Case Study of a Clock Spring® Composite Sleeve Application as a Permanent Pipeline Repair in Indonesia

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Abstract

Pipeline defects can be fixed in one of three ways: Cut out the damaged segment and replace with new pipe; install a full encirclement steel split sleeve over the damaged area; or install a composite sleeve over the damaged area. This paper is to address various case studies of repair applications of Clock Spring® Composite Sleeve repairs in Indonesia.

1. Introduction

Maintaining a pipeline can be costly but can pale in comparison to the cost of a failure. Pipeline operators must balance maintenance costs with pipeline integrity. The purpose is not to save money but to attain a level of safety that is acceptable to the Company and the public at a cost the company can afford. The public, however, is gaining an ever-increasing voice in where the integrity level is set. [1]

Clock Spring Company L.P. believes new composite technology developed for pipeline repair can be a significant variable in the integrity equation. This technology can be a cost effective method of improving safety while keeping maintenance costs down. With many composite repair products available on today's marketplace it is important the repair technology chosen by the operator meets the engineering and testing guidelines established in recent code revisions. [2] The distinctions between different types of composites used for pipeline repair are important and must be understood to ensure the composite repair selected will meet the rigorous specifications demanded by sound engineering, testing and analysis. [3]

2. Clock Spring® Repair System

The Clock Spring® composite repair consists of three parts: a full cured composite sleeve of unidirectional e-glass fibers and a polymer base (the strength member) manufactured to suit the specific pipe diameter; an adhesive to secure the repair; and a load transferring material to transfer the load from the defect to the composite sleeve.

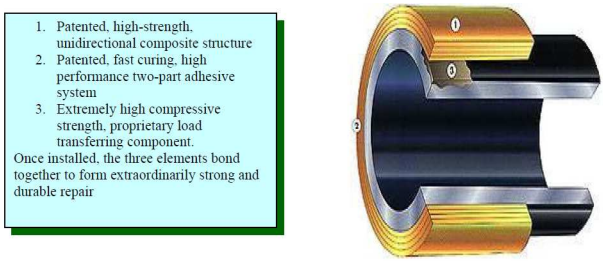

Figure 1. Clock Spring® Systems

A typical repair consists of locating and cleaning the defect area. The defect area and other voids under the repair are filled with a high compressive strength material to transfer the loads from the pipe to the externally applied composite sleeve.

A starter pad is applied to the pipe to secure the inner edge of the composite sleeve. Adhesive is used to secure the sleeve to the pipeline. The composite sleeve is then wrapped around the pipe, typically 8 layers, while applying adhesive between each layer.

The unit is tightened onto the pipe. Excess adhesive and filler will extrude out the edge of the unit ensuring a fully filled, tight fit. The adhesive will cure in about two hours and the repair area can be re-coated and backfilled. The entire installation takes only about 30 minutes.

3. Case Study of Repair Application

<u>High Pressure Gas Transmission Lines Repair</u>

Case Study No. 1:

During routine excavation theexcavator accidentally hit a 28"main gas transmission line situated at in the middle of the Perawang jungle in Pekanbaru – Riau, Indonesia.

The excavator had "caught" the pipeline causing a significant mechanical defect with 3 meters of the pipeline being damaged. As the pipeline is the main supply to a localpower station and also to Singapore, it was critical the pipeline remained in operation, it was mid Summer with temperatures in excess of 39 ºC and a peak period for electricity supply.

A large number of studies have been conducted concerning the suitability of full cure laminate composite sleeves for the permanent repair of mechanical damage and third party interference. The results of these studies have shown that Clock Spring® composite repairs are acceptable. [4]

Figure 2. Installation of repair sleeves on the 28″ gas line

The Clock Spring® repairs for the 28 inch API 5L X65 were installed within 3 days on site without interrupting the pipeline operations.

Figure 3. Installation of repair sleeves on the 28″ gas line

Case Study No. 2:

An external defect suspected due to mechanical damage by backhoe loader during pipeline installation was found after ILI inspection for a main 32″ gas transmission line supplying gas from Sumatera to Java**.**

Figure 4. Defect in the 32″ pipeline also affecting the seam weld

Following excavation and manual surface preparation in accordance to industry standard guidelines a composite repair sleeve was applied to reinforce the damaged area.

Figure 5. Installation of the 32″ seam sleeve

The repair was completed under the supervision of a Clock Spring® installer within 1 day.

Case Study No. 3:

An external defect suspected due to alkaline soil erosion caused a significant mechanical and corrosion damage to the 28″ main high pressure gas transmission pipeline supplying gas to the Duri field in Riau.

Figure 6. The alkaline soil erosion type defect

For this repair 4 corrosion sleeves were needed and the repair was completed under the supervision of a trained and qualified Supervisor within 1 day.

Figure 7. Completed 28″ repair sleeve installation

Offshore Riser and Caisson Repair

Case Study No. 1:

An external defect due to corrosion under insulation (CUI) and hot atmospheric conditions (+80 C) was identified on a high pressure and high temperature riser in Mahakam Delta, East Kalimantan.

Figure 8. Sample of CUI defect

Following surface preparation by sand blasting, a high temperature repair sleeve was applied to reinforce the weak area.

The installation was completed by a two (2) mancrew under the supervision of a trained supervisor within 1 day with no need to shut in the riser and no hot work or specialised installation equipment.

Figure 9. Completed high temperature composite sleeve repair

Case Study No. 2:

External corrosion due to harsh sea environment caused a leak on a 42" skim pileat the splash zone area. The platform is in the Natuna Block.

Following grit blasting and surface preparation in accordance to industry standard guidelines a Snap Wrap full cured laminate repair was applied to seal the leak and reinforce the general corrosion area.

The repair was completed within 1 day.

Figure 10. Completed 42" Skim Pile repair

Case Study No. 3:

A 36" sump caisson was leaking in one of the offshore oil and gas platforms in Natuna Sea. Due to the allowable window of shutdown during the repair, a Snap Wrap was chosen to repair these sections and return the integrity of the caisson.

After surface preparation by sand blasting, the Snap Wrap was applied for one meter of total length to restore the capability of the operating caisson. The repair was made within two days with four (4) man crew only.

The repair provided significant cost savings due to its efficiency, speed and ease of installation.

Figure 11. Sample of completed sump caisson repair

<u>Onshore Pipeline Repair</u>

Case Study No. 1:

Significant external corrosion, up to 74% metal loss, adjacent to and affecting the circumferential girthweld was located within an onshore LPG Gas Terminal in Samarinda, Kalimantan.

A standard bridging technique for the full cured laminate repair sleeves was applied utilising 3 complete 8 layer repair kits to support and bridge over the girth weld.

The repair was installed by a two (2) man crew within 3 hours and with pipeline inoperation and no hot work.

Figure 12. Completed girth weld repair

Case Study No 2:

An external defect due to corrosion under insulation (CUI) and hot atmospheric conditions was found after Long Range UT testing was conducted on a main hot water injection line to the main oil wells in Duri.

Figure 13. Sample of the CUI defect

Following manual surface preparation inaccordance to industry standard (NACE) guidelines, composite repair sleeves were applied to reinforce the corroded area.

In total 16 repair kits were installed by four (4) man crews within 3 days.

Figure 14. Completed high temp repair

Case Study No. 3:

A 12″ gas pipeline in South Sumatera was found to be cracked and leaking and in need of urgent repair. A composite repair sleeve was considered to provide structural integrity and to prevent a running fracture from the longitudinal crack within the maximum operating pressure of 1,200psi (83 bars).

Due to the crack nature of the defect and to prevent expansion/bulging and failure of the pipe either side of the leak repair clamp it was recommended to install 1 meter either side of the clamp 12" Crack Arrestors.

This will not prevent the pipe from continuing to crack but if it does it will prevent rupture. It is very important this region of the pipe is restrained as it will greatly help the complete function of the total repair.

Figure 15. Completed 12″ Crack Arrestor repair

The ease of installation makes the composite sleeve crack arrestor system effective. These units can be installed on the pipeline without the need to cut the pipe, or for any heavy equipment or skilled labor. [5]

The installation was completed by a five (5) mancrew within 1 day.

Case Study No. 4:

Major Gas Distribution Company operating in Surabaya, East Java was having a problem at their 16" gas pipeline due to ground movement and transferred load to the operating pipeline. The operator was worried an insulating joint at this location would potentially leak in the future due to the loads being transferred to the pipeline.

For this repair a wet applied composite fabric was utilised to provide structural integrity to the insulating joint location and to accommodate the complex geometry.

Figure 16. Contour – insulating joint repair

Following excavation and manual surface preparation in accordance to industry standard guidelines, the wet applied composite repair was applied with thickness and axial lengths to prevent potential leakage of the joint in the future. This repair was designed and applied in accordance to current industry guidelines.

The repair was completed under the supervision of a qualified installer within 2 days.

4. Discussions

As shown, composite repairs have proven to be a cost effective repair alternative which allows pipeline operators to respond quickly and without the need to shutdown the operations to meet their repair requirements.

Selecting the appropriate repair technique is an important decision which requires an understanding of the risks and rewards associated with each composite repair alternative and material architecture selected. Safety, permanency and effectiveness are the primary drivers of this decision but cost can become an important issue. Composites, like Clock Spring®, compete with older, more widely accepted welded repair techniques. These new repair options offer advantages over the more traditional repairs and are both more cost effective and are also the safest repair alternative.

Pipeline operators must balance cost and safety but must never error on the side of just cost. Significant time and money is spent trying to determine the minimum repair cost that will provide acceptable safety. Dig up an external corrosion defect that is 30 percent of the wall and 1" long. The code says you can re-coat and backfill. Is that the right thing to do? What if the pipeline is subjected to an abnormal operating condition and it fails? Most pipeline failures occur under unusual operating conditions. You have already spent money digging, cleaning, measuring and analyzing the defect. Why not just fix it. Composites allow this option. Two men and 30 minutes will restore the pipe to "as new" condition.

Composite repairs may not be the right repair option every time but they are an important alternative that can be very effective in most repair cases.

5. Conclusions

Composite repairs are a proven and accepted high pressure pipeline repair technology. Within Clock Spring® to date we have completed over 750,000 repairs in over 72 countries worldwide including Indonesia.

Defects found in pipeline and piping systems both on and offshore can be permanently repaired safely, quickly and economically by using composite technology.

6. References

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7. Biography

Dimas Satya Lesmana is a Chemical Engineer which is currently working as Country Manager for Indonesia region at Clock Spring Company L.P. He was also a certified applicator and the only one certified composite repairs trainer for Clock Spring Company L.P.