Engineering Justification Paper Addendum

Active Network Management (ANM)

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Scottish & Southern Electricity Networks
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Executive Summary

In February 2025, we submitted an addendum to our RIIO-T3 Business Plans – the CP30 Supplementary Information Submission – to Ofgem. This submission included several Active Network Management (ANM) projects essential for connecting multiple customer schemes. These projects are critical to achieving the renewable capacity targets set out in CP2030 and ensuring the timely delivery of net zero commitments.

As part of Ofgem's Draft Determination, Ofgem do not approved the ANM projects in the Load UIOLI mechanism. Following discussions with Ofgem, further clarification was requested before approval of ANM within the mechanism. Specifically, Ofgem sought additional evidence on need certainty and cost certainty to support the case for these investments.

The purpose of this paper is to address Ofgem's request by providing:

- A clear justification of the enduring need for ANM solutions in enabling customer connections and system operability.
- Optioneering, including risk considerations and mitigation measures; and connection data.

Through this response, we aim to demonstrate that ANM deployment under Load UIOLI is both necessary and efficient, delivering consumer value while supporting the UK's clean energy transition.

Summary of ANM Projects

Project	Earliest in Service Year*	Cost (2023/2024 prices):
Shetland ANM	2029	[redacted]
Western Isles ANM	2029	[redacted]
Creag Dhubh ANM	2029	[redacted]
Errochty – Charleston 132kV ANM	2029	[redacted]

Note: this is for all ANM schemes except the 'Smart Flexible TO Operated System' where we are unable currently to provide further information

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1. Introduction

The purpose of this paper is to respond to Ofgem's request for further information following our February 2025 CP30 Supplementary Information Submission. It provides additional detail on the need and cost certainty for Active Network Management (ANM) within the Load UIOLI mechanism.

2. Need Case and Optioneering for ANM

The previous submission outlined the general need for ANM in achieving CP2030 targets with faster connections for new schemes. ANM provides a cost-effective means to unlock capacity, manage constraints, and ensure operability.

We submitted four ANM schemes by 2030, on Shetland, the Western Isles, Creag Dhubh, and the Errochty–Charleston 132 kV OHL, all being advanced under our Large Capital Projects framework. Ofgem has requested detail on certainty and they are presented as below:

2.1. Shetland ANM

The first 600MW HVDC link from Shetland to the GB mainland is oversubscribed and a new 220kV on-island Shetland network is required (see T3BP-EJP-085). The Shetland on-island 220kV transmission network will be a complex system which will join two HVDC systems together to maximise available capacity throughout each year and link together significant ScotWind offshore windfarm schemes with Shetland on-island customers (both large scale strategic demand and smaller scale generation). An ANM scheme must be implemented to actively manage generation and flexible strategic demand and keep all equipment (including both HVDC links) within acceptable limits and the on-island system stable following a fault. SSEN Transmission is currently developing this ANM scheme for deployment in line with the delivery of the 220kV strategy by [redacted] (T3BP-EJP-085). [redacted]

Earliest In Service Year:	2029 – earliest delivery date. [redacted] to align with the 220kV on-island Shetland strategy. Final delivery date and program will be dependent on the outcome of the Connections Reform process.
Cost (2023/2024 prices):	[redacted]

2.1.1. Need Case

The Shetland ANM System will manage flows across both the existing 600MW HVDC link from Kergord 132kV substation, and the 2nd 1800MW HVDC link (in delivery track with pre-construction funding secured) from the proposed Northern Shetland substation (T3BP-EJP-085), on Shetland to the GB mainland.

The cumulative capacity of the generation needed for CP2030, in addition to the [redacted], will be greater than the existing HVDC link capacity. The Shetland ANM scheme is therefore required to connect several CP2030 schemes (as detailed in Table 1) and ensure the reliable and stable operation of the overall Shetland Island system (including both HVDC links to the GB mainland). The Shetland ANM scheme will be designed to monitor the loading and status of both HVDC links – maximising their use and ensuring the Shetland island system responds to NESO operational set points

for both HVDC links (which will be set depending on wider GB network constraints). Control signals (with a backup special protection system) to reduce output will be sent to pre-defined generators if, (a) either HVDC link is lost due to a fault or (b) the export capacity of either HVDC link is likely to be exceeded.

Note – depending on the outcome of the Connections Reform process, the Shetland ANM system may initially need to be employed on the existing 132kV system and 1st 600MW HVDC link, before evolving to monitor the 220kV on-island transmission network in [redacted], and 2nd HVDC link in [redacted].

2.1.2. Optioneering

Option	Description	Progressed?	Rationale
Option 1 (Counterfactual) – Do Nothing	Avoids immediate costs and complexity. Does not require any capital expenditure for new technology and allows operators to stick with familiar, existing procedures, thereby avoiding the challenges of integrating a new system.	No	• Will lead to congestion and limit the integration of new energy sources. • Will result in the inefficient use of infrastructure and may require expensive upgrades in future. • Slows down progress toward a smarter, more sustainable energy system.
Option 2 – Special Protection Schemes (SPS) Only	Manages power system constraints through special protection measures (i.e., operational or smart inter-trip schemes) by reducing power export or import to 0MW during equipment outages or overloading.	No	• An existing solution that offers simplicity, ease of operation, and no additional cybersecurity or software requirements. • However, may face operational challenges such as network asset underutilisation, site-specific communication setups, limited scalability, inability to handle complex constraints, reliance on operator intervention, and the need for manual reconfiguration at each site.
Option 3 - An Active Network Management (TANM) Scheme with Special Protection Schemes (SPS)	• Manages the power flow of transmission connected generation to prevent equipment overloading by sending control signals to adjust exports or imports, with fail-safe mechanisms such as inter-trip schemes. • In the event of communication or device failure, the scheme ensures power flow is reduced to 0MW to maintain network safety. SPS reduces power export or import to 0 MW during equipment outages or overloading.	Yes	• Higher upfront cost and may be complex to implement, requiring new systems and coordination across the network. • However, allows real-time control of electricity flows, helping to avoid congestion and make better use of existing infrastructure. • Improves efficiency, supports the integration of low carbon generation, and reduces the need for expensive physical upgrades to the Shetland network.

2.1.3. Project Status and Funding Mechanisms

The project has been through Gate 0, with an initial high-level project scope developed. Final project scope (including customer communication requirements), cost and program cannot be concluded until Q2 2026 after the Connections Reform process has concluded (allowing us to account for possible connection acceleration requests).

Due to above uncertainty on final scope, cost and program – our preferred approach is to utilize the Load Use It or Lose It (UIOLI) pot, and our ask to Ofgem is that the size of the UIOLI pot is appropriate for us to deliver this ANM project in a timely and efficient manner (for the connection of both transmission and distribution customers to the island).

2.1.4. Risk

Final project scope, cost and program can't be concluded until Q2 2026 after the Connections Reform process (note – the current connection dates of [redacted], and several distribution customers, as detailed in Table 1, will change based on this process). There is currently uncertainty in the combined transmission and distribution queue on Shetland, and some distribution customers may look for an accelerated connection pre-2030, which will require us to change the Shetland ANM project scope to be employed on the existing 132kV system and 1st 600MW HVDC link – i.e. ahead of the 220kV on-island transmission network in [redacted].

2.1.5. High level Program

A high-level program has been provided in the table below:

Stage	Date
Gate 1	Q2 2026 (after Connections Reform)
Section 37 consent submission	N/A (scheme does not need this)
Town and Country Planning (TCP) submission	N/A (scheme does not need this)
Gate 2	Q2 2027
Gate 3	Q2 2028
Gate 4	Q4 2028
TOCA/1st Energy	Q4 2029
Gate 5	Q1 2030

2.1.6. Connection Data for Shetland ANM (ahead of 2nd HVDC link connection)

[redacted]

2.2. Western Isles ANM

The HVDC link (limited to 1800MW capacity) from the Isle of Lewis to the GB mainland, needed to connect significant ScotWind offshore windfarm schemes and on-island windfarm customers, is oversubscribed. An ANM scheme is required to monitor and manage the loading on the HVDC link, curtailing and tripping generation as necessary to protect the HVDC system when operating in both bi-pole mode (limited to 1800MW to meet NETS SQSS limits for Loss of Power Infeed criteria) and monopole mode i.e. 1GW.

Earliest In Service Year:	2029 – earliest delivery date. The targeted delivery date is 2030 to align with delivery of the 1800MW Western Isles HVDC link. Final delivery date and program will be dependent on the outcome of the Connections Reform process.
Cost (2023/2024 prices):	[redacted]

2.2.1. Need Case

The ANM scheme for the Western Isles will monitor and manage the loading of the 1800MW HVDC Link (established under SHET-RI-193) between Arnish 400kV substation on the Isle of Lewis and the new Fanellan GIS Switching Station (established under SHET-RI-194). The scheme will curtail/trip generation to ensure that there is no overloading of the HVDC link by sending signals to generators on the island connected to the transmission network (for both bi-pole mode and monopole mode).

2.2.2. Optioneering

Option	Description	Progressed?	Rationale
Option 1 (Counterfactual) – Do Nothing	Avoids immediate costs and complexity. Does not require any capital expenditure for new technology and allows operators to stick with familiar, existing procedures, thereby avoiding the challenges of integrating a new system.	No	• Will lead to congestion and limit the integration of new energy sources. • Will result in the inefficient use of infrastructure and may require expensive upgrades in future. • Slows down progress toward a smarter, more sustainable energy system.
Option 2 – Special Protection Schemes (SPS) Only	Manages power system constraints through special protection measures (i.e., operational or smart inter-trip schemes) by reducing power export or import to 0MW during equipment outages or overloading.	No	• An existing solution that offers simplicity, ease of operation, and no additional cybersecurity or software requirements. • However, may face operational challenges such as network asset underutilisation, site-specific communication setups, limited scalability, inability to handle complex constraints, reliance on operator intervention, and the need for manual reconfiguration at each site.
Option 3 - an Active Network Management (TANM) Scheme with Special Protection Schemes (SPS)	• Manages the power flow of transmission connected generation to prevent equipment overloading by sending control signals to adjust exports or imports, with fail-safe mechanisms such as inter-trip schemes. • In the event of communication or device failure, the scheme ensures power flow is reduced to 0MW to maintain network safety. SPS reduces power export or import to 0 MW during equipment outages or overloading.	Yes	• Higher upfront cost and may be complex to implement, requiring new systems and coordination across the network. • However, allows real-time control of electricity flows, helping to avoid congestion and make better use of existing infrastructure. • Improves efficiency, supports the integration of low carbon generation, and reduces the need for expensive physical upgrades to the Western Isles network.

2.2.3. Project Status and Funding Mechanisms

The project has been through Gate 0, with an initial high-level project scope developed. Final project scope (including customer communication requirements), cost and program cannot be concluded until Q2 2026 after the Connections Reform process has concluded.

Due to above uncertainty on final scope, cost and program – our preferred approach is to utilize the Load Use It or Lose It (UIOLI) pot, and our ask to Ofgem is that the size of the UIOLI pot is appropriate for us to deliver this ANM project in a timely and efficient manner (for the connection of both transmission and distribution customers to the island).

2.2.4. Risk

Final project scope, cost and program can't be concluded until Q2 2026 after the Connections Reform process.

2.2.5. High level Program

A high-level program has been provided in the table below:

Stage	Date
Gate 1	Q2 2026 (after Connections Reform)
Section 37 consent submission	N/A (scheme does not need this)
Town and Country Planning (TCP) submission	N/A (scheme does not need this)
Gate 2	Q2 2027
Gate 3	Q2 2028
Gate 4	Q4 2028
TOCA/1st Energy	Q4 2029
Gate 5	Q1 2030

2.2.6. Connection Data for Western Isles ANM

[redacted]

2.3. Creag Dhubh ANM

An ANM scheme is required in the southwest of the SSENT system in Argyll to monitor the loading of the Dalmally – Creag Dhubh – Inveranan – Windyhill 275kV OHL for a range of different outage conditions and to curtail and trip generation accordingly. This ANM scheme is required to interface with SPT at Dalmally, Inverarnan and Windyhill 275kV substations.

Earliest In Service Year:	2029 – to align with current connection date of [redacted] (CP 2030 identified scheme)
Cost (2023/2024 prices):	[redacted]

2.3.1. Need Case

Under certain outage conditions, power flows may increase within the [redacted] (established under SHET-RI-13).

The Creag Dhubh ANM scheme is an intertrip scheme that is set up between Creag Dhubh, Dalmally, Inverarnan and Windyhill 275kV substations to monitor the Dalmally – Creag Dhubh – Inverarnan – Windyhill 275kV double-circuit tower line. Following various dual outage scenarios (N'-1 and N-2) an inter-trip signal will be sent to applicable users, in this case the [redacted], to reduce export/import to 0MW.

The inter-trip will operate for the following outage scenarios:

- Circuit A & B
- Circuit A & C
- Circuit B & D
- Circuit B & C

Where:

- Circuit A is the 275kV Dalmally – Creag Dhubh circuit
- Circuit B is the 275kV Creag Dhubh – Windyhill circuit
- Circuit C is the 275kV Dalmally – Inverarnan circuit
- Circuit D is the 275kV Inverarnan – Windyhill circuit

2.3.2. Optioneering

A high-level table summarising our optioneering has been included below. For the Creag Dhubh ANM scheme, there will likely be a limited number of users (with only one user needed for CP2030 [redacted]) which leads us to Option 2 (SPS only) being our preferred solution.

Option	Description	Progressed?	Rationale
Option 1 (Counterfactual) – Do Nothing	Avoids immediate costs and complexity. Does not require any capital expenditure for new technology and allows operators to stick with familiar, existing procedures, thereby avoiding the challenges of integrating a new system.	No	• Will lead to congestion and limit the integration of new energy sources. • Will result in the inefficient use of infrastructure and may require expensive upgrades in future. • Slows down progress toward a smarter, more sustainable energy system.
Option 2 – Special Protection Schemes (SPS) Only	Manages power system constraints through special protection measures (i.e., operational or smart inter-trip schemes) by reducing power export or import to 0MW during equipment outages or overloading.	Yes	• An existing solution that offers simplicity, ease of operation, and no additional cybersecurity or software requirements. • However, may face operational challenges such as network asset underutilisation, site-specific communication setups, limited scalability, inability to handle complex constraints, reliance on operator intervention, and the need for manual reconfiguration at each site.
Option 3 - an Active Network Management (TANM) Scheme with Special Protection Schemes (SPS)	• Manages the power flow of transmission connected generation to prevent equipment overloading by sending control signals to adjust exports or imports, with fail-safe mechanisms such as inter-trip schemes. • In the event of communication or device failure, the scheme ensures power flow is reduced to 0MW to maintain network safety. SPS reduces power export or import to 0 MW during equipment outages or overloading.	No	• Higher upfront cost and may be complex to implement, requiring new systems and coordination across the network. • However, allows real-time control of electricity flows, helping to avoid congestion and make better use of existing infrastructure. • Improves efficiency, supports the integration of low carbon generation, and reduces the need for expensive physical upgrades to the local network.

2.3.3. Project Status and Funding Mechanisms

The project has been through Gate 0, with an initial high-level project scope developed. Final project scope (including customer communication requirements), cost and program cannot be concluded until Q2 2026 after the Connections Reform process has concluded.

Due to above uncertainty on final scope, cost and program – our preferred approach is to utilize the Load Use It or Lose It (UIOLI) pot, and our ask to Ofgem is that the size of the UIOLI pot is appropriate for us to deliver this ANM project in a timely and efficient manner.

2.3.4. Risk

Final project scope, cost and program can't be concluded until Q2 2026 after the Connections Reform process.

2.3.5. High level Program

A high-level program has been provided in the table below:

Stage	Date
Gate 1	Q2 2026 (after Connections Reform)
Section 37 consent submission	N/A (scheme does not need this)
Town and Country Planning (TCP) submission	N/A (scheme does not need this)
Gate 2	Q2 2027
Gate 3	Q2 2028
Gate 4	Q4 2028
TOCA/1st Energy	Q4 2029
Gate 5	Q1 2030

2.3.6. Connection Data for Creag Dhubh ANM

[redacted]

2.4. Errochty – Charleston 132kV ANM

The Errochty to Charleston 132kV OHL corridor is nearly 100km long with a low pre-fault continuous rating of 89MVA. In recent years, the region has experienced significant growth in renewable generation, with more than 100MW of flexible battery storage applications at Burghmuir and Abernethy GSPs. An ANM solution has been proposed as the most cost-effective interim solution to manage potential

overloads on the 132kV network caused by flexible battery storage, ensuring reliability and compliance until an enduring solution is developed and implemented.

Earliest In Service Year:	2029 – Final delivery date and program will be dependent on the outcome of the Connections Reform process
Cost (2023/2024 prices):	[redacted]

2.4.1. Need Case

As most of the contracted generation which triggers the need for reinforcement of this corridor is flexible battery storage, a joint assessment by the NESO, SSEN Distribution and SSEN Transmission, which included a NESO CBA, found that an ANM scheme as an interim measure on this OHL corridor was the most cost-effective solution to maintain reliability and compliance until an enduring solution is developed and implemented.

The ANM scheme, if there is a risk of overload on the 132kV network, will detect the constraint and issue a curtailment signal to the relevant GSP for the SSEN Distribution ANM to take corrective action. Since each GSP connects to only one side of the 132kV double circuit, different curtailment zones with distinct Last-In, First-Out (LIFO) stacks may be required. This ANM design will have interactions with existing protection and operational schemes.

2.4.2. Optioneering

Option	Description	Progressed?	Rationale
Option 1 – Reconductoring	• Reconductoring of Errochty - Charleston 132 kV 115km OHL	No	• Option not coordinated with possible strategic needs of the region. • CBA deemed this not to be the most economic and efficient solution • Reconductoring 100 km of the 132 kV double circuit is economically suboptimal compared to Option 2 • Significant cost of ~[redacted]
Option 2 - an Active Network Management (TANM) Scheme with Special Protection Schemes (SPS)	• Derogation against the NETS SQSS to allow generation to connect ahead of reconductoring Errochty – Charleston (for firm access) • Deployment of ANM scheme for non-firm access	Yes	• Minimises disruption to generation projects. • Facilitates earlier generation access to the network. • Ensures that connection agreements remain on track.

The case for network investment through reconductoring cannot be demonstrated as economic at this time, hence it is proposed that Option 2 is the more cost-effective solution for allowing further generation to connect within this local area.

2.4.3. Project Status and Funding Mechanisms

The project has been through Gate 0, with an initial high-level project scope developed. Final project scope (including customer communication requirements), cost and program cannot be concluded until Q2 2026 after the Connections Reform process has concluded.

Due to above uncertainty on final scope, cost and program – our preferred approach is to utilize the Load Use It or Lose It (UIOLI) pot, and our ask to Ofgem is that the size of the UIOLI pot is appropriate for us to deliver this ANM project in a timely and efficient manner.

2.4.4. Risk

Final project scope, cost and program can't be concluded until Q2 2026 after the Connections Reform process.

2.4.5. High level Program

A high-level program has been provided in the table below:

Stage	Date
Gate 1	Q2 2026 (after Connections Reform)
Section 37 consent submission	N/A (scheme does not need this)
Town and Country Planning (TCP) submission	N/A (scheme does not need this)
Gate 2	Q2 2027
Gate 3	Q2 2028
Gate 4	Q4 2028
TOCA/1st Energy	Q4 2029
Gate 5	Q1 2030

2.4.6. Connection Data for Errochty – Charleston 132kV ANM

2.5. Smart Flexible TO Operated System

As detailed in the CP30 Supplementary Information Submission, Smart Flexible TO Operated System is a control platform that optimises power flows in real time. It combines central and regional intelligence, linking ANM schemes with NESO's Open Balancing Platform (OBP), to ensure secure, flexible operation and enable earlier customer connections while maximising existing network capacity.

2.5.1. Need Case

The four regional ANM schemes address local constraints but growing system complexity and coordination needs require a higher level of intelligence. A Smart Flexible TO Operated System will:

- Provide redundancy if OBP actions are delayed.
- Enable flexible connections for earlier customer access.
- Help NESO maximise transmission capacity.

This hybrid approach, central control with regional ANM integration, reduces costly reinforcements and improves system resilience.

2.5.2. Cost

As detailed in the CP30 Supplementary Information Submission, we cannot confirm the cost now since the concept is at an early development stage, and its scope depends on the outcome of the Connections Reform process, technical integration requirements, and cybersecurity standards. These factors will determine the scale of investment in communication infrastructure and system architecture. Providing a definitive cost now would risk misalignment with future needs. While preliminary allowances suggest flexibility of up to [redacted] may be required, a detailed estimate will only be possible once the design and functional requirements are finalised.

3. Conclusion

ANM is a necessary, proportionate, and efficient response to near-term operability challenges as we integrate substantial new generation and demand ahead of enduring network reinforcements. The four targeted schemes provide controllability where it is most needed, across Shetland and the Western Isles HVDC interfaces, critical 275 kV corridors in Argyll, and the constrained Errochty–Charleston 132 kV route, will protect system limits, enable customer connections, and deliver consumer value consistent with CP2030.

Each project has a clear need case, optioneering, rationale and connection data. We request Ofgem's approval to fund these schemes through the Load UIOLI mechanism to allow timely delivery, ensures security and minimises whole-system cost while supporting the UK's clean energy transition.

Appendix

Summary of ANM Projects

Project	Earliest in Service Year*	Cost (2023/2024 prices):
Shetland ANM	2029	[redacted]
Western Isles ANM	2029	[redacted]
Creag Dhubh ANM	2029	[redacted]
Errochty – Charleston 132kV ANM	2029	[redacted]

Note: this is for all ANM schemes except the 'Smart Flexible TO Operated System' where we are unable currently to provide further information. Preliminary allowances suggest flexibility of up to [redacted] may be required which could also cover the annual operational cost of ANM projects.

**Please refer to each project section for details.*