Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan RIIO-T2BP-EJP-0013 Rev 3.0

Materials Management and Warehousing

Engineering Justification Paper

1. Executive Summary

This Engineering Justification Paper sets out the need for improved materials management and warehousing capabilities over the RIIO-T2 period and beyond. We need to address the limitations of the current warehouse facilities along with an improved inventory management system to drive the changes needed to improve network performance through the reliability, availability and maintainability of asset and spares inventory. These benefits will improve repair times, reduce network and customer risks, rationalise spares holdings and reduce the consequences of system failures through improved logistics and inventory management.

Following Ofgem feedback in the draft determination, SHE Transmission has appointed an independent specialist consultant to review the comments and the proposals put forwarded to ensure they are necessary.

- [redacted]. The report further highlights that the facilities are not suitable for extending or refurbishment due to their existing design.
- The report clearly identifies that the existing facilities have no spare capacity to store any future strategic spares indoor or any bespoke storage to house high cost, long lead time oil filled components such as transformers.
- Lastly, various options were considered, and a Cost Benefit Analysis undertaken to establish the optimal solution for the RIIO-T2 period and beyond. This option selected is to develop two twin-warehouses in the Inverness and Dundee locations.
- Implementation of an Inventory Management System (IMS) will also be required and is detailed in our Non-Operational Capital Expenditure Paper.

The cost to deliver the above option excluding the IMS stands at [redacted]. This cost has been developed through supply chain engagement with current framework contractors and validated by independent industry specialists. The project will be delivered during the RIIO-T2 price control. The warehouse capacity requirements have been fully calculated based on the current and future spares requirements and are detailed within the paper. It should be noted that since the commencement of regulation SHE Transmission has not requested any funding from the regulator to construct warehousing facilities.

Upon project delivery there are several benefits relating to the RIIO-T2 business goals which have been listed below and are detailed further within this justification paper:

- Improved inventory management control to ensure all spares are appropriately managed and maintained resulting in significantly less wastage and plant write-off.
- Business continuity risks are controlled and managed

- Significant improvement of facilities that meet industry standards and comply with current H&S legislation.
- Improved fault network restoration response times contributing to enhanced network performance, with warehouse locations considered for the geographical and environmental challenges in the North of Scotland.
- Reduced need to procure additional spares through projects leading to lower capital costs of projects.
- Spares are stored in a controlled environment ensuring longevity and availability.

This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.

Name of Scheme/Programme	Material Management and Warehousing
Primary Investment Driver	Resilience
Scheme reference/ mechanism or category	SHNLT2032
Output references/type	NLRT2SH2032
Cost	[redacted]
Delivery Year	2025
Reporting Table	D4.3a_Non-Op Capex
Outputs included in RIIO T1 Business Plan	None

2. Introduction

This Engineering Justification Paper sets out our plans to introduce enhanced material management and warehousing during the RIIO-T2 period (April 2021 to March 2026).

The Engineering Justification Paper is structured as follows:

Section 3: Need

This section provides an explanation of the need for the planned works. It provides evidence of the primary and, where applicable, secondary drivers for undertaking the planned works. Where appropriate it provides background information and/or process outputs that generate or support the need.

Section 4: Optioneering

This section presents all the options considered to address the need that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

Section 5: Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. Where appropriate the results of Cost Benefit Analysis are discussed and together with supporting objective and engineering judgement contribute toward the identification of a selected option. The section continues by setting out the costs for the selected option.

Section 6: Conclusion

This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

Section 7: Price Control Deliverables and Ring Fencing

This section provides a view of whether the proposed scheme should be ring-fenced or subject to other funding mechanisms.

Section 8: Outputs included in RIIO-T1 Business Plan

This section identifies if some or all the outputs were included in the RIIO-T1 Business Plan and provides explanation and justification as to why such outputs are planned to be undertaken in the RIIO-T2 period.

Section 9: References

2.1. Post Draft Determination Update

In response to Ofgem's draft determination feedback, SHE Transmission engaged Scala Consulting, a leading international consultancy specialising in Procurement, Supply Chain, Logistics and Customer Service. Their specialist consultants have provided independent, objective expertise to assist SHE Transmission to provide the additional data in support of our justification paper. The outputs provided from Scala were as follows;

- Full review of our existing warehouse capacity. Analytical data has been provided to clearly identify the capacity required for high cost/long lead time strategic spares.

[redacted]

- A full Independent review of costs based on current industry benchmarks
- A review of our current spares holdings and the need for the additional strategic spares within the RIIO-T2 period.
- Analysis of geographic locations and the risks to response times
- Feedback on the best practice and risks within the logistical environment. An example being that the current industry best practice is to decentralise facilities due to the ongoing pandemic and its risks.

Each concern that was raised as part of the draft determination feedback has been fully reassessed for the various options, including do nothing, which have been fully explored in light of Ofgem's comments.

3. Need

The criteria to upgrade the current facilities are summarised in the diagram below, which measures the current infrastructure against five key criteria on a grade of 1-10 (1 being very poor and 10 being very good):

- general location of the facilities in relation to supply/demand
- site specifics (vehicle access, labour availability, flood risk, security, etc.)
- size of the warehouses
- condition of the buildings and site
- safety of the working environment

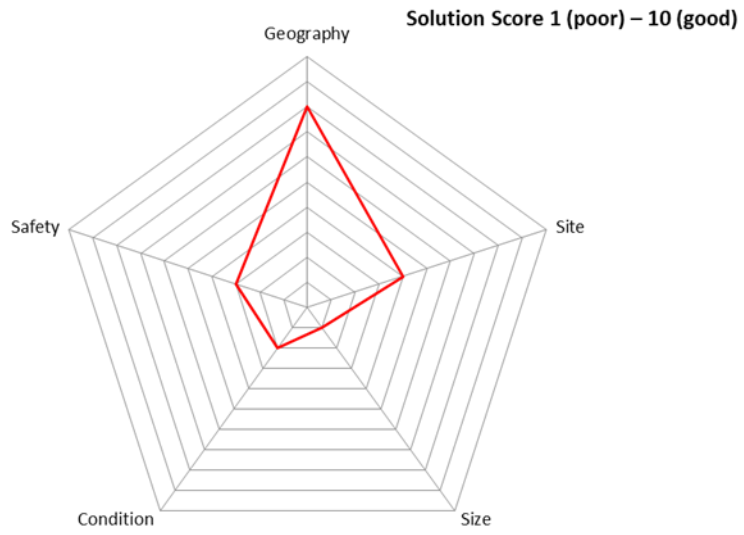


Figure 1 - Performance of current facilities against criteria

This diagram illustrates how the current three-site infrastructure fails to meet the needs of the business. It scores low on four out of five criteria, with the general locations having a good score as they are well placed to serve the north and south of the region.

An optimum solution to meet good industry standards should aim to have a score of eight or more in all key areas to ensure long-term viability, as illustrated below.

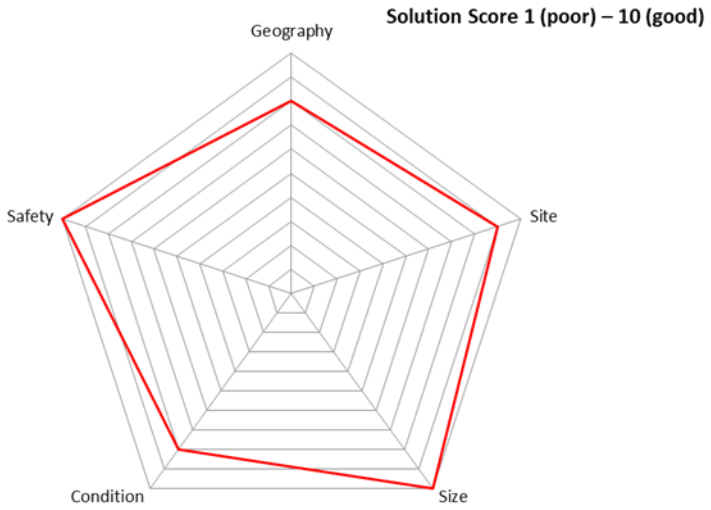


Figure 2 - Expected performance of facilities against criteria

3.1. Existing Facilities

Our current warehousing facilities are:

- [redacted] is a leased site which was formerly utilised as a depot for the Beauly – Denny project during the construction phase. The current constraints are as follows

    - The store has a current storage capacity of 1632m^2 and is currently at full capacity. Crates are being stacked inside the building to avoid weather damage, however this increases the health and safety risks with the potential for crates to topple. Furthermore, due to the capacity constraints, inefficient movement and double handling of spares is required to maximise the current available space.

    - Due to the lack of internal storage, crates and materials are either stored in the external yard (1680m^2) or in temporary shipping containers. Whilst the shipping containers are in good condition, they suffer from condensation issues and increase handling risk for site staff. The condensation damages the items stored in these locations which means additional stock rotation is required to minimise further damage. The yard layout does not allow for a turning circle for large vehicles and therefore additional hazards occur whilst reversing from the site.

    - Spares that are stored in the yard are packaged in accordance with industry standards. This packaging in many instances is sterling board, hardboard or light plywood. These materials are unsuitable for external storage and deterioration of materials is inevitable. This will lead

to damaged assets which will have to be disposed of before the planned end of their useful life.

- The location has limited expansion opportunities with any expansion/upgrade having to be agreed with the landlord. Expenditure at this site would have no long-term benefit to the customer in the event of the lease being terminated by either party.
- The remote location and access difficulties, especially in winter, increase the risk to both staff and the facility in the event of a fire or accident on site.

Figure 3 - Satellite Maps showing the existing XXXXXXXX facility

- No heavy lifting capability is available and therefore mobile cranes are required for each lift. Due to the site layout and legal requirements, a mobile crane needs to be hired on each occasion.
- The site has environmental and access/egress issues being located on a steep minor winding B-road with a weight limiting bridge 3 miles from site. Weather conditions during the winter can cause significant access issues both in receiving and issuing plant and materials. This has the potential to effect response times in the event of a network fault.
- Site security is poor. CCTVs cameras are in place; however, the fencing is inadequate and would not prevent unauthorised access by determined intruders.

- XXXXXXXX in Dundee, where the building was previously part of an old power station and is owned by SHE Transmission.
  - XXXXXXXX main store building is aging and in extremely poor condition. Throughout the building areas are cordoned off due to the presence of asbestos.
  - The store has a current storage capacity of 1100m^2 and is currently at full capacity. Crates are being stacked inside the building to avoid weather damage, however this increases the health and safety risks with the potential for crates to topple.

- Due to the building being part of the old power station and substation the floor is uneven with numerous cable ducting in place. The yard area is also uneven with a trip and fall risk.
- The building does not have any internal lifting equipment. The building design will not allow for alteration for an overhead crane without some significant high cost alteration to the structural steelwork. With no heavy lifting capability available, mobile cranes are required for each lift. Due to the site layout and legal requirements, these cranes need to be hired on each occasion.
- Access to the building is limited with only a single 3-metre-wide roller door that limits access for larger materials. Height is limited to 3.5 metres.
- The building requires significant investment in its heating system with damp being prevalent which leads to degradation of packaging materials
- The location of the XXXXXXXX site is significant. Adjacent to the store to the south is a grain drying facility which gives out significant dust contamination and attracts vermin. Adjacent to the east of the facility is a fertiliser facility, which increases the fire risk significantly.
- Due to the lack of internal storage and the door size, crates and materials are currently stored in the yard. The yard layout and dimension being 1000m2, it does not allow for a turning circle for large vehicles and therefore additional hazards occur with reversing vehicles.

- [redacted], used for transformer storage.
  - The facility has two bunds for storing oil-filled plant. It is currently at 70% capacity with existing plant, however it is forecasted in the next 12 months that an additional six Grid transformers of various voltages/rating will be required to be stored with a further three to be ordered as part of the RIIO-T2 Strategic Spares requirement. These Transformers are retained as part of the operational contingency plan in the event of a plant failure.
  - The storage site is adjacent to the main substation with the risk, however low, of potential damage to high cost/long lead Grid Transformers in the event of a catastrophic plant failure within the substation.
  - The location is exposed with plant vulnerable to all types of weather conditions. Transformers require ongoing additional maintenance to ensure their serviceability in the event of a Transformer failure on the network. If stored indoors, these activities would be kept to a minimum.

- The location has pine trees to the west of the site which is used for site screening, this however encourages nesting birds and requires ongoing maintenance to remove pine needles and cones and has the potential risk of plant damage in the event of a tree fall.
- No lifting facilities are on site therefore all transformers must be skidded into location or contract lifts arranged.

In addition to these warehouse facilities, overhead line and small substation plant spares are stored at various substation sites across our network. All facilities were selected to fulfil short-term operational needs and have medium-term limitations as warehouse facilities. These facilities do not meet our fundamental requirements for effective and safe warehousing facilities. Without suitable facilities, materials may be stored in exposed locations and therefore not comply with manufacturer's recommendations, with the material vulnerable to the environmental conditions, as well as being more vulnerable to theft. Photographs of our existing facilities are contained within Appendices A – C.

3.2. Health and Safety

Storage and handling systems are subject to the requirements of the:

- Workplace (Health, Safety and Welfare) Regulations 1997
- Provision and Use of Work Equipment Regulations (PUWER)
- Lifting Operations and Lifting Equipment Regulations (LOLER).

These regulations intend that storage areas are safe to use and suitable for their intended purpose, and that stock should be stored and stacked so that it is not likely to fall or move and cause injury. People working between, or close to, stored products may be exposed to significant risk of injury, for example if a stack collapses, or product moves or falls unexpectedly.

[redacted]

3.3. New Technology Types

At the commencement of the RIIO-T1 period the network was primarily of a 132/275kV Air Insulated Switchgear (AIS) design which has changed to a significantly more complex design of 132/275/400kV

AIS and Gas Insulated Switchgear (GIS) both SF6 and Non-SF6. In addition, our network now includes diverse assets such as HVDC, 220kV subsea cables, 275 & 400kV Gas Insulated Switchgear and specialised equipment such as Static VAR Compensators (SVCs) and Statcoms that help manage the network. These significant changes to the network are not solely limited to substations and cable. The addition of 400kV overhead lines to our asset base and the improved technology utilised by the protection and control systems have contributed to an evolving network. As a result, our requirements for spares holdings has also increased, and will continue to increase, significantly, with a need to store not only more types of spares, but an increased volume to correspond with the increased asset base.

3.4. Inventory Management

A further consequence of the growth of our network is the increased importance of our Inventory Management System (IMS). The existing inventory management system is a manual process which was fit for purpose at the commencement of the RIIO-T1 period but is now unsustainable and inefficient.

Note that while the IMS is integral to this work and is discussed throughout this paper, related costs for this aspect of the project are contained within our Non-Operational Capex submission and not part of the costs herein.

However, deployment of such an Inventory Management Scheme would be of limited benefit without the support of improved physical infrastructure as described in this paper.

3.5. Fault Response Capabilities

Most Original Equipment Manufacturers (OEMs) work to a “just-in-time” system, meaning that plant is only manufactured for customers when required. This results in low levels of spares being readily available. Therefore, if a failure occurs, lead times can vary from several days or weeks to months, or even years dependent on the spare required and from where it is being supplied. It should be noted that the vast majority of our strategic assets such as transformers, switchgear and cables are manufactured outside of the UK. There are no longer any UK based transformer manufacturers for transmission size equipment.

Much of the SHE Transmission network is designed to be resilient to some asset failures. However, if the lead times are significant, this can lead to an increased risk to the remainder of the network. There are also multiple sites where single point of failure exists and reliance on available spares is significant. Whilst we currently share some resources with other network owners, due to differences in the type of plant installed and in order to maintain an acceptable level of risk, it is not possible to pool all our resources; therefore, SHE Transmission must obtain, store and manage a certain level of spares.

3.6. Existing and Future Spares Holdings

Scala has reviewed our current and forecasted spares holding requirements and have found the overall capacity required is 15,000m^2. The capacity requirements of these warehouse facilities have been estimated based on the current stockholding dimensions/weight of spares, proposed additional spares as listed within paper "T2BP-EJP-0015 Operational Strategic Spares Justification" and the high likelihood that "second-hand spares" will become available from load-related projects within the RIIO-T2 period. Again, the impact of the diversity of the installed equipment and the need to meet the OEMs engineering recommendations has a considerable influence on the capacity requirements. The volume of spares to be stored has been based on various factors such as existing stockholding, standardisation of material, engineering design, scheduling/ lead times, procurement strategy, inspection criteria, quality controls, unique packaging and storage requirements. See Table 1 for a full breakdown.

The total floor space required for future stock levels has been split into standard warehousing needs (general spare parts, pallet and shelf storage, etc) and specialist bunded warehousing for the storage of oil-filled items such as transformers (including all units currently stored in XXXXXXXX Yard). The reason for this split is that the construction cost of a bunded warehouse is more expensive than for a standard building due to the increased amount of material and protective environmental measures required. The floor space has also been calculated to allow for efficient unobstructed access to spares which meets the required industry standard.

Current Location	Category	Units	Unit M2	Unit M3	Unit Kg	Storage Type	Floor Space	Stock Projection +66%	Building 1 Standard	Building 2 Bunded
Carolina Port	CABLE	78	1.208	0.902	1,520	Floor	337	561	561	
Carolina Port	CABLE	5	6.539		10,192	Drum	117	195	195	
Carolina Port	CABLE	31	1.208	0.902	1,520	Floor	134	223	223	
Carolina Port	Mixed OHL parts	13,093				Shelf	208	346	346	
Carolina Port	Switchgear Spares	73	0.199	0.260		Pallet	35	58	58	
Carolina Port	Switchgear Spares	39	0.199	0.260		Pallet	20	33	33	
Carolina Port	PROTECTION & CONTROL CP	10	4.120	6.842	1,672	Floor	147	245	245	
Carolina Port	PROTECTION & CONTROL CP	127	0.535	0.554	422	Pallet	50	83	83	
Carolina Port	PROTECTION & CONTROL CP	28	0.535	0.554	422	Pallet	13	21	21	
Carolina Port	SWITCHGEAR CP	43	2.543	3.899		Floor	391	651	651	
Carolina Port	SWITCHGEAR CP	54	2.543	3.899		Floor	490	817	817	
Carolina Port	TRANSFORMERS CP	65	1.025	1.086	211	Floor	238	397		397
Carolina Port	TRANSFORMERS CP	22	1.025	1.086	211	Floor	81	134		134
Carolina Port	Miscspares	120	1.263	0.978	402	Pallet	115	192	165	27
Carolina Port	Miscspares	63	1.263	0.978	402	Pallet	60	100	86	14
Tealing Yard	Earthing Transformers	17	2.680	4.908		Floor	163	271		271
Tealing Yard	Earthing Transformers	5	2.680	4.908		Floor	48	80		80
Tealing Yard	PROTECTION & CONTROL	45	3.215	2.028	964	Floor	517	861	861	
Tealing Yard	SWITCHGEAR	2	2.500	3.020		Floor	18	30	30	
Tealing Yard	GRID TRANSFORMERS	3	7.740	4.810	80,000	Floor	995	1,659		1,659
Tealing Yard	GRID TRANSFORMERS	3	7.740	4.810	80,000	Floor	359	599		599
Fanellan	CABLE	11	4.782		6,939	Drum	188	313	313	
Fanellan	CABLE	7	4.782		11,163	Drum	120	199	199	
Fanellan	OHL	30	3.047		3,011	Drum	326	544	544	
Fanellan	OHL	28	3.047		3,011	Drum	305	508	508	
Fanellan	OHL	7,397				Shelf	118	196	196	
Fanellan	SWITCHGEAR	21	0.662	1.150	186	Pallet	15	25	25	
Fanellan	TRANSFORMERS	2	4.047	3.186	963	Floor	29	48		48
Fanellan	CABLE	91	1.335	1.163	277	Pallet	88	146	146	
Fanellan	CABLE	965	1.335	1.163	277	Pallet	910	1,517	1,480	37
Fanellan	TRANSFORMERS 275KV	2	50.760			Floor	363	604		604
Fanellan	TRANFORMERS 400KV	2	85.800			Floor	613	1,021		1,021
Fanellan	CB 132KV	7	5.250			Floor	131	219		219
Fanellan	CB 400KV	6	10.000			Floor	214	357		357
Fanellan	CB 275KV	1	21.000			Floor	75	125		125
Fanellan	CB 33KV	1	6.160			Floor	22	37		37
Fanellan	CVTKV	6	7.500			Floor	161	268		268
Fanellan	CABLE TERMINATIONS	6	6.000			Floor	129	214		214
Fanellan	GIS SPARES	3	100.000	sqm		Pallet	300	500	500	
Fanellan	DISCONNECTORS	18	6.000			Floor	386	643		643
Regional Totals		**22,573**					**9,024**	**15,039**	**8,286**	**6,754**

Table 1 - Volume of Spares required

4. Optioneering

This section presents all the options considered to address the need that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

When reviewing our options in this area, we produced a four-tier approach to our development, in addition to a "Do Nothing" option:

- Minimum Requirements
    - The bare minimum required to "keep the lights on" & maintain legal/regulatory compliance
- Responsible Operator
    - A more resilient network for longer term customer benefit
- Progressive Network Enabler A&B
    - An adaptable, sustainable and flexible network, providing enhanced value to current and future customers

4.1. Do Nothing

This option consists of maintaining existing business practices and facilities. The independent Scala warehouse report specifically does not support the Do Nothing option as it does not address that the existing facilities do not meet current logistical and warehouse standards, particularly for Health and Safety as raised on Section 3.1 or that the land is inadequate to accommodate the warehouse capacity requirements. To summarise the consequences of continuing to run these existing facilities are as follows:

[redacted]

[redacted]

specialists due to the safety/location and environmental factors. Any monies spent to refurbish the current facilities would be uneconomical and inefficient.

On this basis, this option is not taken forward to detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

4.2. Minimum Requirements (Baseline)

Single Warehouse and refurb of existing sites in RIIO-T2. Construction of additional facilities in RIIO-T3.

The minimum requirements in this area would be to develop a new single warehouse at Dundee (4500m^2) and refurbish the remaining facilities in the RIIO-T3 period. Transformer storage would remain at XXXXXXXX substation (noting that this site and the XXXXXXXX site have limited room for expansion). An Inventory Management System will be developed and implemented to reduce the risk of inaccurate data and improve emergency response times, alongside Service Level Agreements (SLAs) with haulage contractors to provide transportation capabilities when required.

This option only provides the following benefits:

- The replacement of the XXXXXXXX facility.
- Improved physical protection of spares at that site with new security systems in place.
- The controlled of spares by the Inventory Management System. Spares would only be ordered based on an agreed inventory policy.
- Provision of greater data accuracy for spares held in storage.
- Provision of heavy lifting capability at the new facility. This will help reduce crane hire costs on that site at £50k per annum and allow store staff to meet the manufacturers specifications to rotate large cable drums in a safe environment at that location only.
- Provision of bespoke storage to reflect the various mix of materials. E.g. meeting temperature & humidity requirements.

- Increased Quality Controls and assurance. E.g. Materials would not be released for service without the material provenance.
- Reduced theft risk - By removing materials from open view in live substations it lessens the attraction of attempted theft and therefore access into a live busbar environment. It also removes the need for staff to access a live compound environment with cranes and lifting equipment.
- Mitigates many of the H&S risks at the new facility.

Whilst this addresses some of the concerns raised, it retains the following risks:

- Insufficient internal storage capacity for standard and oil filled equipment requirements based on future network expansion, the report from Scala highlights the total capacity requirements to be 15000m^2, see para 3.5.
- Storage of Transformers in proximity of a live substation site at XXXXXXXX is not desirable in the event of a proximity plant failure.
- To delay construction of the second facility into the RIIO-T3 period and retain the leased building at XXXXXXXX, which is at full capacity, it would cost £2.85 million to extend in order to improve the internal storage capacity by 2800m^2 and upgrade the yard including security. However, this does not address the location issues or all the H&S risks
- To meet the overall warehouse capacity requirement, SHE Transmission would require leasing a further warehouse during the RIIO-T2 period. The total cost is £2.75m based on commercial rates at circa £550k per annum for a modern facility with lifting capability.

As highlighted by independent industry specialists SCALA, the existing facilities have been deemed as unsuitable for refurbishment due to the high cost/location and environmental factors. In addition, with XXXXXXXX being a leased building, any monies spent to refurbish the current facilities would be uneconomical and inefficient.

This option includes the construction of additional new facilities in the RIIO-T3 period. To delay construction of the facilities into the RIIO-T3 period does not address the current issues of location, Health and Safety operational risks.

This option has been taken forward for detailed analysis and is considered the baseline option.

PROGRESSED TO DETAILED ANALYSIS

4.3. Responsible Operator (Option 1)

One twin-warehouse at one location.

This option examines the proposal to develop two large warehouses at one location complete with in-house logistics support. The capacity required is a standard warehouse (8,500m^2) and a bespoke bunded warehouse (6,500m^2) to house oil filled components such as transformers in order to minimise the risk to the environment in line with our Sustainability Strategy. This option offers the following benefits in addition to those listed under Minimum Requirements.

- Provision of bespoke storage to reflect the various mix of materials e.g., meeting temperature & humidity requirements.
- Excellent transport link with less than one mile to a to major trunk road.
- High cost lead assets stored and maintained internally which maintain their condition in readiness for installation
- All materials will be stored in line with the requirement of the manufacturer's specification
- The controlled of spares by the Inventory Management System. Spares would only be ordered based on an agreed inventory policy. It is envisaged that this allow an optimised spares holding.
- Provision of greater data accuracy for spares held in storage avoiding inefficient delays on stock clarifications.
- Improved efficient ways of working. Design of floor space and racking will allow for unobstructed access to spares and avoid double handling of goods.
- Provision of heavy lifting capability within the facility.
- Significant improvement on Health and Safety risks. Fully compliant with regulations and legislation

Whilst this addresses some of the concerns raised, it introduces the following risks:

- Storage of all spares of a given asset type in one location introduces business continuity risk in the event of a fire or pandemic scenario. The estimated value of stock holding by the completion of RIIO-T2 will be in the region of £25 - 30m dependant on final project designs.
- Reaction time during fault/storm situations will be increased for the far north of Scotland. Proposed location for the single large warehouse would be Dundee due to land availability.

- Additional environmental impact as vehicle movement will be increased due to distances involved.

This option has been taken forward for detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

4.4. Progressive Network Enabler (A) (Option 2)

One twin-warehouse in the South location and one standard warehouse in the North location.

The Progressive Network Enabler option is to develop a two-location warehouse option in the south area and one warehouse in the north. The locations provisionally selected have excellent transport links being in close proximity to major trunk roads. The Dundee facility would have a standard warehouse (4,500m^2) and a bunded warehouse (6,500m^2), and a second, standard warehouse (4,500m^2) would be located in the Inverness area. This option, similar to the single warehouse option, would address the current poor facilities but has the benefit of reducing the risk of a single warehouse for all spares other than transformers and other oil filled equipment.

This option addresses all the concerns raised in this area.

- The reduction of business continuity risk by having two locations.
- Excellent access/egress to each facility, with an improved reaction time during fault/storm situations. Each proposed location is less than one mile from to a major truck road
- Materials will be stored in line with the requirement of the manufacturer's specification
- The controlled of spares by the Inventory Management System. Spares would only be ordered based on an agreed inventory policy.
- Provision of greater data accuracy for spares held in storage.
- Improved efficient ways of working. Design of floor space and racking will allow for unobstructed access to spares and avoid double handling of goods.
- Provision of heavy lifting capability at each facility.
- Provision of bespoke storage to reflect the various mix of materials. E.g. meeting temperature & humidity requirements.
- Managed risk for oil filled spares. Response time risk can be managed for major plant failures due to time taken to decommission and remove the existing asset.

- High cost, lead assets stored and maintained internally which maintain their condition in readiness for installation.

Whilst this addresses some of the concerns raised, it introduces the following primary risks:

- Business continuity risk remains in RIIO-T2 for oil filled spares in the event of a catastrophic event such as fire or pandemic. The estimated value of stock holding by the completion of RIIO-T2 will be in the [redacted] load- or non-load related project.

- Location of the bunded store in the South area would also increase restoration times in the North region by c.3 hours, depending on fault location. There is also a risk of weather delays impacting this further if the road conditions are not suitable for plant transport, which is not uncommon in the Highlands during the winter months.

On this basis, this option is taken forward for detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

4.5. Progressive Network Enabler (B) (Option 3)

Two warehouses in the South location and two warehouses in the North location – Built in RIIO-T2

The Progressive Network Enabler option is to develop a two-location warehouse option in both the Dundee and Inverness areas. The locations provisionally selected have excellent transport links being in close proximity to major trunk roads. Each area would have warehouse capacity of 7500m^2 and have two stores buildings at each site to allow for one building to be bunded for oil filled plant. This option, similar to the single warehouse option would address the current poor facilities but has the benefit of reducing the risk of a single warehouse.

This option addresses all of the concerns raised in this area.

- The reduction of business continuity risk by having two locations for all spares.

- Excellent access/egress to each facility, with an improved reaction time during fault/storm situations. Each proposed location is less than one mile from to a major truck road

- Materials will be stored in line with the requirement of the manufacturer's specification

- The controlled of spares by the Inventory Management System. Spares would only be ordered based on an agreed inventory policy. This will decrease spares holding and reduce costs into the RIIO-T3 period.

- Improved efficient ways of working. Design of floor space and racking will allow for unobstructed access to spares and avoid double handling of goods.

- Provision of greater data accuracy for spares held in storage.
- Provision of heavy lifting capability at each facility.
- Provision of bespoke storage to reflect the various mix of materials. E.g. meeting temperature & humidity requirements.
- High cost, lead assets stored and maintained internally which maintain their condition in readiness for installation.

On this basis, this option is taken forward for detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

A summary of the above optioneering is shown in **Error! Reference source not found.**, below.

	Do Nothing	Minimum Requirements (Baseline)	Responsible Operator (Option1)	Progressive Network Enabler A (Option2)	Progressive Network Enabler B (Option3)
Fully Controlled facility with lifting capability	✗	✗	✓	✓	✓
All SHET Owned facilities	✗	✗	✓	✓	✓
Improved Fault Response	✗	✗	Partial	Partial	✓
Non-live substation environment	✗	✗	✓	✓	✓
Diversity of location	✓	✓	✗	✓	✓
Quality control	✗	✗	✓	✓	✓
Capacity Requirement met fully	✗	✗	✓	✓	✓
Single site Risk Mitigation	✓	✓	✗	✗	✓
Aligns with Stakeholder Requirements	✗	✗	✗	Partial	✓

Table 2 - Optioneering Summary of RIIO-T2 Deliverables

5. Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. It examines three comparative factors in order to determine the preferred option:

- Cost,
- Risk
- Stakeholder Requirements

5.1. Cost Benefit Analysis

All costs have been reviewed by Scala and a breakdown is available within the Warehousing Review report. A Cost Benefit Analysis (CBA) has been carried out in order to assess the preferred choice between options. Our CBA Methodology sets the process and mechanics of our approach to CBA. In order to carry out this CBA, the following complete solutions were costed to allow comparison:

Option	Description	Capital Cost
Baseline **Minimum Standard**	One new Warehouse in Dundee and extend XXXXXXXX Store and retain XXXXXXXX Transformer store. Construct new warehouses in RIIO-T3	[redacted]
1 - Responsible Operator	Construct two new Warehouse Facilities in Dundee. Construct two new Warehouse Facilities in Inverness in RIIO-T3.	[redacted]
2 - Progressive Network Enabler A	Construct two Warehouse Facilities in Dundee and One in Inverness. Construct a second bunded warehouse in Inverness in RIIO-T3.	[redacted]
3 - Progressive Network Enabler B	Construct two Warehouse Facilities in both Inverness and Dundee in RIIO-T2.	[redacted]

Table 3 - CBA Options for Comparison

The costs listed above have been benchmarked by out independent consultants, Scala.

CBA Option No.	Total Forecast Capital Expenditure (£m)	Total NPV (£m)	Delta (Option to baseline)
Baseline - Minimum Standard	[redacted]	[redacted]	
1 - Responsible Operator	[redacted]	[redacted]	[redacted]
2 - Progressive Network Enabler A	[redacted]	[redacted]	[redacted]
3 - Progressive Network Enabler B	[redacted]	[redacted]	[redacted]

Table 4 - CBA NPV Results

These costs have been independently verified by Scala.

The resulting CBA calculation, which only considers whole life costs given the unquantifiable nature of associated benefits, identifies the Responsible Operator options as the option that delivers most value compared to the baseline. However, as the CBA is cost-based only, this does not account for the benefits delivered by the remaining options. Based upon our assessment of these benefits (as shown in table 3), and in conjunction with the independent review from industry specialists, we believe Option 3, Progressive Network Enabler B, to be the optimal solution. For marginal additional cost (£2.5m), Option 3 delivers considerably more benefit:

- Significantly reduced risk in oil-filled spares in the event of a catastrophic event such as fire or pandemic. The estimated value of these high-cost, long-lead spare assets by the completion of RIIO-T2 will be in the region of £[redacted] dependent on final project designs.
- Reduced restoration times enabled by the location of a bunded store in both north and south areas by c.3 hours, depending on fault location, and can react more efficiently in the event of a network failure in the far north of Scotland.
- Excellent access/egress to each facility, with an improved reaction time during fault/storm situations. Each proposed location is less than one mile from to a major truck road
- Attaining SHE Transmission ownership of these facilities will enable bespoke, future-proofed stores are constructed providing better long-term value to consumers.

- Materials will be stored in line with the requirement of the manufacturer's specification, allowing assets to achieve their design life and providing better long-term value for consumers.
- Safer and more efficient ways of working. Design of floor space and racking will allow for unobstructed access to spares and avoid double handling of goods. Provision of full controlled heavy lifting capability at each facility.
- High cost, lead assets are stored and maintained internally which maintain their condition in readiness for installation.
- Full alignment with stakeholder feedback. The stakeholders recognised that the existing facilities are unsuitable and that a two-location solution was the most practical.

5.2. Risk and Benefit Analysis

In order to demonstrate the benefits of delivering this project, we have carried out a Risk and Benefit Analysis. For each option taken forward to Detailed Analysis, it looks at the existing risks, the likelihood of these risks being realised, and the severity should that happen. The likelihood and severity combine to give an overall Unmitigated Risk Rating.

Mitigation actions delivered by the delivery of each option are then identified for each risk, and the likelihood and severity are reappraised, resulting in a Mitigated Risk Rating.

This exercise was carried out for the Materials Management proposals. As can be seen in Table 2, the Unmitigated Overall Risk Rating is "Severe". Once all the mitigations are considered, the Mitigated Risk Rating is unchanged for the Responsible Operator option and falls to "Medium" for both Progressive Network Enabler options. The full Risk & Benefit Analysis is contained within Appendix D.

Table 2 - Risk & Benefit Summary Table

5.3. Stakeholder Engagement

On 5 March 2019, SHE Transmission hosted a stakeholder workshop, aimed at gathering feedback from its stakeholders on its approach to network resilience and reliability for the RIIO-T2 plan. A total of 46 stakeholders attended the workshop, representing 31 organisations. At that time, stakeholders opted for the "Responsible Operator" option, however due to the review following the draft determination by Ofgem, the Progressive Network Enabler (B) option that is now the preferred selection. This is broadly similar to the original Responsible Operator option that was selected by the stakeholders.

5.4. Costs – Minimum Requirements

This option entails the construction of a new warehouse in Dundee and the extension of XXXXXXXX Store, alongside the retention of XXXXXXXX Transformer store. This defers the expenditure of a new warehouse in the north area until RIIO-T3. The class 2 estimate costs for the total works as listed is [redacted] in RIIO-T3, [redacted]. The estimate is based on engagement with experienced framework contractors and industry specialist support.

5.5. Costs - Responsible Operator

As described above, this option will see the construction of single warehousing facility with in-house logistics support. This option would include bespoke storage to house oil filled components such as

transformers and the deployment of a robust Inventory Management System and an enhanced transportation and distribution capability along with the new warehousing facilities.

The class 2 estimate costs for the total works as listed [redacted]. The estimate is based on engagement with experienced framework contractors and industry specialist support.

5.6. Costs - Progressive Network Enabler (A)

As described above, the Progressive Network Enabler option would expand upon the Responsible Operator option to develop two warehousing facilities with three warehouses in total, two in Dundee and one in Inverness

The class 2 estimate costs for the total works as listed is £[redacted] all works. The estimate is based on engagement with experienced framework contractors and industry specialist support

5.7. Costs - Progressive Network Enabler (B)

As described above, the Progressive Network Enabler options would expand upon the Responsible Operator option to develop two locations in Dundee and Inverness.

The class 2 estimate costs for the total works as listed [redacted]. The estimate is based on engagement with experienced framework contractors and industry specialist support.

5.8. Proposed Solution

We have examined each of the options in terms of three comparative factors:

- Cost
- Risk Reduction
- Stakeholder Requirements

From our analysis and the independent review from industry specialists the “Progressive Network Enabler” option B is proposed as the optimal solution. The following points should be noted,

- Cost – Whilst costing marginally more than other options, it provides significantly more benefits in terms of performance, service and operational risk reduction especially by having a new facility in the Inverness area that can react more efficiently in the event of a network failure in the far north of Scotland.
- Full alignment with stakeholder feedback. The stakeholders recognised that the existing facilities are unsuitable and that a two-location solution was the most practical.

6. Conclusion

This Engineering Justification paper sets out the need for Warehousing due to SHE Transmission's strategy to improve network performance over the RIIO-T2 period and beyond.

The paper analysed SHE Transmission's current spares options, along with the warehouse capacity requirements and determined that there was a need to improve the way spares are managed, handled and stored. A new warehousing system separate from current inappropriate facilities would reduce long term costs, reduce risks, remove the current site environmental and safety issues and further ensure security of supply of spares for the Transmission network is improved.

An optioneering assessment took place which investigated four options, three of which were taken forward for detailed analysis.

Taking account of that detailed analysis, the preferred option is the Progressive Network Enabler Option B, the construction of two twin-warehouses in Dundee and Inverness; two key geographical locations that meet our operational needs.

The cost analysis for this project stands [redacted]. This cost has been developed in conjunction with reputable contractors and fully assessed and reviewed by industry specialists. Whilst the option B cost is more £2m more expensive than option A, the risk reduction to oil filled components [redacted].

The project will be delivered over the RIIO-T2 period and will have the following associated benefits relating to the RIIO-T2 business goals:

- Safe, secure and efficient working environment with managed and controlled stock.
- Reduced customer restoration times in the event of a network failure. Both sites will be able to facilitate outages in short order creating a redundancy measure and increasing system security. This addresses the goal set out in the "Network for Net Zero" business plan relating to our goal to aim for 100% transmission network reliability for homes and businesses.

This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.

7. Price Control Deliverables and Ring Fencing

As set out in our Regulatory Framework paper (section 1.12 and Appendix 3) we support a key principle from Citizens Advice – one that guarantees delivery of outcomes equivalent to the funding received - to ensure that RIIO-T2 really deliver for consumers. At the project level this means that if we don't deliver the output, or a materially equivalent outputs, we commit to returning the ex-ante allowance for the output not delivered.

This means that if the funding for Materials Management and Warehousing should be ring-fenced and if it does not go ahead, we will return the allowances of [redacted]

It also means that we commit to delivering the output specified above for the [redacted]. If we do not deliver the output, or a materially equivalent output, we commit to returning a proportion of the ex-ante allowance. The detailed methodology should be decided at when developing the Close Out methodologies but should apply the same principles of uncertainty mechanisms - that any under delivery should be material.

8. Outputs included in RIIO-T1 Plans

There are no outputs associated with this scheme included in our RIIO-T1 plans.

9. References

- Scala Warehouse Condition Report
- T2BP-EJP-0015 Operational Strategic Spares Justification
- Non-Operational Capex Paper
- Sustainability Strategy

Appendix A – XXXXXXXX current facility pictures

Whilst the XXXXXXXX Store is a more modern building, it has several restrictions which challenges the facility as a long-term solution in comparison to a bespoke warehouse that will meet the needs for, SHE Transmission in the RIIO-T2 period and beyond.

Again, similar to the XXXXXXXX facility, it was not designed as a warehouse as it was originally constructed as a bottling plant. The limitations include, lack of height for the installation of a heavy lift overhead crane and storage capacity (Pictures 1-5).

The other significant factor that needs to be taken into consideration is the site access for major Transmission assets (Pictures 6 - 10). The site is located on a single-track road which access is not only hazardous during the winter period but restricts some plant from being stored at XXXXXXXX. E.g. Transformers.

Figure 4 - Low ceiling height

Figure 5 - Material on floor due to capacity constraints

Figure 6 - limited storage capacity

Figure 7 - Poor ground conditions for external storage area

Figure 8 - Picture 5 – Numerous shipping containers required due to lack of capacity

Figure 9 - Access to XXXXXXXX, junction on left hand is site access, single track road

Figure 10 - Multiple trees en route which cause issues with high loads

Figure 11 - Various narrow pinch points and inclines.

Figure 12 - Narrow bridge from the North

Figure 13 - Narrow bridge from the South

Appendix B – XXXXXXXX current facility pictures

The current warehouse facilty at XXXXXXXX was previously an indoor 132kV Substation that was constructed in the early 1970's. The design of the building does not allow for any overhead cranes for heavy spares and therefore these are located outside in all weather. (Pictures 1&2).

Access to the building is limited to a single door that again constrains storage of spares indoors. (See Picture 3).

The various pictures (4 to 6) show the building is in poor condition with major investment required to bring it up to a standard along with the store being in proximity to a grain drying facility (Picture 7) which causes issues with vermin and dust contamination.

Figure 14 - General picture of store, with columns that restrict storage, limit access and restrict installation of Overhead crane without significant investment.

Figure 15 - Wall bushings that require removal

Figure 16 - The access to the building is limited due to the current door dimensions. This is the only vehicular access.

Figure 17 - Exterior of building is in poor condition with major settlement cracking on walls

Figure 18 - to the rear of building again in poor condition with limited space.

Figure 19 - Exterior side of building is limited as this was previously a cable trench for major cables and will need significant investment to be load bearing.

Figure 20 - The Warehouse on the East side in in extreme proximity to a grain drying facility. During the summer months this gives us significant issues with dust and contamination, along with a vermin concern.

Appendix C – XXXXXXXX current facility pictures

Our current Transformer storage facility is based in an area on the boundary of XXXXXXXX Substation. (Picture 1) This area is exposed to all types of weather, which in turn effects the condition of the stored Transformers and other oil filled spares. (Picture 4)

The bunded area itself in in general poor condition and requires further expenditure to include additional power supplies to the Transformers so to prevent moisture ingress in the control boxes. (Picture 1-3).

Whilst at the time of the pictures were taken, the bunds were not at full capacity, it is forecasted within the RIIO-T2 period that the asset pool for oil filled spares will increase either by new spares procured to help mitigate the network risk or spares that are generated by enhancements to the network through load related projects.

The new warehouse facilities have been designed to support the forecasted requirements.

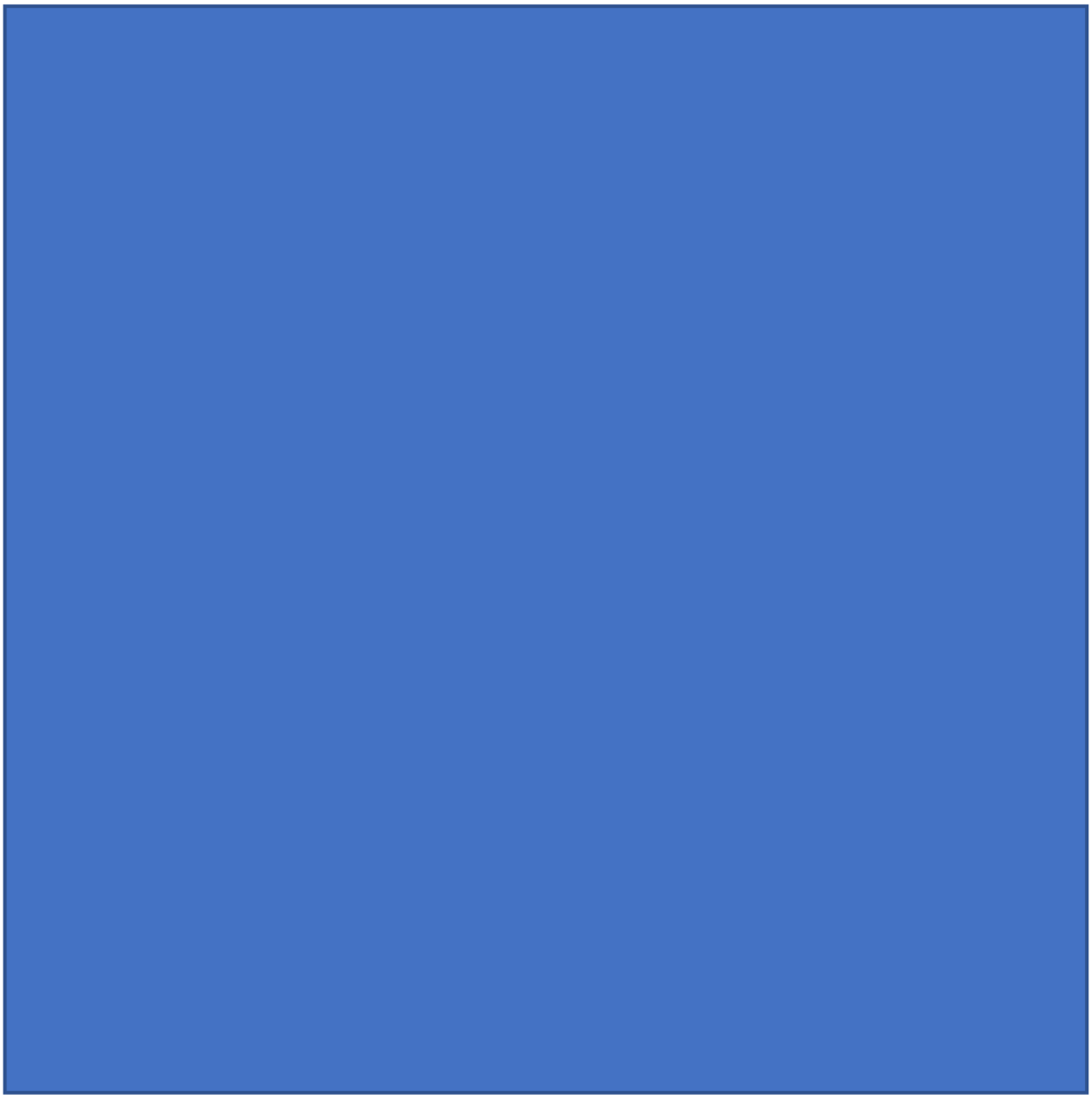
Figure 21 - Poor bund condition in an exposed location in proximity to a live HV zone

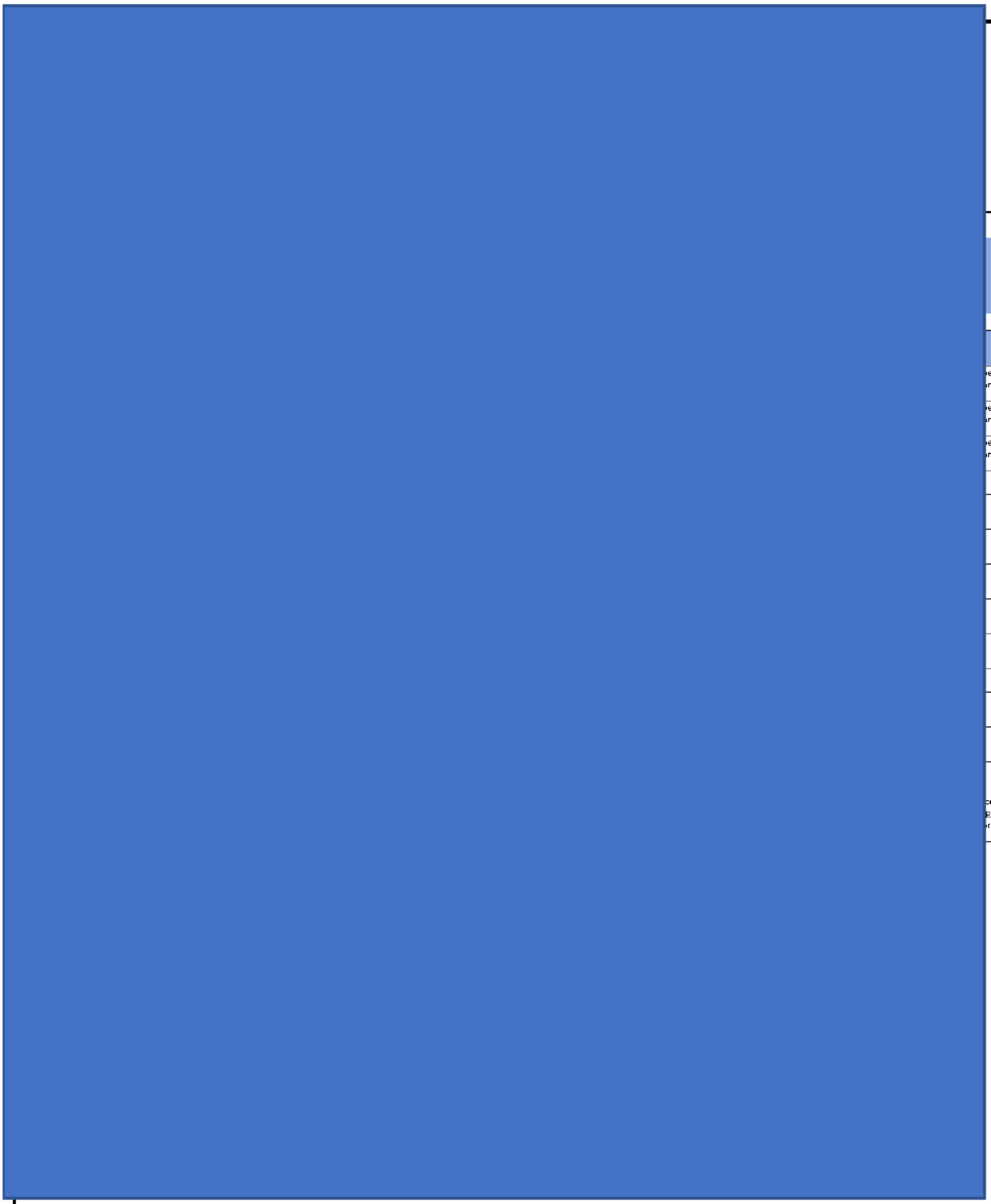
Figure 22 - No lifting equipment on site. Each movement on site requires mobile cranes and significant planning prior to any movement.

Figure 23 - No electrical supplies to Transformers are available. Significant investment required to upgrade.

Figure 24 - Stored Grid transformers are degrading due to weather conditions

Appendix D – Risk and Benefit Analysis





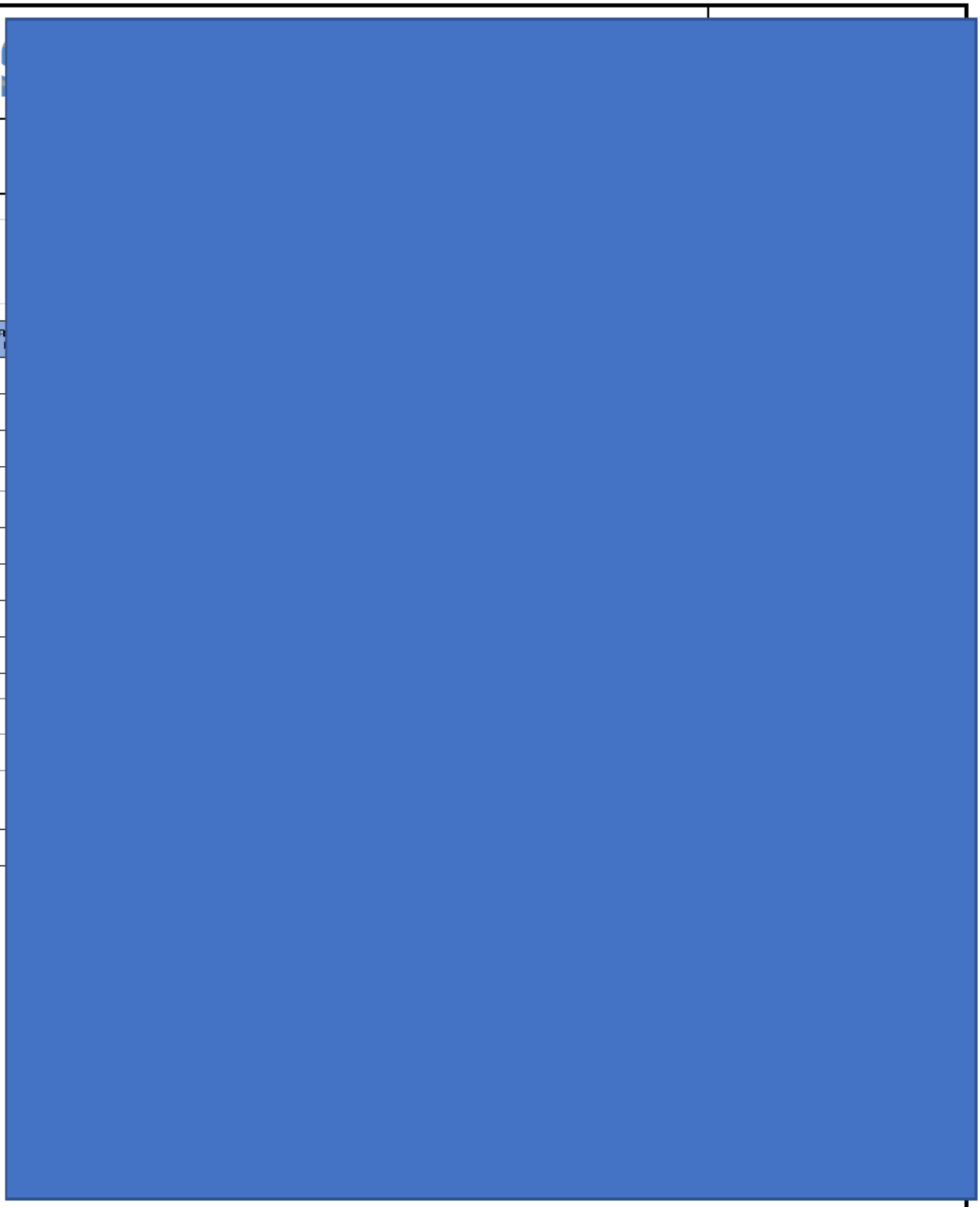


Figure 27 - Risk Mitigation Delivered by Progressive Enabler 'B' Option