# MARAVEN 2” AND 6” RISER INSITU RECLADDING TRIALS

LAKE MARACAIBO VENEZUELA OCT 96 - DEC 97

TECHNICAL REPORT

AND

RECOMMENDATION

RETROWRAP (STD) WRAPAROUND RISER

ENCAPSULATION SYSTEM

PREPARED BY

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## INTRODUCTION 1

Retrowrap Standard Splash Zone Corrosion Protection Wraps were installed on 2" and 6" risers by divers in Lake Maracaibo, Venezuela 23rd October 1996. Following discussions at the NACE Corrosion '95 meeting in Orlando with Aleida Romero de Carruyo, Sr. Corrosion Engineer for Maraven, and a subsequent meeting in Venezuela, November 1995, when it was agreed that Maraven would install trial wraps on 2" and 6" risers by divers on production platforms. The objective would be to evaluate the retrowrap concept as an alternative, less expensive splash zone corrosion protection system, to that currently being utilized, a factory applied vulcanized neoprene.

A significant advantage would be the ability to install off-shore on existing risers without carrying out significant surface preparation or shutting down production. Also there is the facility of easy removal and replacement to facilitate routine inspection of the riser substrate at regular intervals throughout the design life.

Since retrowrap is a cold applied system not requiring slot blasted substrate preparation, installation was not restricted by the requirement of a hot-work permit. Wraps were supplied in differing length options to enable the client to identify the optimum, most efficient length for ease of on-site handling.

| | 1.5 METERS LGTH | 3 METERS LGTH |
|---|---|---|
| **2" RISER** | one | one |
| **6" RISER** | three | |

Note: All above wraps were supplied with integral overlapping seals to facilitate multiple wrap installation.

The installation was carried out under the technical supervision of the writer on the 23rd of October1996 using divers employed by Maraven maintenance department.

Substrate cleaning was limited to removal of marine growth and de-laminated coal tar epoxy coating. Wrap installation progressed quickly considering the divers had no previous experience of the system.

After completion of the installation it was tentatively agreed that the wraps should be removed after three months and re-installed following substrate inspection. This evaluation period was later extended to December 1997. This report covers the removal, regelling, reinstallation and recommendations following the successful operation.

It should be noted, however, that the diving contractor used for December 1997 was different from that used for the original installation (October 1996).

While awaiting issue of work and travel permits at the Maraven Maracaibo shore base, discussions with maintenance personnel indicated their concern with the fact that the retrowraps had been installed in the lake using Stainless 316L fasteners. The writer explained that more expensive options such as Monel or Titanium were available, but in his opinion such materials would not be necessary, particularly since bolts are:

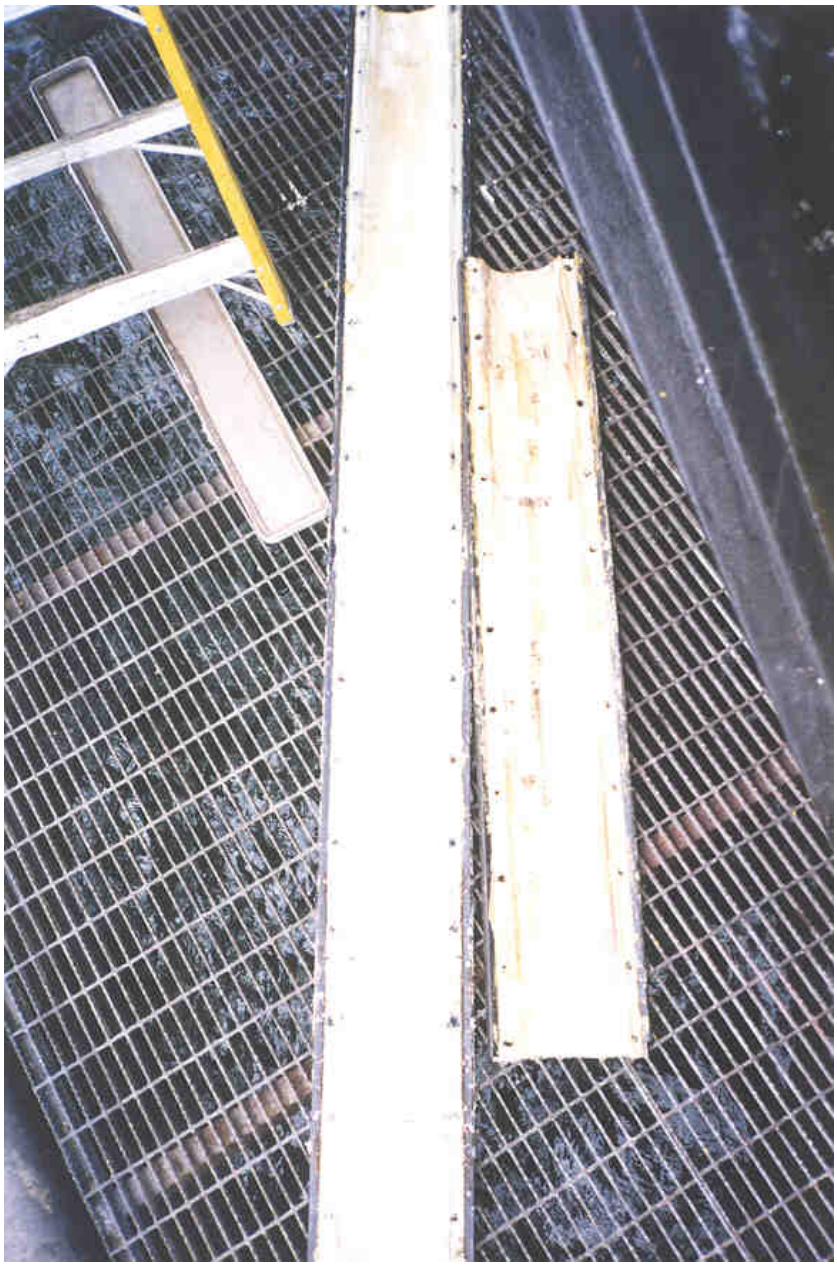
1) significantly under-stressed when compared to their ultimate tensile strength;
2) while in service the bolts are completely insulated from the structure since no conductive materials are used within the wrap fabric or the closure flange.

Upon arrival at the first location we found that the 2" wraps had already been removed from the riser; close inspection of which indicated that no corrosion had occurred during the 13 months that the units had been in service (see figure 1 below).

2" riser after retrowrap removal. Note the cohesive transfer of gel from the wrap to the riser with zero evidence of corrosion

Fig 1

From the above photograph it can be seen that the thixotropic gel factory impregnated into the wrap in a layer had cohesively whetted out upon the riser surface to provide active primary protection. Examination of the removed wrap (see Figure 2.) confirmed that no corrosion had occurred during the service life and that the wrap had not sustained any exterior damage while in service.



Even distribution of gel within the inner layer. Note the discoloration of the upper (shorter) section due to transfer of original coating debris

Fig 2

It should be noted that the staining that appears on the inner layer of the 2” X 1.5M section (Figure 2.) was from the coal tar epoxy coating, which had probably not been wiped down after marine growth removal and prior to wrap installation.

The divers reported that no difficulty was experienced when removing the Stainless 316L bolts; close visual examination of the bolts revealed no obvious signs of corrosion. However, one bolt set was retained by the Maraven representative, Mr. Ferrier Euclides, for laboratory analysis.

The divers also recovered a 150mm X 12mm diameter carbon steel draw bolt which had inadvertently been left in position by the divers in the sub-sea section during the initial installation (see Figure 3.) which shows that extensive corrosion had occurred to the exposed 85mm section of the draw bolt which had protruded from the closure flanges, while the remaining section (which had been protected by the corrosion inhibited gel contained within the flange assembly) had maintained the draw bolt in perfect condition. A text book demonstration of the corrosion protection performance of the inhibited gel.

A comparison of draw bolts (as supplied) with bolt after 13 months exposure. Note almost 50% metal loss on the exposed section

. Fig 3

## 6 inch Risers



Following inspection of the 2 inch risers and wraps, we traveled to the next platform where the divers had removed the wraps from the 6 inch risers which had been installed in 3 x 1.5m sections (See Figure 4). Close inspection revealed as with Figure 1 no post wrap installation corrosion of the riser had occurred with cohesive transfer of the gel from the wrap to the riser surface.

The off white color shows the even cohesive transfer of the gel to the riser surface. Note: The darker area is where the gel was removed by diver to observe the substrate.

Fig. 4

Inspection of the retrowrap confirmed that no damage had occurred while in service with no degradation, from UV exposure, of the closure flange.

The divers reported that all the stainless 316L bolts could be removed without difficulty and that the removal of the wraps had been achieved very quickly (see Figure 5) Very light marine growth had occurred on the external wrap surface. Some discoloration of the inner layer had been caused by the debris of the original coating including the inclusion of some barnacle shells following removal of marine growth prior to the original installation of the wrap in 1996. The three number overlap joints proved to be effective with no evidence of water ingress into the joint area.

No external UV degradation of the outer fabric or closure flange. Very light marine growth. Note: Slight localized discoloration caused from debris from original coating after removal of marine growth prior to original installation.

Fig. 5

## Regelling 7

Regelling of the 2 inch and 6 inch wraps was easily carried out by the writer on the platform deck using additional gel provided in 4 liter containers. The gel was cold applied and spread using a spatula over the wrap inner surface to a film thickness of approximately 1 to 1.5mm and the wraps made ready for reinstallation.

## Reinstallation

As stated earlier, the divers who had removed the wraps unfortunately were not the same company that had been trained by the writer in 1996; therefore some confusion existed while attempting to install the first of the wraps underwater without the correct equipment originally provided by CCI during installation and training in 1996

(1) compressed air operated impact wrench
(2) custom built 1/2" Ø draw bolts
(3) custom built extended reach 7/8" box wrench
(4) correct size combination wrenches

The resultant problems, due to the elastomeric nature of the wrap, was that upon refitting the wrap around the riser a 70mm gap existed between closure flanges, making it impossible to fit the permanent fasteners until the flange faces were first drawn together using the correct tools that had been originally supplied for this operation.

Fortunately the writer had brought with him spare draw bolts and hand tools and with the assistance of Azex personnel, the divers were quickly instructed into the correct installation procedure.

## Underwater installation

We recommenced using draw bolts; however since no impact wrench was available on the work boat, tightening of the flanges was accomplished by the much slower hand alternative using adjustable wrenches and a 7/8" combination wrench provided by the writer. Once having installed the first wrap the divers gained confidence and the second wrap installation went smoothly. Those watching the installation were able to observe the upper .5m of the wrap being closed without incident.

The upper 1.5m long wrap was installed by riggers using a platform suspended from the upper work deck. Having had the advantage of being able to observe the divers installing the upper section of the second wrap above water, the installation of the third wrap went very easy and the total time of 45 minutes was a credible effort particularly when considering they were using hand tools only (see Figure 6).

Fig. 6

## 2 inch diameter reinstallation 9

Having trained the divers on the 6 inch installation, the second dive team returned to the 2 inch riser and reinstalled the wraps unsupervised without any reported incident or difficulty. Post installation inspection indicated that the area of the wrap visible above water had been installed correctly with the exception of several nylok nuts were missing from the stainless steel fastener assemblies. However, since these were above the tidal range, their deletion will have little or no effect upon the installation primarily since the function of the nylok nut is to maintain the fastener thread free from marine growth also the risk of the stainless nuts vibrating loose is reduced due to the wrap fabric being under tension and applying a constant force across the closure flanges.

## Recommendations

Retowrap installation can be carried out quickly and efficiently providing the correct tools are available and procedures are followed.

### Tools required

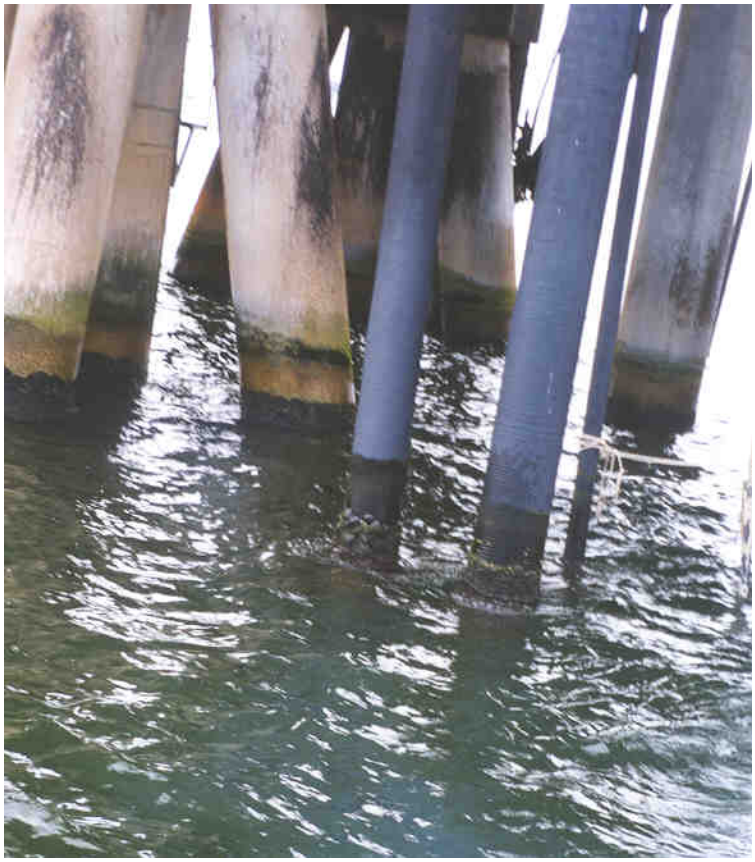
1. One number 300 ft./lbs pistol grip compressed air operated 1/2" drive impact wrench fitted with a 7/8 CCI supplied extended box or tube wrench.
2. One number impact wrench as above fitted with CCI supplied 9/16 extended box wrench.
3. CCI supplied 1/2 Ø draw bolts e.g. a 3 meter long wrap requires 20 draw bolts plus spares.
4. One number 9/16 combination wrench.
5. One number 7/8 combination wrench.

### Surface preparation

While hand scrapping is an acceptable surface preparation practice, the writer suggests that consideration be given to using a 20-30,000 PSI hydroblasting unit which would significantly speed up surface preparation and obviate the risk of marine growth being accidentally left remaining on the riser prior to wrapping. However, independent post installation riser inspection would also overcome these problems assuming inspector divers were available.

### Disbonded neoprene on adjacent risers

While inspecting the 2 inch risers, the writer observed excessive blistering under the neoprene coating on an adjacent 8 inch riser. We would recommend that at the earliest opportunity the neoprene coating be removed and wall thickness measurements be carried out to establish the percentage metal loss followed by application of retrowrap which in this instance would overlap the existing neoprene coating by minimum of 150mm (see Figure 7 next page).



Observe riser next to
concrete raker pile.
Note severe disbondment
of neoprene at water level

Fig 7

Completed overlapping & wrap installation on 6” riser. Note: Outline of the lower wrap integral seal is clearly visible and position of flanges. Also fact that the thixotropic gel has been caused to exude from wrap at the upper wrap riser/interface

Fig 7A

## Conclusions

In carrying out these trials which have been conducted in a similar manner to those performed by Shell, Aramco, BP, and Hibernia, CCI hopes that we have demonstrated the suitability and cost effectiveness of the retrowrap protection system which can provide both a viable alternative to vulcanized neoprene on new risers and a retrofit repair solution for offshore risers where cold installation can be carried out without requiring shutdown of the platform.

In conclusion, may I take this opportunity to thank Maraven for the facilities provided and look forward to the possibility of a long-term working relationship.

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For and behalf of CCI
Anthony E. J. Strange