Heat Network Technical Assurance Scheme

Existing Heat Networks

Technical Specification

Substation

Milestone 4

HNTAS-EX-TS-SS-M4

Version History

Revision	Notes	Date
V0.1	Draft issue	17/12/25

Disclaimer

The following HNTAS Code document is published in draft format. This document is intended to give the sector early sight of HNTAS requirements in their current stage of development for the purpose of facilitating sector understanding of the scheme.

Draft Code documents, including Technical Specifications and Assessment Procedures, have been reviewed and consulted on through a series of technical workshops with participation from a range of experts from across the heat network industry. The content of this document is still in development and subject to change. Requirements should not be considered as fixed at this stage.

Changes which may be made to this document in future include those to:

- reflect learnings from the New Build and Existing network pilot programmes;
- align with aspects of HNTAS which are subject to public policy consultation;
- align with new requirements in TS1 and MMS;
- align the terminology of this document with that used in other HNTAS documentation;
- rectify errors in this draft version; and
- improve clarity of contents.

The Key Failures set out in the draft Code documents have been identified as a specific area for review, to ensure that:

- all Key Failures enable a binary assessment;
- Key Failures are only included for genuine issues presenting major risks to KPIs, and that moderate or lower risks are considered via non-conformity processes; and
- Key Failures do not duplicate Technical Requirements unless there is a clear justification to do so.

DESNZ will be welcoming feedback on the information in this document via a change management process. This process will run in parallel to the HNTAS policy consultation and DESNZ invites stakeholders to engage with both, once they are open. You can sign up to receive updates on future detailed draft technical documents as they are published by contacting: heatnetworks@energysecurity.gov.uk.

Please be advised that this document references other HNTAS draft Code documents which have not yet been published. References to other documents will also be subject to change following the publication of updated standards. The final version of this document will be released before the launch of HNTAS.

Contents

Foreword

This Technical Specification forms part of the UK Government's Heat Network Technical Assurance Scheme (HNTAS, The Scheme) delivered by the Department for Energy Security and Net Zero, in partnership with the Scottish Government and Ofgem. The Department for Energy Security and Net Zero appointed FairHeat as technical author for this document.

The Scheme has been designed and developed in consultation with a range of experts across the heat network industry in the form of Technical Sub-Working Groups, culminating in a series of Technical Specifications and Assessment Procedures to facilitate the validation and verification of performance outcomes of Elements within a Heat Network.

This document specifies HNTAS Requirements for a Substation Element within an Existing Heat Network required at Milestone 4.

This document sits within a series of Technical Specifications for a Substation, which features within a wider Code documentation structure, as outlined in Table 1.

This Technical Specification has been issued in draft format and will be updated prior to scheme launch.

For further information on the use of this document within the Heat Network Technical Assurance Scheme, please refer to:

- the Heat Network Technical Assurance Scheme – Existing Heat Networks – Scheme Rules – Assessment Regime (HNTAS-EX-SR-XX-AS) document;
- the Heat Network Technical Assurance Scheme – Ongoing Regime – Scheme Rules – Replacement Regime (HNTAS-ON-SR-XX-RR) document.

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This group was engaged to produce the New Build Phase 4: Operation Substation Technical Specification, which was used as the foundation for producing this document.

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Shadow Code Management Committee

During the development of HNTAS, a Shadow Code Management Committee has been established, with representation from the Department for Energy Security & Net Zero (DESNZ), the Scottish Government, Ofgem and Heat Trust. The following items have been presented to, and approved by, this committee:

- Structure of Code documents for Existing Heat Networks
- Approach to Technical, Performance Monitoring and Data Protection and Smart Metering Requirements at each Milestone
- KPIs and thresholds at each Milestone

Code Document Structure

Technical Specifications

Document Type	Element		Milestone					
			Overview	Milestone 2	Milestone 3A	Milestone 3B	Milestone 4	Milestone 5
			M0	M2	M3A	M3B	M4	
Technical Specification	Energy Centre	EC	HNTAS-EX-TS-XX-M0	HNTAS-EX-TS-EC-M2	HNTAS-EX-TS-XX-M3A	N/A	HNTAS-EX-TS-EC-M4	HNTAS-NB-TS-EC-P4
	District Distribution Network	DD		HNTAS-EX-TS-DD-M2		N/A	HNTAS-EX-TS-DD-M4	HNTAS-NB-TS-DD-P4
	Substation	SS		HNTAS-EX-TS-SS-M2		N/A	HNTAS-EX-TS-SS-M4	HNTAS-NB-TS-SS-P4
	Communal Distribution Network	CD		HNTAS-EX-TS-CD-M2		N/A	HNTAS-EX-TS-CD-M4	HNTAS-NB-TS-CD-P4
	Consumer Connection	CC		HNTAS-EX-TS-CC-M2		HNTAS-EX-TS-CC-M3B	HNTAS-EX-TS-CC-M4	HNTAS-NB-TS-CC-P4

Table 1: Existing Network Technical Specification structure

Scope

This document specifies the HNTAS Requirements for a Substation within an Existing Heat Network at Milestone 4.

Following demonstration of conformity with Milestone 4, ongoing requirements are set out in the Heat Network Technical Assurance Scheme – New Build Heat Networks – Technical Specification – Substation – Phase 4: Operation (HNTAS-NB-TS-SS-P4) document.

A Substation is defined as a connection between Distribution Networks, which contains an exchange of thermal energy (e.g. via plate heat exchangers), together with requisite ancillary equipment, or a connection between a Distribution Network and a single Consumer Heat System, where the instantaneous hot water system is greater than 70 kW and/or space heating system is larger than 20 kW.

A detailed definition of the Substation is contained within the Heat Network Technical Assurance Scheme – Existing Heat Networks – Technical Specification – Overview (HNTAS-EX-TS-XX-M0) document.

References

Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- Heat Network Technical Standard (TS1) (HNTAS, 2025)
- Heat Network Metering and Monitoring Standard (MMS) (HNTAS, 2025)
- Heat Network Technical Assurance Scheme – Existing Heat Networks – Scheme Rules – Assessment Regime (HNTAS-EX-SR-XX-AS)
- Heat Network Technical Assurance Scheme – Ongoing Regime – Scheme Rules – Replacement Regime (HNTAS-ON-SR-XX-RR)
- Heat Network Technical Assurance Scheme – New Build Heat Networks – Technical Specification – Substation – Phase 4: Operation (HNTAS-NB-TS-SS-P4)
- Heat Network Technical Assurance Scheme – Existing Heat Networks – Technical Specification – Overview (HNTAS-EX-TS-XX-M0)

Informative references

There are no informative references in this document.

Terms and Definitions

For the purposes of this document, the terms and definitions given in the Heat Network Technical Assurance Scheme – Terms and Definitions (HNTAS-XX-TD) document apply.

M4. Requirements for Milestone 4

M4.1. Technical Requirements

The applicable HNTAS Technical Requirements in Table 2 shall be fulfilled.

Technical Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.1.1.	The O&M Manual shall be up-to-date in accordance with the applicable technical standard(s).	TS1 7.17.3 TS1 7.17.6	SS-M4-E01 SS-M4-E04
M4.1.2.	The Planned Preventative Maintenance (PPM) Schedule shall be in accordance with the applicable technical standard(s).	TS1 7.6.5 TS1 7.12.1 TS1 7.12.4 TS1 7.12.5 TS1 7.15.2 TS1 7.15.3 TS1 7.15.4 TS1 7.15.5 TS1 7.15.10 TS1 7.15.11 TS1 7.15.12 TS1 7.17.2 MMS 1.1.8 MMS 1.3.3 MMS 1.3.4 MMS 1.3.5 MMS 1.3.6	SS-M4-E02
M4.1.3.	All documentation and drawings shall be up-to-date in accordance with the applicable technical standard(s).	TS1 7.12.2 TS1 7.17.6 TS1 7.17.8 MMS 4.1.2	SS-M4-E01 SS-M4-E04 SS-M4-E11 SS-M4-E24
M4.1.4.	All documentation and drawings shall be stored in a manner that facilitates easy access to organisations responsible for carrying out operation and maintenance activities in accordance with the applicable technical standard(s).	TS1 7.15.16 TS1 7.17.9	SS-M4-E10

Technical Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.1.5.	The Substation, including the Metering and Monitoring System, shall be maintained in accordance with: • the O&M Manual(s); • the PPM Schedule; • any manufacturers requirements; and • the applicable technical standard(s). A minimum of 6 months of evidence shall be provided to demonstrate this at Milestone 4.	TS1 7.6.1 TS1 7.6.2 TS1 7.6.3 TS1 7.6.4 TS1 7.6.5 TS1 7.12.4 TS1 7.12.5 TS1 7.13.1 TS1 7.14.5 TS1 7.14.6 TS1 7.15.1 TS1 7.15.2 TS1 7.15.10 TS1 7.15.11 TS1 7.15.12 TS1 7.17.2 MMS 1.1.8 MMS 1.3.3 MMS 1.3.4 MMS 1.3.5 MMS 1.3.6	SS-M4-E01 SS-M4-E02 SS-M4-E03 SS-M4-E04 SS-M4-E05
M4.1.6.	Where maintenance activities require that insulation needs to be removed, the insulation shall be refitted or replaced as soon as practically possible in accordance with the applicable technical standard(s). Where insulation is found to be wet, this shall be removed and replaced with new insulation in accordance with the applicable technical standard(s).	TS1 7.13.1	SS-M4-E01SS-M4-E02 SS-M4-E30
M4.1.7.	All Operatives responsible for carrying out operation and maintenance activities shall have received appropriate training in accordance with the applicable technical standard(s).	TS1 7.14.1	SS-M4-E06
M4.1.8.	All Operatives and Specialists responsible for carrying out operation and maintenance activities shall have received a site-specific induction in accordance with the applicable technical standard(s).	TS1 7.14.2	SS-M4-E06
M4.1.9.	The Operating Risk Register shall be up-to-date in accordance with the applicable technical standard(s).	TS1 7.14.6 TS1 7.17.1	SS-M4-E09

Technical Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.1.10.	No earlier than 6 months prior to assessment, equipment and pipework condition in the Substation shall have been determined, and remedial actions carried out where necessary in accordance with the applicable technical standard(s).	TS1 7.16.1 TS1 7.16.2 TS1 7.16.3 TS1 7.16.4 TS1 7.16.5 TS1 7.16.8	SS-M4-E07
M4.1.11.	Where necessary, the destructive testing of pipework shall have been carried out in accordance with the applicable technical standard(s).	TS1 7.16.6 TS1 7.16.7	SS-M4-E07
M4.1.12.	The Resilience Strategy shall be up-to-date in accordance with the applicable technical standard(s).	TS1 7.9.1 TS1 7.9.2 TS1 7.9.3 TS1 7.9.4	SS-M4-E08 SS-M4-E09
M4.1.13.	The Planned Preventative Maintenance (PPM) Schedule shall include activities that sufficiently maintain the water quality in accordance with the applicable technical standard(s).	TS1 7.11.8 TS1 7.11.9 TS1 7.11.10 TS1 7.11.11 TS1 7.14.6 TS1 7.15.11	SS-M4-E02

Technical Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.1.14.	The Substation water quality shall be maintained within the required KPI thresholds. Water quality sampling (and dosing of Chemically Treated systems) shall be carried out in accordance with the applicable technical standard(s). The applicable water quality KPIs shall be reported to HNTAS at the following intervals: • parameters measured via continuous monitoring shall be reported once per month; and/or • parameters measured via laboratory testing of on site samples shall be reported in accordance with sampling frequency in the applicable technical standard(s). The following data shall be provided as a minimum: • for systems without continuous monitoring, a minimum of 2 sets of samples taken 3 months apart; or • for systems with continuous monitoring, a minimum of 3 months of KPI data.	TS1 7.11.1 TS1 7.11.3 TS1 7.11.4	SS-M4-E14 SS-M4-E15 SS-M4-E17
M4.1.15.	For Depleted Water systems, top-up water shall meet water quality parameter limits in accordance with the applicable technical standard(s). The following data shall be provided as a minimum: • for systems without continuous monitoring, a minimum of 2 sets of samples taken 3 months apart; or • for systems with continuous monitoring, a minimum of 3 months of KPI data.	TS1 7.11.7	SS-M4-E16

Technical Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.1.16.	Water treatment records shall be up-to-date detailing the: • sampling; • dosing (where applicable); and • the remedial actions carried out regarding water quality, in accordance with the applicable technical standard(s). Water quality records shall contain, for each parameter, a graphical representation where both the trend and limits can be observed.	TS1 7.11.5	SS-M4-E15
M4.1.17.	Where stagnant conditions occur in specific parts of the Substation, circulation shall have been established through these areas in accordance with the applicable technical standard(s).	TS1 7.11.12	SS-M4-E18
M4.1.18.	Installed equipment no longer in use shall have been disconnected and drained in accordance with the applicable technical standard(s).	TS1 7.11.13	SS-M4-E04 SS-M4-E20
M4.1.19.	No earlier than 6 months prior to assessment, an inspection shall have been undertaken by a competent individual or individuals within a team separate to the team responsible for Substation O&M activities, in accordance with the applicable technical standard(s). The inspection shall check against conformity with Technical Requirements and ensure that Key Failures are not occurring. Where non-conformities are identified, the report shall outline what remedial actions are required to ensure future conformity. Any reports produced through this inspection shall be uploaded to HNTAS.	TS1 7.15.14	SS-M4-E21

Technical Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.1.20.	Water quality equipment shall have been installed in accordance with the applicable technical standard(s).	TS1 3.11.14 TS1 3.11.15 TS1 3.11.16 TS1 3.11.17 TS1 3.11.19 TS1 3.11.22 TS1 3.11.27	SS-M4-E22
M4.1.21.	Working pressures shall have been calculated and determined, with risks mitigated where necessary, in accordance with the applicable technical standard(s). *Note: it is expected that this assessment has been undertaken with consideration for the other Elements present in the Heat Network.*	TS1 3.6.1 TS1 3.6.2 TS1 3.6.3 TS1 3.6.4 TS1 3.6.7 TS1 3.6.9 TS1 3.6.10 TS1 3.6.11 TS1 3.6.12 TS1 3.6.13 TS1 3.6.14	SS-M4-E23
M4.1.22.	Where applicable, it shall be demonstrated that all required Statements of Conformity have been obtained for completed Assessed Works as per the Heat Network Technical Assurance Scheme – Ongoing Regime – Scheme Rules – Replacement Regime (HNTAS-ON-SR-XX-RR) document.		SS-M4-E29
M4.1.23.	The KPI Schedule shall be up-to-date with accurate information and references to relevant documentation.		SS-M4-E31
M4.1.24.	The Technical Parameters Schedule shall be up-to-date with accurate information and references to relevant information.		SS-M4-E32

Table 2: Technical Requirements for the Substation at Milestone 4

M4.2. Performance Monitoring Requirements

The applicable Performance Monitoring Requirements in Table 3 shall be fulfilled.

Performance Monitoring Requirement		Applicable technical standard(s)	Evidence Requirement(s)
M4.2.1.	The Metering and Monitoring Strategy shall be up-to-date in accordance with the applicable technical standard(s).	TS1 7.12.2 MMS 4.1.2	SS-M4-E24
M4.2.2.	The Automatic and Remote Monitoring System (ARMS) shall be specified in accordance with the applicable technical standard(s).	TS1 3.12.5	SS-M4-E25
M4.2.3.	Monitoring Points (including all thermal energy meters, utility meters, and sensors) shall be sized and specified in accordance with the applicable technical standard(s).	TS1 3.12.2 TS1 3.12.3	SS-M4-E26 SS-M4-E27 SS-M4-E28
M4.2.4.	Thermal energy meters shall have been recalibrated (where necessary) in accordance with the applicable technical standard(s).	TS1 7.12.4 TS1 7.12.5 MMS 1.1.8 MMS 1.3.3 MMS 1.3.4 MMS 1.3.5 MMS 1.3.6	SS-M4-E24 SS-M4-E28
M4.2.5.	The Metering and Monitoring System shall calculate and report, at the required interval, each applicable Substation KPI to HNTAS.		SS-M4-E12
M4.2.6.	The Substation performance shall be within the required KPI thresholds at the point of assessment. A minimum period of 3 months worth of KPI data shall be provided at the point of assessment. Where performance deviates outside of KPI thresholds within the data provided, the Responsible Party shall outline the root cause(s) of this deviation, the remedial actions undertaken to restore the KPI to within required thresholds, and provide justification why each deviation will not impact future conformity with KPI thresholds.	TS1 7.8.1 TS1 7.8.2 TS1 7.8.6 TS1 7.12.6 TS1 7.17.4	SS-M4-E12 SS-M4-E13

Table 3: Performance Monitoring Requirements for the Substation at Milestone 4

M4.3. Key Failures

The applicable Key Failures listed in Table 4 shall not be present.

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.1.	PPM personnel (or contracts) not in place and/or maintenance not scheduled at sufficient frequency, or not at all.	Maintenance not carried out on network, which could result in a reduction in performance of the Substation and network. This could lead to KPI thresholds not being achieved.	SS-M4-E02
M4.3.2.	Operatives carrying out maintenance activities have not received sufficient, or any training specific to the network.	Lack of awareness of network requirements and characteristics. This could lead to false diagnosis of network issues, and/or incorrect maintenance activities carried out on the network, which impacts the longevity and performance of the network.	SS-M4-E06

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.3.	Adjustments made to the control system which are either one of or combination of the following: • unjustified; • negatively impact on performance; • not recorded; or • not in accordance with the Description of Operation (unless justified for performance improvement).	Unnecessary changes to system performance which results in KPI thresholds not being achieved. Examples include: 1. an increase in temperature set point could lead to elevated heat losses from the system, and therefore may not meet the KPI threshold. 2. changes to pressure set point could lead to equipment being subjected to pressures outside of its permitted range, or air ingress to the system if the set point is decreased, leading to issues with water quality. 3. changes to pump controls could lead to consumers not receiving heat at the terminal connections, or excessive energy consumption where pumps are placed into hand mode. 4. adjustments not recorded may pose a lack of clarity to future operators and may result in incorrect or non-optimal operation and maintenance.	SS-M4-E03 SS-M4-E12 SS-M4-E13
M4.3.4.	Equipment unnecessarily in manual operation mode.	The Substation does not operate in accordance with the design intent and Description of Operation, which may result in KPIs not being met.	SS-M4-E03 SS-M4-E12 SS-M4-E13

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.5.	Pressurisation unit not monitored and maintained in operation.	Frequent equipment failure, resulting in network downtime.	SS-M4-E03 SS-M4-E05 SS-M4-E07 SS-M4-E08 SS-M4-E14
M4.3.6.	Inspection of pump bellows not carried out.	Failure of pump bellows, leading to catastrophic outcomes such as major leaks and extended outages of the Heat Network.	SS-M4-E03 SS-M4-E12 SS-M4-E13
M4.3.7.	Equipment left in fault (e.g. pumps left in fault mode, causing redundancy of major plant to not be maintained).	Network not being operated and maintained in accordance with the Description of Operation. Redundancy removed from the network. Insufficient equipment available to deliver heat to the network, which could impact the security of heat supply to consumers.	SS-M4-E03 SS-M4-E12 SS-M4-E13
M4.3.8.	Pump differential sensors left in fault.	Pumps respond incorrectly to variations in network demand, or do not respond at all. This could: • cause excessive network flow rates at periods of low heat demand, which unnecessarily increases parasitic energy consumption and network return temperature, which may cause KPIs not to achieve their thresholds; or • cause low network flowrates at periods of high demand, which may reduce the heat supplied to end consumers and reduce consumer comfort.	SS-M4-E03 SS-M4-E12 SS-M4-E13

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.9.	Nuisance alerts and alarms, on the control system or Metering and Monitoring System, preventing the operating teams identifying and resolving genuine issues.	Nuisance faults becoming prevalent and frequent, making it difficult to capture actual faults within the Substation. This could lead to failure of equipment and/or reduced performance, resulting in KPIs not being met.	SS-M4-E03 SS-M4-E12 SS-M4-E13
M4.3.10.	Where alerts and alarms are removed from the control system or Metering and Monitoring System, failure to engage in a suitable change management process to facilitate this.	Removal of alerts and alarms without a change management process could result in necessary alerts and alarms being removed from the system, putting the network at increased risk of failure and may not alerts operatives when failures are occurring.	SS-M4-E03 SS-M4-E04 SS-M4-E12 SS-M4-E13
M4.3.11.	Leaking and/or weeping items left unrectified.	Increased water consumption of the network, leading to issues with water quality and reduced equipment longevity. Insulation becoming wet, increasing the heat losses from the network, and increasing the likelihood of pipework corrosion.	SS-M4-E03 SS-M4-E14
M4.3.12.	Exercising of ancillary equipment (e.g. isolation valves) not carried out.	Valve seizure due to being left in the same position for extended periods. This could lead to the valve needing replaced prematurely. Significant disruption to the network could be experienced during maintenance activities as a result of sections of the network not being able to be isolated.	SS-M4-E02 SS-M4-E03
M4.3.13.	Water quality sampling not undertaken in accordance with industry standards.	Unable to identify issues with water quality in the Substation. This could lead to reduced equipment longevity and increased maintenance requirements for equipment.	SS-M4-E03 SS-M4-E14 SS-M4-E15

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.14.	Water quality equipment not maintained (e.g. filters not replaced, strainers not cleaned).	Reduced efficiency of equipment due to poor water quality. Heat supply issues due to blocked strainers that have not been maintained.	SS-M4-E03 SS-M4-E14 SS-M4-E15
M4.3.15.	Equipment not properly decommissioned when no longer required.	A significant dead leg in the Substation created, which could increase the risk of bacterial growth. This could reduce the water quality of the Substation and lead to increased maintenance requirements.	SS-M4-E20
M4.3.16.	Insulation left damaged, wet, or not reinstalled following maintenance activities, including pipework and equipment.	Increased heat losses from the network due to damaged or wet insulation, or due to insulation being removed from pipework and not replaced. This could result in heat losses not achieving the KPI threshold.	SS-M4-E21
M4.3.17.	Monitoring Points not producing reasonable and expected data.	Unable to accurately monitor performance and risks falsely being able to achieve or not achieve KPI thresholds.	SS-M4-E12
M4.3.18.	Monitoring Points not communicating with ARMS.	ARMS unable to extract, record and store data from monitoring point, and therefore KPIs cannot be calculated, and performance monitored.	SS-M4-E12
M4.3.19.	Monitoring Point faults not identified and rectified. This includes batteries not being replaced where battery powered meters are installed.	Unable to measure performance data required for KPIs.	SS-M4-E03 SS-M4-E12 SS-M4-E13
M4.3.20.	Faults with ARMS not identified and rectified (e.g. gateways faulty).	Unable to monitor performance - extract, record, and store data, or calculate and report on KPIs.	SS-M4-E03 SS-M4-E12 SS-M4-E13

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.21.	Documentation not kept up-to-date (e.g. drawings not updated with changes to network, maintenance activities carried out not recorded, changes to control system where necessary not recorded, Condition Log not updated when equipment is replaced, risk register not updated).	Documentation not reflective of installed network and actual operation, which can lead to incorrect operation and maintenance of network.	SS-M4-E11
M4.3.22.	The condition of Heat Network equipment leaves the system with insufficient resilience.	Increased risk of equipment failure and increased risk of interruption to heat supply.	SS-M4-E07 SS-M4-E08
M4.3.23.	Resilience Strategy is not up-to-date and reflective of changes made to the Heat Network.	Increased likelihood of an interruption to heat supply and increased impact should that interruption occur.	SS-M4-E08
M4.3.24.	Inappropriate thermal energy meter installed.	Inaccurate measurement of performance data due to inappropriate specification or size of thermal energy and/or utility meter.	SS-M4-E26
M4.3.25.	No water meters on water top up connection to Heat Network.	Unable to monitor top up water and, therefore, leaks from the network, making the Heat Network less reliable and more susceptible to interruptions.	SS-M4-E22 SS-M4-E24
M4.3.26.	Pressurisation, expansion and/or vacuum degassing equipment is not installed as per manufacturers requirements. This includes not providing the required minimum separation distance between connections to the network and using the incorrect connections.	Pressurisation, expansion and/or vacuum degassing equipment not operating correctly, increasing the risk of outages and network downtime.	SS-M4-E22

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.27.	Inadequate labelling of plant, ancillary equipment, and pipework.	Increased difficulty in knowing which equipment has been maintained and/or serviced in operation, which could lead to pieces of equipment not being maintained, resulting in premature failure. Inadequate labelling of pipework could present confusion throughout the network between flow and return pipework, which could result in pipework being plumbed incorrectly further downstream.	SS-M4-E21
M4.3.28.	Missing, unclear, or incorrectly labelled control system points and Monitoring Points physically on-site, within O&M documentation and on the ARMS. Examples include incorrect sensor naming and meter naming.	Difficulty in identification of control system points and Monitoring Points for future O&M operatives, risking the ability to be able to accurately measure performance and report on KPIs.	SS-M4-E01 SS-M4-E24
M4.3.29.	Lack of appropriate isolation, vent and drain strategy.	Operator is unclear of required isolation, ventage and drainage requirements when conducting planned and unplanned remedial maintenance activities.	SS-M4-E02 SS-M4-E08

Key Failure		Outcome to avoid	Evidence Requirement(s)
M4.3.30.	Inappropriate consideration of system working pressures, including: • incorrect calculation of system working pressures; • inappropriate mitigation of risks posed by system working pressures; • inappropriate equipment specified for system working pressures; and • lack of/inappropriate pressure safety system.	Increased risk posed by system working pressures, including: • exposure of personnel to high pressure water; • equipment failure; and • interruptions to heat supply.	SS-M4-E23
M4.3.31.	Differential pressure exceeding the differential pressure rating of equipment.	Increased risk posed by differential pressures, increasing the likelihood of equipment failure and inefficient/ineffective operation.	SS-M4-E23
M4.3.32.	Material installed/specified which is incompatible with the Water Quality Strategy.	Increased risk of corrosion, major leaks and interruptions to heat supply.	SS-M4-E22

Table 4: Key Failures for the Substation at Milestone 4

M4.4. Evidence Requirements

The applicable Evidence Items listed in Table 5 shall be provided to demonstrate fulfilment with the Technical Requirements, Performance Monitoring Requirements, and avoidance of Key Failures.

Evidence Item		Detailed description and requirements
SS-M4-E01	O&M Manual	A completed O&M Manual shall be provided, which shall include any changes made to the O&M manual during operation.
SS-M4-E02	Planned Preventative Maintenance (PPM) Schedule	To include a schedule outlining the operation and maintenance plan for all equipment in the Substation. Shall detail wherever Specialists or external bodies are required to carry out PPM activities.
SS-M4-E03	Maintenance and Remedial Action Log	To detail any operation and maintenance activities carried out on the Substation. Shall detail the date the activity was carried out and the person that performed the activity. Shall outline any remedial actions carried out on the network as part of the operation and maintenance activity.
SS-M4-E04	O&M Change Log	Shall be a log of any changes made to the network during operation. This includes: • changes that result in the hydraulic arrangement deviating from previous; • changes to the spatial layout of the Substation; • changes to the control system, set points or Description of Operation; • changes to the Resilience Strategy; • changes to the Operating Risk Register; and • equipment that has been replaced. This is not to include activities noted in the maintenance and remedial action log for the general maintenance carried out on the Substation.
SS-M4-E05	Equipment servicing certification	Shall include all servicing certification for each piece of equipment. Shall include certification at the frequency as required by the PPM Schedule. Shall include detail for each piece of equipment as required by the PPM Schedule.

Evidence Item		Detailed description and requirements
SS-M4-E06	Register of Operatives	To include a list of all personnel that have carried, or will carry out, operation and maintenance activities on the Substation. This shall include for each person: • confirmation that the person has completed a site-specific induction; • the activity(s) that the person has carried, or will carry out; • the training that the person has received in relation to the activity(s); • the relevant qualifications (where applicable) that the person has; and • the relevant experience that the person has.
SS-M4-E07	Condition Log	To include all basic asset data and condition data for all Heat Network equipment within the Substation, including: • asset name; • asset ID; • asset classification code; • asset classification description; • asset criticality; • asset maintainer; • asset location; • asset install date; • asset condition grade; • asset priority grade; • whether asset is beyond economic repair; • asset operational status; • date of last condition survey; and • remaining life expectancy (years).

Evidence Item		Detailed description and requirements
SS-M4-E08	Resilience Strategy	Shall outline the Resilience Strategy for the Heat Network, including: • the redundancy and recovery measures implemented; • the disaster recovery plan; • the critical spares log; and • the plant replacement strategy. This shall contain the strategy in the case of loss of heat supply within the Heat Network, and design items for Resilience (for example, isolation valve locations, locations for temporary heat supply).
SS-M4-E09	Operating Risk Register	A project specific risk register which shall include all risks outlined and proposed approaches to eliminate during operation of the Heat Network, mitigate or manage these risks.
SS-M4-E10	Document Storage System Statement	Shall outline the system intended to be used for storing and accessing documentation related to the Heat Network. Shall outline any hierarchy of access to the storage system relative to the personnel carrying out operation and maintenance activities.
SS-M4-E11	Substation drawings	As-built drawings of the Substation with any necessary changes made during operation implemented. Shall include: • schematics; and • drawings (layout, plan, elevation).
SS-M4-E12	Reporting of KPIs	A minimum of 3 months worth of KPI data shall be reported to HNTAS at the point of assessment. Where KPIs are outside of required thresholds for the reporting period, the Responsible Party shall upload a note justifying this discrepancy to HNTAS.
SS-M4-E13	KPI Remediation Report	Where any Substation KPI is not within its required threshold for 3 consecutive reporting intervals, a report shall be produced which shall outline: • the findings of the investigation undertaken by a competent individual into the root cause issue of non-conformity; and • the remedial action(s) taken, or planned to be taken, for the KPI to return to within its required threshold. Where a diagnosis is not yet known, the report shall outline a plan for acquiring a diagnosis as to why the KPI has not achieved its threshold.

Evidence Item		Detailed description and requirements
SS-M4-E14	Reporting of water quality KPIs	Water quality KPIs reported to HNTAS. The following data shall be provided as a minimum: • for systems without continuous monitoring, a minimum of 2 sets of samples taken 3 months apart shall be provided; or • for systems with continuous monitoring, a minimum of 3 months of KPI data shall be provided.
SS-M4-E15	Water quality sampling records	For each sample, shall include: • hydraulic location the sample has been taken from; • date the sample has been taken; and • result of sample for each water quality KPI. Trends in water quality KPIs over time shall be graphically represented.
SS-M4-E16	Top-up water sampling records	For Depleted Water systems, sampling records to ensure that top-up water meets water quality parameter limits. For each sample, shall include: • hydraulic location the sample has been taken from; • date the sample has been taken; and • result of sample for each water quality KPI.
SS-M4-E17	Evidence of water quality specialist engagement (where applicable)	Written evidence that a water quality specialist has been engaged to carry out operation and maintenance activities on the system where KPI thresholds have not been achieved.
SS-M4-E18	Evidence of circulation provision through stagnant areas	Shall contain justification of why it is technically infeasible to remove stagnant areas. Shall contain evidence that the control system temporarily enables circulation through these stagnant areas at appropriate intervals. For example, the regular change over of redundant equipment, or temporarily enabling circulation through pipework or equipment that would otherwise not be required.
SS-M4-E19	Water Quality Remedial Action Log	To detail any operation and maintenance activities carried out on the Substation to remediate water quality. Shall detail the date the activity was carried out and the person that performed the activity. Shall outline any remedial actions carried out on the network as part of the operation and maintenance activity.

Evidence Item		Detailed description and requirements
SS-M4-E20	Evidence of equipment disconnection	Where equipment has been decommissioned, photographic evidence that equipment has been completely disconnected from the system.
SS-M4-E21	Annual Inspection Report	To outline the findings of the annual inspection. Shall include the current status of the control system in relation to the O&M manual.
SS-M4-E22	Evidence of water quality equipment installed	Commissioning certificates for water quality equipment installed within the Substation. Where applicable, this shall outline the required design criteria for the equipment that required commissioning and the final commissioned value for each criteria.
SS-M4-E23	System Pressure Assessment	Assessment of working pressures in the system. Shall include: • calculation of the System Maximum Working Pressure; • calculation of the Local Maximum Working Pressure; • identification of the risks that arise as a result of calculated working pressures; • assessment of the likelihood and impact of the identified risk; and • mitigation of the risks posed by working pressures (where appropriate).
SS-M4-E24	Metering and Monitoring Strategy	Shall contain a description of how data required to calculate KPIs will be measured, extracted, recorded, and stored at the required read frequency, how the raw data will be transformed, and how KPIs will be calculated and reported. The strategy shall also include: • schedule of KPIs; • schedule of Monitoring Points; • data flow diagram; • schematic with labelled Monitoring Points; and • Monitoring Point labelling strategy.
SS-M4-E25	ARMS Specification Conformity Statement	Shall contain evidence that the ARMS has been specified in accordance with the applicable technical standard(s).

Evidence Item		Detailed description and requirements
SS-M4-E26	Evidence of Monitoring Point specification conformity	Shall contain evidence of how each Monitoring Point has been specified in accordance with the applicable technical standard(s).
SS-M4-E27	Meter sizing calculations	Shall outline the inputs, methodology and calculations used to size meters and applicable pipework.
SS-M4-E28	Thermal Energy Meter Records	Shall contain record of the installation and commissioning of thermal energy meters. This shall include: • meter make; • type; • serial number; and • year of install. Shall also contain record of the recalibration date of thermal energy meters or evidence of successful sampling and testing where required in accordance with the applicable technical standard(s).
SS-M4-E29	Assessed Works Statement of Conformity	Evidence that, where required as per the Heat Network Technical Assurance Scheme – Ongoing Regime – Scheme Rules – Replacement Regime (HNTAS-ON-SR-XX-RR) document, applicable works have successfully completed assessment.
SS-M4-E30	Photographic evidence of insulation replacement	Shall include photographic evidence of areas where insulation has had to be reinstalled or replaced following maintenance activities. Photographs shall be presented clearly with no blur.
SS-M4-E31	KPI Schedule	Shall contain all applicable KPIs to be met by the Substation. Shall be complete with accurate up-to-date information and contain references to relevant documentation.
SS-M4-E32	Technical Parameters Schedule	Shall contain all applicable Technical Parameters for the Substation. Shall be complete with accurate up-to-date information and contain references to relevant documentation.

Table 5: Evidence Requirements for the Substation at Milestone 4

M4.5. Key Performance Indicators

Table 6 contains the Key Performance Indicators for a Substation in an Existing Heat Network to be met at Milestone 4.

KPIs are split into two types:

5. Assessed KPIs: These are KPIs which are assessed against pre-determined thresholds throughout the Operation and Maintenance Phase in order to achieve and maintain HNTAS Certification.

6. Reported KPIs: These are KPIs which are not assessed against a pre-determined threshold through the Operation and Maintenance Phase, but still provide valuable information, so are to be reported in the same format.

The specific requirements in relation to the reporting of KPIs are included in the Performance Monitoring Requirements Section.

Figure 1 illustrates the required Monitoring Points for measuring Substation KPIs. The Monitoring Points are also listed in Table 7, along with the data required from each Monitoring Point and the minimum read frequency. The Monitoring Points to be used to measure KPIs are illustrated in orange in Table 6.

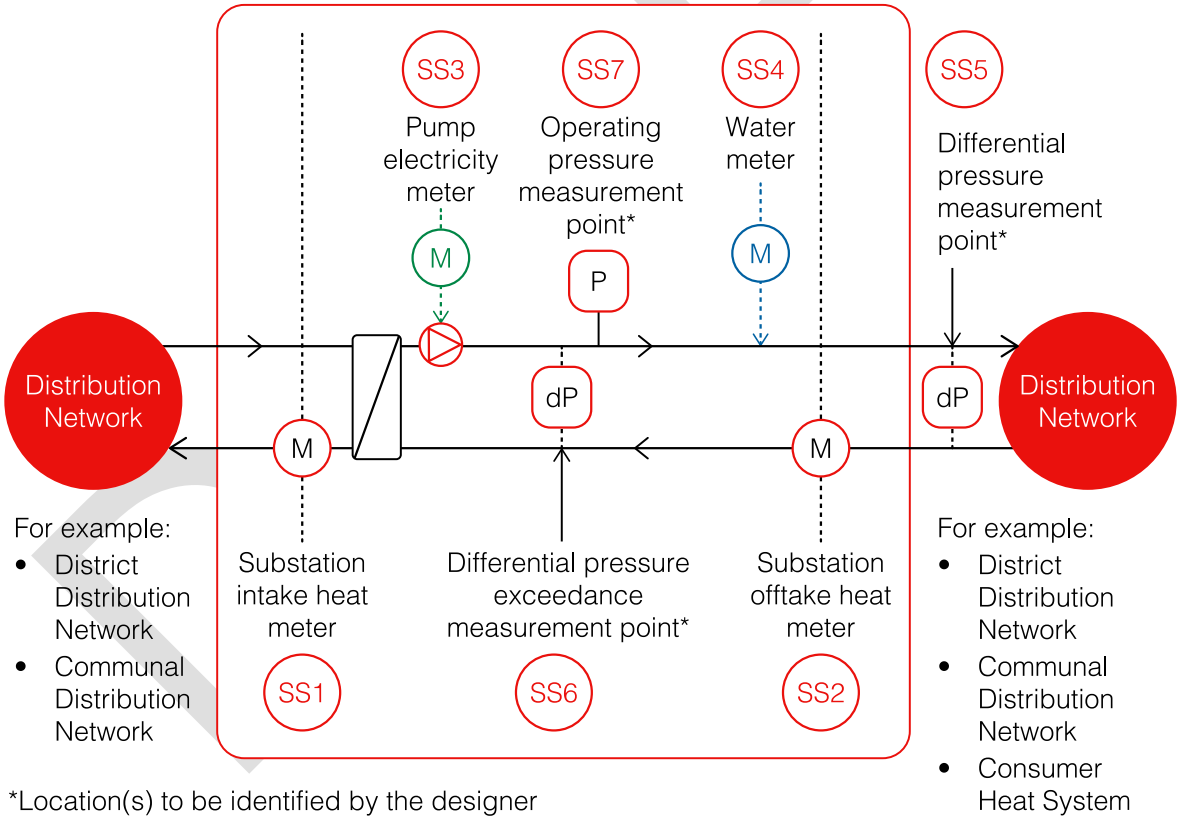

Figure 1: Diagram indicating required Substation Monitoring Points

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-01	Automatic and Remote Monitoring System (ARMS) connectivity	Total number of days where Monitoring Points has connected to the ARMS within 24 hours of last connection.	(Number of Monitoring Point days) / (total Monitoring Points * total days in period) Number of Monitoring Point days = Σ number of days each Monitoring Point has connected to the ARMS within 24 hours of last connection.	Assessed KPI	≥ 99%	Monthly
SS-KPI-02	Substation Monitoring Point data completeness	Number of total reads received in comparison to the total reads expected within the given [time period] for each Monitoring Point.	(Total number of reads recorded across [time period] / total reads expected across [time period]) x 100 Total reads expected = Σ (Monitoring Point x frequency of Monitoring Point x [time period])	Assessed KPI	≥ 95%	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-03	Substation Monitoring Points operational	Of the Monitoring Points which are connected to the ARMS (as per SS-KPI-01) and have complete data (as per SS-KPI-02), the number of which are operating as expected. Monitoring Points that are operating as expected will have (dependent on type of Monitoring Point): 1. No error codes (meters) 2. No negative readings (meters) 3. No signals outside of operating parameters (sensors)	Verification that each Monitoring Point is operating as expected. Measurement will be dependent on ARMS and may be automated.	Assessed KPI	100% of Monitoring Points, which are connected to ARMS (as per SS-KPI-01) and have complete data (as per SS-KPI-02)	Monthly
SS-KPI-04	Substation unplanned interruptions	Number of unplanned interruptions reported per annum.	Number of unplanned interruptions = ∑ (unplanned interruptions for given [time period]).	Assessed KPI	≤ 3 interruptions per annum.	Previous 12 months

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
		A Substation interruption is defined as an event causing: • The flow temperature at the Substation offtake (SS2) to be below the minimum required flow temperature for more than 12 hours, due to an issue originating in the Substation. • The differential pressure at the specified differential pressure measurement point(s) (SS5) (note this location may change during operation) to be below the minimum required differential pressure for more than 12 hours, due to an issue	*GUIDANCE:* *Responsible Party to state the location of the differential pressure measurement point(s).*		Prorated and rounded down for a reporting frequency < 12 months e.g. ≤ 0 interruptions for a 3 month measurement period.	Measured on monthly rolling basis Minimum measurement period of 3 months

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
		originating in the Substation. An unplanned interruption is an interruption as defined above, where the Heat Network end user has not been provided with at least 48 hours written notice of such interruption.				
SS-KPI-05	Substation planned interruptions	Number of planned interruptions reported per annum. A Substation interruption is defined as an event causing: • The flow temperature at the Substation offtake (SS2) to be below the minimum required flow temperature for more than 12 hours, due to an issue originating in the Substation.	Number of planned interruptions = ∑ (planned interruptions for given [time period]). *GUIDANCE:* *Responsible Party to state the location of the differential pressure measurement point(s).*	Assessed KPI	≤ 1 interruption per annum.	Previous 12 months Measured on monthly rolling basis

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
		• The differential pressure at the specified differential pressure measurement point(s) (SS5) (note this location may change during operation) to be below the minimum required differential pressure for more than 12 hours, due to an issue originating in the Substation. A planned interruption is an interruption as defined above where notice has been given to the end user at least 48 hours prior to the interruption occurring.				
SS-KPI-06	Substation average flow temperature	Average flow temperature for given [time period] measured at the Substation offtake (SS2).	Average flow temperature = ∑ (Flow temperature at each time point for given [time period])/ ∑(time points for given [time period])	Reported KPI	[expected average flow temperature]	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-07	Substation average return temperature	Average return temperature for given [time period] measured at the Substation intake (SS1).	Average return temperature = ∑ (Return temperature at each time point for given [time period])/ ∑(time points for given [time period])	Reported KPI	[expected average return temperature range]	Monthly
SS-KPI-08	Substation flow temperature variance from set point	Average difference between the actual flow temperature measured at the Substation offtake (SS2) and the set point.	Average variance = ∑ (Actual flow temperature – set point at each time point for given [time period])/ ∑(time points for given [time period])	Assessed KPI	± 2 °C	Monthly
SS-KPI-09A	Substation volume weighted average flow temperature (VWAFT)	Substation flow temperature weighted against volumetric flow rate, measured at the Substation offtake (SS2).	Where T = flow temperature for each time recording (t) for given [time period], and q = flow rate for each time recording (t) for given [time period] or cumulative volume for each time recording (t) for given [time period]. $VWAFT = \frac{\sum(T_t \times q_t)}{\sum q_t}$	Assessed KPI	[Substation] flow temperature] ± 3 °C	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-09B	Substation volume weighted average flow temperature (VWAFT) *Note: applicable for networks which do not have a fixed flow temperature (e.g. weather compensated systems)*	Substation flow temperature difference from its set point weighted against volumetric flow rate, measured at the Substation offtake (SS2).	Where T = difference between flow temperature and its setpoint for each time recording (t) for given [time period], and q = flow rate for each time recording (t) for given [time period] or cumulative volume for each time recording (t) for given [time period].	Assessed KPI	± 3 °C	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-10A	Substation flow temperature stability	The percentage of time flow temperature, measured at the Substation offtake (SS2) is within upper and lower bounds of the design set point. The upper and lower bounds shall not exceed ± 5 °C from the flow temperature set point. The lower bound shall also be equal to or greater than the minimum flow temperature of the network required to deliver >45 °C DHW to outlets within Consumer Heat Systems, or is the minimum flow temperature required at the Substation to deliver the minimum required flow temperature for the network it is supplying.	Stability = ∑ (time points spent within the upper and lower threshold of the design set point for given [time period]) / ∑ (time points for given [time period]).	Assessed KPI	≥ 95% spent within thresholds Upper threshold: [Upper temperature stability threshold (e.g. 60 °C)] Lower threshold: [Lower temperature stability threshold (e.g. 50 °C)]	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-10B	Substation flow temperature stability *Note: Applicable for networks which do not have a fixed flow temperature (e.g. weather compensated systems)*	The percentage of time flow temperature differential from its setpoint, measured at the Substation offtake (SS2), is within the upper and lower bounds. The upper and lower bounds shall not exceed ± 5 °C from the flow temperature set point. The lower bound shall also be equal to or greater than the minimum flow temperature of the network required to deliver >45 °C DHW to outlets within Consumer Heat Systems, or is the minimum flow temperature required at the Substation to deliver the minimum required flow temperature for the network it is supplying.	Stability = ∑ (time points spent within the upper and lower threshold of the design set point for given [time period]) / ∑ (time points for given [time period]).	Assessed KPI	≥ 95% spent within thresholds Upper threshold: [Upper temperature stability threshold (e.g. 60 °C)] Lower threshold: [Lower temperature stability threshold (e.g. 50 °C)]	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-11	Substation flow temperature uptime	The percentage of time flow temperature, measured at the Substation offtake (SS2) is above the Minimum Required Flow Temperature. Minimum required flow temperature will be project specific and shall be set for each Substation. Minimum required flow temperature of the network is the flow temperature required to deliver >45 °C DHW to outlets within Consumer Heat Systems, or is the minimum flow temperature required at the Substation to deliver the minimum required flow temperature for the network it is supplying.	Uptime = ∑ (time points spent above minimum required flow temperature for given [time period])/ ∑ (time points for given [time period])	Assessed KPI	≥ 99.5% above [minimum required flow temperature]	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-12	Substation average approach temperature	Average approach temperature for given [time period]. Approach temperature is defined as the temperature difference between the return temperature at the Substation offtake (SS2) and the return temperature at the Substation intake (SS1).	Average return temperature = ∑ (Difference between Substation offtake (SS2) return temperature and Substation intake (SS1) return temperature (°C) per time point for given [time period]) / ∑ (time points for given [time period]).	Assessed KPI	≤ 5 °C	Monthly
SS-KPI-13	Pressure differential uptime	The percentage of time the pressure differential spends above the minimum differential pressure set point at the specified differential pressure measurement point(s) (SS5).	Uptime = ∑ (time points spent above [Setpoint – 10%] for given [time period])/ ∑ (time points for given [time period]) *GUIDANCE:* *Responsible Party to state the location of the differential pressure measurement point(s).*	Assessed KPI	≥ 99.5% spent above [minimum differential pressure]	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-14	Maximum allowable differential pressure exceedance	The percentage of time the pressure differential spends below the maximum allowable differential pressure at the specified differential pressure exceedance measurement point (SS6).	Percentage time below maximum = 1 – [∑ (reads above maximum for given [time period]) / ∑ (reads for given [time period])] *GUIDANCE:* *Responsible Party to state the location of the differential pressure exceedance measurement point(s).* *It is expected this would be at the highest differential pressure point, which is typically across the network distribution pumps, but may also be across sensitive equipment, or across the network flow and return.*	Assessed KPI	100% spent below [maximum allowable differential at the defined measurement point]	Monthly
SS-KPI-15	Maximum allowable operating pressure exceedance	The percentage of time the operating pressure spends below the maximum allowable operating pressure at the specified operating pressure measurement point(s) (SS7).	Percentage time below maximum = 1 – [∑ (reads above maximum for given [time period]) / ∑ (reads for given [time period])] *GUIDANCE:* *Responsible Party to state the location of the operating pressure measurement point(s).*	Assessed KPI	100% spent below [maximum allowable operating pressure at the defined measurement point]	Monthly

KPI ID	KPI	KPI description	KPI measurement methodology	Assessed KPI or Reported KPI	Milestone 4 KPI Threshold	KPI measurement frequency
SS-KPI-16	Volume of top up water added to the network	Volume of top up water added to the network as percentage of total system pipework volume per [time period], measured at the Substation water meter (SS4). Network may include other Elements, such as the Distribution Network pipework served by the Substation.	Amount of top-up water = volume added measured in [time period] (m^3) / total system pipework volume (m^3) System volume excludes thermal storage.	Assessed KPI	≤ 0.17% of total [system pipework volume] per month.	Monthly
SS-KPI-17	Network distribution pump energy	Total pump energy use (kWh) measured at the Substation pump electricity meter (SS3) over the given [time period].	Total pump energy use (kWh) over given [time period].	Assessed KPI	≤ 1.2% of annual heat generation (kWh)	Previous 12 months Measured on monthly rolling basis Minimum measurement period of 3 months

Table 6: Key Performance Indicators - Substation and Milestone 4

M4.6. Monitoring Points

ID	Element	Monitoring Point	Data required at Monitoring Point	Minimum frequency of reads	Further comments
SS1	Substation	Boundary (intake)	Meter read (kWh) Instantaneous power (kW) Flow rate (m^3/h or l/s) Flow temperature (°C) Return temperature (°C) Volume (m^3 or l)	5 minutes	Shall be located in the intake boundary to the Substation. To measure heat delivered to the Substation.
SS2	Substation	Boundary (offtake)	Meter read (kWh) Instantaneous power (kW) Flow rate (m^3/h or l/s) Flow temperature (°C) Return temperature (°C) Volume (m^3 or l)	5 minutes	Shall be located in the offtake boundary to the Substation. To measure heat delivered to the network from the Substation.
SS3	Substation	Network distribution pump	Meter read (kWh)	30 minutes	Required to measure pump energy consumption. Required per pump set, rather than individual pumps when contained within pump set.
SS4	Substation	Water meter	Volume (m^3 or l)	30 minutes	Required to measure volume of top-up water entering the network.

ID	Element	Monitoring Point	Data required at Monitoring Point	Minimum frequency of reads	Further comments
SS5	Substation	Defined differential pressure measurement point	Differential pressure (kPa, bar)	5 minutes	Location is determined by the Designer on a project basis. Likely to be located externally to the Substation at the index point(s) of the Distribution Network. Where this isn't the case, this differential pressure measurement may be within the Substation (across the pumps).
SS6	Substation	Defined differential pressure exceedance measurement point	Differential pressure (kPa, bar)	5 minutes	Location shall be determined by the Designer on a project basis.
SS7	Substation	Defined operating pressure measurement point	Pressure (kPa, bar)	5 minutes	Location shall be determined by the Designer on a project basis.

Table 7: Minimum required Monitoring Points - Substation and Milestone 4