

Structured Approach for Investigating Submarine Cable Failures

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ABSTRACT

The paper presents a structured analytical approach for conducting a root cause failure analysis of an AC HV submarine cable fault considering the applicable international standards. The analytical approach was applied during investigation of the root causes of a submarine cable failure experienced in 2021 only after two years of its installation and without obvious signs of an external damaging object. The analysis probed into the cable manufacturing process, its handling, transpooling and final installation to identify all factors and scenarios that may have contributed to the cable failure. Challenges to any similar analysis and investigation are addressed from the examination and deconstruction of the faulty cable section to the scientific analysis undertaken in collaboration with a reputable independent laboratory. The structured approach followed in investigating the cable fault has largely contributed in defining the failure root cause.

KEYWORDS

Submarine Cable, Investigation Structure, Failure, Mechanical Damage, Lead Sheath.

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INTRODUCTION

Saudi Aramco has a vast network of Submarine Power cables with total length in excess of 2000km supplying power to offshore producing facilities within the Arabian Gulf. The substantial expansion in the Company's offshore facilities during the past 10 years naturally introduced higher risks to the existing in-service submarine cables from the increased marine traffic and construction activities [1]. To mitigate against such risks to in-service submarine cables Saudi Aramco sanctioned an in-house readiness initiative that addressed all identified gaps that could hinder rapid repair of damaged submarine cables [2]. A target was set by the Company to repair damaged submarine cable within 42 days. Subsequently, three submarine cable failures were successfully repaired within 17 days in 2019, 37 days in 2021 and 14 days in 2023 incident.

Following any submarine cable repair operation, an investigation is launched with the aim to determine the root cause of the failure. This paper presents a generic structured approach that can be followed while investigating a failed submarine cable fault based on the preliminary identified type of failure being a result of an obvious damage caused by an external object to a failure without a clear cause. A list of recommended tests with their respective standards are provided in addition to a comprehensive list of data, information and reports related to the failed cable to be examined as part of the investigation.

A real case study of a failed 115kV submarine cable is used to demonstrate the investigation approach starting from the collection of sufficient number of cable specimens taken from the recovered cable length including the flashed-over point, an overview of the conducted analysis and the identified findings and finally the determined root cause of the cable failure.

THE INVESTIGATION APPROACH

The ultimate objective of the presented structured approach is to provide guidelines for conducting a detailed