



Cable Integrity Risk Assessment (CIRA)



Subsea power cables are critical yet vulnerable aspects of any offshore project. Cable installation or continued operation of wind farms in mobile, high energy environments lead to challenges ensuring adequate protection and an acceptable risk profile for the cable assets. In addition, many project developers are now seeking to have a fuller quantification of risk at point of sale of assets, and to have a thorough understanding of risk to carry through to the operation phase of a project. As such, the CIRA was developed by Cathie as part of a holistic and nuanced view on risk mitigation over the whole project lifecycle. Understanding the current risk to cables and the potential development of risk is key to planning the wind farm operations, both for monitoring and potential remedial measures.

What is a CIRA?

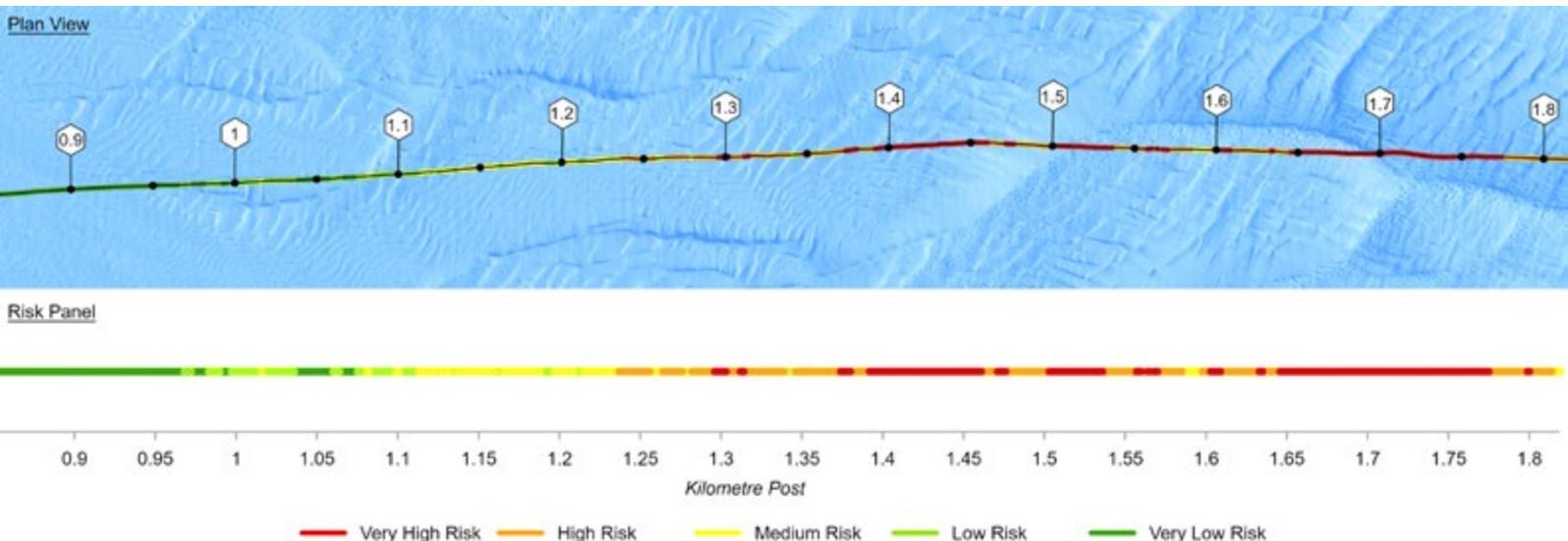
A Cable Integrity Risk Assessment (CIRA) is designed as a post-installation review of the cable risk, which can be considered as a retrospective cable burial risk assessment (CBRA) and follows a similar approach to that outlined in the Carbon Trust guidance (CTC835, Feb 2015). Data produced for the measured depth of burial of the cable, during installation ('live'), as-built (following installation) or as-surveyed (during the operational lifetime of the cable) is reassessed against the original known risks and any newer understanding of those risks which may have been developed over the course of the construction and / or operational phase.



The aim of the CIRA is to establish a repeatable process that defines the cable risk to create a management plan for the lifetime of the cable, including strategic planning of inspection and remediation works, where required. This process should begin during and alongside the cable installation, and, for this reason, the CIRA can be split into 2 distinct processes:

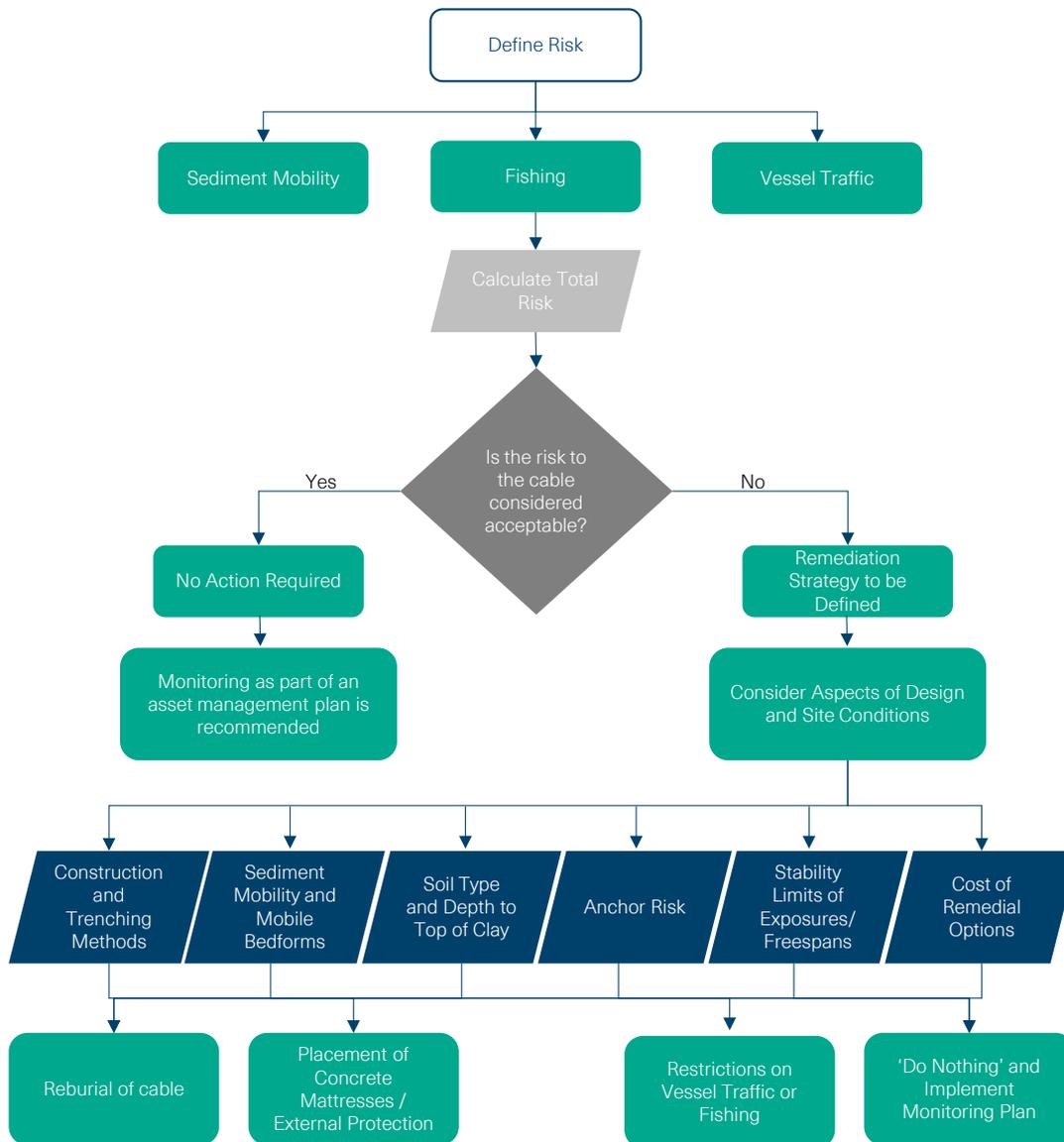
- **CIRA Live** - ongoing assistance during installation to aid decisions on multiphases, remedial requirements and reasonable endeavours discussions. Thus, informing, and reducing where possible, the necessity for other cable protection measures such as rock protection. This may be undertaken by a qualified engineer remotely, or an engineer placed on the installation vessel itself.
- **CIRA** - The report reviews the contractors as-built against the initial CBRA and reassesses risk for all cables or zones along the cable and delivers a 'traffic light system' showing clearly where the highest lifetime risk exists, providing recommendations for the future survey durations and potential remedial works. The relationship with Cathie is maintained through the lifetime with the operator, re-performing the CIRA after significant events or periodic surveys and updating the risk profile. This can therefore be used in conjunction with other live analysis such as DTS and DAS, and combined with a GIS package (portal) managed by Cathie if required.

The basis of the integrity risk assessment for a submarine cable relies on identifying the potential hazards, associated risks and evaluating the level of protection that may be afforded to the cable by its armouring (internal and/or external), burial beneath the seabed and by any other means, such as rock dumping. There are a wide range of obstacles and seabed users which can present a hazard to subsea cables, including fishing, emergency anchoring of shipping vessels, dredging and seabed mobility.



Risk assessment methodology

The following flowchart covers an outline methodology for the assessment of risk, following the guidance by Carbon Trust and carried out for the CIRA, a discussion over the acceptability of this risk by all stakeholders and then the definition of the remediation strategy.



Once the total risk is understood, the requirement for mitigation can be established.

The later section of the flowchart, once the acceptability of risk has been discussed with the operator, aims to establish the likely future risk to the cables, the possible development of the mobile seabed and to strategies and management plan covering monitoring and remediation of the cables.

In highly mobile areas leading to a changing burial profile, the movement of the sandwave crest will be investigated and compared to the cable location to predict when in the future the risk to the cable may be greater, or when may be a suitable, and most efficient and cost-effective, time to carry out remediation. It is also possible that this most suitable time may not be appropriate in the short term, and therefore risk is required to be managed and a monitoring strategy for the area developed.



CATHIE

From a single snapshot of one bathymetric or, ideally, depth of burial survey of the cable, it is difficult to predict how the sandwave will behave going forwards. Multiple bathymetric surveys can be utilised and the sandwave crest and shape mapped. Multiple bathymetric surveys are shown as an example below.

A prediction of the sandwave movement rate can be carried out and estimations of the change in sandwave shape to allow the best strategy for management of the risk to be carried out.

Where the cable is exposed or the risk is considered too high to be acceptable, considering the owners appetite to risk, remediation should be considered, typically this will be by remedial burial or the use of external protection. However, external protection may be moved by the sandwaves and carrying out a re-burial program straight away in areas of significant sandwaves with multiple peaks and troughs may not be the best approach as the cable is likely to become exposed or burial reduced again with further movement.

Using an average movement rate of the sandwave per year, it is possible to predict when the sandwave may move past the cable's at risk area to predict when it will be best to complete a remedial burial programme.

Representative Track Record

Cathie has developed the CIRA following experiences as key authors of the Carbon Trust CBRA guidance (CTC835, Feb 2015), carrying out over 75 CBRA's for projects around the world, assessing on over 17,000km of cables, and learning about the clients needs and common post-installation problems. Cathie have since delivered cable integrity risk assessments, helping operators and owners confirm risk profiles post-installation for insurance and asset sales, as well as to develop the cable management strategy.

