Cost Benefit Analysis Model

**The Protection Cost Benefit Analysis (CBA) Recommendation**

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| The current **Protection CBA Recommendation** for the 33kV submarine electricity cable **Eday - Westray** is the baseline option:* Cable surface laid on the seabed – Approximately 8,200m
* Split pipe protection on both shore ends – Approximately 100m per shore end
* New cable removed at the end of its economic life.

This is deemed to be the best value solution based on the current available information whilst addressing risks & impacts as well as needs of stakeholders:* Split pipe at the shore end limits the risk to the cable from abrasion as well as providing some cable stability. Additionally, this provides protection to public safety should the shore end be exposed due to erosion.

The **Final CBA Recommendation** scenario has an overall societal value of **minus £13,313,875.** This includes consideration of impacts on health and safety, socio-economic, environmental and wider economic and engineering impacts. The final recommendation of this summary report may not fully align with the final **Project Description.** This is becausefollowing a Cable Burial Risk Assessment (CBRA)and On-bottom Stability Study (OBSS), further protection/stabilisation of the cable may be required. It will be confirmed whether the proposed installation method deviates from the CBA recommendation and justification given as to why this deviation is required.Areas where stabilisation is required will be defined in the OBS On-Bottom Stability (OBS) study. The OBS study will define how much the cable is predicted to move under storm conditions using DNV approved software, if the cable is predicted to move by more than 10 x its Outer Diameter then it is considered to be unstable. Where the cable is shown to be unstable concrete mattresses, burial or similar methods may be proposed in addition to the CBA recommendation in order to further stabilise the cable. Rock bags are not proposed to be used on the Eday – Westray cable due to their height being likely to reduce the water depth by more than the 5% limit which will be a Marine Licence condition. The outcome of the CBRA will determine the depth of burial which is required to protect the cable from perceived risks from marine users. At present, all burial in the CBA model is assumed to be at a depth of at least 0.6m. |

**Background**

On the 7th August 2020 at 21:01, the existing Eday – Westray 33kV submarine cable crossing between the islands of Eday and Westray, in the Orkney Isles, faulted in service. Initially 974 customers were affected. The 33kV network was configured to provide restoration of supplies with local generation on Eday curtailed off. The H&I Region subsequently carried out fault testing and confirmed the presence of a wet fault within the submarine cable section on a single phase (red) to earth at approximately 3,935m offshore from the overhead line termination at the Westray side and 4,600m from the overhead line termination at Eday. This location coincides with a previous fault repair carried out in June 2016, located at a water depth of approximately 15m. Subsequently, Scottish Hydro Electric Power Distribution plc (SHEPD), are now undertaking the planning of an end to end replacement project following initial optioneering. This project is being carried out under a fault scenario and therefore processes are being expeditated to return the cable/circuit to service as soon as possible. This project requires additional emphasis as the second submarine cable, Sanday – Eday, which feeds the Island of Eday subsequently faulted on 01/11/2020 leaving the island disconnected from all grid supplies. Customers on Eday were subsequently being fed via mobile diesel generation until a temporary grid connection solution was put in place for domestic customers on 5th March 2021.

This CBA model was designed to help with the identification of the best value method of cable installation, burial, protection, inspection and maintenance which satisfies all current legislation. It allows modelling of the material risks and impacts identified by stakeholders for the Eday - Westray submarine electricity cable. This model must be used in conjunction with the Cable Burial Risk Assessment (CBRA) and On Bottom Stability Study (OBSS). The CBRA will indicate were there is risk of damage to the existing cable and recommend a suitable burial depth to mitigate this risk, additionally the OBSS will show were the cable requires additional stabilisation, if the cable is determined to be “unstable”. A combination of the three assessments will be used to form the final project description. At present, due to the fault scenario, a CBRA and OBSS have yet to be carried out and therefore the models run in this CBA are based on theoretical install scenarios, SHEPD knowledge of current cable install and likely achievable levels of burial.

The CBA model assigns financial values across the following key categories for each cable installation method and design:[[1]](#footnote-1)

* Health and safety
* Socio-economic
* Environmental
* Wider economic and engineering

These values are then aggregated to estimate the **‘societal value[[2]](#footnote-2)’** of each solution.

The output of the CBA model helps to demonstrate (to ourselves, our customers, our regulators and all users of the sea environment) that the method(s) proposed to deploy for installing this submarine electricity cable justifies the expenditure and provides best value[[3]](#footnote-3). The CBA model supports our marine licence application by illustrating how we consider the cumulative impact of our engineering design.

Initially 28 different CBA models have been developed, including the baseline, to identify the best value solution i.e. the solution with the highest **societal value** which balances the risks, impacts and the needs of stakeholders. The number of models may be subsequently increased or reduced if and when further information, like the CBRA and OBSS, become available.

Following completion of the installation design by the appointed contractor, the proposed protection/installation method will be updated and included within the CBA documents to allow direct comparison to other options. This version of the CBA Recommendation report supersedes all previous versions.

**The process to arrive at the final recommendation**

The starting point for the CBA process is Scotland’s National Marine Plan (NMP) (2015) which highlights the following policies, in Chapter 14, which need to be taken into account on a case by case basis for reaching a decision regarding the development and activities involved in installing a submarine electricity cable:

* Cables should be suitably routed to provide sufficient requirements for installation and cable protection.
* New cables should implement methods to minimise impacts on the environment, seabed and other users, where operationally possible and in accordance with relevant industry practice.
* Cables should be buried to maximise protection where there are safety or seabed stability risks and to reduce conflict with other marine users and to protect the assets and infrastructure.
* Where burial is demonstrated not to be feasible, cables may be suitably protected through recognised and approved measures (such as rock or mattress placement or cable armouring) where practicable and cost-effective and as risk assessments direct.
* Consideration of the need to reinstate the seabed, undertake post-lay surveys, monitoring and carry out remedial action where required.

Based on the need to comply with the Scotland’s National Marine Plan the following three phases of work with regards to the CBA model have been carried out as part of this marine licence application.

**Phase one:**

Phase one draws on the initial burial assessment[[4]](#footnote-4) and the Scotmap National Marine Plan Interactive Map to address Factor 1 and identify a suitable route against which the impacts included within the CBA model categories can be compared. The CBA model[[5]](#footnote-5) is then used to identify the **Burial Scenario** using our three[[6]](#footnote-6) recognised burial methods and to provide evidence to address Factor 3 (cables should be buried to maximise protection where there are safety or seabed stability risks and to reduce conflict with other marine users). The output of this phase of analysis is described as the **Burial Scenario**.

From a technical and operational perspective, the following parameters (used in the cost benefit analysis following agreement with stakeholders) identify where burial is achievable by:

* Jetting and Mass Flow Excavation where there is a minimum sediment depth of 1.5 metres for 50 metres along the seabed
* Ploughing where there is a minimum sediment depth of 2 metres for 500 metres along the seabed

From initial engagement with contractors, the method of burial installation which would be proposed, if required, for this cable, is by post lay jetting. Therefore, in this CBA model, post lay jetting is the only method which has been considered when considering burial.

The above statements indicate where it is deemed feasible to undertake burial activities using the stated methods as part of the CBA. The depths indicated do not represent the depths at which a cable must be covered to be deemed “buried” as part of the analysis. The minimum depth of cover which is required to deem the cable “buried” is where the top of the cable is covered by layers of sediment no less than 0.6m deep. The CBRA and OBSS will provide recommended minimum depths of burial/cover at given locations along the route based upon the perceived risks to the cable and marine users. For the purposes of the CBA, cable burial of 0.6m or greater will be deemed “Buried” any depth shallower than 0.6m will be deemed as surface laid.

**Phase two:**

The **Burial Scenario** is then input into phase two of the CBA model which uses the key assumptions around our three recognised protection methods to develop a **Hybrid solution(s)** which include elements of both burial and protection that are feasible. This phase seeks to address Factor 2 (a method to minimise impacts on the environment, sea bed and other users) and Factor 4 (where burial is demonstrated not to be feasible, cables may be suitably protected where practicable and cost-effective and as risk assessments direct). A process of engagement is then conducted to identify if these scenarios are practicable, cost effective and address the possible risks. The **Final CBA Recommendation** will then be made for the scenario which representsthe overall best value solution.

**Phase three:**

Based on the process of engagement, including the pre applications consultation events, the **Hybrid solution(s)** can be refined and then entered into the CBA model to obtain estimated societal value. During the phase three analyses a sensitivity analysis is carried out on key assumption to understand how the value of impacts may vary. Phase three also provides the evidence base to support consideration of Factor 5 which examines the need to reinstate the seabed, undertake post-lay surveys and monitoring and carry out remedial action on an ongoing basis. The **Final CBA Recommendation** will then be made for the scenario which representsthe overall best value solution.

**Eday – Westray: Phase one**

The input to phase one of the CBA analysis was standalone installation assessments for the Eday - Westray cable. The installation corridor topography is characterized by thin surficial sediments overlaying a mixed boulder-type and rocky seabed. This leads to localised regions of sandwaves where sediment deposition has accumulated and is subject to tidal currents, areas of exposed boulders, and rocky outcrops. It is considered unlikely that burial would be achievable over any significant lengths of the replacement cable route.

From initial site investigations and historic inspections of the cable shore ends it has been confirmed that split pipe protection will be required on both shore ends, for all installation scenarios. This will provide additional protection in the inshore area and minimise damage from abrasion. Additionally, this will increase cable stability. Onshore erosion has uncovered the shore end of the existing cable at Eday. As such, all install scenario models show split pipe protection on both shore ends, with the exceptions of option 1A (100% surface lay), just to show all possibilities. Due to the confirmation that split piping will be required, this has been taken as the base case scenario in which to compare all other options. The base case shows both shore-ends with split pipe protection with the remainder of the cable being surface laid.

Table 1 provides an overview of the scenarios that were considered in this phase of the analysis.

**Table 1** Phase 1 initial burial scenarios

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Option** | **Scenario methods** | **Total Societal****Value** | **Net change^****(£)** | **Net Change^****(%)** |
| Baseline | Split pipe 2.38% (0.2km) / Surface lay 97.62% (8.2km) | -£13,313,857 | - | - |
| 1A | Surface lay 66.67% (8.4km) | -£9,393,503 | £3,920,353 | -29.45% |
| 1B | Jetting 30.95 (2.6km) / Split pipe 2.38% (0.2km) / Surface lay 66.67% (5.6km) | -£13,533,093 | -£219,237 | 1.65% |
| 1C | Jetting 26.19% (2.2km) / Split pipe 2.38% (0.2km) / Surface lay 71.43% (6.0km) | -£13,518,855 | -£204,998 | 1.54% |
| 1D | Jetting 20.24% (1.7km) / Split pipe 2.38% (0.2km) / Surface lay 77.38% (6.5km) | -£13,437,713 | -£123,856 | 0.93% |
| 1E | Jetting 16.67% (1.4km) / Split pipe 2.38% (0.2km) / Surface lay 80.95% (6.8km) | -£13,490,379 | -£176,522 | 1.33% |
| 1F | Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km) | -£13,409,237 | -£95,380 | 0.72% |
| 1G | Jetting 97.62% (8.2km) / Split pipe 2.38% (0.2km) | -£10,549,922 | £2,763,935 | -20.76% |
| 1H | Jetting 71.43% (6.0km) / Split pipe 2.38% (0.2km) / Surface lay 26.19% (2.2km) | -£13,780,806 | -£466,949 | 3.51% |
| 1I | Jetting 60.71% (5.1km) / Split pipe 2.38% (0.2km) / Surface lay 36.91% (3.1km) | -£13,685,426 | -£371,569 | 2.79% |
| 1J | Jetting 51.19% (4.3km) / Split pipe 2.38% (0.2km) / Surface lay 46.43% (3.9km) | -£13,656,950 | -£343,093 | 2.58% |
| 1K | Jetting 82.14% (6.9km) / Split pipe 2.38% (0.2km) / Surface lay 15.48% (1.3km) | -£13,876,186 | -£562,330 | 4.22% |

^The net change is compared to the baseline assumption.

From this phase of analysis, two options showed a positive increase in societal value when comparing against the baseline option. These were option 1A (100% surface lay), and option 1G (Shore end split piping and + 97.62% burial by jetting) As explained previously, split pipe protection will be a requirement on both shore ends to avoid physical damage to these sections of cable, so this rules out option 1A from being feasible. It is highly unlikely that 97% burial can be achieved along this route based on the historic data, which shows sections of the cable on top of the sea bed. When burial percentage is reduced, as little as 15% (1.3km) the societal cost of this installation (Option 1K) increases above the baseline installation, at 4.22% circa £563k more than base case. From the initial burial assessments, it is shown that should full burial not be achievable, it is actually better value to society to do far less burial. Option 1F shows the lowest change from baseline value at an increase of only 0.72%, circa £95k, in cost to society. This option shows only around 10% burial along the route, equivalent to 0.9km of burial. Based on the phase one outputs and the fact that 100% burial in not achievable on this route, the output models indicate that the baseline scenario is the least cost to society and has the highest overall societal benefit.

Should burial be required along the route, following CBRA or OBSS, the CBA model shows lower levels of burial in this route, will have a better value to society. The recommendation from this phase of analysis would be that; should 100% burial not be achievable on this route, the cable be surface laid in its entirety with the exception of both shore ends which should have split pipe protection.

**Eday - Westray: Phase two**

Phase two of the analysis then sought to identify scenarios beyond the initial assessment scenarios (Phase 1 output) where burial only was considered, by adding additional protection which may be practicable, cost-effective and address marine user risk including anticipated Marine Licence conditions.

Table 2 provides an overview of the scenarios that were considered in this phase of the analysis.

These models have been run using additional methods of protection as it is believed from historic data that some level of cable stabilisation will be required along this route. With 100% burial unlikely to be achievable, some rock bagging of mattressing may be required to provide suitable cable stability and or protection.

For clarification, the assumption has been taken that 1 rock bag will cover 2.4m of submarine cable, in each scenario where rock bags have been used. The length of cable indicated in each model to be covered with this protection method is assumed to be covered by these bags. When it comes to installation, these bags are likely to be spread out along the cable allowing much greater lengths of cable to be stabilised. This will be determined within the OBSS.

For concrete mattressing, it is assumed 1 mat would cover approximately 6m of cable.

**Table 2** Practicable and cost-effective burial and protection scenarios

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Option** | **Scenario methods** | **Total Societal****Value** | **Net change^****(£)** | **Net Change^****(%)** |
| Baseline | Split pipe 2.38% (0.2km) / Surface lay 97.62% (8.2km) | -£13,313,857 | - | - |
| 2A | Rock Bagging 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 91.67% (7.7km) | -£16,691,963 | -£3,378,107 | 25.37% |
| 2B | Mattress 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 91.67% (7.7km) | -£22,866,471 | -£9,552,614 | 71.75% |
| 2C | Jetting 10.71% (0.9km) / Rock Bagging 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 80.96% (6.8km) | -£16,787,344 | -£3,473,487 | 26.09% |
| 2D | Jetting 82.14% (6.9km) / Rock Bagging 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 9.53% (0.8km) | -£17,254,293 | -£3,940,436 | 29.60% |
| 2E | Jetting 82.14% (6.9km) / Rock Bagging 15.48% (1.3km) / Split pipe 2.38% (0.2km) | -£16,438,232 | -£3,124,376 | 23.47% |
| 2F | Jetting 51.19% (4.3km) / Rock Bagging 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 40.48% (3.4km) | -£17,035,056 | -£3,721,200 | 27.95% |

 ^The net change is compared to the baseline assumption of end to end surface lay.

Within the six scenarios considered in Table 2, zero scenarios provided a reduction in the cost to society when comparing to the baseline installation. It was shown that concrete mattressing has a significant negative effect on the value to society when comparing the same length of cable being protected by rock bagging. Option 2A and Option 2B indicate this by the 46% variance/increase in costs between both options. It is anticipated that a condition of the Marine Licence will be that the new cable installation works will not be allowed to reduce the water depth by more than 5% of the water column (measured at Lowest Astronomical Tide). As the cable route is shallow (typically <20m) over almost its entire length even a 1m reduction in depth due to rock bags could result in a breach of this licence condition.

Should any level of concrete mattressing be required following detailed route engineering, it is likely to have a negative impact on the overall value to society. Any requirement for this method to be utilised should be clearly justified.

**Eday - Westray: Phase three**

In this phase of analysis, the best value solutions from phases 1 and 2, along with other likely install scenarios, were refined and challenged to identify the best value solution using the societal value as an indicator of value before a **Final CBA Recommendation** was made.

Sensitivity analysis was conducted to help identify the key variables which have a major influence on the cost and benefits of a submarine electricity cable project. These are:

* Age: Life expectancy of the cable
* Full life cycle costs
* Social costs
* Decommissioning costs
* Health and safety risk

The sensitivity scenarios considered changes in predicted lifecycle of the new cable and the effects of decommissioning the existing cable, when looking at the best value solution identified in phases 1 & 2.

Option 1F was taken as the most likely install method, should some level of burial be determined as being required to provide stability and or protection for the cable. Option 1F was the closest value to the baseline option with a variance of 0.72% equivalent to £95,380 and is made up of Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km). Should higher levels of burial be required following on OBSS and CBRA, say up to 30% (2.6km) of full route length, the additional cost to society is up to circa £124k as demonstrated in table 1. At this stage the baseline option would still be the preferred option of installation if the cable is not deemed to be at risk and require burial.

Table 3 shows the impact of an increase in the life expectancy of the cable when compared against the base case. In the baseline options, unprotected (surface laid) sections of cable have life expectancy set at 20 years. Options 3E & F also consider the effect of decommissioning the existing installed submarine cable. Options 3G & H show the baseline model with an assumption on cable life expectancy being extended. Furthermore, as rock bags are likely to breech marine license conditions, options 3I & 3J have been included as any cable stabilisation is likely to be through concreate mattressing if required from the OBSS.

**Table 3 Sensitivity testing**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Option** | **Scenario methods** | **Total Societal****Value** | **Net change^****(£)** | **Net Change^****(%)** |
| Baseline | Split pipe 2.38% (0.2km) / Surface lay 97.62% (8.2km) | -£13,313,857 | - |  |
| 3A | Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km)**[Unprotected sections life expectancy set at 25 Years]** | -£11,361,131 | £1,952,725 | -14.67% |
| 3B | Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km)**[Unprotected sections life expectancy set at 30 Years]** | -£10,964,953 | £2,348,904 | -17.64% |
| 3C | Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km)**[Unprotected sections life expectancy set at 35 Years]** | -£10,675,896 | £2,637,960 | -19.81% |
| 3D | Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km)**[Unprotected sections life expectancy set at 45 Years]** | -£10,193,045 | £3,120,812 | -23.44% |
| 3E | Jetting 10.71% (0.9km) / Split pipe 2.38% (0.2km) / Surface lay 86.91% (7.3km)**[Unprotected sections life expectancy matches baseline at 20 years + Decommission existing cable]** | -£14,100,799 | -£786,942 | 5.91% |
| 3F | Jetting 10.71% (0.9km) / Rock Bagging 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 80.96% (6.8km)**[Unprotected sections life expectancy matches baseline at 20 years + Decommission existing cable]** | -£17,478,906 | -£4,165,049 | 31.28% |
| 3G | Split pipe 2.38% (0.2km) / Surface lay 97.62% (8.2km)**[Unprotected sections life expectancy set at 25 Years]** | -£11,292,168 | £2,021,689 | -15.18% |
| 3H | Split pipe 2.38% (0.2km) / Surface lay 97.62% (8.2km)**[Unprotected sections life expectancy set at 30 Years]** | -£10,901,111 | £2,412,746 | -18.12% |
| 3I | Mattress 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 91.67% (7.7km)**[Unprotected sections life expectancy set at 25 Years]** | -£18,480,628 | -£5,166,772 | 39% |
| 3J | Mattress 5.95% (0.5km) / Split pipe 2.38% (0.2km) / Surface lay 91.67% (7.7km)**[Unprotected sections life expectancy set at 30 Years]** | -£17,637,759 | -£4,323,903 | 32% |

^The net change is compared to the baseline assumption.

Overall there is an increase in the societal value, as expected, if the cable life is extended. The current cable installation has only been installed in this location for 7 years and has experienced 2 faults. However, these faults have been attributed to poor electrical condition of the current cable and therefore it is anticipated that the new cable to be installed, will be of a higher quality. The average cable life of SHEPDs cable fleet is around 25 years, given this is a high tidal area, the life on an unprotected cable has been modelled as 20 years (applied to all unprotected cable sections in the models in tables 1 and 2). Given that the existing cable is a SWA cable and the proposed cable will be of DWA construction it is being assumed that cable life due to mechanical damage could be extended. Additionally, providing that the cable is suitably stabilised, minimal mechanical damage from abrasion should be expected, this again forms part of the assumption that cable life could be extended. Protected sections of cable are anticipated to have a life expectancy of 45 years. Models 3A-3D show the change in societal value of the original Option 1F should cable life expectancy of the full cable be extended.

If considering just a small increase in cable life against initial expectations of 20 years, there is a significant change in societal value. An increase of cable life of just 5 years from 20 to 25 years as per model 3A, returns a positive increase in societal value against the base case option of 14.6% or circa £1.9million. This increase is not unreasonable to assume, when considering the additional mechanical protection on the cable at both shore ends as well and some protection through burial, the 25year average life of SHEPD’s cables is also generally from SWA cables. Significant route engineering and micro routing as well as CBRA’s and OBSS being conducted as part of this install give confidence that an increase in life over the average age of SHEPD’s cables can be achieved. This shows there is likely to be a positive impact on societal value by installing the cable with this level of protection.

However, when applying the same increases of life expectancy to the base case option, this again comes out on top as the best overall solution in terms of societal value. Direct comparisons can be drawn between options 3A and 3G then again between models 3B and 3H. Under both scenarios, the base case option has a better overall value to society.

Options 3E and 3F consider the impact on societal value if the current cable is fully decommissioned as part of this install. In both options there is clear indication that this will negatively affect the overall value to society. This is therefore not recommended unless essential for new cable routing.

Options 3I and 3J show that even when considering an increase in cable life over the original base case, concreate mattressing has a significantly negative effect on societal value. In both options there is clear indication again that this will negatively affect the overall value to society.

**Interpretation of results**

Phase one of the CBA model shows surface laying the new Eday - Westray submarine electricity cable results in the highest societal value (i.e. lowest net cost) when compared to the baseline scenario, however, it has already been pre-determined that split pipe protection will be required on both shore ends for mechanical protection of the cable, and thus this option is eliminated. The next best option is option 1G, which in addition to split piping the shore ends, models the remainder of the cable being buried through post lay jetting. From existing information, it is not believed this can be achieved. This leaves a preferred option from phase 1 being the baseline installation.

Phase two shows combinations of protection scenarios in compliance with the National Marine Plan hierarchy of installation and the need to consider the views of other stakeholders and marine users. The baseline option still provides an overall better value to society than any of the hybrid options modelled in phase 2. From the models investigated, it would indicate that should the OBSS determine concrete mattresses are required in specific locations for cable stability, the least amount of mattresses used will provide better value to society.

Phase three shows the impact of other possible outcomes to the recommended option. The sensitivity testing examined if the cable life expectancy was greater than expected what societal benefit this would produce. The results from this were that as life expectancy increased the overall societal benefit also increased. Additionally phase 3 concluded that decommissioning of the existing cable would result in a negative impact on the overall cost to society. Under all feasible scenarios the base line option presents the best overall value to society.

**Recommendation**

The CBA model considers the societal value of different installation methods for the Eday - Westray submarine electricity cable. It is understood that other externalities not modelled need to be considered. These include marine planning policy, final engineering design requirements including any requirements for shore end protection and the cumulative impact of our submarine electricity cables on other legitimate marine users. It is therefore proposed, at this stage, that the baseline option which is a combination of 0.2km of split pipe protection and 8.2km of surface lay is put forward for further design consideration.

The CBA has modelled this as section 1 and 9 (Split piping) with the remainder surface laid. The specific locations will be derived at detailed design stage to mitigate the risk to other marine users and minimise the environmental impacts at a micro siting basis.

Whilst the marine licence CBA has identified the baseline option to have the lowest societal impact verses the other viable options, the National Marine plan suggests that burial should be maximised as far as possible for replacement subsea cables. Should burial be required for stabilisation or protection following the CBRA/OBSS the phase 1 analysis indicates that additional burial can be delivered whilst only having a small impact on the overall societal value versus the baseline.  Option 1F (10% Burial) has a societal value of -£13,409,237 compared with baseline of -£13,313,857. The total variance between both options is approximately **£96k**. Therefore, should additional burial be required following the CBRA and OBSS, this should not greatly affect societal value.

Following detailed design there may be the requirement for additional protection or burial, for stability of the replacement cable. This will be determined through the refinement phase of the project and reference will be made in the final CBA recommendation summary.

It is recommended that the baseline scenario be progressed as the preferred installation method at this stage.

1. The Submarine Electricity Cables Cost Benefit Analysis Methodology Statement can be found here: [http://news.ssen.co.uk/media/266365/SSEN-CBA-Method-Paper-120pp-22336-WEB.pdf](http://news.ssen.co.uk/media/147004/4731-ssepd-submarine-cables-doc-july-2016_06.pdf)  [↑](#footnote-ref-1)
2. Societal value is the cost or benefit to society which includes the private costs / benefits plus any external costs / benefits. Private costs / benefits in the CBA model would be regarded as the Economic and Engineering category and the external costs would be noted as the Health and Safety, Socio-economic and the Environment categories. [↑](#footnote-ref-2)
3. We define best value as the method(s) of installation which satisfy all current legislation and provides a sustainable balance of economic, safety and wider social and economic impacts. [↑](#footnote-ref-3)
4. The initial burial assessment is the output of the process which SSEN has carried out in conjunction with stakeholders to identify a suitable route and obtain the required environmental surveys of the seabed and benthic habitats on which to carry out the cost benefit analysis. [↑](#footnote-ref-4)
5. The CBA tool methodology is available at <http://news.ssen.co.uk/submarinecables/information/> [↑](#footnote-ref-5)
6. The three methods commonly used by the industry to install cables are: Ploughing, Jetting and Mass Flow Excavation. A forth installation method of horizontal directional drill (HDD) - can be used on submarine electricity cables shorter than 2km in length. [↑](#footnote-ref-6)