



Executive Summary

Audit of procedures

For Pipeline repair system using Epoxy filled full encirclement shell repairs

(Epoxy Sleeve Repair – ESR)

by PII Ltd.

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Customer	ExxonMobil Production Deutschland GmbH (EMPG) Riethorst 12 30659 Hannover
Order No. / Date	PO 4500253129 dated 4th April 2005
Test object	Epoxy-Sleeve-Repair (ESR) repair shell by PII Ltd., Cramlington, UK
Operator	ExxonMobil Production Deutschland GmbH
Notified body	TÜV Rheinland Industrie Service GmbH KST 975 – Pipelinetechnik Am grauen Stein 51105 Köln
TÜV report No.:	975-9275212
Responsible	Dipl.-Ing. W. Schmidt Dipl.-Ing. A. Wißkirchen
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1 Executive Summary

ExxonMobil Production Deutschland GmbH has asked TÜV Rheinland Industrie Service GmbH, department Pipelinetechnik in Cologne, to audit PII Ltd's pipeline repair system which uses epoxy filled repair shells (Epoxy Sleeve Repair – ESR).

The audit shall determine the strengthening effect of said repair method and the application on pipelines to repair different types of defects like dents, internal and external metal loss etc.

The audit shall consider the typical application on pipelines. This includes that the ESR method is applied on depressurized pipes or, especially for high pressure gas lines, at reduced internal pressure only. The operating conditions and the load type (mainly static load, low dynamic load) shall be taken into consideration. In addition conservative, practical limits of the ESR method shall be determined for the repair of cracks and crack-like features in static and dynamic loaded pipelines.

The assessment showed that the ESR repair method using welded steel half shells as described in the documentation of PII Ltd., Cramlington, UK is suitable for the repair of defective pipeline spoils by reinforcement in circumferential direction.

In order to determine the reinforcement factor TÜV Rheinland Industrie Service GmbH has developed a software which considers different conditions of buried and unburied pipelines, the operating and installation parameters (installation pressure) as well as dimensions of the pipeline and related sleeve. The reinforcement factor can only be determined for parameters of individual cases. The test results confirmed the results of the software.

The reinforcement factor has to be calculated and documented in each individual case (defect type and size, remaining strength of the pipe, strength of the sleeve, gap length, shell installation pressure). The comparison with the test results showed that the calculated results are conservative for the typical pipeline defects like shape deviations, dents and groove shaped features.

The bonding between epoxy grout and pipeline and/or sleeve cannot be guaranteed in each case, therefore for safety reasons the reinforcement effect can conservatively only be considered in circumferential direction and above the pressure during the installation. A secured reinforcement in axial direction of the pipe could not be verified due to a possible disbanding.



Considering that the epoxy grout is encased and cannot escape, the repair method can be regarded as permanent, as long as the tension of the grout is below the proportional limit.

The material properties of the epoxy grout were determined by testing. The proportional limit could be established at 7.7N/mm². Yielding below that limit is not to be expected. The existing tension within the epoxy grout is calculated using the TÜV software.

The sleeve has to be designed that it is able to withstand the full internal pressure on its own. Depending on the type and size of the defect this may require higher wall thickness than the original pipe. The material properties of the sleeve must comply with local regulations for pipelines.

The welds (longitudinal seam welds and girth welds) of the sleeve must be created in accordance with local regulations for pipelines. Due to the lack of a pressure test the welds have to undergo non-destructive testing. Considering the wall thickness, 2 (two) methods have to be applied; ultrasonic testing and another method like MP-testing.

Considering that the defective pipe is in an unacceptable state, the repair and the installation works have to be accepted by an authorized expert. The authorized expert has to assess especially whether the repair is sufficient in regards to the achieved reinforcement and that the pipeline will be in an acceptable state afterwards.

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