# CABLE PROTECTION METHODOLOGY AT SURF ZONE IN MALDIVES

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**Abstract:** NEC was contracted for the turn-key supply of a submarine cable system for a customer in the island nation of the Maldives. This paper describes the cable protection methods used in the completion of the cable system, which would be useful for future projects in similar environments.

## 1. INTRODUCTION

The Maldives consists of thousands of islands in the southern Indian Ocean, arranged in more than 20 atolls, each with a ring-shaped coral reef enclosing a lagoon. In this marine environment, submarine cables in the surf zone are subject to heavy wave action, especially during the South East Monsoon season.

The submarine cable system was designed to connect atolls by means of several non-repeatered cable systems from North to South. In order to construct a secure, cost effective and environmentally friendly submarine cable system, it was necessary to study in detail the best cable protection methodology in the surf zone.

From past experience, cable protection by means of conventional articulated pipe protection was expected less effective, as the pipes have been eroded and broken by wave action.

Another factor to consider was the high number of landing points. Since the system was configured as six non-repeatered segments with 12 landings, a cost- and time-effective solution was required.

## 2. CABLE PROTECTION METHODOROGIES

Several protection methods were studied from the viewpoints of operation and maintenance, cost and environmental affect.

### 2.1 Cast Iron Articulated Pipe

Traditional Cast Iron Articulated Pipe (hear under Articulated Pipe) provides the protection against abrasion and impact in shallow water.
This methodology has long time history and is field proven in submarine cable industry.
Upon the past project, we experienced that Articulated Pipe was continuously moved by the wave action especially within surf zone and the movement of Articulated pipe cause the abrasion between the seabed then gradually wear the wall of the pipe. Finally articulated pipe was broken and removed from the cable. In addition, one piece of Articulated pipe was removed, a neighbouring one would also be removed as like a chain reaction.

 

**Photo-1 Damaged Articulated Pipe**

### 2.2 HDD

Horizontal Directional Drilling (HDD) is a trenchless technique for installing conduits under ground which makes underground bores controlling the course straight or with moderate curvature along the planned route.

HDD provide maximum security to the near shore cable. And also the environmental impact is small. However the cost and its lead time and operation duration including transportation of such heavy equipment between the sites shall be cause the impact for the project implementation. Regrettably adoption of HDD methodology was not possible to the project.

**HDD Machine**

### 2.3 Coral Reef Trenching

Trenching across coral reef with trench depth approx. 3-5m is to avoid surface wave influence.

Usually the cable is installed in the trench with Articulated Pipe. This methodology provide the effective protection for the cable.

However the environmental massive damage of breaking coral reef was not acceptable for the authority. Therefore this methodology also could not be applied for the project.

**Photo-2 Reef Cut**

## 3. ESTABLISH CABLE PROTECTION PLAN

Following the evaluation of cable protection methodologies, the enhanced cable protection by means of Articulated Pipe was considered.

### 3.1 Fixing Pipe on to Seabed

In order to reduce the movement that shall cause abrasion of Articulated Pipe, fixing the Articulated Pipe onto seabed with the clamp shall be effective.

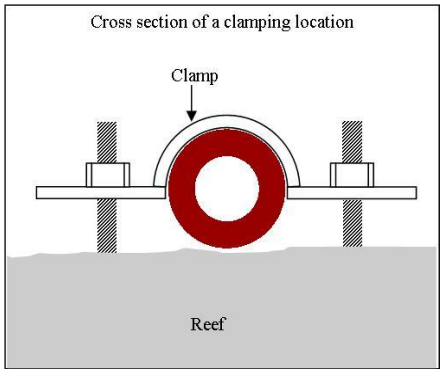


**Figure-1 Clamp and Anchor Bolts**

It is best to clamp for all pieces of Articulated Pipe on to seabed however in that case the number of the clamps required will be an unrealistic amount and the material cost and installation duration were not allowed for the project schedule. Permissible range of the clamp amount for the project was calculated as every 10m intervals.
The concern was that there will be 20 joints within 10m of Articulated Pipes. Each joint shall be designed to have "play" for adjusting to install along the cable route.
The clamps with 10m intervals was expected just to reduce the movement of Articulated Pipe and the abrasion risk caused by the movement of Articulated Pipe remains.

### 3.2 Adoption of Polyurethane Duct

The countermeasure against abrasion which can not avoid with clamps of 10m intervals was to change the material of Articulated Pipe from the cast iron to Polyurethane.
Polyurethane is unbreakable elastomer. It is expected that Polyurethane Duct provides the higher protection performance against abrasion and impact compared with cast iron pipe.

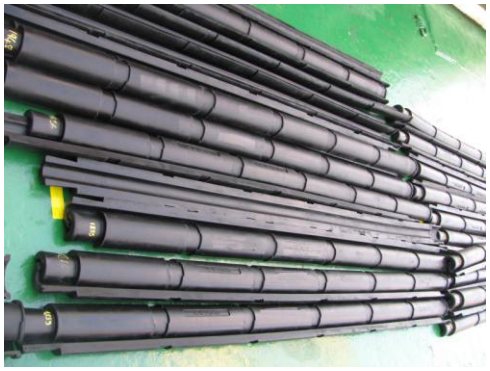

**Photo-3 Typical Polyurethane Duct**

Polyurethane Duct is commonly used for the cable closing point with underlaid pipeline in the submarine cable industry.

Usually unit cost of Polyurethane Duct is higher than Articulated Pipe. In order to reduce the cost impact of changing material, detailed diver swim surveys were carried out around surf zone each sites. The purpose of the survey is to confirm the actual condition of the sites. As the result of the diver swim survey, the areas inshore side of the surf zone were relatively stable condition and it was assumed that there were less risk of abrasion damage then it was decided that Polyurethane Duct would only be adopted on and offshore side of the surf zone.

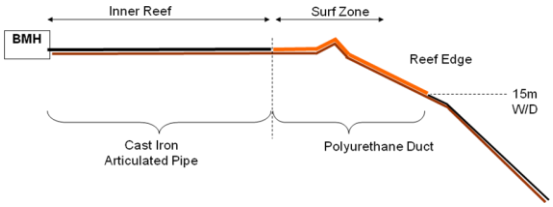


**Figure-2 Protection Diagram**

### 3.3 Route Design

If the wave came from side of cable route, the affect to move the cable is increased. In order to minimize the side wave, the cable route was designed to pass the surf zone in perpendicular direction.

## 4. FIELD INSTALLATION

During cable landing, Polyurethane Duct was attached to cable on after deck of the cable ship.
In order to cover surf zone with Polyurethane Duct properly, the distance between BMH and surf zone was carefully measured and attached a marking tape on to the cable prior to conduct the cable landing operation. The marking showed the section where Polyurethane Duct would be installed.
12 of landing operations were carried out during marine operation in the project. Articulated Pipe, Polyurethane Duct and Clamp with 10m intervals were installed as planed.

During installation, Clamping team faced several difficulties to do the work due to seabed undulation and soft seabed feature consisted from live and dead coral reeves which do not have adequate hardness to hold the anchor bolts of the clamps. It was required to adjust the clamp location to install relatively harder seabed in around.
The natural trenches were observed along or across the cable route. In case it was possible to move the cable by the diver, cable was put into the trench as much as possible and clamped in the natural trench to reduce the potential movement.

**Photo-4 Polyurethane Duct and Clamp in Natural Trench**

## 5. OBSERBATION OF PROTECTION CONDITION AFTER MONSOON

A diver inspection was conducted after the first monsoon season of after installation. Generally there was no damage observed on Polyurethane Duct section except 1 of 12 landing sites.
The site was where the landing route was not perpendicular direction with surf zone due to proximity of existing cable. During cable installation at the site, it was observed that cable route crossed several natural trenches. In that area, it was not possible to drop the cable into the natural trench.
It was assumed that the force of side wave to the cable was stronger than the other sites and the force cause continuous movement of the Polyurethane Duct, then the clamp which were installed every 10m intervals was also removed.
For the other 11 of 12 landing sites, some loosen clamps were observed however Polyurethane Duct conditions were quire normal and loosen clamps should not be affected for the security of the Polyurethane Duct and the Cable.
There was no abnormal observation for the Articulated Pipe section.

## 6. CONCLUSION

What we learned from the project for cable protection methodology at surf zone are;

- Application of Polyurethane Duct is effective against abrasion.
- Cable Route must be designed to across the surf zone in perpendicular direction to minimize the force of side wave
- Effects of the cable clamping on to seabed by means of anchor bolts are depend of the seabed structures.

In addition to above, keeping periodical observation and adequate maintenance such as replacement of the Polyurethane Duct and Clamps shall be important for long-term usage of the submarine cable system.