SUBMARINE CABLE SPATIAL PLANNING DISCUSSION BASED ON INCREASING MARINE ACTIVITIES

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Abstract: With global social and economic development, the demands of seabed space are increasing rapidly. The security and reliability of submarine cable systems during its long term design life is more and more critical. Reliable cable route planning can highly mitigate suffering from the increasing external risks and achieve a long term life. This paper discusses the constraints and influences on the planning of submarine cable systems based on past cable faults. The constraints and influences in nearshore areas (0-50m water depth) from offshore areas (50-200m water depth) are discussed.

1. INTRODUCTION

Man is increasingly realising the importance and economic value of the marine environment. As such, marine activities have increased over the years. Such activities include shipping, fishing, anchoring, dredging, oil and gas exploitation and the installation of submarine cable systems. Since the seabed is the common resource, appropriate spatial planning in the design of submarine cables is very necessary to limit conflict between seabed activities.

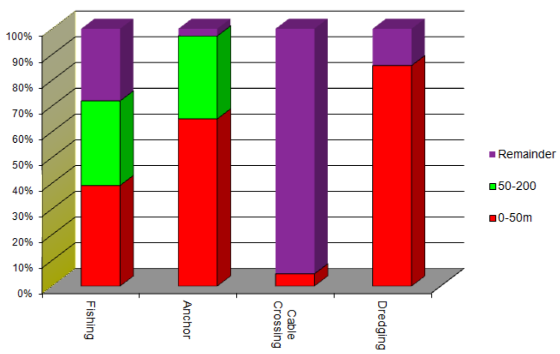
To study the future, it is always good to learn from the past. Historical cable fault data from Global Marine Systems' 2008 route engineering course (Figure 1 and Graph 1) indicates the fault mechanism of anthropogenic (human related) cable faults on the continental shelf. Although the data is not exhaustive or completely current, it is indicative of common fault distribution.

Based on the cable faults data, the constraints of submarine cable system have been sorted into nearshore faults (0-50m) and offshore faults (50-200m).

It is believed that the understanding of these fault mechanisms will contribute to the planning of submarine cables in the future.

Cable Fault	0-50m	50-200	Remainder	Total
Fishing	455	382	326	1163
Anchor	232	115	10	357
Cable Crossing	1	0	20	21
Dredging	24	0	4	28

Figure 1 Cable Fault Distribution (GMSL)



Graph1 Cable Fault Distribution (GMSL)

2. NEARSHORE CONSTRANITS AND INFLUENCES

As defined above, the nearshore area in this paper includes beach and coastal area. Closer to land, this area is more easily influenced by the activities of man. On the beach, factors such as coastal development for tourism and industry - including land reclamation - are the main man-made influences for submarine cable operations. In the coastal area, fishing, anchoring, shipping, dredging and regional political constraints are major constraining influences.

The fault statistics demonstrate that, globally, fishing and anchoring are the main factors affecting submarine cables security, and therefore influencing submarine cable route planning. However, in some regions, local regulation also significantly restricts the submarine cable route planning process.

2.1 FISHING

According to the cable faults data, fishing activity has caused the most cable faults in the nearshore area. According to the research of Stephen C. Drew and Alan G. Hopper 2009, fishing with mobile gear such as bottom trawls was a major cause of faults.

The bottom trawl consists of a cone-shaped net, trawl ground gear and trawl doors towed across the bottom by a fishing vessel. Trawl doors keep the net open during trawls. Although not designed to, the doors do make contact with/penetrate the seabed and will snag an unprotected cable (See Figure 2) [1].

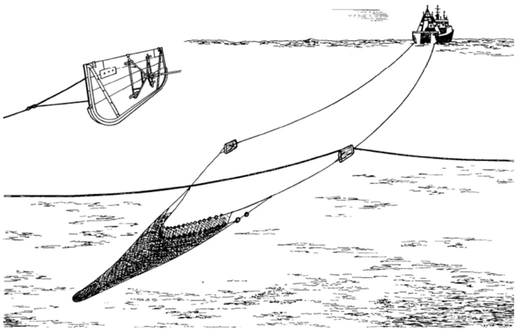


Figure 2 Bottom Trawl Catch Cable (Stephen C. Drew and Alan G. Hopper)

With regard to the fault statistics in Figure 1, the number of faults due to fishing reported in nearshore and offshore areas are similarly high. Although fishing methods and vessel numbers may vary, both areas are shown to be high risk.

For planning, sometimes fishing areas are clearly marked on hydrographic charts enabling the cable designer to limit interaction. However, such fishing activity is typically static, so research is required to assess the full extent of all fishing activity so as to understand risk. As a cable designer, this allows higher risk areas to be avoided, or risks mitigated by burial or increased levels of armouring. Risk can be further mitigated by publicising a cable route once the cable has been installed, and engaging with the fishermen through fisheries liaison to illicit cooperation in not deploying gear near cables.

2.2 ANCHORING

Submarine cable designers know vessel anchoring is a high risk to cables in nearshore areas. Anchor design means that they typically penetrate the seabed much deeper than most fishing gear, and as such are a greater threat. However, unlike trawl fishing activities which impact on a much wider area, anchoring is a localised threat to an anchor drop site. Risk obviously increases if anchor holding is compromised, and many cables are broken when anchors drag.

Examining the fault statistics in Figure 1, there are significantly more faults in the nearshore area than the offshore area. This is likely to be related to the numbers of vessels in coastal zones, and the increasing number of vessels able to anchor in shallower waters compared to water depths in excess of 50m.

For the route engineer, where anchoring is regulated or expected (typically close to ports), these high risk zones can typically be avoided or mitigated against through deeper burial or armouring. However, in open waters, a risk remains. It is therefore important for cables to be published on hydrographic charts to enable vessels to avoid deploying or dragging anchors through cables.

2.3 DREDGING

It is not surprising that dredging features in the nearshore cable fault statistics. Dredging is a highly destructive practice that will cut through cables very easily. Dredging is more prevalent in nearshore areas as the effort to borrow from deeper waters increases significantly, and the likely travel distance to the dredging grounds increases with depth.

Typically though, dredging is regulated, and as such is a manageable risk to route engineers. Even though illegal dredging is not unknown, typically dredging concessions are regulated and therefore charted or registered with authorities. If research does not highlight such areas, it is likely the permit process will identify this conflict of seabed use.

In practice is it advisable to avoid dredging areas regardless of thoughts of burial depths exceeding the base of extraction. Seabed levels change and a once safe cable can soon be at risk.

3. OFFSHORE CONSTRAINTS AND INFLUENCES

Analyzing historical cable faults, there are less cable faults in offshore areas than in nearshore areas. However, fishing activity remains the number one risk to submarine cable system safety in offshore areas.

3.1 SHIPPING ACTIVITIES

Cable faults associated with anchoring reduce away from land. It is suspected that this is related to the greater sea area, the fact that vessel traffic will be less away from land, and as water depth increases, so fewer vessels have the capability of anchoring. Cable route planners can use this knowledge to assess shipping risks close to shore compared to risk further offshore.

3.2 FISHING ACTIVITIES

As with nearshore areas, fishing remains the primary cable fault mechanism. Fishing techniques which interact with the seabed can vary regionally, but the difference in water depths considered in this study means that both nearshore and offshore methods are similar, and this is reflected in the fault totals in Figure 1.

As with nearshore cable route planning, the route engineer will study the distribution of local fishing habits and look to avoid - by routing or through burial - where possible. If avoidance is not possible, increased armour will negate some risk.

Additionally, publicising the as-laid cable route and undertaking fisheries liaison will promote system security.

4. OTHER INFLUENCES

4.1 REGIONAL POLICY

In some areas, regional policy impacts highly on submarine cable spatial planning. Such regulation is more prevalent in nearshore areas where man extends his influence into the sea.
Singapore is a typical example. Singapore owes much of its past - and will rely heavily in the future – to the shipping industry. As it is considered a critical industry by this small island nation, it acts to protect its future security. Singapore therefore restricts other seabed users to areas where they will have least impact on shipping activity, and this includes submarine cables. In Singapore, in modern times, submarine cable landings have been restricted to three strategic landing sites: Tuas, Tanah Merah and Changi North (see Figure 3). The approaches to these landings are constrained to narrow strips between historical anchorages so as not to impact on existing shipping activity. Cables are also required to be deeply buried so as not to present a snagging risk to anchors.
When cable landings are full, Singapore requires cables going out of service to be removed to make space for replacements.
However, regulatory issues are typically well understood, so a planner can design routes to comply with requirements and as such, limit the likelihood of cable failure.

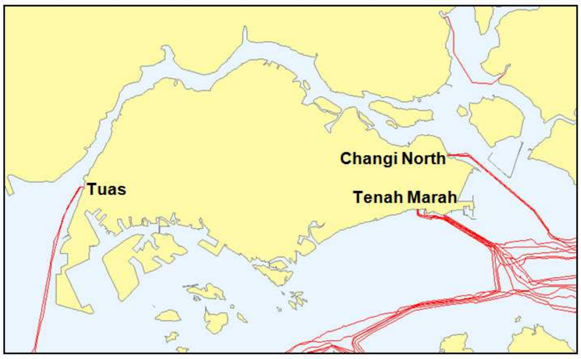


Figure 3 Telecommunication cable landings in Singapore

4.2 CABLE CROSSINGS

Considering the remaining fault causes, fault mechanisms tend to be balanced between nearshore and offshore.

It is assumed that cable crossing faults are operationally related. The lack of faults in water depths less than 200m probably relates to route engineers following good practice and avoiding interaction with third party systems in shallow water. It would take additional research to understand why faults occur outside this area (assume water depths are recorded) as there should be little risk if industry standard crossing rules are applied.

5. CONCLUSION

As the world continues to develop, man is increasingly taking possession of more of the marine environment. It is increasingly likely that all new submarine cables will conflict with some other seabed activities in one way or another. Old influences such as fishing and anchoring will continue to be major risks, and lessons from route planning today can be utilised in the future to minimise these risks.
Historical routing risks in the nearshore and offshore environment can therefore be studied to show how effective cooperation between users is maintained.

6. REFERENCES

[1] Stephen C. Drew and Alan G. Hopper, Fishing and submarine Cable s Working Together, International Cable Protection Committee, February 23 2009, Page 19-25.

