1 dent investigation, it was determined that the maximum permissible working pressure (which was 4 MPa) was lower than the maximum operating pressure (which was 6.5 MPa) of the material. In Level 1 of the assessment, the number of pressure cycles was judged to be zero. However, in Level 2 of the evaluation, the allowed was examined. Additionally, a finite element analysis is carried out to decide whether or not the component has to be replaced or if it can be mended. The study reveals that there is no need for a replacement since the maximum permitted working pressure is still below the maximum operating pressure after detecting the possible failure in the tubular item due to dent damage as determined by fitness-for-service evaluation. A prototype is created that can monitor the conditions within a tubular item and offer pressure, temperature, and pH indications in a tubular object integrated with the blynk application so that users can monitor through a smartphone.

ABSTRAK

Abstrak tesis yang dikemukakan kepada Senat Management & Science University sebagai memenuhi sebahagian keperluan untuk ijazah Bacelor Sains Mekanikal (Kepujian).

FITNESS-FOR-SERVICE ASSESSMENT FOR TUBULAR OBJECT IN OIL AND GAS APPLICATION

Oleh

AFIFAH SALSA FAUZIAH

Juni 2022

Fakulti: **Sains Maklumat dan Kejuruteraan**

Artikel ini membentangkan kajian kes penilaian integriti kejuruteraan peralatan but gas yang rosak secara mekanikal milik Pertamina Hulu Rokan, sebuah syarikat minyak dan gas Indonesia. Selepas memerhatikan lekuk mudah pada jarak 7 kilometer, larian pemeriksaan dalam talian bagi instrumen kebocoran fluks geometri dan magnet telah dilakukan mengikut kod dan standard American Petroleum Institutes (AP1) 579. Tekanan kerja maksimum yang dibenarkan (4MPa) adalah kurang daripada tekanan operasi maksimum saluran paip (6.5MPa), seperti yang ditentukan oleh penilaian lekuk Tahap 1. Sementara penilaian Tahap 2 menilai bilangan kitaran tekanan yang dibenarkan menjadi 188 kitaran, penilaian Tahap 1 menganggarkan bilangan kitaran tekanan menjadi sifar. Di samping itu, analisis unsur terhingga dilakukan untuk menentukan sama ada komponen perlu diganti atau hanya diperbaiki. Kajian itu mendedahkan bahawa tidak ada keperluan untuk penggantian kerana tekanan kerja maksimum yang dibenarkan masih di bawah tekanan operasi maksimum selepas mengesan kemungkinan kegagalan dalam item tiub akibat kerosakan kemek seperti yang ditentukan oleh penilaian kecergasan untuk perkhidmatan. Prototaip dicipta yang boleh memantau keadaan dalam item tiub dan menawarkan petunjuk tekanan, suhu dan pH dalam objek tiub yang disepadukan dengan aplikasi blynk supaya pengguna boleh memantau melalui telefon pintar.

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TABLE OF CONTENT

LIST OF FIGURE

LIST OF TABLES

CHAPTER I
INTRODUCTION

1.1 PROJECT BACKGROUND

A *dent* is defined as persistent distortion as a consequence of external stress. Dents may increasing the stress in the Tubular Object, enabling initiation sites for fatigue and stress corrosion cracking (SCC) [1]. Furthermore, dents weaken the coatings that tends to protect on the Object's surface, enabling water, bacteria, and other impurities to come into touch with the metal surface of the Tubular Object. The ding may increase both static and dynamic stress susceptibility, leading to the ultimate collapse of tubular items. Dents may impede the procedure and result in financial losses[1]. For that reasons, its important to conduct failure analysis to prevent it from happen. One of the most used assessment to analyze the failure in oil and gas industry is Fitnes-for-Service (FFS).

Fitness-for-Service Assessment (FFS) is an evaluation conducted by industry best practices. The FFS evaluation assesses the structural integrity of an asset or component to see whether it is adequate for its intended usage. The Fitness-for-Service (FFS) evaluation gives a quantifiable measure of structural integrity in asset integrity management. The evaluations indicate the necessity for asset/component replacement or maintenance [2].

After identify the failure, tools to prevent failures is needed for continuous time by design a failure monitoring system using temperature and pressure sensors and microprocessor. this system will have functioned as a monitoring system to prevent failure to happen by measuring the temperature, pressure and pH indicator inside the tubular object. this system is using a microprocessor as the data processor and temperature, pressure, and pH sensor as the data input.

1.2. PROBLEM STATEMENT

Constrained Dents in a tubular item do not affect the Object's bursting strength considerably. Because of the ductility of the pipe, the considerable stresses and strains caused by the dent may be sustained [1]. Deep dents may fail due to inaccessibility or wall weakness in the affected area. Dents may cause increased stress in tubular objects, facilitating fatigue and stress corrosion cracking (SCC) [1]. Furthermore, dents destroy coatings which useful as protective agent on the surfaces of the Tubular Object, enabling water, bacteria, and other pollutants to come into contact with the metal surface of the Tubular Object [1]. Failure in engineering is vital due to possible loss and can leads to accidents in working place. Failure Prediction Tools for the oil and gas companies to prevent Dent failures to occur is not yet implemented in Indonesia.

1.3. OBJECTIVE OF THE PROJECT

The objectives of the study are as follows:

1. To study the failure of dents in tubular objects using fitness for service assessment
2. To design a failure monitoring system using temperature,pH, pressure sensors and microprocessor.

1.4. SCOPE OF THE PROJECT

The scopes of the project are:

1.1 Fitness-For-Service Assessment (FFS) evaluations are engineering analyses from a quantitative point of view that test the integrity of a structure in a damaged or defective component in service [2]. America Petroleum Institute 579 / FFS was intended to give instructions for performing FFS evaluations of faults in pressure vessels, piping, and tankage that are typically experienced in the petrochemical industries [2].

1.2 This FFS assessement will be applied to analyze the dent damage in gas boot in Pertamina Hulu Rokan field to make decisions whether it should be run,repair, or replace to verify that the equipment which under pressure containing flaws that were discovered during an inspection may continue to run safely.

1.3 The remaining Thickness Ratio (Rt) and COV are factors utilized in the FFS method with API RP 579 for the General Metal Loss approach (Coefficient of Variation) [3].

1.4 The monitoring system is a collaboration of several devices that is as a Pressure

sensor, a linear temperature sensor, Ph Sensor, Alphanumeric LCD, and NodeMCU as a microprocessor.

1.5 SIGNIFICANCE OF THE PROJECT

This Fitness-for-Service assessment could provide such a comprehensive analysis about failure that could happen in a Object. End users and operators get economic and safety advantages from fitness-for-service evaluations. On the monitoring system, the engineer could possibly monitoring the object indicator as long as the sensor and the microprocessor works properly. This project also can help Oil and gas industry to prevent company to spending money due to failure which can cost time and money. The money saved by implementing this system can be used for other purpose in order to improve their business or to cover other expenses. This project is performing under the SDG 9 which is Focuses on the engineering innovation and infrastructure solution.

1.6 LIMITATION OF THE PROJECT

This system and asssesement are gathered for Tubular Object in Pertamina Hulu Rokan Oil and Gas Industry. The system only can show the pressure, temperature, and pH indicator. The accuracy of the Temperature sensor, that will be used in this project is +/-0.5^{O}C and the maximum limit of the pressure sensor is 150psi.

CHAPTER V

CONCLUSION

After carrying out a fitness-for-service assessment, it was found that the dent defect is still in the safe criteria because the maximum allowable pressure value is still below the operating pressure value, so it is not necessary to replace equipment, but it is recommended to make repairs so that there is no greater damage.

The prototype is working accordingly, the sensor can detect the precise value of the indicator needed to prevent the dent damage which is the temperature of the fluids, the pressure inside the tubular object, and the pH of the fluids. The prototype made can prevent the occurrence of similar dent damage because this oil monitoring system prototype can show important indicators on tubular objects. the use of an oil monitoring system can be done using a smartphone connected to the blynk application. users can monitor without having to look at indicators in the field.

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