

SHELL LEMAN DELTA REPORT DOCUMENTS

In 2010, Shell in the UK commissioned an inspection of its Lemman Delta Platform after concerns from maintenance staff about advanced corrosion on the ageing platform. The inspection report (Shell Lemman Delta Follow Up Report) described the condition of the substrate and potential solutions. Following this report, an Enviropeel application was commissioned for part of the platform. After six years, a Shell Inspector visited the site to determine the effectiveness of the Enviropeel application. His report found that the application had performed as predicted, completely arresting all existing corrosion on the protected substrates while other, unprotected substrates showed considerable further corrosion.

Following this report, Shell approved Enviropeel for use as a remedial coating on structures with existing corrosion.

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Leman Delta - Enviropeel Inspection Visit – 10.08.16

Date of visit:

10.08.16

Personnel Present:

Chris Clark – Shell

Location:

Leman Delta Platform

Southern Sector

Introduction:

In 2010 A&E Systems (now known as Enviropeel) carried out an application of their Enviropeel product to heavily corroded flanges on Well Head WH415 (See previous report from A&E Systems titled *'Shell Leman Delta – Follow Up Report'* During the initial Enviropeel application the heavy corrosion and unsound substrate was removed from WH415 branch flanges, these were treated using the Enviropeel system. It was agreed to return to the Leman Delta Platform and remove sections of the Enviropeel in order to assess the materials performance over the intervening 6 years.

Comments / Observations:

10.08.16

The writer arrived on the Leman Delta Platform and following the relevant introductions, inductions and permits being raised entered the Well Head area with the Bilfinger operative. An initial inspection of the Enviropeel applied to the branch flanges of WH415 indicated no obvious signs / areas of premature material breakdown or failure had occurred. The material had obviously discoloured and weathered as would be expected when exposed to the required service environment. See picture



It was decided that Enviropeel applied to Flanges No5 & No8 would be removed for assessment purposes. Flange No5 was removed first. A standard scraper was used to make the initial incision, once penetrated the Enviropeel was easily removed and for want of a better expression 'peeled of like wallpaper'



Once the Enviropeel had been fully removed a visual inspection of the exposed substrate was carried out. When compared to the flanges that were prepared prior to the Enviropeel application in 2010 and pictured in 2010 A&E Systems report titled '*Shell Leman Delta – Follow Up Report*' the writer would confirm that little or no further substrate degradation or corrosion build up has occurred on either Flange No5 & No8.

On Flange No5 there was an amount of residual coating still in place. The writer assumes that this coating must have been tightly adhered to the substrate when the initial Enviropeel application took place in 2010. Upon examination and using a blunt scraper to indicatively test the current adhesion the writer would state that this residual coating, after 6 years encapsulation using Enviropeel, remained tightly adhered to the substrate, indicating no moisture ingress or corrosion creep.

In comparison a flange on WH415 that was not encapsulated using Enviropeel and had remained exposed for the previous 6 years exhibited excessive corrosion and scale build up. See picture



Conclusion:

To conclude, the 2010 application of Enviropeel has, in the writers opinion arrested the corrosion of the flanges examined during the visit, Flange No5 & No8. The encapsulation properties of the Enviropeel product has performed as expected in preventing moisture ingress and further corrosion. Whilst only two examples were inspected, there would be no reason, on the basis of the information gained to suggest the remaining encapsulated flanges would not be in the same condition.

Kind regards



Chris Clark

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SHELL LEMAN DELTA FOLLOW UP REPORT

CLIENT: SHELL UK

LOCATION: SHELL LEMAN DELTA, NORTH SEA

DATE OF INSPECTION: 24/06/2010

The Delta platform has twelve wellheads, eleven of which are very heavily corroded with no protection from the remaining elements of the paint system. The twelfth wellhead is a reasonably new build and is only showing the first signs of corrosion. Following inspection, the following remedial actions are being considered.

The pictures below show the depth of the rust layer and the condition of the substrate beneath. Also apparent, is the level of corrosion present between the flange faces.



Below: a fully cleaned substrate shows that the bolts and nuts appear to retain reasonable integrity.



Remedial options for heavily corroded substrate:

1. **No action:** If the wellheads are to remain in service, taking no action is not an option likely to be chosen. Allowing the levels of corrosion to increase could have safety implications
2. **Blasting and painting:** the advanced levels of corrosion with up to 13mm of corrosion scale in places would require high levels of preparation, blasting alone would be unlikely to remove it - chipping and/or needle guns would be required. Some areas of corrosion are inaccessible to preparation techniques, for example, heavy corrosion between flange faces could not be removed sufficiently well to allow normal coating adhesion to be achieved. There would be a high risk of localised coating failure and some risk to the substrate from the impact of the preparation.
3. **Replacement:** whether this is a viable option depends on criteria to which we do not have access. Given that eleven of twelve would need replacing, the cost would be substantial.
4. **Encapsulation:** various forms of external barrier coating are available for passive protection of vulnerable substrates. However, one which offers an ability to stabilise the substrate through inhibition, as well as an external barrier protection would seem to offer the most chance of success.

ENVIROPEEL ENCAPSULATION

The inspectors do not believe that options 1 or 2 are viable, and assume that, given the age of the platform and the production area, the operators would prefer not to go to the enormous expense of replacing infrastructure.

On this basis, if the intention is to extend the safe working life of an ageing asset whose current integrity might be threatened by further corrosion, stabilisation of the substrate for 10 years would seem to offer a reasonable outcome. Indeed, with maintenance, the potential for corrosion prevention on the substrate using Enviropeel would not be necessarily be limited to any specific period.

Tests showed that removal of the scale was time consuming and presented some risk to the substrate, but it was also apparent that the rust scale was sufficiently adherent to allow application over it without compromising the integrity of the encapsulation or of the structure.

Enviropeel does not require the level of preparation required for conventional coating systems. For standard Enviropeel applications, contact between the coating and the substrate provides a thin film of inhibiting oil that coats the substrate, preventing the corrosion process. Although the rust scale would be between the steel surface and the outer coating, the film will still perform this inhibiting function, but the inevitable increase in porosity of this substrate compared with normal steel, means that additional inhibitor would be required to ensure complete isolation. This is standard practice for Enviropeel applications where clean steel substrates cannot be obtained.

Enviropeel would be prepared to warrant its applications for five years, with an extension to ten years. This warranty would include an agreed inspection regime.

LOGISTICS

There remain some logistical barriers to operation on these platforms but the main difficulty for the trial project - the power supply - could easily be dealt with by providing a suitable outlet from the existing supply which was of the right type and had sufficient capacity to power the Enviropeel units.

SHELL LEMAN DELTA

Application Report

This platform is located in the UK sector of the North Sea, an area where around 70 offshore platforms have been in operation for more than 30 years and another 55 for 20-30 years, some well beyond their original design lifetimes. Effective maintenance of offshore platforms and their equipment is paramount for safety and continuity of production - but costs and challenges to success are high.



PRIOR TO APPLICATION

The Leman Delta platform operated by Shell was showing signs of its age. The photos below show a typical well head on the structure, with heavy corrosion and closer details of corrosion effects on flanges and bolts.

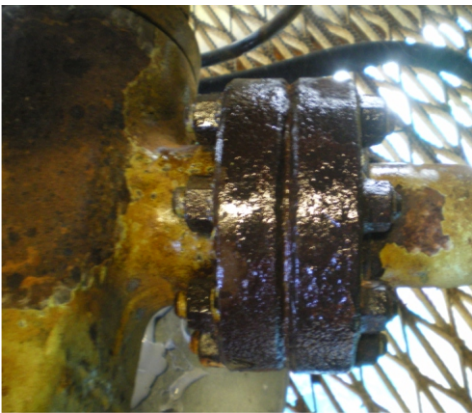


PREPARATION

Removal of corrosion showed the condition of substrate. The depth of corrosion is clearly visible as corrosion scale is removed. It was not possible to completely remove corrosion between flange faces.

The bottom photo shows preparation complete on a typical small flange, ready for application of inhibitor.





PRE-TREATMENT & APPLICATION

The pictures above and left show elements of a well head following removal of all unsound material and the application of Enviropeel pre-treatment inhibitor to condition the substrate and ensure full inhibitor penetration.

Once the preparation of the substrate was complete, Enviropeel was applied to the flanges and joints. This application is designed to arrest all existing corrosion within the encapsulation and prevent any further deterioration of the substrate, fully protecting the infrastructure for a minimum of ten years.

Long-term testing of this application led to the endorsement by Shell in 2017 for Enviropeel as a maintenance coating for corrosion-affected infrastructure.

